

Southeastern Anatolia Project (GAP)

İ. H. OLCAY ÜNVER

President, Republic of Turkey Prime Ministry Southeastern Anatolia Project Regional Development Administration, Uğur Mumcu'nun Sokağı 59, G.O.P., 06700, Ankara, Turkey

ABSTRACT *The recognition of the great water potential of the Euphrates and Tigris Rivers in south-east Turkey led to plans for their sustainable development for irrigation and hydropower generation and to control floods and droughts. This integrated socio-economic development project, called the Southeastern Anatolia Project (GAP), is one of the largest of its kind in the world. The water resources development programme includes 22 dams, 19 hydropower plants and the irrigation network for 1.7 million ha of land. The US\$32 billion project comprises not only water resources development projects, but also investments in all development-related sectors.*

Pre-project Conditions

Area and Population

The GAP project area lies in south-eastern Turkey (Figure 1), covering nine Provinces (Adiyaman, Batman, Diyarbakır, Gaziantep, Kilis, Mardin, Siirt, Şanlıurfa, Şırnak), corresponding to approximately 10% of the country's total population as well as its surface area. The project area includes watersheds of the lower Euphrates and Tigris rivers and the upper Mesopotamian plains. The total surface area is 75 000 km², of which 42.2% is cultivated (36% rain-fed), 33.3% pastures, and 20.5% forest and bush. Average gradient over 94% of the total surface area is less than 12%, which is the threshold of cultivability. Salinity and alkalinity problems are minimal, and most of the soil has good drainage conditions. Wind erosion is minimal, but water erosion in places could be moderate to strong.

The population of the region in the 1985 census was 4.3 million, of which 49.9% was urban. The average population density was 58 persons per km², compared with the national average of 65. Annual population growth was about 3.7%, which was above the national average (2.54%). A distinguishing feature of the region's population was the number of young people. In 1985, 49% of the region's population was within the 0–14 age-group and 48% was in the 15–64 age-group. Those under the age of 30 made up almost two thirds of the population. Fertility rates in 1985 were 4.02 in the region, but only 2.59 in Turkey as a whole. Infant mortality rate in 1985 was 111 per thousand in the region, compared with 109 in Turkey overall. The economically active population (ages 15–65; 48% of the region's overall population) indicates a high dependency rate (Table 3). Although the fertility rate is higher in rural areas, the population is increasing in urban centres more rapidly owing to high migration rates. The

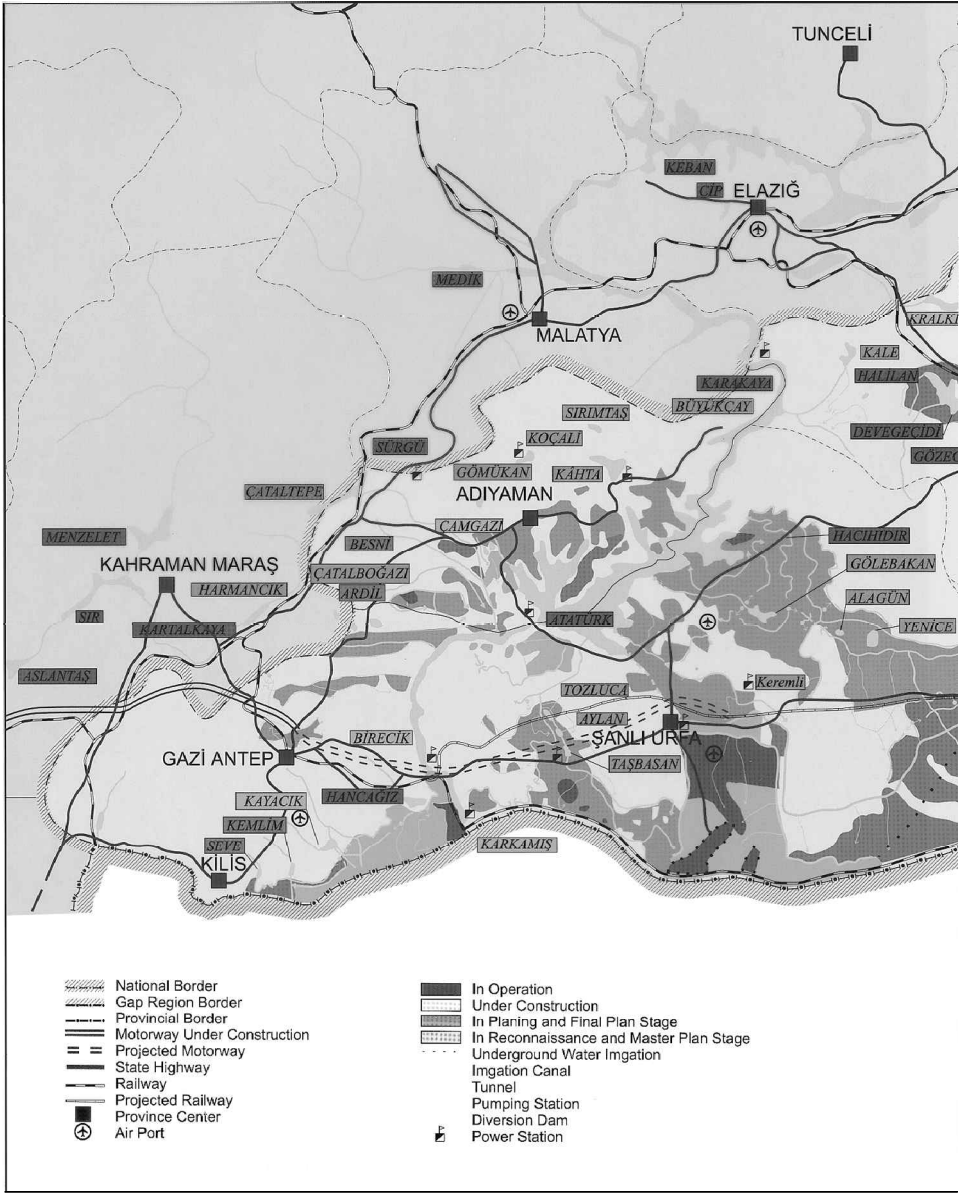
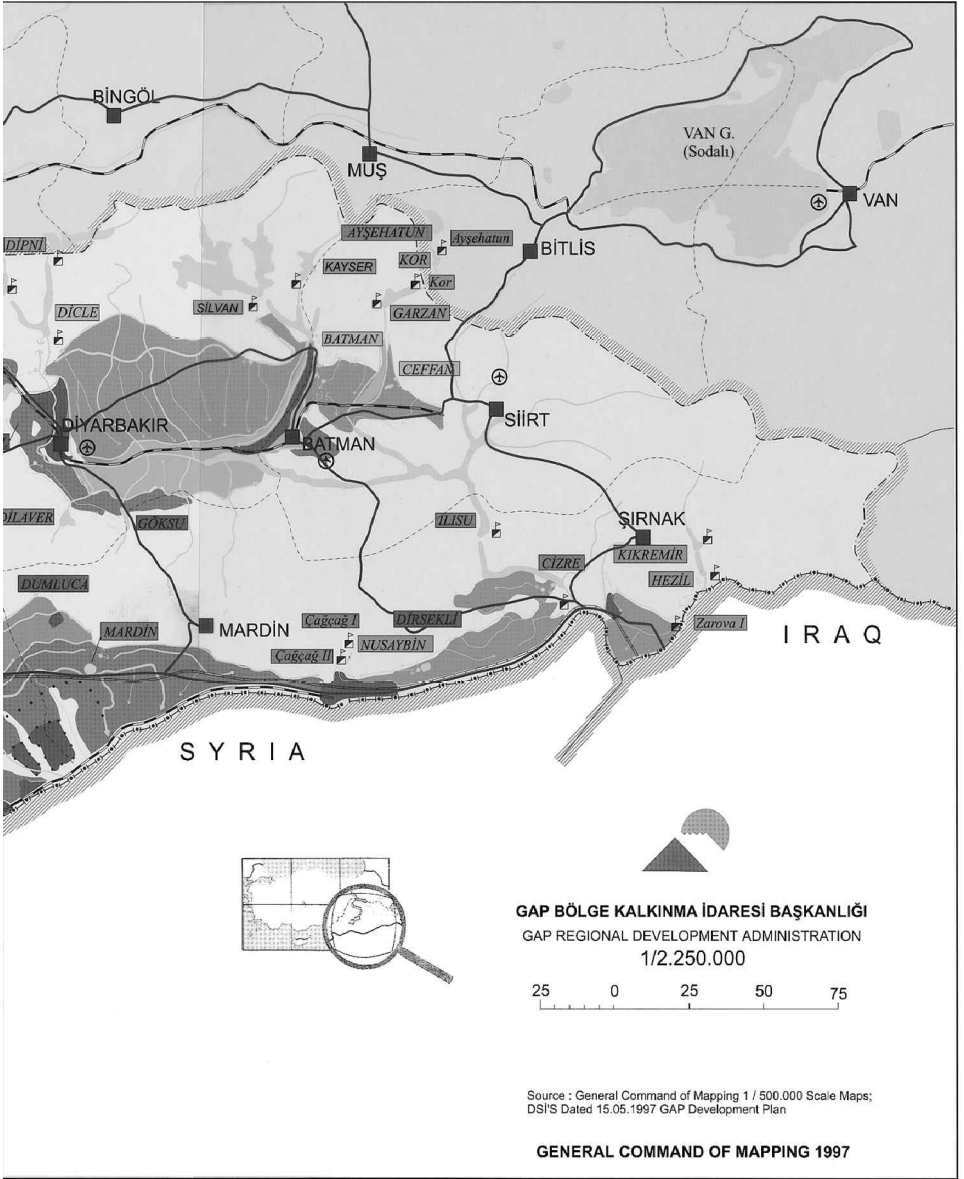


Figure 1. GAP region map.

population share of the region has increased steadily from 7% of the national total in 1945 to 8.5% in 1985. In 1985, 44% of the population of the region lived in 3463 settlement-villages and hamlets, each having a population under 2000; another 31% was concentrated into eight settlements, each having more than 50 000 people. Both inter-regional and intra-regional migration are significant issues in the GAP area.

Economy

A comparison of gross regional product (GRP) of the region in 1985 with the GDP of Turkey (Table 3) clearly indicates the level of its underdevelopment. In



1985, the region accounted for 4% of GNP. Per capital income was only 47% of the national average.

Agriculture is by far the dominant production sector, accounting for nearly 40% of GRP. It contributes to over 9% of the agricultural value-added of Turkey. Rain-fed agriculture is predominant. Depending primarily on water availability constraints, crop diversification is limited and productivity is low. The crop pattern was 34% wheat, 18.5% barley, 19.7% lentils, 2.8% cotton, 9.4% multi-seasonal produce and 2.2% sesame.

Nearly 70% of the economically active population is engaged in agriculture, but it only generates 44% of the gross regional product. Similarly, the animal stock is large, but productivity is low. Traditional production methods still predominate, but agricultural modernization has started.

Only 2% of the country's total value-added from the manufacturing industry was produced in the GAP region during the 1980–85 period. In 1985, 95% of the manufacturing industry employed less than five workers. The main industries are textiles (32%), metal products (21%), food and beverage (19%), wood products (15%), and chemicals (5%). Industrial employment comprises 5% of the regional labour force as compared with 16% for Turkey. The growth rate of employment reached its peak in 1985, at 19%, which was 4.7 times higher than the national average. The public sector was more successful in generating value-added during this period. The annual growth rate of industrial value-added was 15.5% during 1980–85, but it declined later. Industry accounted for nearly 60% of the region's electricity consumption.

Mining is an important activity in the region's economy. Twenty-two types of ores have been identified as being economically feasible for production. All Turkey's petroleum and phosphate reserves are in the project region. In 1985, the GAP region contributed 4.4% of the total value-added of the mining sector of Turkey.

Social Services

National literacy rates increased from 67% to 77% between 1980 and 1985. The literacy level in the region in 1985 was 55%. There was a considerable difference between male and female literacy rates at 71.7% and 39%, respectively. Corresponding figures for the country were 86% for men and 68% for women.

Medical facilities and personnel in the region were inadequate. The number of persons per doctor was 3631, and per nurse 2758, which compared unfavourably with the national figures of 1391 and 1630, respectively. The number of persons per hospital bed was 847 compared with 484 for Turkey in 1985.

There were 3500 rural settlements without drinking water supply, i.e. 35% of total rural settlements. This ratio increased to 55% if those with inadequate water supply were included. On a population basis, 22% of the rural population in the region did not have access to clean drinking water; 29% of the villages had telephone services, 66.8% were electrified and 90% of the rural settlements were linked to the road networks.

Urban centres, having better living standards and services, have been attracting substantial rural migration. Urban infrastructure has therefore become inadequate.

Water Resources Development Programme

The GAP area is rich in water and soil resources. The Euphrates and Tigris rivers represent over 28% of the nation's water supply by rivers, and the economically irrigable areas in the region make up 20% of those for the whole country. The development of the region was originally conceived as relating to its water resources, which were later combined in a comprehensive water and land resources development package (GAP-RDA, 1997a). For this purpose, 13 groups of projects were planned on the Euphrates and Tigris rivers and their tributaries by the General Directorate of State Hydraulic Works (DSİ) (Table 1):

Table 1. Water and land resources development projects in the GAP Region

Project	Capacity (MW)	Production (GWh)	Irrigation area (ha)	Present stage
I. Karakaya Project:	1 800	7 354		
●Karakaya Dam & HEPP	1 800	7 354		OP
II. Lower Euphrates Project:	2 450	9 024	706 281	
●Atatürk Dam & HEPP	2 400	8 900		OP
●Şanlıurfa HEPP	50	124		U/C
●Şanlıurfa Irrigation Tunnels				
(a) Şanlıurfa Tunnels & Irrigation			150 000	U/C
(b) Mardin–Ceylanpınar Gravity Irrigation			208 000	M/P
(c) Mardin–Ceylanpınar Pumped Irrigation			118 000	M/P
●Siverek–Hilvan Pumped Irrigation			160 000	Rec
●Bozova Pumped Irrigation			70 000	Rec
III. Border Euphrates Project:	852	3 168		
●Birecik Dam & HEPP	672	2 516		U/C
●Karkamış Dam & HEPP	180	652		D/D
IV. Suruç–Baziki Project			146 500	
●Suruç–Baziki Plain Irrigation			146 500	Rec
V. Adıyaman–Kahta Project:	195	509	78 700	
●Çamgazi Dam & Irrigation			7 430	U/C
●Gömikan Dam & Irrigation			7 762	M/P
●Koçalı Dam & HEPP	40	120	21 605	M/P
●Sarımtaş HEPP	28	87		M/P
●Fatopaşa HEPP	22	47		M/P
●Büyükcay Dam, HEPP & Irrigation	30	84	12 322	M/P
●Kahta Dam & HEPP	75	171		M/P
●Pumped Irrigation from Atatürk Reservoir			29 599	M/P
VI. Adıyaman–Göksu:	7	43	71 600	
●Çataltepe Dam Irrigation				F/S
●Erkenek HEPP	7	43		F/S
VII. Gaziantep Project:			90 000	
●Hancağız Dam & Irrigation			7 330	OP
●Kayacık Dam & Irrigation			14 740	U/C
●Kemlin Dam & Irrigation			1 930	F/C
●Pumped Irrigation from Birecik Reservoir			66 000	F/S
Individual projects:			60 440	
Nusaybin Irrigation			75 000	OP
Çağçağ HEPP	14.4	42		OP
Akçakale Groundwater Irrigation			15 000	OP
Ceylanpınar			27 000	OP
Hacihidir Project			2 080	OP
Dumluca Project			1 860	OP
Suruç Groundwater Irrigation			7 000	OP
VIII Dicle–Kralkızı Project:	204	444	130 150	
●Kralkızı Dam & HEPP	94	146		U/C
●Dicle Dam & HEPP	110	298		U/C
●Dicle Right Bank Gravity Irrigation			54 280	U/C
●Dicle Right Bank Pumped Irrigation			75 870	U/C

Table 1. continued

Project	Capacity (MW)	Production (GWh)	Irrigation area (ha)	Present stage
IX. Batman Project:	198	483	37 350	
● Batman Dam & HEPP	198	483		U/C
● Batman Left Bank Gravity Irrigation			9 570	U/C
● Batman Left Bank Pumped Irrigation			9 180	F/S
● Batman Right Bank Gravity Irrigation			18 600	D/D
X. Batman–Silvan Project:	240	964	257 000	
● Silvan Dam & HEPP	150	623		Rec
● Kayser Dam & HEPP	90	341		Rec
● Dicle Left Bank Gravity Irrigation			200 000	Rec
● Dicle Left Bank Pumped Irrigation			57 000	Rec
XI. Garzan Project:	90	315	60 000	
● Garzan Dam & HEPP	90	315		Rec
● Garzan Irrigation			60 000	Rec
XII. Ilisu Project:	1 200	3 833		
● Ilisu Dam & HEPP	1 200	3 830		D/D
XIII. Cizre Project:	240	1 208	121 000	
● Cizre Dam & HEPP	240	1 208		D/D
● Nusaybin Cizre Irrigation			89 000	Rec
● Silopi Plain Irrigation			32 000	Rec
Individual projects:	OP	19 030		
	U/C	7 282		
● Devegeçidi Project			7 500	OP
● Silvan I & II Irrigation			8 790	OP
● Nerdüş Irrigation			2 740	OP
● Çınar–Göksu Project			3 580	U/C
● Garzan–Kozlu Irrigation			3 700	U/C

Note: Individual projects are not included in grand total.

Key: OP = in operation; U/C = under construction; D/D = detailed design completed; F/S = feasibility study; M/P = master plan; Rec = Reconnaissance.

Euphrates projects:

- (1) Karakaya Project;
- (2) Lower Euphrates Project;
- (3) Border Euphrates Project;
- (4) Suruç–Baziki Project;
- (5) Adıyaman–Kahta Project;
- (6) Adıyaman–Göksu–Araban Project;
- (7) Gaziantep Project.

Tigris projects:

- (8) Dicle–Kralkızı Project;
- (9) Batman Project;
- (10) Batman–Silvan Project;
- (11) Garzan Project;
- (12) Ilisu Project;
- (13) Cizre Project.

The package included the construction of 22 dams, 19 hydroelectric power

plants and the irrigation facilities to serve 1.7 million ha of land. The total installed capacity of the power plants is 7500 MW with an annual production of over 27 billion kWh.

The Euphrates basin projects has 5304 MW installed capacity, will generate 20 billion kWh of energy and will irrigate 1 million ha of land. Fourteen dams and 11 hydroelectric power plants are planned for this basin.

Among the Euphrates basin projects, the largest is the Lower Euphrates project which covers the following seven schemes:

- (1) Atatürk dam and hydroelectric power plant;
- (2) Şanlıurfa irrigation tunnels;
- (3) Şanlıurfa hydroelectric power plant;
- (4) Şanlıurfa–Harran plains irrigation;
- (5) Mardin–Ceylanpınar plains irrigation;
- (6) Siverek–Hilvan pumped irrigation;
- (7) Bozova pumped irrigation.

The Tigris basin projects have 2172 MW installed capacity, will generate 7 billion kWh of electric energy and will irrigate 700 000 ha of land. Eight dams and eight hydroelectric power plants are planned for this basin.

GAP as an Integrated Regional Development Project

The Southeastern Anatolia region is a part of Upper Mesopotamia, the cradle of the ancient Mesopotamian civilization. The recognition of the great water potential of the Euphrates and the Tigris rivers led to plans for their sustainable development for irrigation and hydropower generation and to control floods and droughts. The work that was initially planned as predominantly a large-scale water resources development project was later transformed into an integrated multisectoral regional development programme. The aims and the main features of the integrated project are outlined in the GAP Master Plan (SPO, 1989).

Project planning and implementation are based on the Master Plan and an Action Plan (GAP–RDA, 1993c). The Master Plan was prepared to determine the region's potential, identify the bottlenecks in the development process, and to set the development objectives, goals and strategies. A three-phase programme for development was initiated. The GAP Action Plan was prepared for a five-year period by considering interactions between sectors, population projections and spatial development forecasts on the basis of numerous studies. Macro-level planning and management, coordination, monitoring, evaluation and implementation in selected areas are carried out by the GAP Regional Development Administration as well as other respective state agencies.

The integrated project comprises not only multipurpose dams and irrigation systems but also investments in all development-related sectors such as agriculture, energy, transportation, telecommunications, health care, education, urban and rural infrastructure development.

The strategy adopted in the GAP Master Plan for the region's development has the following four basic components:

- (i) develop and manage soil and water resources for irrigation, industrial and urban uses in an efficient manner;
- (ii) improve land use through optimal cropping patterns and agricultural practices;

Table 2. Cropping patterns for the GAP region, 1986 and 2005

Crops	Cropping patterns	
	1986 (%)	Master Plan (2005) Irrigated area (%)
Primary crops:		
Wheat	33.9	25
Barley	18.5	15
Lentil, chickpeas, beans	19.7	8
Cotton	2.8	25
Winter vegetables	0.1	2
Multi-seasonal produce	9.4	20
Sub-total	84.4	95
Other crops:		
Soybean	0.0	10
Corn	0.1	8
Peanuts	0.0	5
Sunflower	0.2	5
Sesame	1.9	5
Vegetables (inc. potato)	2.2	6
Melons	0.0	0
Tobacco	0.4	0
Rice	0.1	0
Maize	0.1	0
Fallow (*)	9.5	0
Sub-total	5.0	39
Total (cropping intensity)	89.4	134

Note: (*) Fallow is excluded from crop intensity calculations.

- (iii) promote agro-industry and other types of industry based on indigenous resources;
- (iv) provide better social services, education and employment opportunities to control migration and to attract qualified personnel to the area.

The GAP Master Plan's basic development scenario is to transform the region into an export base for its agricultural products.

For spatial development of the region, three main cities, i.e. Gaziantep, Şanlıurfa and Diyarbakır, are considered to be the main development axis. Investments are to be concentrated along this corridor for improving infrastructure and for attracting agro-industry and other employment-generation opportunities. For the medium-to-long term, this corridor will be expanded by promoting economic interaction with other sub-regions.

When the project is completed, the ratio of irrigated land to the total GAP area will increase from 2.9% to 22.8% while that for rain-fed agriculture will decrease from 34.3% to 10.7%.

As a direct result of the introduction of irrigation, agricultural production and crop variety will increase substantially. Under the dry farming system, field crops such as wheat, barley, lentils, pistachios and grapes are widely cultivated. Cropping intensity will increase from 89% to 134%. The most striking change will be in land used for cotton cultivation, which will increase from 2.8% to 25%. The cropping patterns before and after the project are given in Table 2.

An increase in agricultural production contributes to infrastructural development and increased economic activities accelerate development of agro-industry and other agricultural services. The region is fast becoming attractive for domestic and foreign investment projects. Initial developments are expected in flour, flour-based products, leather, margarine, cotton and the textile industry (GAP-RDA, 1995b).

As a direct result of the GAP investments, the living standards of many inhabitants have already started to increase. With progressive implementation, more and more people have become direct beneficiaries of the project. Rural-urban interactions have increased following the construction of transportation and communication networks. The region is becoming more open to the outside world and thus attracts additional investments. The population is expected to increase from six million in 1997 to 10 million by 2005, with 66% living in urban centres. Urbanization in the region has received a boost, and rural migration should slow down considerably. Employment opportunities which will have been created by GAP are estimated to amount to some 3.8 million in various sectors (see Table 3).

Education and health services in the Region will be improved to at least the current national average by 2005. Specifically, the enrolment ratios in schools and the levels of health facilities are planned to exceed the current national average by 2005.

The project is socially essential as it is intended to significantly improve the living standards and quality of life of the local people, increase their per capita income, create new employment opportunities, and protect the environment. It is also economically viable as it will radically change the economic structures, increase production and more than quadruple the GRP.

Institutional Setting

One of the outcomes of the GAP Master Plan Study was a set of proposals for the management of the comprehensive development programme. The basic principles set for the terms of references of the entity that would manage the programme were as follows:

- regional perspective;
- integration of sectors with each other as well as integration within individual sectors;
- ability for multisectoral planning;
- flexibility in implementing and funding;
- hierarchical independence of existing ministries/bodies;
- authority to control land use to ensure operationalization of integration issues, including land-water resources integration;
- ability to interfere locally when needed while performing an advisory function in preparation of national implementation programmes of different government agencies;
- ability to coordinate public entities;
- while still accountable to the government, flexibility to incorporate/collaborate with the private sector, NGOs, international organizations, professional societies and local governments.

As no existing organization would be able to undertake these, a new organization, i.e. the Southeastern Anatolia Project Regional Development Administra-

Table 3. Main social and economic indicators of intermediate and eventual development

	1985		1990		2005	
	GAP Region	Turkey	GAP Region	Turkey	GAP Region	Turkey
I. Composition of Gross Domestic Product:						
(1) Agriculture (%)	39.56	10.37		16.8	23.2	
(2) Industry (%)	15.69	12.34		24.8	29.8	
(3) Services (%)	44.75	77.29		58.4	47.0	
II. Population:						
(1) Total population (millions)	4.3	50.5	5.2	56	10	71.7
(2) Urban population (millions)	2.14	26.8	2.9	33	6.6	
(3) Rural population (millions)	2.15	23.7	2.3	23	3.4	
(4) Percentage urban	49.9	53	55.7	58.9	66	
III. Employment:						
(1) Total (millions)	1.5	20.5	1.7	23.3	3.8	
(2) Agriculture (%)	71	59	67.2	53	51	
(3) Industry (%)	5	11	6.1	12.4	10	
(4) Services (%)	24	30	26.7	34	39	
IV. Per capita GRP:						
TL (thousands)	860	1 822			1 784	
1988 prices (\$)	637	1 350			1 320	
V. Age—group (%)						
(1) 0–14	48.77	37.52	47.16	34.96		27.55
(2) 15–64	48.17	58.09	50.16	60.68		66.59
(3) 65 & over	2.76	4.20	2.62	4.28		5.86
VI. Number of students per school:						
1. Primary	128.5	134.6	132.8	134.4		
2. Secondary	415	362	374	364.8		
3. High school	427	478	501	449.6		
VII. Number of students per teacher:						
1. Primary	39.9	31.1	42.8	30.4		
2. Secondary	48.4	37.5	60.8	45.6		
3. High school	15.4	12.2	17.9	12.5		
VIII. Enrolment ratio (%):						
1. Primary			79	96	100	100
2. Secondary			33	60	80	100
3. High school			18	25	44	75
4. Tertiary			3	12	15	19
IX. Literacy rate (%):						
1. Total	55	77	60	80.4	100	100
2. Male	71.7	86	75.5	88.7	100	100
3. Female	39	68	44.7	71.9	100	100
X. Hospitals:						
1. Total	45	722	53	857	730	
2. State	37	607	49	732	600	
3. Private	8	115	4	125	120	

Table 3. continued

	1985		1990		2005	
	GAP Region	Turkey	GAP Region	Turkey	GAP Region	Turkey
XI. Number of beds:						
(1) Total	5 026	103 918	5 658	120 738	24 680	
(2) State	4 854	99 044	5 517	114 508		
(3) Private	172	4 874	141	6 230		
XII. Number of health Personnel:						
(1) Doctors	1 185	36 427	2 397	50 639	12 656	
(2) Nurses	1 544	30 854	2 169	44 904	15 821	
(3) Midwives	1 149	17 987	1 885	20 415	9 492	
XIII. Number of persons:						
(1) Per doctor	3 631	1 391	2 152	1 115	750	750
(2) Per nurse	2 758	1 630	2 353	1 249	600	600
(3) Per bed	847	484	854	453	370	370
XIV. Fertility rate	4.02	2.59	4.37	2.65	2.49	2.49
XV. Infant mortality rate (per 1000)	111	109	66	67	31.8	31.8
XVI. Rural electricity (%)	66.8	85	99.7	99.9	100	100
XVII. Rural drinking water:						
(1) Has (%)	35.6	50.8	44.7	60.7		
(2) Has not (%)	41.5	32.5	38.9	26.1		
XVIII. Consumption of electric power (MWh):						
1. Industry (%)	60.5	66.9	59.5	62.4		
2. Home (%)	19.9	17	19.8	19.4		
XIX. Cotton production (1000 tons)	61.7	518	137.3	654.6	1 453	

tion (GAP-RDA), was established under the auspices of the Prime Ministry. The new organization had two principal bodies and a coordination facility:

- (1) *The High Council of GAP*: This is the political body or the 'board' of the administration. Chaired by the Prime Minister, it provides unique flexibility and speed in transforming technical proposals into political decisions and implementing them. Its three permanent members are the State Minister in charge of GAP, the State Minister in charge of Planning and the Minister of Public Works and Settlement. The presence of the Planning Minister ensures coordination and harmonization of the GAP programme with the national investment and implementation plans and programmes. The membership of the Public Works and Settlement Ministry brings in the physical development including the infrastructure and land/water resources component of socioeconomic development. The High Council acts on behalf of the Cabinet of Ministers on issues related to GAP and the GAP-RDA.

- (2) *GAP Regional Development Administration*: This is the technical entity, equivalent to an undersecretariat in the governmental hierarchy. Headquartered in the nation's Capitol, it maintains a regional directorate in the project area, employing at both offices specialists from a large spectrum of disciplines, ranging from engineers to economists, from social scientists and sociologists to urban and regional planners. It holds land planning and land use authority both for urban and non-urban zones and uses. It has the legal charge to undertake regional planning and provide advisory services to the government and is equipped with the authority to plan, design and actually implement projects as necessary.
- (3) *GAP Coordination Council*: Chaired by the State Minister in charge of GAP, the GAP Coordination Council takes its membership from the related government agencies, professional societies, NGOs, local governments and universities. Convened three to four times a year, it provides the local, non-governmental, private sector and academic inputs and serves as a forum for interaction and dissemination of ideas, criticism and innovations. Every other meeting is held at a different regional site.

The establishment of GAP-RDA in 1989 has brought a much needed integral perspective, resource utilization rationale and flexibility to the project. It has also led to the evolution of a sustainable development framework for the socio-economic development programme (Ünver, 1996).

Current Status of GAP Development

GAP is the most comprehensive, integrated regional development project ever attempted in Turkey, or for that matter in any developing country. The total project cost is estimated at \$32 billion, of which \$12.5 billion had already been invested by the end of 1996 (GAP-RDA, 1996c; 1997b).

The construction of dams, hydropower plants and irrigation networks is underway. The project, when completed, will generate 27 billion kWh of electricity per year. Hydroelectric energy production in 1995 from the GAP schemes was 16 billion kWh. Over 135 000 ha of land are now under irrigation, and another 200 000 ha are currently being prepared to receive irrigation.

The construction of the following projects has now been completed: Karakaya Dam and hydroelectric power plant (HEPP); Atatürk Dam and HEPP; Şanlıurfa tunnels; Hancağız Dam; Derik-Dumluca Dam; Hacıhıdır Dam; Devegeçidi Dam; Çınar-Göksu Dam; Çağ-Çağ HEPP; Şanlıurfa STOL airport; Gaziantep and Mardin Organized Industrial Districts; and 17 small-scale industrial districts.

The following GAP projects are presently under construction: Kralkızı Dam and HEPP; Dicle Dam and HEPP; Batman Dam and HEPP; Çamgazi Dam and HEPP; Kayacık Dam and HEPP; Birecik Dam and HEPP; Şanlıurfa HEPP; Şanlıurfa-Harran irrigation; Kralkızı-Dicle irrigation; Batman Left Bank irrigation; Çınar-Göksu irrigation; Garzan-Kozluk irrigation; Şanlıurfa water treatment and supply project; Gaziantep water treatment and supply project; Diyarbakır water treatment and supply project and other 47 urban water projects; 16 urban sewerage and wastewater projects; 10 Organized Industrial Districts and 15 Small Scale Industrial Estates; Gaziantep-Şanlıurfa motorway; Adıyaman airport; mass housing projects for the cities of Gaziantep, Şırnak, Diyarbakır, Batman, Mardin and Şanlıurfa agricultural land consolidation project.

Over 98% of all villages have now been connected to the road networks, and 99.7% of villages were electrified by 1990. By 1990, all the villages had been provided with telephone connections. Television and radio broadcasts now reach rural areas extensively.

Since the initiation of the project, healthcare facilities have been significantly upgraded. There were 53 hospitals, and 5658 beds in the region in 1990, and 2397 doctors and 2169 nurses. The person/bed ratio has been improved to 854, the person/doctor ratio to 2152 and the person/nurse ratio to 2353. Health services are still below national levels and an ambitious programme is under way, with World Bank financing, to further improve them rapidly.

Even though the literacy rates have improved markedly they are still below national averages. The literacy rate increased from 55% in 1985 to 69% by 1990. Male and female literacy rates increased to 75.5% and 44.3% respectively. The enrolment ratio was 79% in primary school, 33% in secondary, 18% in high school and 3% in tertiary education, as compared with 96%, 60%, 25% and 12% respectively in the country as a whole, indicating room for further development.

Municipal infrastructure services were still largely inadequate in the region. The rapid urbanization and limited financial resources have resulted in low capacities and unmet demand. In 1987, out of the total of 89 municipalities, only two had adequate sewerage services and 15% adequate municipal water networks, but 80% of them had maps and development plans. While conditions have improved, still out of 172 municipalities, 33% have water supply networks and 18% water networks under construction, but only four adequate sewerage systems.

The Impact of Irrigation (in a Pilot Area in Harran Plain)

The Lower Euphrates Project is one of the GAP schemes on the Euphrates river and consists of Atatürk Dam and HEPP, Şanlıurfa tunnels, Şanlıurfa hydro-electric power plant, Şanlıurfa–Harran irrigation, Mardin–Ceylanpınar irrigation, Siverek–Hilvan pumped irrigation and Bozova pumped irrigation. Main public investments in the Lower Euphrates project have now been completed. One of them comprised Atatürk Dam and Şanlıurfa tunnels. Atatürk Dam was completed in 1990 with a reservoir capacity of 48.5 BCM. Water reaches the Şanlıurfa–Harran plains via the Şanlıurfa tunnels system, which consists of two parallel tunnels each 26.4 km long and 7.62 m in diameter. One of the tunnels was completed in 1995, and irrigation is now practised in a 50 000 ha area.

Şanlıurfa–Harran plain has two main canal systems. Şanlıurfa main irrigation canal will irrigate 43 000 ha of land by gravity and 5000 ha by pumping. The Harran main irrigation canal will irrigate 98 500 ha by gravity.

A pilot area selected from the Şanlıurfa–Harran irrigation scheme is used here to show the impact of irrigation (GAP–RDA, 1995a). The pilot area is located on Şanlıurfa main irrigation canal system; 51.3 km of main irrigation canal, 69.9 km of secondary canal, 1040 km of tertiary canal, 45.5 km of main drainage, 2100 siphons and other related facilities have already been constructed. Land consolidation activities have been completed in 20 000 ha. There are 62 villages, and 4000 families, totalling over 26 000 population.

Table 4 shows crop production in the pilot area prior to irrigation. Total production in 1994 was valued at \$31.5 million. The value-added was \$60 per decar.

When irrigation was introduced in 1995, major changes in cropping patterns

Table 4. Land used for crop production in 1994, prior to irrigation

Crops	Land (ha)	(%)
Wheat	14 700	49
Barley	6 000	20
Cotton	6 300	21
Lentils	2 400	8
Vegetables	600	2
Total	30 000	

occurred in the pilot area. Table 5 shows the land used for production of various crops under irrigation. The most striking change has been in the land used for cotton, from 21% to 45%. Production value rose to \$120.6 million and the value-added per decar to \$182, both showing significant improvement in only one year. The annual per capita income increased from \$1034 in 1994 to \$3963 in 1995. This area is now monitored by the GAP Administration via a socioeconomic monitoring project to assess the impact of irrigation on different facets of life and economy.

Sustainable Development and Basic Strategies of GAP

GAP and its Prospects

GAP is an integrated regional development project that is being implemented in the nine south-eastern provinces of Turkey. The region covers 75 000 km², is currently home to about 6 million people, and is a less developed region of Turkey by basic socioeconomic indicators.

Early in the next century, GAP's physical facilities will have been completed. Nineteen power plants will be humming to produce 27 billion kW of electricity annually, and farmers will be tilling 1.7 million ha of irrigated land, producing

Table 5. Land used for crop production after introduction of irrigation (1995)

Crops	Land (ha)	Production (tons)	Prod.value (\$000s)
Wheat + barley	25 600	104 960	24 985
Cotton	24 000	96 000	91 200
Maize (*)	410	2 900	480
Sesame (*)	100	70	100
Beans (*)	10	10	2
Vegetables	300	750	2 250
Lentils	3 000	3 300	1 584
Total	53 420**	207 990	120 601

Notes: *Secondary crops; (**) over 30 000 ha owing to increased intensity.

bountiful crops. Agro-industrial factories will dot the land, some 10 million people will be living in the region, mostly in the towns and there will be employment for almost everyone who asks for it. Extremes of misery will no longer exist, and prosperity will be evident for everyone except the most prejudiced and opinionated.

There is little doubt that all the dams and power plants will be built, and all the irrigation facilities will be completed, if not by the planned dates then not very much later. So long as financial resources are forthcoming, these physical facilities can be put in place almost like clockwork. But once the physical facilities are in place, unless the necessary measures are taken, there is no guarantee that there will be much prosperity, or even if there is prosperity that many will share in it, or that prosperity will not be a transient affair. The guarantees for such can be provided only if development is human oriented, and if it is designed and implemented with a focus on sustainability.

Sustainable Development and Basic Strategies

Sustainable development is that which “meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development, 1987). Under this broad concept, there is a plethora of issues: social, economic, cultural, gender, educational, health, physical, agricultural, environmental etc. At the hub of all this is the human being either as the object or as the agent or both. Hence, human development in various dimensions is a *sine qua non* for sustainable development, and the draft strategy for Turkey’s 7th Five Year Development Plan (SPO, 1995) recognizes it as such. It is also an integral part of the UNDP’s ‘Fifth Country Programme 1995–1999 for the Republic of Turkey’ (UNDP, 1994) either in the form of explicit programmes such as ‘Gender and Development’, ‘Social Development and Disparity Reduction’ or implicitly.

In a seminar sponsored by the UNDP and the GAP Administration held on 17–29 March 1995, and attended by people from a wide spectrum of institutions including universities, government agencies, non-governmental organizations and local bodies, there was consensus on the following points to which the GAP Administration subscribes (GAP-RDA & UNDP, 1995):

- (1) Special emphasis needs to be placed on the human dimension in addition to the economic growth targets of GAP if sustainability of regional development is to be achieved.
- (2) To this end, the human dimension included in the implementation of GAP should be revised; the services provided should be more widely diffused and diversified through the establishment of ‘multi-purpose social centres’; and efficiency in service provision must be increased.
- (3) People’s participation in project development and implementation is necessary for sustainable development and to inculcate in people the habit of taking collective and social costs and benefits into consideration.

To ensure participation, emphasis must be given to information, education, training and organization of people in all related matters and in all dimensions. These activities should cover all areas ranging from employment to production and to generating resources, from management of collective facilities to healthy urbanization and nutrition.

Measures must be adopted to ensure that all related population groups who

share in the costs and benefits participate in project implementation. To this end, those groups and individuals who are willing to participate in the short and medium term and who have leadership qualities, as well as the groups which are in need of assistance, must be identified.

- (4) As the region is experiencing a socioeconomic transformation in connection with GAP, to minimize the costs—both social and individual—and to maximize benefits, again both social and individual, priority must be given to efforts to streamline information exchange between the project's planners/executors and its users/beneficiaries.
- (5) Given the resources at hand and likely to be forthcoming, rapid population growth serves to decelerate socioeconomic development.
- (6) A regional development scheme can be translated into reality and can be successful and sustainable only to the extent it is supported by an effective public administration, coordination and harmonious division of labour.
- (7) Infrastructure must be completed; health services and training must be extended in a more efficient fashion.
- (8) Ways and means and the institutions necessary to offer equitable opportunities to all and to safeguard the existence of an environment conducive to the development of future generations must be developed.
- (9) Institutions must be equipped with the means to operate effectively with a view to preventing excessive and uncontrolled use of resources.
- (10) The 'user pays' principle must be followed to the maximum extent possible both to conserve resources and to generate financial resources for new investments to make growth and development sustainable.
- (11) Projects must be organized in rationally manageable sizes.
- (12) Measures should be adopted to attract private sector and foreign financial resources to the region. However, controls should be exercised on such flows to minimize their negative impacts on the environment, both man-made and natural.

Main Components of Sustainability for GAP

(1) *Social sustainability in GAP.* The main goal of sustainable development is to create a sustainable society. Social sustainability in GAP depends on the following factors.

First, community participation in decision making, in project design and implementation, in management of natural resources and irrigation and production systems, in environmental protection and other social processes.

A pre-condition of participation is organization at community level among persons who share the same interests and face similar problems. According to the field studies conducted by the GAP Regional Development Administration, there are two main constraints on community participation. One of them is the lack of a participatory approach on the part of the planners and implementers who work in public institutions. The classical approach is very often top-down rather than bottom-up. Change of this individual and institutional behaviour pattern will no doubt contribute to sustainable development in GAP.

The other constraint is wide socioeconomic disparities among population groups. Development of social services and income-generating activities for poor and disadvantaged population groups would contribute to the establishment of the basis for community participation and sustainable development.

The second factor is equity and fairness among population groups. Equity does not mean all having the same, but that all have the same opportunity of access to employment, means of income, to fulfil basic needs (such as food, water, shelter, energy), education, health, leisure, culture, information, clean environment and social security. In this sense, equity is the lack of debilitating and demeaning poverty and is the necessary condition for a sustainable society.

Inasmuch as wide inequalities hamper participation and sustainable development, there is the need to reduce disparities among social groups and to develop and implement special projects targeting integration of different groups. In the GAP region, there are great inequalities between genders and between socioeconomic strata. Women live in greatly disadvantaged conditions and therefore special projects should be implemented for the improvement of women's status. Development of family support services should be an important component in such projects.

In terms of socioeconomic strata, landless peasants and small landholders, peasants in unirrigated areas, and those living in urban areas or 'gecekondu' (squatter housing) and employed in the informal sector, are first-order target groups whose needs should be addressed by special, income-generating projects if development is to be equitable and sustainable. If such are not implemented, massive population movements—both intra-regional and inter-regional—can be expected.

The third consideration is a sustainable population structure. Size, growth rate and population structure are three of the most important factors that bear upon the sustainability of development. Given the technology level, there are limits, if not absolute limits, to the carrying capacity of the environment and to the rate of regeneration of renewable resources.

With regard to population, there are three main issues in the GAP region:

- the extremely high growth rate;
- intra- and inter-regional migration;
- settlement pattern.

Development and implementation of effective mother-child services is essential as well as their integration with the projects for the improvement of women's status.

Massive migration flows in the GAP region challenge the sustainability of society and development. Though some population movements are necessary, even healthy, for a rational settlement pattern in respect of the requirements of the economy, excessive and rapid population movements do not enhance sustainability. Hence, population movements need to be regulated with regard to their size, timing and direction through 'market' mechanisms. For this to happen, development inequalities between regions and social groups should be lessened.

In terms of settlement patterns, there are three issues that need to be addressed: (i) in rural areas, provision of social services in central, larger settlements for better access, since the state cannot provide all of the necessary services in each and every settlement owing to resource constraints; (ii) resettlement of those who have lost their houses and lands (to reservoirs); (iii) settlement of nomadic groups. Projects that successfully address these problems would integrate the related population groups into the development process, and provide rationality in the use of resources.

Human resources development is another factor. Development of human resources is essential for the sustainability of society and development. It

requires effective education, training and provision of health services. In the design and implementation of human development projects, underprivileged groups should be the priority targets.

(2) *Physical and spatial sustainability.* In 1996, the 172 municipalities of the GAP region had a population of 3 million accounting for 60% of the region's population. Municipal infrastructure services in the region are less than adequate.

Rapid population growth and urbanization are the key factors underlying the enormous growth in the demand for urban services and the increased environmental degradation. Studies by GAP-RDA indicate that the region's population will grow from 5.26 million in 1990 to about 10 million by 2005. The growth of population, two-thirds of which will occur in urban areas, will increase the demand for water of a quality suitable for domestic and industrial use, for treatment of wastes, for housing and recreation areas, and for commercial and industrial sites.

In order to prevent big public investment projects from adversely affecting the quality of water, soil and air, policies must be designed and implemented and the interactions within and between ecosystems must be given due consideration. Integrating land-use policies and practices in the urban and rural areas in a way supportive of development is crucial in formulating regional strategies to manage water and land resources.

Cities are the engine of economic growth, but the environmental implications of such growth need to be assessed and addressed. The most immediate and critical problems facing the cities in the region are the health impacts of urban pollution resulting from inadequate water, drainage and sewerage, poor urban and industrial waste management, and air pollution. With such a multiplicity of problems, and given the scarcity of financial resources at both the local and central government levels, it is important for each city to identify specific priorities, policies and actions needed to address the most immediate issues.

Environmental considerations need to be built into the projects, particularly into physical planning. Due consideration should be given to protecting the natural environment. In this context, development plans (at the regional and local level) should be designed in the framework of the GAP Master Plan strategies and irrigated agricultural land must be protected. In this spirit, the GAP Administration has produced plans, programmes and projects both at the regional and individual city levels so as to control and/or steer developments in the desired directions.

The following are some of the plans and projects prepared by GAP-RDA with a view to controlling and steering land use, and creating a better living environment:

- (1) A 1/250 000 scale GAP Regional General Development Plan that shows general economic, social and spatial development expected by 2005 and the distribution of investments at sub-regional level. The plan covers the spatial distribution of population, employment, transportation, irrigated areas, important cities and land use in their surroundings.
- (2) 1/25 000 scale development (land use) plans for nine sub-regions that are developing rapidly. These are plans specifying the land uses for housing, industry, agriculture, tourism, transportation and other activities in cities

and their adjacent areas. The Master Plans seek to establish a certain balance between various land uses, to protect and preserve the environment and to prepare the ground for initiation of measures to achieve this end by specifying the necessary social and technical infrastructure.

- (3) 1/5000 scale master (zoning) plans and 1/1000 scale implementation plans for 25 cities. These plans show the population densities and land-use intensities of the various zones (housing, industry, commerce, green spaces, recreation areas etc.) in conformity with the 1/25 000 scale plans and the expected demographic and economic structures of cities by 2005–10.
- (4) Drinking water, sewerage and treatment plant projects for 29 cities, electricity projects for 17 cities, telecommunications projects for 45 cities, solid waste disposal projects for four cities. These have been prepared within the framework of Master (zoning) Plans and Implementation Plans with due consideration for environment and population growth.

An ambitious programme is now under way to satisfy the need for master (land use) plans and zoning plans for areas and cities for which no such plans exist. Moreover, existing plans are being updated to take new, and/or likely developments into consideration as needed.

Objectives, Outputs and Activities

Spatial planning means urban, rural and regional planning. Its targets cover economic, social and geographical space as well as time. It is imperative that agricultural and industrial spatial concerns are balanced in physical planning.

Efficient use of resources has important beneficial effects on the environment because it reduces both waste and the consumption of natural resources. Potential negative impacts of development need to be minimized by proper planning (land use planning), monitoring, analysis and the initiation of preventive measures in due course.

Land degradation in the GAP region is a common problem and common causes are deforestation, overgrazing, poor farming practices and explosive population growth, especially in large urban areas. In addition, economic policies such as subsidies for agricultural inputs, taxes, etc. contribute to the problem.

Land degradation is a direct product of poor land management. Hence, land management practices need to be improved in the region by proper physical planning and plan implementation if growth is to be sustainable, and physical plans should take the 'carrying capacity of the environment' into consideration.

Some of the tools used for these objectives are: (a) development plans that indicate distribution of land (used for different purposes), population, employment, transportation, infrastructure, and environmentally sensitive fragile areas that need special protection measures; and (b) environmental management plans that seek (1) to minimize reductions in the quality and/or quantity of natural resources, and (2) to enhance the environment and natural resources.

(3) *Sustaining the environment.* Activities aimed at sustaining environmental quality must be largely based on two main principles: (a) management of human activities geared at development goals and initiatives; (b) controlling or limiting harmful impacts of human activities on the environment.

Implementation of a comprehensive natural or ecological conservation programme in order to sustain the environmental carrying capacities of natural resources for future activities and generations calls for the following:

- (a) minimization of erosion of productive topsoil and humus;
- (b) minimization of discharge of organic and non-organic wastes into the ambient environment;
- (c) enhancing water-retaining and productive capacities of the land;
- (d) management of water resources both in terms of quantity and quality;
- (e) detailed and realistic planning of cultivation, grazing and tree planting (afforestation) sites, together with crop varieties and farming practices. This category of activities encompasses:
 - determination of soil characteristics;
 - improvement of farming practices;
- (f) assessment of physical effects of actual implementations; this is necessary to identify project-specific environmental problems. Hence, environmental impact assessment is one of the main objectives of the overall GAP project as it evolves.

(4) *Sustainable development of natural resources.* The development of land and water resources is the backbone of GAP. Sustainable development means more efficient use of natural resources. Soil erosion and loss of soil productivity reduce yields and remove large areas of agricultural land from production. Overuse of fertilizers and pesticides pollutes surface and groundwater. Executive irrigation causes salinization and waterlogging of cropland.

Sustainable development requires conserving water by ending wasteful uses and improving the efficiency of water systems. It also means improving water quality, limiting surface water withdrawals to the extent of the required amounts as determined by soil and crop type and irrigation method, and limiting groundwater withdrawals to the rate of regeneration.

Water Conservation

An essential difference between traditional and sustainable systems is the introduction of anticipation of changes: changes in the system itself, changes in the supply of water and changes in demand are all changes that must be anticipated and planned for.

When a certain development plan is prepared, consideration must be given to its impact on nature and society, both under present conditions and under likely changes. These considerations must enter all stages of the system, from basic design to final operation and maintenance.

Water use on a sustainable basis entails prevention of pollution, losses through evaporation and excessive use.

Soil Degradation

In general, soil degradation in the GAP region can be a result of the following:

- agricultural activities (improper irrigation, overuse of pesticides and fertilizers);
- deforestation;

- overexploitation;
- overgrazing;
- industrialization;
- degradation due to water and wind erosion;
- chemical deterioration due to the exhaustion of nutrients;
- salinization and acidification.

In the context of GAP, the primary focus is on agricultural activities. This requires the cooperation of several institutions as well as farmers.

To promote soil conservation, programmes are being implemented for intensive training of farmers, afforestation of watershed areas and to devise and implement means to prevent the use in particular of the irrigated lands for non-agricultural purposes in the GAP region.

Forests, Climate Change and Biodiversity

Forests have a dual role as habitat and carbon sink. Tropical and temperate forests have the highest potential for carbon storage as wood fibre and leaf canopy. At the same time, the many levels of the forest canopy, with their varying light intensities and moisture levels, allow a multitude of habitats to coexist in a small area, creating favourable conditions for biodiversity.

Preserving forests thus contributes to both climate stability and biodiversity goals. Other forest values are independent of these, namely as human habitat and as a repository of natural resources. Although all these values may be present together in the intact forest, different management strategies emphasize one over the others.

Management schemes such as executive reserves can preserve important habitat values while still providing subsistence and commodity values to human populations. Even more intensive forest uses, such as agroforestry systems, can be compatible with many biodiversity conservation goals, especially when the uses are part of an integrated land-use plan that includes undisturbed land.

The main headings of this component are:

(a) *Water conservation:*

- limiting losses through evaporation and excessive use;
- preventing pollution.

(b) *Soil conservation:*

- training farmers;
- afforestation, especially of watershed areas;
- preventing or limiting use of fertile land for non-agricultural purposes;
- preventing soil degradation by limiting or halting deforestation, overexploitation, overgrazing, erosion, salination, excessive groundwater withdrawal, and loss of soil nutrients.

(5) *Sustainable agricultural development.* The objective is the creation of a system that improves in a substantial and lasting way the underlying productivity of natural resources and cropping patterns so that farmers can meet increasing levels of demand in concert with population and economic growth without impairing the environment.

Ingredients of such a development model must be: (a) stable; (b) regenerative;

(c) productive; (d) profitable; (e) resilient; (f) self-reliant; and (g) socioculturally integrative, or non-disruptive at least.

Sustainable agricultural development requires not only conservation, renewal/recycling and minimizing environmental damage, but also suitable production practices, appropriate technology, profitability and a system of reinforcing incentives.

The following are concrete areas of intervention to achieve sustainability in agriculture:

(a) establishment of a sustainable agricultural development framework composed of policies, approaches and techniques for the GAP region. This framework is translated into projects such as:

- proper irrigation and on-farm development activities;
- schemes of agricultural production (as to 'what to produce' and 'how to produce' in the most efficient way);
- post-harvest management, processing of crops and establishment of agro-industries;
- schemes of input supply;
- marketing techniques and information channels;
- organizing farmer participation in agricultural activities (including irrigation);
- wastewater treatment/management and/or recycling;

(b) establishment of guidelines for project management, coordination, implementation and financing of GAP agro-projects;

(c) identification of distinct projects for which foreign financial, technical and manpower (expert) support is needed;

(d) participatory organization in the form of farmers' cooperatives and water users' groups;

(e) research and development (R&D) in breeding improved crops and livestock and in appropriate irrigation and farming methods;

(f) review and revision of credit policies so as to make credit more accessible to small and medium farmers;

(g) establishment of an effective extension system.

(6) *Economic viability.* Economic viability is an umbrella term which includes, but is not limited to, social, environmental, natural resource and agricultural sustainability and human development. Further issues that must be addressed for sustainable economic development in the GAP Region are the following:

(a) building of a large capacity regional transportation system that will facilitate manipulation of large quantities of goods in and out of the region, and that will meet the increasing demand for passenger transportation. The backbone of such a system must include:

- an international airport as the regional hub;
- improvement of railway links to the ports on the Eastern Mediterranean (Mersin and İskenderun) and to the Gulf countries;
- improvement of highways and construction of new motorways or expressways, along the main routes of the flows of goods and people;

- (b) review and revision of credit policies so as to make credit more accessible to small-scale entrepreneurs;
- (c) creation of a better interaction system between entrepreneurs, managers and organizations such as KOSGEB (Small and Medium Scale Industries Development Administration) in order to have access to economically viable and profitable technologies;
- (d) establishment of on-or-off-the-job training centres to help people to learn arts, crafts or develop their aptitude for using high-tech equipment.

Examples from Implementation Projects

In this section some of the GAP projects are summarized with their sustainability dimensions.

Regulation of Water in Irrigation Canals and Determination of Water-saving Irrigation Methods

Objectives of the study are the delivery of irrigation water to users in the most efficient manner given the limitations imposed by the canal system, the achievement of an equitable distribution of water and the elimination of water losses. The study has been done by GERSAR-BRL (GAP-RDA, 1992a). To improve the canal regulation techniques for large irrigation canals in the GAP region, a simulation study is made for the Harran main canal. In this study, different canal regulation solutions were designed and compared in order to choose the best one. Six alternatives were proposed and one of them—mixed regulation—was selected (Ünver & Voron, 1993) and is now being implemented.

At the end of the study, the following measures were recommended for the design of future schemes or as modifications to the existing schemes in GAP: (1) the use of alternative designs for upstream control structures on the main and secondary canals, and (2) the use of downstream control systems in conjunction with upstream control systems and intermediate storage reservoirs.

Management, Operation and Maintenance of GAP Irrigation System (GAP-MOM)

The overall objective of the GAP-MOM study was to identify the most suitable management, operation and maintenance arrangements so that the resources invested in irrigation development are utilized optimally to: (a) realize the full agricultural production potential of the GAP region, and (b) contribute effectively to overall development of the region in terms of increased economic activity, population settlement and employment creation (GAP-RDA, 1994c).

The GAP-MOM study had three phases. Phase I covered identification of the most appropriate model for the development of irrigated agriculture, Phase II was the implementation phase of the recommended model and Phase III was the monitoring and evaluation stage of the organizational structures established in the pilot areas.

The basic aim in this project was to develop a sustainable MOM model using a bottom-up approach. For the efficient use of water in the pilot areas, the infrastructure will be rehabilitated, water measurement structures will be established, the irrigation water distributed will be measured, irrigation techniques

and equipment suitable for the region will be used and demonstration studies will be undertaken for the farmers.

Pilot Implementation of Modern Irrigation Technology

After the delivery of the irrigation water to the field, the method of application of this water to the root zone of the crop determines the type of on-farm irrigation system. In order to improve the field water distribution and irrigation techniques, several irrigation water management practices were proposed for a large pilot area (3131 ha) in the Şanlıurfa irrigation project (GAP-RDA, 1992a). The soil and topographical characteristics of the pilot area are similar to the average of the GAP irrigation schemes. Consequently, the different solutions developed for the pilot zone can easily be applied to other irrigation schemes with suitable adaptations. Five different equipment-management solutions have been applied. In these solutions, gravity versus pressurized irrigation, on-demand versus rotation system and upstream versus downstream control combinations were analysed. The 'on-request' solutions, Californian and sprinkling appeared to be the most advantageous ones. For that reason, sprinkler and drip irrigation systems were installed to the chosen farms for demonstration in 1995 (Ünver *et al.*, 1993). This large-scale pilot study has now been adopted for other similar schemes in GAP, e.g. sprinkler irrigation was chosen for the Yaylak irrigation network which will serve an area of 18 300 ha.

Recycling of Urban Wastewater

It is a well known fact that urban wastewater, when used in irrigation without any treatment, causes epidemic diseases. In addition to traditional treatment plants, projects are being implemented for the use of slow-rate land-treated urban wastewater in irrigation.

Reuse of Irrigation Return Water

The study of the reuse of drainage water in the irrigation of the Urfa-Harran plain was prepared by DSI in 1992 (DSI, 1992). In this study, drainage water collected by the diversion structures will be conveyed to a pumping station where it will be lifted back into canalets to irrigate the lower parts of the plain.

Another exercise was carried out in the GAP-MOM study (GAP-RDA, 1994b). The impact of reuse on the quantity and quality of water drainage from the Urfa-Harran plain was modelled. The findings of the study indicate that there are considerable advantages in reusing as much drainage water as possible. At the same time, the policy of reuse will depend upon the development of irrigation and crop pattern in the plain.

Transfer of Irrigation Systems to Farmers

Sustainable irrigation development requires not only sound design and good implementation of the engineering structures but also proper management of the irrigation systems. For this reason, GAP-RDA started a study of 'Management, Operation and Maintenance of GAP Irrigation System (GAP-MOM Study)' in

1993 (GAP-RDA, 1994a). One of the most important results of the study is 'The Water Users' Groups' (Ünver, 1994). Water users' groups, which are formed by farmers, are responsible for the total management of irrigation services at the tertiary level. This leads to better maintenance, control and more efficient use of water and also creates a participatory frame in the planning and design of irrigation schemes. In the GAP region all irrigation schemes have been turned over to water users' groups.

Eastern Anatolia Erosion Control and Watershed Rehabilitation Project

This World Bank-supported project aims to restore sustainable range, forest and farming activities in the Upper Euphrates watershed (which covers three provinces: Malatya, Elazığ and Adiyaman), to reduce soil degradation, erosion and sedimentation in reservoirs as well as to increase productivity and incomes (World Bank, 1993). Via a participatory approach, it aims to enhance planning and implementing capacity and improve the responsiveness of rural services' agencies to farmers' needs. A sub-project for *in situ* gene conservation supported by a Global Environment Trust grant is being implemented to establish, manage and monitor sites for the conservation of the wild relatives of globally significant herbaceous and woody species indigenous to Turkey.

The project has five components: (1) conducting surveys and inventories of sites with unique and rich germ plasm resources; (2) establishing and managing gene management zones; (3) developing a data management system; (4) facilitating institutional collaboration and strengthening through workshops, technical assistance and training; and (5) developing a national plan for *in situ* conservation of genetic resources.

The project was started in 1993 jointly with the Ministry of Forestry, Ministry of Agriculture and Rural Affairs and Ministry of Environment.

Protection of Biodiversity

A project is under way which aims to demonstrate the feasibility of a comprehensive and integrated multi-species approach to conservation of genetic diversity. To do so requires maintaining a sufficiently large habitat to accommodate the greatest variability of wild and weedy crop relatives, primitive crop types, other plants, animals, insects and micro-organism species that interact in a common evolutionary system.

The three-year pilot project, 'In-Situ Conservation of Genetic Diversity', a sub-project of the Eastern Anatolia Watershed Rehabilitation Project, began in 1993 and is funded through the Global Environment Facility (GEF) with a grant of \$5.1 million.

Institutional Capacity Building

This project aims to identify the institutional obstacles to community participation and respond to training needs for planners and field workers in public institutions and local administrations to equip them with methods of participatory project preparation and implementation.

Development Plans and Infrastructure Projects in the GAP Region

This programme aims to meet the rapidly growing demand for urban services such as development plans, sewerage and wastewater treatment, water supply, storm drainage, solid waste disposal, electricity, telecommunications etc. for some 170 cities in the region (GAP-RDA, 1993b). GAP Administration prepared 27 urban development plans, nine development plans for rapidly growing urban areas at 1:25 000 scale between 1993 and 1995. Based on these plans, the drinking water, sewage and treatment projects for 29 cities at 1:5000 and 1:1000 scale, electricity projects for 17 cities, and telecommunications projects for 45 cities were designed. In addition to these, designs for solid waste disposal for four big cities and wastewater treatment plants for nine cities were prepared at 1:25 000 scale.

GAP Administration has been implementing three urban sewerage and wastewater treatment systems and one water supply project. Gaziantep solid waste disposal plant was completed, privatized and is now in operation.

GAP Administration has been supporting local municipalities to solve their urgent infrastructure problems by giving financial aid. GAP-RDA spent TL90.2 billion on 10 municipalities in 1992, TL120.4 billion on 52 municipalities in 1993 and TL203 billion on 139 municipalities in 1996 (at 1997 prices).

Environmental Studies in the GAP Region

For the GAP region, the following innovative studies were made to minimize the adverse environmental effects, and to protect and regenerate the environment for sustainable environmental development.

GAP region environment study—Tigris basin. An environment study was made for the Tigris basin, to investigate the environmental effects of regional development in GAP involving not only irrigation but agroindustries, urban infrastructure, land use, transportation and growth in social services such as education and tourism as well (GAP-RDA, 1993a).

The project was carried out on seven components—air, water, soil, solid waste, noise, flora and fauna—to be implemented in three stages:

- (1) preparation of inventory for flora and fauna within the project area;
- (2) identification of the size of air, water, soil, solid waste and noise pollution together with pollutant sources;
- (3) formation of an appropriate monitoring and evaluation model for the measured environmental parameters in various stations within the project area.

The first stage has been completed.

Environmental impact assessment study. By identifying potential environmental impacts in the project planning stage, it is possible to pinpoint the need for mitigation measures which can then be implemented at an early stage. For this purpose as part of the GAP-MOM study in 1993, an initial environmental impact assessment of GAP irrigation projects was made for sustainable development of GAP with minimum disruption to the environment (GAP-RDA, 1994d).

The potential environmental impacts of irrigation schemes in the GAP region on the areas of hydrology, pollution, geotechnics, sedimentation,

ecology, socioeconomy, health and imbalances were assessed in terms of being positive or adverse and the likelihood of their occurrence. The mitigation measures required to offset the adverse impacts of the irrigation projects were defined.

Application of the Turkish Environmental Law and Regulations

The Environmental Law (coded 2872) came into force in 1983. The aim of the law is not only to prevent and eliminate environmental pollution, but also to allow for the proper management of nature, historical values and the land in such a way as to utilize and preserve such richness with concern for future generations. According to the basic principles that govern the application of the Environmental Law, and as stated in the Constitution, citizens as well as the state bear responsibility for the protection of the environment. After 1985, regulations were put into effect to facilitate the implementation of the law. One such regulation is the Environmental Impact Assessment (EIA) Regulation. EIA will help to identify project-specific environmental problems and formulate counter-measures. Site selection for major projects, industrial zones and individual projects must incorporate EIA before any implementation can even be proposed.

Environmental issues are considered at both central and local levels. At central level, the ministries apply their organizational laws and regulations concerning the environment in addition to the EIA Regulation. These are operationalized, at local level, via provincial directorships and regional offices. Major players at field level are governorates, metropolitan and other municipalities as well as implementing agencies concerned with the prevention of pollution and the protection of the environment (Ministry of Environment, 1992).

Agricultural Research and Development Project

A comprehensive R&D package was executed to determine agricultural technology for irrigated lands in conformity with land, water, plant and ecological conditions. The project, initiated in 1989, was carried out by Çukurova University Agricultural Faculty for the GAP-RDA. The main components of the project were (1) an integrated agricultural research and development package consisting of seven projects (Horticultural Crops, Adaptation and Variety Trials; Field Crops Adaptation and Variety Trials; Plant Water Consumption Research Projects; Plant Protection Research Projects; Determination of Basic Characteristics of Soil Resources; Improvement of Livestock in GAP Region; and Improvement of Crop Rotation Systems, Cultural Techniques and Marketing); (2) establishment and management of Koruklu Research and Experiment Station; (3) establishment of an agricultural data bank; (4) establishment and management of a remote sensing centre (GAP-RDA, 1996a).

Farmers' Training and Extension Activities

Farmer training programmes are carried out by the Ministry of Agriculture under the Agricultural Extension and Applied Research Project which is financed by the World Bank.

The basic approach in this project is to disseminate knowledge to farmers in an applied manner, by extension specialists who reside in their villages and

work with them. These specialists, who are agricultural technicians, serve a group of three to six villages, train 'leader' farmers who will serve as examples to others, and report to sub-province and province specialists in a hierarchical organization.

Agricultural Commodities Marketing Survey Planning of Crop Pattern and Integration of Marketing and Crop Pattern Studies

The objective of this project was to determine the 'optimal' crop patterns, marketing possibilities and policy simulations under alternative economic, world market and policy scenarios. The model incorporated the variables such as crop pattern, production, trade, livestock and human consumption, international trade, producer prices, factor prices, factor use at the project, GAP region and national level (GAP-RDA, 1992b).

Employment and Income-generating Projects Geared towards Non-irrigated Areas

This programme aims to enhance the economic status of the rural people in non-irrigated areas through activities and projects such as carpet weaving, bee-keeping, mushroom growing, animal husbandry, aquaculture etc.

Consolidation of Agricultural Lands to Improve Efficiency

The land consolidation programme aims to integrate and reform the fragmented parcels of land owned by the same individuals into one or two parcels, equivalent in size and quality to the fragmented pieces, to achieve manageability, economic viability and harmony with the irrigation system to conserve the land.

Redistribution of State-owned Agricultural Lands to Landless Farmers

The land in the region is composed of private-land properties, state-owned land and communal land which belongs to the village community. The government land consists of forests, bushes, some pastures and some agricultural land.

The GAP region has a large land potential for agricultural production, but it seems that the structural characteristics of land holdings create problems for the better utilization of the land resources. Some 53% of the farming families own 8% of the land area, and 51% of the land area is owned by 8% of landowners. In an agrarian reform programme state-owned agricultural lands are being distributed to landless farmers for better utilization of land resources and to demonstrate an equity approach in sustainable agricultural development. So far, 2500 families have been given farmland under this programme.

Participatory Urban Zoning and Planning

Socially acceptable urban development should be guided primarily by objectives of social equality of distribution. It should be ensured that the specific needs of the various interest groups will be considered in the planning process at the local level. In order to achieve the objectives of this approach, the GAP Administration has initiated a new programme that covers local participation in

the city planning process with local people, NGOs, public and private entities, seeking maximal local input and transparency.

Participatory Resettlement and Sustainable Redevelopment as a Result of Dam Reservoirs

The GAP Administration has started a study for the resettlement of those places that will be affected totally or partially by the dam reservoirs. The objective is to minimize the negative social and economic impacts of compulsory resettlement on the people living in the area and to enable them to adapt to their new conditions, under which they are retrained and can regain their productive activities and self-sufficiency. Another component of the project is to enhance participatory resettlement planning and related activities according to the principle of 'sustainable development' which is adopted by the GAP Administration in relation to all implementation under GAP.

The Atatürk Dam Reservoir Sub-regional Development Plan

This land-use exercise aims to assess the impacts of the Atatürk Dam reservoir on the existing natural, social, cultural and economic environment through the preparation of an environmental impact assessment (EIA) study (GAP-RDA, 1996b). In addition to the EIA, a strategy for tourism and recreation facilities and a transportation plan will be prepared. The development plan will provide a framework for sustainable development through the preparation of a comprehensive set of planning guidelines to direct the future growth of the area.

Phase I of the Project has been completed, and covered two sections: the 'Background Document' and the 'Development Plan'. Phase II of the project is to plan and design for, in more detail, specific projects identified in the development plan of Phase I.

Establishment of Multipurpose Community Centres for Women (CATOM)

As a part of the programme to improve the status of women, this project aims to raise the literacy level of the female population, extend their school maintenance, develop productive skills in diverse areas, create income-generating and productive employment opportunities, improve health, nutrition and hygiene standards, enhance awareness building in home economics and maternal-child health, alleviate the domestic work burden and make women active agents of community development (GAP-RDA, 1994e).

Seven CATOMs are now operational, reaching out to some 2000 women. Another seven are planned for 1997.

CATOMs are realized with the cooperation of the GAP Administration, UNICEF, Labor Placement Office and Provincial Governorate with the active participation of local people.

GAP Entrepreneur Support and Guidance Centres (GAP-GİDEM)

This programme aims to enhance and encourage private sector investments in the GAP provinces by providing consultancy services to entrepreneurs. It is foreseen that these provincial offices will primarily provide information and

assistance to investors and enterprises in the region, in particular to identify new economic areas with investment potential, formulate and appraise investment projects, identify and approach sources of financing, identify technical, strategic, marketing, and/or equity partners from other regions of Turkey as well as foreign countries, and provide consultancy in feasibility studies, investment incentives, infrastructure etc.

GAP-GİDEM will facilitate the provision of consultancy services in close cooperation with other national entities such as the Turkish Development Bank (TKB) and Turkish Union of Chambers and Commodity Exchanges (TOBB).

Eco-city and Eco-village Planning and Development on Pilot Areas

The aim here is to improve the technical capacity of the GAP Administration in developing an eco-city and eco-village planning approach and enhancing adoption and adaptation of the principles and process of Local Agenda 21 in the region, starting with pilot cases in Adiyaman city centre and Harran village in the GAP region.

The eco-city planning approach for the Adiyaman project envisages the development of a theoretical and technical framework for eco-city planning for Adiyaman city; assessment of the adaptability of this approach considering the current planning practices; identification of the indicators of sustainability taking account of the carrying capacity of the planning area and the preparation of Local Agenda 21.

Harran eco-village project aims to develop planning policies for the establishment of ecological rural settlement, to determine an eco-agricultural development and rural land-use planning system with a view to establishment of the ecosystem and carrying capacity of the area, to formulate an environmental management model and to include public participation.

Conclusion

GAP is the most comprehensive, integrated regional development project ever attempted in Turkey. GAP as a people-centred development aims to remove the 'gap' between the project area and more developed regions in Turkey, and to promote equitable development. It has adapted a sustainable approach which protects and regenerates the environment and safeguards options for future generations. Equitable development, participation, protection of the environment, the creation of employment opportunities, improvement of the living standards of local people, promotion of land-use planning and the integrated provision of infrastructure are the main strategies of the GAP approach.

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