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GAP: AN IRRIGATION AND DEVELOPMENT PROJECT IN TURKEY

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INTRODUCTION

The Southeastern Anatolia Project (GAP) in Turkey, which was initiated in 1976 with the Karakaya Dam consists of thirteen major projects. Twenty-two dams and seventeen hydroelectric power plants (HPP) with a total capacity of 7 561 MW will be constructed as part of it. GAP will provide irrigation for 1 641 282 hectares of land and will have an annual output of 25 003 GWh of power (1).

Turkey has about 27.7 million hectares (ha) of land suitable for agriculture. Surveys show that it is economically feasible to irrigate 8.5 million ha of this land, but currently irrigation is limited to 3.3 million ha. After the completion of GAP, it will become economically feasible to irrigate an additional 19.3 percent of the irrigable land in Turkey. Thanks to the favorable climate, there will be a manyfold increase in productivity. Research shows that agricultural income may increase 17.5 fold in areas which will be irrigated after the completion of GAP (Tekinel, 1988, 9).

The present installed power capacity in Turkey is 10 100 MW, consisting of 6 200 MW thermal and 3 900 MW hydro. The share of hydroelectric power was 38 percent in 1986. Economically viable hydropower potential is estimated at 32 700 MW and annual energy of 118 000 GWh is figured under average hydrological conditions. Only 12 percent of the total hydropower potential has been developed (2). In GAP, it is planned that at full development as mentioned above 25 003 MW of electric energy will be generated annually with the installed capacity of 7 561 MW. The total annual generation of electricity accounts for 21.2 percent of Turkey's economically viable hydropower potential (3).

GAP is not only an agricultural development project. It is a comprehensive development project which has implications for the whole of Turkey. Naturally, the initial impetus will be felt in the agricultural sector. However, the development in the agricultural sector will have a positive effect on the industrial and service sectors in the region. Because as agricultural production rises in the region, food-grains, fibers, vegetable oils, timber, etc. will circulate in increasing quantities. In order to convert these into economically usable assets, adequate

1. One hectare (ha) is equal to 10 decares and 2 471 acres.

2. State Planning Organization, 1989, Volume 4, F-2.

3. State Planning Organization, 1989, Volume 1, 2.

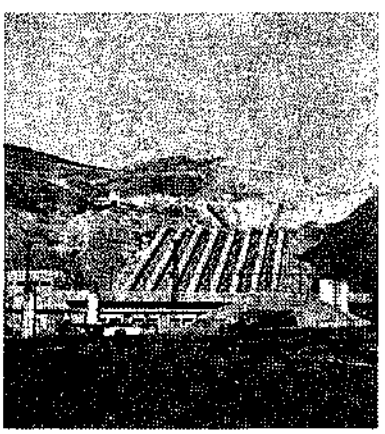


Figure 1. Atatürk Dam Hydropower Stations (photograph by author, November 1991).

handling, storage and processing facilities on sound lines need to be established in the region. For increasing agricultural production, more material inputs such as fertilizers, agricultural equipment, improved seeds etc., will be used, most of which should be produced in the region. Beside these, increased agricultural production can be achieved through active and well-conceived agricultural research, extension, training and educational systems that must be organized locally.

In this paper, GAP is discussed in three sections. The natural conditions, social structure, settlement, land tenure and the main features of GAP are explained in the first part. One of the small irrigation schemes, (The Devegeçidi Irrigation Scheme) in GAP, established in 1972, was studied in 1982. The first goal of this study is to describe the farms within the scope of the Devegeçidi Irrigation Scheme and the economic situation of the farm families benefiting from it. The second goal of the Devegeçidi study is to draw conclusions which may be used in the planning of GAP. By using the results of the Devegeçidi study, the scope and framework of the planning of GAP will be discussed. The results of the Devegeçidi Irrigation Scheme and its plans are given in the second part. Conclusions are given in part three.

THE SOUTHEASTERN ANATOLIA PROJECT (GAP)

NATURAL CONDITIONS, SOCIAL STRUCTURE AND SETTLEMENT PATTERNS IN THE REGION

The Southeastern Anatolia Project covers of eight provinces (Adıyaman, Diyarbakır, Gaziantep, Mardin, Siirt, Şanlıurfa, Batman and Şırnak) which are located south of Turkey's border with Syria and Iraq (**Figure 2**). The region comprises 9.7 percent of the surface area of Turkey. The area which will be affected by GAP is composed mainly of plains surrounded by mountains in the west, north and east, through which the rivers Euphrates and Tigris flow.

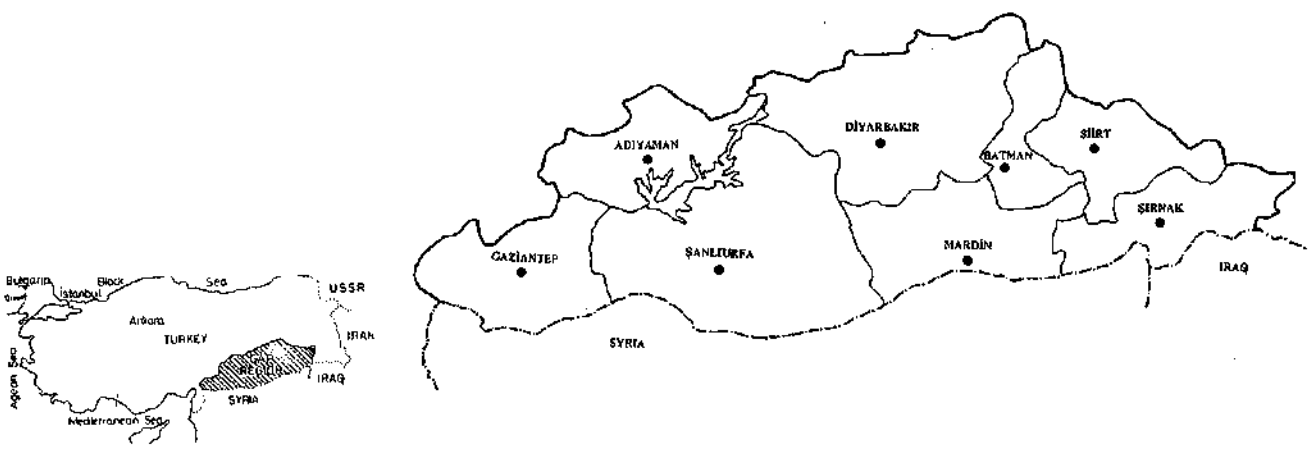


Figure 2. Provinces in the Southeastern Anatolia, Turkey (Drawing by K. Gülcen).

4. One square kilometer (sq km. or km^2) is equal to 0.3861 square miles.

5. State Planning Organization (1989) Volume 2, 5-14.

6. 1 milimeter (mm.) is equal to 0.04 inches, and 1 meter (m) is equal to 39.37 inches.

According to the 1990 census, the total population in this region was 5.2 million (about 9.2 percent of Turkey's total population). The population density in the region was lower than the average population density in Turkey: 68 persons/km^2 as opposed to 73 persons/km^2. The population density within the region varied from 37 persons/km^2 in Şırnak to 149 persons/km^2 in Gaziantep in 1990 (4).

The urban population in the region accounted for 56 percent of the total population in 1990, somewhat lower than the national average (59 percent). The region is characterized by both a high rate of population growth and a high out-migration rate. In 1980, the regional birth rate was 7.0 percent whereas the national rate was 4.5 percent (5).

Climate

Because this region is cut-off from the influence of the Mediterranean, it has a predominantly inland climate, with high temperatures and low precipitation in the summer. The highest precipitation is found south of the Taurus Mountains, which are in the north-west of the region. Precipitation declines steadily towards the south. While annual precipitation is between 1200 and 1300 mm/m^2 in the north, near the Taurus Mountains, it is as low as 300 mm/m^2 near the southern border (6). Precipitation usually occurs during winter.

Land Resources

As shown in Table-1, the total land in the region suitable for agriculture is 7 295 733 ha. The land suitable for cultivation in classes I, II, III and IV constitutes 42.8 percent of the total land in the region. Şanlıurfa has the largest land area with 26.1 percent of the region's total, followed by Diyarbakır (21.1 percent), Mardin (16.9 percent), Siirt (15.1 percent), Gaziantep (10.5 percent) and finally Adıyaman (10.4 percent).

Land Capability Classes	Size	Percentage
Suitable for cultivation		
I	911 752	12.5
II	818 690	11.2
III	732 556	10.1
IV	658 991	9.0
Sub-total	3 121 989	42.8
Unsuitable for cultivation		
V	1 713	0.02
VI	857 701	11.8
VII	3 040 997	41.7
VIII	273 333	3.7
Sub-total	4 173 744	57.2
Total	7 295 733	100.0

Table 1. Distribution of Land (ha); Source: The General Directorate of Soil and Water.

Water Resources

There are surface (rivers) and ground-water resources in this region. The Euphrates and Tigris rivers constitute the majors surface-water resources. There are no other major surface water resources such as lakes or springs.

The Euphrates has a catchment area of 102 276 km^2 in the north of the Syrian border. Its mean annual run-off is estimated to be 30.4×10^9 m^3. This river also has a remarkable seasonal run-off, the highest in April and the lowest in September. The Tigris river has a catchment area of 38 295 km^2 in Turkey. Its mean annual run-off near the Syrian border is estimated to be 16.8×109 m^3. Its seasonal run-off variation is similar to that of the Euphrates.

There is a good potential for ground-water in the region. According to the General Directorate of State Hydraulic Works survey, the annual ground-water safe yield is estimated to be $1\,526 \times 10^6$ m^3. Except for some small-scale irrigation and municipal water supply facilities, these ground-water reserves are not in use at the moment.

LAND TENURE AND LAND USE

The State Institute of Statistics (SIS) has carried out five agricultural censuses in 1927, 1952, 1963, 1970 and 1980. In addition to these, there are two inventories of rural areas undertaken by the General Directorate of Village Works (GDVW) in the years 1962-1968 and 1981. According to the results of the agricultural censuses, the number of land-owning farmers in Turkey was 1 751 239 in 1927 (7).

The number of farmers increased by 44 percent between 1927 and 1952, by 22.7 percent between 1952 and 1963, decreased by 1.4 percent between 1970 and 1980. The average farm size per farmer was 24.9 decares in 1927, 76.9 decares in 1952, 54.0 decares in 1963, 55.8 decares in 1970, and 57.5 decares in 1980. As can be seen from the figures given above, the number of farmers in Turkey rose sharply between 1927-1963. After 1963, the rate of increase in the number of farmers, lost its speed. The highest average farm size was in 1952. After 1952 however, due to the high rate of increase in the number of farm families, the average farm size decreased from 76.9 decares in 1952 to 55.3 decares in 1963. The average farm size has changed very little since 1963.

The agricultural censuses carried out by SIS, do not give an opportunity for studying the distribution of farms at the provincial level. Because of this, an inventory which was undertaken by the General Directorate of Village Works in the year 1981, is used. The General Directorate of Village Works estimated the number of farmers in the region to be 416 459. Nearly 40.3 percent of the farm families in the region were landless. The proportion of landless farm families is 22.1 percent in Adıyaman, 45.3 percent in Diyarbakır, 35.0 percent in Gaziantep, 43.2 percent in Mardin, 44.9 percent in Siirt and 42.3 percent in Şanlıurfa. The national proportion for landless farm families is 31 percent. The percentage distribution of land-owning holdings and their sizes are given in **Table-2.**

As can be seen in **Table-2**, 82.7 percent of the farm families own less than one third (29.8 percent) of the total agricultural land in the region, whereas 17.3 percent of farm families own more than two thirds (70.2 percent) of it. The same distribution at the national level is better than the region. For example, 92 percent of farm families own 59 percent of the total agricultural land in the country, whereas 8 percent of the farm families own 41 percent of the total agricultural land.

7. This information is given by the State Institute of Statistics (SIS, 1970, 20). According to the State Institute of Statistics this figure was 2 527 800 in 1952 (SIS, 1956, 134); 3 100 850 in 1963 (SIS, 1965, 6); 3 058 905 in 1970 (SIS, 1979, 3); and 3 434 163 in 1980 (SIS, 1982, 9).

In the composition of the figure for 1963, farm families not engaged in agriculture (104 630), landless farmers (308 899), and state farms (97) are not included. In the composition of the figure for 1970, farm families engaged in animal husbandry (3 317 688) are not included. In the composition of the figure for 1980, only farm families engaged in agriculture are included.

Table 2. The Percentage Distribution of Holdings. Source: (General Directorate of Village Works, 1985, 56-59).
N= Percentage of land-owning farm families; S= Percentage of total size of holdings.

Holding Size (decares)	Adıyaman	Diyarbakır	Gaziantep	Mardin	Siirt	Ş.Urfa	Reg. Total	Nat. Total
1.25								
N	56.1	57.7	27.8	68.5	73.8	29.7	52.7	57.7
S	11.1	8.3	5.1	15.6	16.2	2.8	7.9	16.6
26-50								
N	17.4	17.6	20.9	11.0	10.3	16.4	15.7	20.7
S	12.1	8.7	8.3	8.3	9.3	4.8	7.8	18.7
51-100								
N	13.4	11.3	23.4	9.3	7.3	22.7	14.3	13.4
S	17.7	11.1	17.7	13.1	13.0	13.6	14.1	23.7
101-200								
N	8.3	7.4	17.7	7.1	5.7	17.8	10.4	5.9
S	20.8	14.1	26.9	18.9	20.0	19.6	19.8	20.6
201-500								
N	3.6	3.9	8.5	2.7	1.8	8.8	4.8	1.9
S	18.9	16.4	27.4	16.9	14.2	20.7	19.9	13.3
501-1000								
N	0.9	1.2	1.4	0.8	0.8	3.2	1.4	0.2
S	9.9	12.0	9.6	11.0	16.7	17.2	13.0	3.8
1000+								
N	0.4	0.8	0.3	0.5	0.3	1.3	0.6	0.1
S	9.5	29.3	5.0	16.2	10.7	21.4	17.5	3.3
Land Owning Farm Families (thousands)	39	56	34	49	30	42	249	*3 849*
Total Land Owned (thousand decares)	2 105	4 133	3 424	2 553	1 166	5 485	18 865	*158m*
Average Size of Holdings (decares)	54.7	74.5	101.9	52.3	38.9	129.3	75.8	41.2

THE MAIN FEATURES OF GAP

The General Directorate of State Hydraulic Works (DSİ) estimates that all the physical investments for GAP will be completed by 2001. Of the thirteen projects that GAP subsumes, seven will be constructed in the Euphrates River basin, and the other six in the Tigris River basin. As stated above, 1 641 282 hectares of land will be irrigated and 25 003 GWh/annum of hydroelectricity will be produced after the completion of GAP (Table-3).

The Karakaya dam in the Euphrates River basin which is a single-purpose project for hydroelectricity has already been completed.

The Atatürk dam and Şanlıurfa tunnel are the key constructions for the realization of the Lower Euphrates Development Project, and both of them are under construction. The Atatürk dam with a height of 184 m, is a multi-purpose dam primarily for irrigation and generation of hydroelectricity. It will create a reservoir with a gross storage capacity of $48\,700 \times 10^6$ m^3 and an active storage capacity of $19\,300 \times 10^6$ m^3.

Table 3. The Main Components of GAP; Source: The General Directorate of State Hydraulic Works.

Project	Sub-Project	Area Irrigated (ha)	Power Generation	
			Capacity (MW)	Production (G Wh/year)
1. Lower Euphrates Project				
1.1 Atatürk Dam and HPP		-	2 400	8 100
1.2 Ş.Urfa Tunnel and HPP		-	48	124
1.3 Ş.Urfa-Harran Irrigation		141 535	-	-
1.4 Mardin-Ceylanpınar Irrigation		-	-	-
1.4.1 First Stage Irrigation		230 130	-	-
1.4.2 Second Stage Irrigation		104 809	-	-
1.5 Siverek-Hilvan Pumped Irrigation		160 105	-	-
1.6 Bozova Pumped Irrigation		69 702	6	16
2. Karakaya Dam and HPP Project		-	1 800	7 354
3. Border Euphrates Project				
3.1 Birecik Dam and HPP		-	672	1 797
3.2 Karkamış Dam and HPP		-	180	470
4. Suruç-Baziki Project		146 500	44	107
5. Adıyaman-Kahta Project				
5.1 HPP (5 Projects)		-	196	509
5.2 Irrigation Projects (5 Projects)		77 409	-	-
6. Adıyaman-Göksu-Araban Project		71 598	-	-
7. Gaziantep Project		81 670	-	-
Sub-total (1+7) For Euphrates River Basin		1 083 458	5 346	18 477
8. Tigris-Kıralkızı Project				
8.1 Kıralkızı Dam and HPP		-	90	142
8.2 Dicle Dam and HPP		-	110	118
8.3 Dicle Right Bank Irrigation		52 033	-	-
8.4 Dicle Right Bank Pumped Irrigation		74 047	-	-
9. Batman Project				
9.1 Batman Dam and HPP		-	185	483
9.2 Batman Right Bank Irrigation		18 758	-	-
9.3 Batman Left Bank Irrigation		18 986	-	-
10. Batman-Silvan Project (Dam and HPP)		213 000	300	1 500
11. Garzan Project		60 000	90	315
12. Ilısu Dam and HPP		-	1 200	3 028
13. Cizre Project				
13.1 Cizre Dam and HPP		-	240	940
13.2 Silopi Irrigation		32 000	-	-
13.3 Nusaybin-Cizre-İdil Pumped Irrigation		89 000	-	-
Sub-Total (8 to 13) For Tigris River Basin		557 824	2 215	6 526
Total (1 to 13) For Whole GAP		**1 641 282**	**7 561**	**25 003**

The Şanlıurfa tunnel will carry water from the Atatürk dam reservoir to the main canals of the Urfa-Harran and Mardin-Ceylanpınar irrigation schemes. It consists of two tunnels, each 7.62 m in inner diameter and 26.4 km long. Its capacity will be 328 m^3/second. The Atatürk dam and Şanlıurfa tunnel projects are scheduled for completion in 1991 and 1992 respectively. The irrigation of the Şanlıurfa-Harran area will be completed in the year 1992. The dams of Kıralkızı, Dicle and Batman in the Tigris River basin are under construction. The Batman project is scheduled for completion in 1993.

A CASE STUDY IN GAP: THE DEVEGEÇİDİ IRRIGATION SCHEME

EXISTING IRRIGATION SCHEMES

Nearly 120 000 ha. of land in the region are presently irrigated through local or state constructed schemes. The present irrigated area constitutes nearly 7 percent of the potential irrigable land with GAP. Twenty-two irrigation schemes were constructed by the General Directorate of State Hydraulic Works (DSİ). Some of the following projects are operated by DSİ (Taraklı, 1987, 32):

Project	Area Irrigated (ha)
Diyarbakır-Devegeçidi	7 500
Diyarbakır-Gözegöl	550
Diyarbakır-Batman	3 500
Mardin-Nusaybin	5 750
Diyarbakır-Halilan	550
Urfa-Hacıkamil	450
Urfa-Akçakale (ground water)	13 800
Urfa-Ceylanpınar (ground water)	9 000

The Devegeçidi Irrigation Scheme is located near Diyarbakır. Irrigation started in 1972. The original plan was to irrigate 8 959 hectares of land. However, because of urbanization and the cancellation of plans to irrigate the area to the west of Diyarbakır, only 7 500 ha. of land are being irrigated at the present time (Taraklı, 1987, 37).

SCOPE AND METHOD

Most of the data included in this research were collected during the summer of 1982 (8). The data concerning the production and income of farmers are from the growing years of 1981-1982. The growing year starts on December 1st and ends on October 31st of the following year.

There were no previous statistical records on the techniques used by the farmers, or their incomes, expenses, etc. For this reason, it was necessary to collect information directly from the farmers themselves. Data was collected in two stages. Some information related to agricultural techniques in use in the area, labor demand for different agricultural activities, the irrigation technique, and prices for agricultural products were obtained from a group of farmers during the first stage. All of the settlements in the area were visited to gather this first

8. Source: Taraklı (1987) 20-25.

set of information. Occasionally, more than one visit had to be made in order to establish a relationship with the inhabitants suitable for the research. All of the thirty-one settlements, eighteen villages and thirteen sub-villages (hamlets) in the area covered by the Devegeçidi Irrigation Scheme were included in this research. Eighteen of these thirty-one settlements are owned by sixteen landlord families while the remaining thirteen are owned by farm families.

A total of 1701 families lived in thirty-one settlements. 1302 of these (76.5 percent) were landless. The remaining 399 of them (23.5 percent) living in the area owned land. There were an additional 97 land-owning families living outside the area and not practicing agriculture. 786 farm families out of 1701 living in the area are engaged in agricultural production, and 680 benefit from irrigation.

According to the scope of this research project, the survey was restricted to these 680 farm families. The farm families which benefited from irrigation were divided into four groups by size of holding and a sample of fifty farmers was randomly selected. The distribution of the farmers in the four groups is given below:

FARM SIZE GROUP (decares)	NUMBER OF FARMS Number of families	Percent
1-10 (very small)	103	15.2
11-100 (small)	412	60.6
101-300 (medium)	115	16.9
301-2000 (large)	50	7.3
Total	680	100.0

PRESENT ECONOMIC AND SOCIAL STRUCTURE OF SAMPLE FARMS

Privately Owned Lands

The average amount of land owned by farm families included in the sample was 110.2 decares. The average amount of land owned was 8.6 decares in the first group, 58.0 decares in the second group, 120.8 decares in the third group, and 726.5 decares in the fourth group. However, all the farmers did not use all the land they owned; instead, they leased some of it to others. On the whole, 68.9 percent of the land was used by the owners themselves (Table-4).

LAND TENURE	FARM SIZE GROUPS 1-10	11-100	101-300	301-2000	Average
1. Privately Owned	8.6	58.0	120.8	726.5	110.2
2. Leased	7.2	32.1	18.3	145.3	34.3
3. Hired	5.9	30.6	56.7	86.8	35.4
4. Farm size (4=1 - 2+3)	7.3	56.5	159.2	668.0	111.3

Table 4. Farm Sizes (decares); Source: Taraklı (1987) 56-97.

Farm Size

The average farm size in the research area was 111.3 decares. The average farm size was 7.3 decares in the first group, 56.5 decares in the second group, 159.2 decares in the third group, and 668.0 decares in the fourth group (**Table-4**). The percentage of hired land in the research area was 31.8 percent. The ratio of hired land was higher for small farms than for the larger ones. For example, the ratio of hired land was 80.8 percent in the 1-10 size group, 54.2 percent in the 11-100 size group, 35.6 percent in the 101-300 size group, and 13.0 percent in the 301-2000 size group. It thus becomes clear that hired land was very important in the first two groups. Hiring and leasing of the land were organized on a yearly basis subject to an oral contract according to local customs.

Farm Family Size

The average farm family size was 5.29 in the 1-10 size group, 9.90 in the 11-100 size group, 9.33 in the 101-300 size group, 18.06 in the 301-2000 size group and the average for all groups was 9.70. Two or three generations lived together especially in the large farms. The nucleus family was typical in the case of the poorest farm unit. The largest farm family size was fifty-one in 1982. The ratio of the juvenile population to the total population was 53.3 percent while the national average remained at 39.0 percent. There was no meaningful difference in the ratio of juvenile population between the farm groups.

The ratio of literacy for the population 6 years of age and over, was 44.3 percent (67.9 percent for males and 15.2 percent for females) while the national average was 67.5 percent (80.0 percent for males and 54.7 percent for females according to the State Institute of Statistics, 1984, 56).

The average size unit for the man labour force was 2.68 in the 1-10 size group, 5.04 in the 11-100 size group, 4.71 in the 101-300 size group, 9.28 in the 301-2000 size group and the average for all the groups was 4.94 (**10**). The farm family labour time available for agricultural activities was 730.12 man days in the 1-10 size group, 1 417.87 man days in the 11-100 size group, 1 366.13 man days in the 101-300 size group, and 2 512.36 man days in the 301-2000 size group. The average for all groups was 1 385.37 man days.

10. The equivalents of 'man labour' force are given below:

Age group	Equivalent of man labour force
7-14	0.50
15-49	1.00 for male; 0.75 for female
50-64	0.75 for male; 0.50 for female

The ratio of farm family labour time actually used for farm activities to the total farm family labour time available for agricultural activities was 33.48 percent in the 1-10 size group, 29.27 percent in the 11-100 size group, 49.35 percent in the 101-300 size group, 30.87 percent in the 301-2000 size group and the average for all groups was 33.17 percent. It thus means that the ratio of unemployed farm family labour time to the total farm family labour time available for agricultural activities was 66.52 percent in 1-10 size group, 70.73 percent in the 11-100 size group, 50.65 percent in the 101-300 size group, 69.13 percent in the 301-2000 size group and 66.83 percent in the average for all groups. It may be seen easily that the farm family labour time was used most effectively in the 101-300 size group. Once more, the situation of 301-2000 size group may be described as a case of under-employment instead of unemployment, because the farm family members are not actively seeking work but are engaged in activities unsatisfactory in one way or another.

The number of total man days used for farm activities was 262.47 man days in the 1-10 size group, 843.02 man days in the 11-100 size group, 1 675.38 man days in the 101-300 size group, 3 346.66 man days in the 301-2000 size group and the average for all groups was 1 079.82 man days. Hired labour time was used in all farm groups. The ratio of hired labour time used for farm activities was 6.81

percent in the 1-10 size group, 50.77 percent in the 11-100 size group, 59.76 percent in the 101-300 size group, 76.82 percent in the 301-2000 size group and the average for all farm groups was 57.45 percent. The ratio of hired labour time was the highest in the 301-2000 size group and smallest in the 1-10 size group.

Capital and Debt

11. At that time 1 US dollar was equal to 178 TL.

The total capital value of sample farms are shown below (11). The composition of the total capital value (consisting of value of land, land improvements, building, plant, machine-equipment, livestock, cash in hand) differs among farm groups. For example, building capital (or building wealth) constituted the highest ratio (55.6 percent) in the 1-10 size group. However, land value constituted the highest ratio in the other size groups. The ratio of land capital was 27.9 percent in the 1-10 size group, 38.0 percent in the 11-100 size group, 53.0 percent in the 101-300 size group, 44.1 percent in the 301-2000 size group and the average for all groups was 43.5 percent. The debts (consisting of value of credits from banks and private sources, value of hired land and livestock) in ratio to the total capital value was highest (39.1 percent) in the smallest size group. The ratio of debt decreases steadily with the increase in farm size; it was 36.6 percent in the 11-100 size group, 24.6 percent in the 101-300 size group, 19.9 percent in the 301-2000 size group and the average for all group was 27.7 percent.

FARM SIZE GROUP (decares)	TOTAL CAPITAL VALUE (1000 TL)
1-10 (very small)	433
11-100 (small)	2 081
101-300 (medium)	4 350
301-2000 (large)	16 787
Average	3 296

Farm Land Use

Mechanization is higher in the cultivation of wheat and cotton in Turkey and in the region, than the production of summer vegetables. For this reason, the ratio of cultivation of summer vegetables was higher in the 1-10 size group than the other farm groups, and the percentage of cereal cultivation was highest in the group of the largest farm. For example, the percentage of land devoted to industrial crops (mainly cotton) in the sample farms was 36.2 percent; 27.5 percent of the land was devoted to cereals (mainly wheat and rice), with 5.2 percent for summer vegetables on the average (**Table-5**).

CROP	FARM SIZE (decares)				
	1-10	11-100	101-300	301-2000	Average
Cereals	-	18.3	16.3	40.6	27.5
Pulses	-	6.2	7.3	1.5	4.3
Industrial Crops	19.7	49.4	48.0	20.8	36.2
Forage Crops	-	-	-	0.2	0.1
Summer Vegetables	78.4	6.5	7.9	1.1	5.2
Orchards	-	-	-	0.2	0.1
Fallow	-	-	-	2.3	1.0
Grazing Land	-	-	-	6.9	3.0
Uncultivable Land	1.9	19.6	20.5	26.4	22.6
Total	100.0	100.0	100.0	100.0	100.0
Percentage of Irrigable Land	97.8	81.3	66.9	69.1	72.6
Percentage of Unirrigable Land (Dry land)	2.2	18.7	33.1	30.9	27.4

Table 5. The Percentage of Total Farm Land Use.

Gross Production Value

The amount of gross production value, its distribution among the different agricultural activities, and its comparison with other kinds of production are given in **Table-6.** In all farm groups, the share of the value of crop products was higher than the share of animal products in gross production value. The average ratio of the value of crop products is 80 percent. This ratio is higher in the 1-10 and 301-2000 size groups than in the 11-100 and 101-300 size groups. Total gross production value increases steadily with the increase in farm size. However, the amount of gross production value per decare of land is highest in the smallest farm group. This shows that farming intensity is higher in the smallest size farms than in the other size groups.

Table 6. Gross Production Value (1 000TL) and Source of Income.

FARM SIZE (decares)	SOURCE Crop Products	Animal products	Total	Gross Prod.
1-10				
Value (TL/decare)	129	14	143	19 575
Percent	90	10	100	
11-100				
Value (TL/decare)	533	166	699	12 359
Percent	76	24	100	
101-300				
Value (TL/decare)	1502	564	2066	12 979
Percent	73	27	100	
301-2000				
Value (TL/decare)	3150	211	3361	5 030
Percent	94	6	100	
Average				
Value (TL/decare)	828	213	1041	9 354
Percent	80	20	100	

Table 7. Marketable Income (TL) and Comparison Units. Values are given in 1000 TL.

FARM SIZE (decares)	SOURCE Crop Products	Animal Products	Total	Comparison Units Marketable Income 1000TL/ decare	1000TL/ person	%Gross Prod. Value
1-10						
Value	78.3	10.1	88	12.1	16.7	62
Percent	89	11	100			
11-100						
Value	258.4	104.9	363	6.4	36.7	52
Percent	71	29	100			
101-300						
Value	753.5	489.5	1 243	7.8	133.2	60
Percent	61	39	100			
301-2000						
Value	1 087.7	81.3	1 169	1.8	64.7	35
Percent	93	7	100			
Average						
Value	375.8	153.9	530	4.8	54.6	51
Percent	71	29	100			

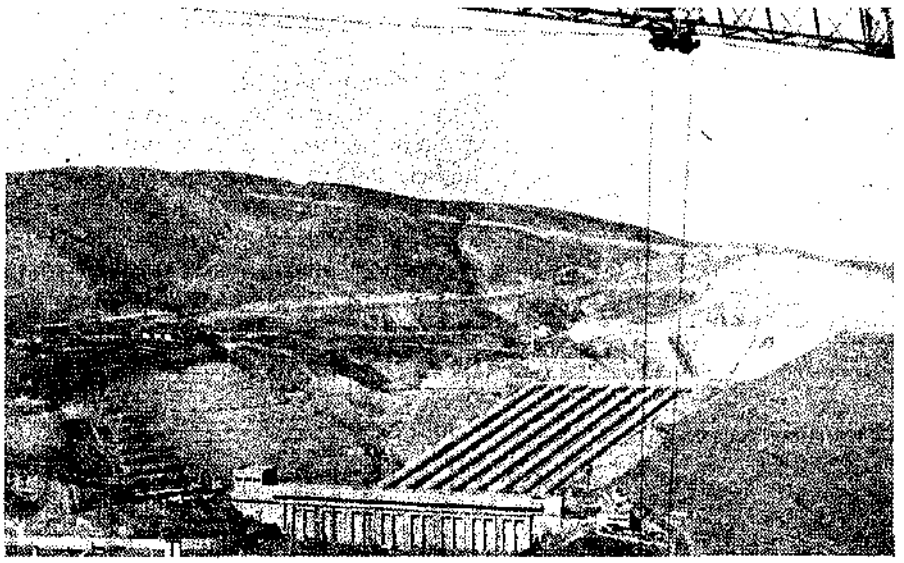
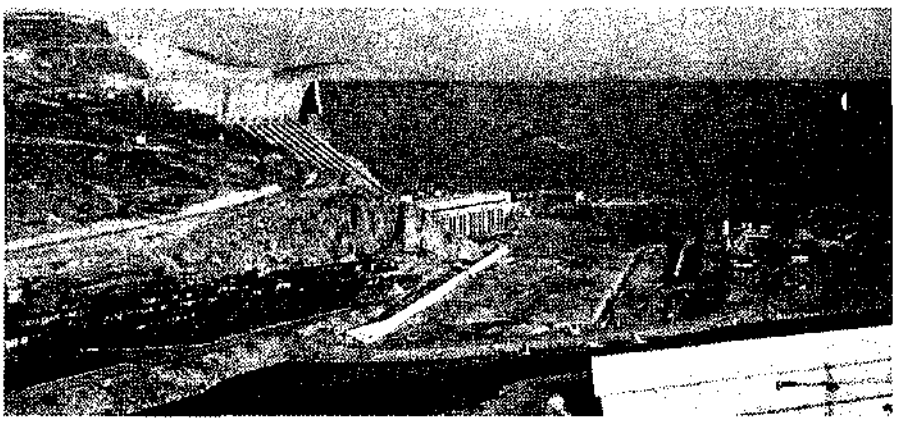
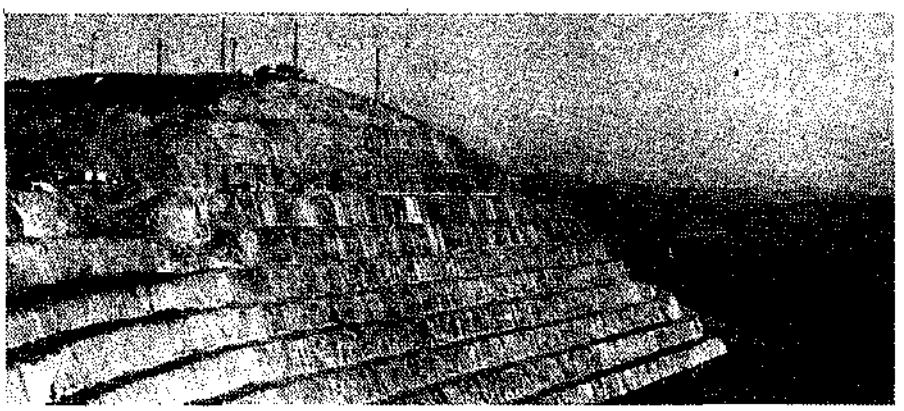


Figure 3. Atatürk Dam Hydropower Stations (photograph by the author, November 1991).

Marketable Income

The marketable income was calculated by subtracting running expenses from the value of gross production value. The figures shown in **Table-7** indicate that the smaller farms are more beneficial from the view point of national economy, because the value of marketable income per decare is highest in the smallest farm size group. However, the 101-300 size group emerges as the most economic size group from the viewpoint of the farm population, because the value of marketable income per person is highest in this group of farm.





Figures 4-5. Atatürk Dam Hydropower Stations and the reservoir (photograph by the author, November 1991).

PLANNING OF SAMPLE FARMS

The purpose of this planning was to find the profitable farm organization on the Devegeçidi Irrigation Scheme, which is characterized by low productivity and low income. For the planning, linear programming technique in which the cost of running expenses as a variable resource, was used and optimum plans for the different farms were derived (Taraklı, 1987, 108-157).

The plan is based on twelve annual, and one perennial crop activities, fifteen crop rotations and two livestock (cow and sheep) activities. This takes into account one production technique, namely, mechanized crop production. The data used in the model are gathered mainly from Ceylanpınar State Farm and Şanlıurfa Research Farm which are located in GAP.

Ten groups of inputs (land size, cost of labour, seed, fertilizer, chemicals, irrigation water, tractor and equipment, farm family labour time, amount of manure and running expenses) for crop production and five groups of inputs (forage, feed concentrates, veterinary expenses, farm family labour time, barn and sheep fold size) for animal husbandry are incorporated in the plan. Farm family labour time is divided by the five periods of time. Land is classified into irrigated land, fertile dry land, shallow dry land. The amount of production factors which were used for the planning are given in **Table-8.**

Output from crop production activities is divided into five: Crop yield for human consumption, crop yield for industrial use, feed yield for animal consumption, forage yield and feed yield crop by-product for animal consumption. The outputs of livestock activities include live animals for sale, milk, wool and manure.

Table 8. Production Factors Available For Use:
1. The size of grazing land and uncultivable land are not included.
2. The actual figures are used.
3. The alfalfa cultivation is equal to 25 percent of irrigated land.
4. Except for the 1-10 group, the size of the vegetable growing area is decided according to the ten percent of farm family labour time during the 2nd, 3rd and 4th periods.
5. The total farm family labor time and the periods are derived for field survey.
6. The numbers are nearer to the present figures, only the breed of milking cow is changed.

PRODUCTION FACTORS	FARM SIZE (decares)				
	1-10	11-100	101-300	301-2000	Average
Total farm size [1] *decares*	7.1	56.5	159.2	533.5	101.4
Irrigated land [2] *decares*	7.1	45.9	106.5	461.4	80.8
Fertile land (dry farming) [2] *decares*	0	7.7	16.7	60.9	12.0
Shallow land (dry farming) [2] *decares*	0	2.9	36.0	11.2	8.6
Alfalfa cultivation [3] *decares*	1.8	11.5	26.6	115.4	20.2
Vegateble cultivation [4] *decares*	7.1	24.3	23.5	43.1	23.8
Farm Family Labour Time *(man/hours)*					
Total [5]	5840	11344	10928	20096	11080
First period *(January 1-March 10)*	1104	2144	2064	3800	2096
Second period *(March 11-July 20)*	2112	4104	3952	7264	4008
Third period *(July 21-August 31)*	672	1304	1264	2312	1208
Fourth period *(September 1-October 31)*	976	1896	1824	3360	1848
Fifth period *(November 1-December 31)*	976	1896	1824	3360	1848
Milked cows [6] *cow units*	2	4	4	6	3.84
Milked sheep [6] *sheep units*	0	10	10	0	7.75

Two alternatives were selected and taken into account to prepare two plans with the linear programming. For the first alternative in planning the farm family labour time which is given in Table-8, was taken as limiting factor for the sample farms except for the 301-2000 size group, and hired labour for cotton picking was included as a possibility.

For the second alternative in planning, the farm family labour time was not taken as a limiting factor except for animal husbandry. In all stages, it was assumed that the yields obtained on the research farm or on the state farm are possible, and that the inputs needed for such levels of production will be undertaken by the farmers. The expected increases and decreases in the marketable income and in the running expenses are given in Table-9.

As is seen in Table-9, it is feasible to increase marketable income from 4.6 to 5.4 times of what has been achieved until now, thanks to irrigation during the past eleven years by the first and second alternatives respectively. In addition to the rules mentioned above, it will be necessary to practice double-cropping in 57 percent of the land in the first alternative and in 64.7 percent of the land in the second alternative. Furthermore, winter vegetables and forage crops also have to be introduced into the project area.

Table 9. The percentage of increasing or decreasing rate of marketable income and running expenses; (+) shows an increase, and (-) shows a decrease

Planning Alternative	Income or Expenses	Farm Size (decares)				
		1-10	11-100	1101-300	301-2000	Average
First						
	Marketable income (%)	+613	+467	+165	+1198	+460
	Running expenses (%)	+257	-30	-19	+186	+46
Second						
	Marketable income (%)	+577	+588	+238	+1138	+538
	Running expenses (%)	+820	+360	+167	+186	+260

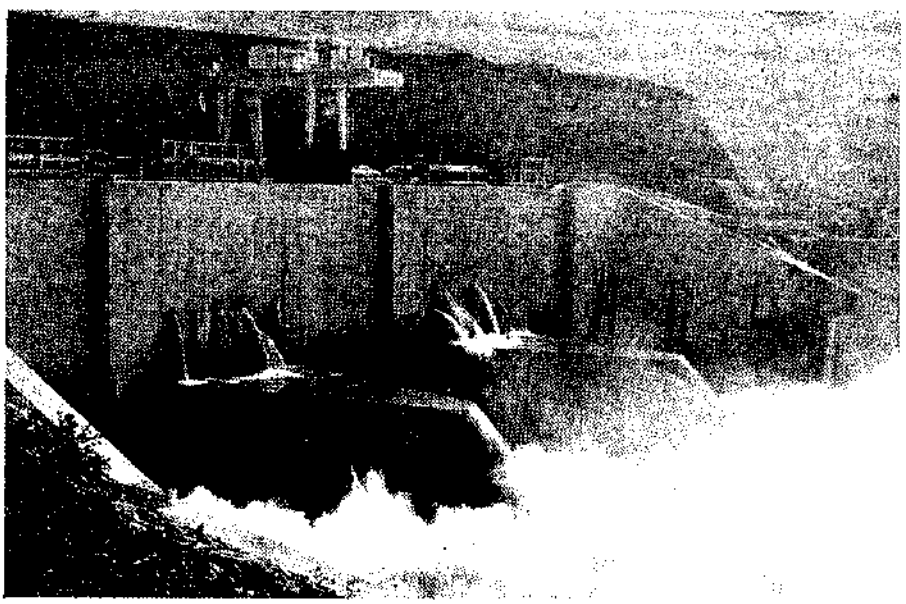


Figure 6. Atatürk Dam Diversion Canal and Outlets; waters flowing 500 m^3 per second to Syria and Iraq (photograph by author, November 1991).

CONCLUSIONS

Admittedly, GAP is a big project, but solving its social and economic problems so as to assure the highest benefit is more difficult than the construction of its physical units. In the light of the evaluation of the Devegeçidi Irrigation Scheme, the following recommendations can be formulated for GAP:

1. As stated before, the land tenure system and the distribution of the agricultural land holdings are not suitable for creating social justice in the Devegeçidi Irrigation Scheme and GAP. Once more, the efficiency of small farms is higher than large farms. As a result, a more equitable distribution of land suitable for securing social justice must be achieved through land reform or similar actions,

2. The research on the Devegeçidi Irrigation Scheme shows that an additional 3.2 or 3.3 million of rural population will be necessary to maximize efficiency in the area concerned when all the irrigation projects subsumed by GAP will be realized (Taraklı, 1987, 159). The huge population should be settled in the rural area (where the present rural population is 2.2 million) while GAP is being completed.

In this respect, another solution could be more intensive mechanization, but this requires the establishment of new strategies and further studies.

3. The number of additional tractors that will be needed in GAP equals 55 percent of Turkey's present number of tractors and the additional amount of fertilizers that will be consumed in GAP equals 17 percent of Turkey's present consumption level (Taraklı, 1987, 159). The input availabilities for agricultural development depend on the outputs of other sectors in the economy. Hence, these industries will have to be developed.

4. The other element in agricultural development is the demand side. The research shows that agricultural products can be increased manyfold in GAP. The demands of agricultural products are not elastic. Because of this, the demand side of agricultural products has to be studied in order to achieve planning results in agricultural supply.

5. Lots of the new crops will be cultivated in GAP by introducing irrigation water in the region. For this reason, it is necessary to establish a special type of extension and other services such as credit programs, storage facilities, processing and marketing services must be provided in all stages of production. A single country-wide system of services is not efficient enough to secure the highest benefits. A regional organization has to be established in GAP.

6. If the planning results obtained from the research on the Devegeçidi Irrigation Scheme are not taken into account for the full development of the rural areas affected by GAP, the annual agricultural income will remain at the Devegeçidi Irrigation Scheme's 1982 level. We then get the following results: The annual marketable income loss in GAP area will amount to 634 x 10 9 TL. on the basis of the 1982 prices (Taraklı, 1987, 161).

GAP: GÜNEYDOĞU ANADOLU SULAMA VE GELİŞME PROJESİ

ÖZET

Alındı : 14.11.1991
Anahtar Sözcükler : GAP, Bölge Planlama, Ekonomik Kalkınma, Tarımsal Planlama.

Güneydoğu Anadolu Projesi GAP, Adıyaman, Diyarbakır, Gaziantep, Mardin, Siirt ve Şanlıurfa illeri ile yeni illerden Batman ve Şırnak illerini kapsamaktadır. Söz konusu bölge, ülke alanının %9.5'ine (74 000 km^2) eşittir. 1990 yılı nüfus sayımlarına göre bölgenin toplam nüfusu ise 5.2 milyondur. Bölge, nüfusça ülkenin %9.2'sine eşittir.

Güneydoğu Anadolu Projesi ile, Fırat ve Dicle nehirleri üzerinde yirmibir adet baraj inşaatı planlanmıştır. GAP'ta öngörülen projelerin tamamlanması ile toplam kurulu hidroelektrik enerji gücü 7 561 'Megawatt'a ulaşacak ve 25 003 'Gwh' enerji üretilebilecektir. GAP'ta toplam hidroelektrik kurulu gücü, Türkiye'nin halen kurulu hidroelektrik gücünden daha fazladır.

GAP'taki sulama projelerinin bitirilmesi ile, 1 641 282 hektar alan sulanabilecektir. Bu genişlik, halen Devlet eliyle sulanan büyük sulama alanlarının genişliğinden daha fazladır.

GAP'ta sulama ile sağlanabilecek üretim artışını ortaya koymak için, 1972 yılında işletmeye açılmış bulunan Diyarbakır'daki Devegeçidi sulama alanında yapılan bir araştırmanın bulgularına başvurmak olanaklıdır. Devegeçidi sulama alanında 1982 yılında, sulama ile üretim değeri onbir yıl içinde kuru tarıma göre ancak dört kat artmıştır.

Elde edilen bilgiler ve Türkiye'de mevcut tarım teknikleri temel alınarak iki değişik planlama modeli kurulmuştur. Planlarda öngörülen tekniklerin çiftçilerce GAP'ta uygulanabilmesi durumunda, gayrisafi üretim değeri birinci seçeneğe göre 14.4, ikinci seçeneğe göre ise 19 kat artırılabilecektir.

Devegeçidi sulama alanında elde edilen sonuçları GAP geneline daha kolay anlaşılabilir biçimde uyarlayabilmek için, gayrisafi üretim değeri 1982 birim fiyatlarına göre buğday eşdeğerine çevrilmiştir. Buna göre, tüm GAP sulama alanında kuru şartlarda 1.7 milyon ton buğdaya eşdeğer gayrisafi üretim değeri elde edilebilirken, Devegeçidi sulama alanında onbir yıl sonra ulaşılabilen düzeyde bu değer 6.7 milyon ton buğday eşdeğerine yükselebilmiştir.

Oysa ülkemizde mevcut tarım tekniğinin çiftçilerce tüm GAP'ta uygulanabildiğini varsaydığımızda, aynı üretim değerini, birinci seçeneğe göre 24.4 milyon ton, ikinci seçeneğe göre de 32.2 milyon ton buğday eşdeğerine çıkarmak olasıdır.

Başka bir deyişle, eğer GAP'ta bazı planlama kararları yerinde ve yeterince uygulanamadığı durumda, birinci seçeneğe göre yılda 17.7 milyon ton, ikinci seçeneğe göre de 25.4 milyon ton buğdayın değerine eşit gayrisafi üretim değeri kaybı olacaktır. Bu kaybın önlenmesi, ancak GAP'ta üretilen tarımsal ürünlerin iç ve dış pazarlarda uygun fiyatlarla değerlendirilmesiyle olanaklıdır.

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