

## **The south-eastern Anatolia project (GAP) in Turkey and Middle East in terms of economic, strategic and politic**

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### **Abstract**

The South-eastern Anatolia Region has political, economic, commercial and strategically importance as well as religious due to the fact that it has been used as settlement, and hosted for divine religions. This region is on the historical Silk Road, and Turkey part of the Mesopotamia, which means to the land between two rivers in Latin, composed of fertile soil and located in a geographical place where the energy resources roads crosses. There have been significant delays in the realization of the South-eastern Anatolia Project (GAP) due to the some external factors. In this study, we discuss political, economic, and strategically importance of the GAP project. In Turkey, background of the GAP is based on the Keban Dam Project in 1930s. GAP was firstly planned as irrigation and hydroelectric power plant (HEPP) projects on the Tigris and Euphrates Rivers. This project was transformed to multipurpose regional development program after 1980s. The Tigris and Euphrates 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 entry country. Turkey has a total gross hydropower potential of 433 billion kWh/year, but only 125 billion kWh/year of the total hydroelectric potential of Turkey can be economically used. By the construction of new hydropower plants, 36% of the economically usable potential of the country would be tapped. The GAP region has a 22% share of the country's total hydroelectric potential, with plans for 22 dams and 19 hydroelectric power plants, installed capacity with 7500 MW. Once completed, 27 billion kWh of electricity will be generated annually. GAP also constitutes 21% irrigation potential of Turkey together with the irrigation area having approximately two millions hectare.

**Keywords:** *Hydroelectric power, Irrigation, the South-eastern Anatolia Project (GAP)*

### **Introduction**

Water resources development around the world has taken many different forms and directions since the dawn of civilization. Humans have long sought ways of capturing, storing, cleaning, and redirecting freshwater resources in efforts to reduce their vulnerability to irregular river flows and unpredictable rainfall. Early agricultural civilizations formed in regions where rainfall and runoff could be easily and reliably tapped. The first irrigation canals permitted farmers to grow crops in drier and drier regions and permitted longer growing seasons. The growth of cities required advances in the sciences of civil engineering and hydrology as water supplies had to be brought from increasingly distant sources. On the other hand, our modern industrial societies routinely and dramatically modify the hydrologic cycle through unprecedented construction of massive engineering projects for flood control, water supply, hydropower, and irrigation [1-3].

The GAP will play an important role in the development of Turkey's energy and agriculture sector in the near future. For this reason, it is suitable to examine the general structure of this Project and its effects in terms of economically, strategically, and politically. The GAP project is one of the largest power generating, irrigation, and development projects of its kind in the world, covering 3 million hectare of agricultural land. This is over 10% of the cultivable land in Turkey; the land to be irrigated is more than half of the presently irrigated area in Turkey [4]. In this paper, general structure of the project was summarized, and then, economic development and strategic role of the GAP project were investigated.

### General structure of the gap project

The GAP region comprises nine provinces (Adiyaman, Batman, Diyarbakir, Gaziantep, Mardin, Sirnak, Siirt, Sanliurfa and Kilis) in South-eastern Turkey, bordering Iraq and Syria, and covers about 75193 km<sup>2</sup> of land which corresponds to about 10% of the total area of Turkey. Figure 1 presents location map of Euphrates, Tigris Basins, and GAP region and South-eastern Anatolia Projects (GAP Projects). All of the six provinces in the GAP region are net out-migrating areas with the exception of Gaziantep. In spite of the above mentioned fact still the average annual growth of the region's population has been 3.0% in the last 20 years, much higher than the national average of 2.5% [5]. Total population in the GAP region at the 2011 census was about 7.82 million which accounts for 10.5% of the national total of 74.7 million (Table 1). 63% of regional population lives in urban settlements and 37% in rural areas. The GAP region is one of the less developed regions in Turkey, and its per capita gross regional product was 47% of the per capita gross domestic product of Turkey in 1985 [6-9].

Table 1 General Features of the GAP Region [10]

Parameters	GAP region	Turkey	Ratio (%)
Total area (km <sup>2</sup> )	75193	780000	9.7
Population (x 10 <sup>6</sup> )	7.82	74.7	10.5
Water budget (billion m <sup>3</sup> )	52.9	186.1	28.4
Irrigable land (x 10 <sup>6</sup> hectare)	1.82	8.5	21.4
Hydropower potential (TWh)	27.5	122	22.5

The GAP integrated project initially commenced in 1936 with the hydrological surveys conducted on the Euphrates River and Keban Strait and developed towards 1960. Efforts were intensified in preparation of the feasibility of the Lower Euphrates presently consisting of 12 subprojects with the addition of the Euphrates and Tigris projects in 1970. At the present time, the South-eastern Anatolia Project (GAP) has continued to be implemented as a multifaceted, integrated development project. Within this framework the Ataturk Dam has been completed and water has been brought to the Harran Plain [6, 8, 9, 11].

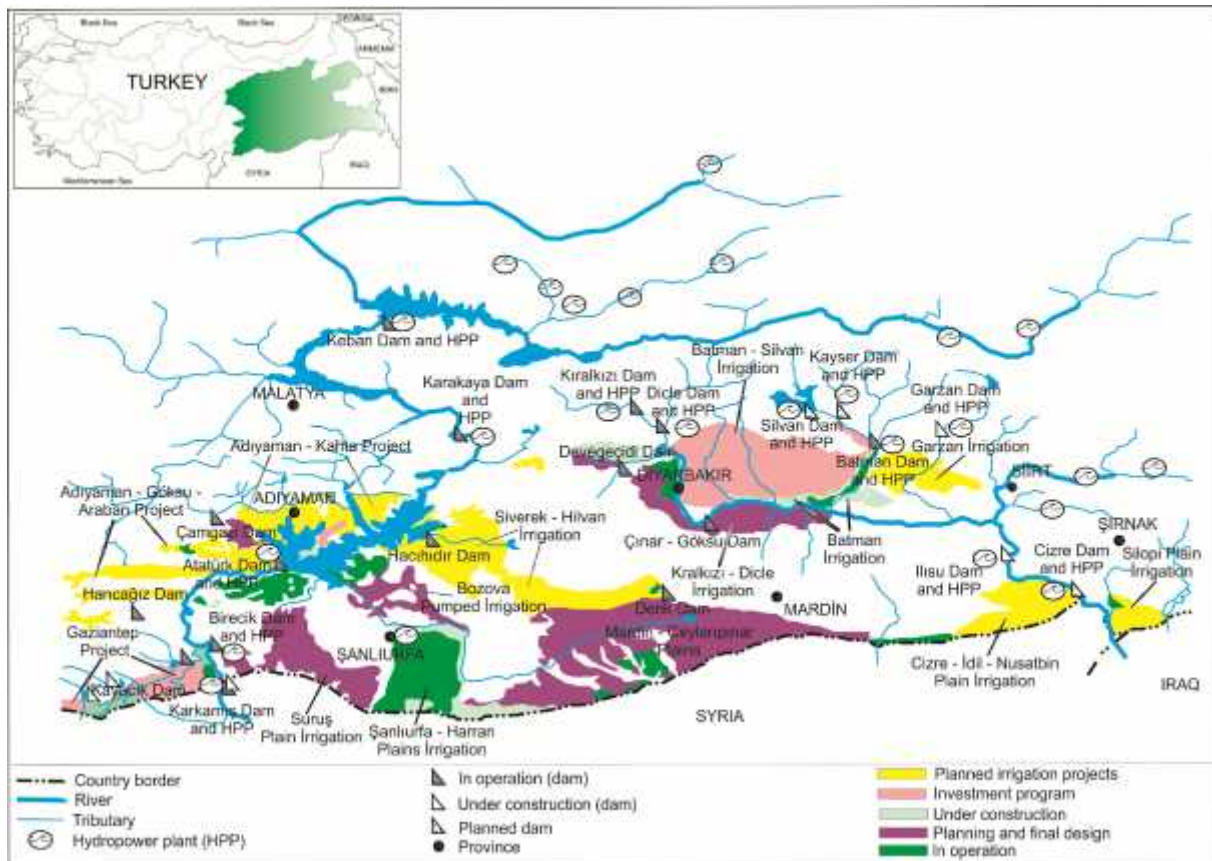


Figure 1 Location Map of Euphrates and Tigris Basins and GAP Region and South-eastern Anatolia Projects (GAP Projects)

The GAP project originally planned by the State Hydraulic Works is a combination of 12 major projects primarily for irrigation and hydroelectric generation. The project includes the construction of 22 dams and 19 hydroelectric power plants on the Euphrates and the Tigris rivers and their tributaries. The Tigris and Euphrates Rivers originate in the mountains of Turkey, flow south through Syria and Iraq, and drain through the Shatt Al-Arab waterway into the Persian Gulf. Average annual runoff in these two rivers exceeds 80000 million cubic meters, of which about 33000 million are generated in the Euphrates and 47000 in the Tigris (Tables 2 and 3). Flows in both rivers are extremely variable. Altogether the GAP region comprises of about 10% of Turkey's surface area and also about 10% of total population (Table 1). The region is located in the basins of Euphrates and Tigris Rivers, which together represent over 28% of nation's water supply by rivers and constitute 22.5% of the total hydroelectric energy potential of the Turkey. The economically irrigable areas in the region make up 21% of those for the whole country [12]. GAP has been an example of good water resources management. The components of the project have been realized by implementing modern concepts of water management, environmental conservation, and women participation. This is sincerely appreciated by various government and UN-related organizations [10]. It is planned that upon completion, over 1.8 million hectare of land will be irrigated and 27 billion kWh hydroelectric energy will be generated annually [13]. On the other hand, it is assumed that in addition to energy production and improvement in agricultural sectors, the effects of this project on the social structure of the region will be considerable [4].

Table 2 Tigris River Information in Brief [10]

Basin area: 387000 km <sup>2</sup> ; mean annual discharge: 52 BCM (billion m <sup>3</sup> )		
Riparian position	Basin area (% of total) Contribution to annual discharge	Main water uses
Turkey upstream	57600 km <sup>2</sup> (14.9%) 20.840 BCM (40%)	Irrigation, hydropower
Syria-border with Turkey/Iraq	1000 km <sup>2</sup> (0.3%)	
Iraq downstream	- 292000 km <sup>2</sup> (75.3%) 26.571 BCM (51%)	Irrigation (diverts water through Thartar Canal to Euphrates), hydropower
Iran-upstream on one tributary	- 4.689 BCM (9%)	

Table 3 Euphrates River Information in Brief [10]

Basin area: 444000 km <sup>2</sup> ; mean annual discharge: 32 billion m <sup>3</sup>		
Riparian position	Basin area (% of total) Contribution to annual discharge	Main water uses
Turkey upstream	146520 km <sup>2</sup> (33%) 28.922 BCM (90%)	Irrigation, hydropower, water supply, flood control
Syria downstream	84360 km <sup>2</sup> (19%) 3.213 BCM (10%)	
Iraq downstream	204240 km <sup>2</sup> (46%) 0 BCM (-)	Irrigation, water supply, inhabitants of marshes

### Economic development of the gap

Together with the Ataturk and Karakaya dams which combined provide a significant share of energy in the interconnected system, the total energy production by the hydropower plants of the region, including Kralkizi, Karkamis, Dicle and Birecik which started operating in 1999 and 2000, reached about 184 billion kWh yearly electricity production. On the other hand, the monetary equivalent of 186 billion kWh energy generated in the period between the first operation of plants and the end of 2009 is about US\$ 14 billion. If this magnitude is expressed in terms of alternative energy sources, it is comparable to the importation of 50 million tons of fuel oil. Turkey produced about 36 billion kWh hydraulic energy in 2009. In this total, the GAP region has a share of 34% as shown in Table 4 and Figure 2.

Table 4 Energy Production Comparison between GAP and Turkey [14, 15]

Year	Turkey			GAP Hydraulic GWh	GAP/Turkey	
	Thermal GWh	Hydraulic GWh	Total GWh		Hydraulic (%)	Total (%)
1999	81 804	34 668	116 432	14 864	42.7	12.7
2000	94 187	30 899	125 026	12 160	39.2	9.7
2001	99 064	24 024	123 021	11 509	47.9	9.3
2002	95 464	33 712	129 016	12 420	36.8	9.6
2003	104 810	35 346	140 115	15 298	43.3	10.9
2004	104 214	46 112	234 010	22 410	48.7	14.8
2005	121 912	39 643	161 524	18 708	47.2	11.6
2006	131 405	44 244	176 079	21 414	48.5	12.2
2007	155 021	35 836	191 168	18 224	51.0	9.5
2008	164 298	33 324	198 392	15 642	47.0	7.8
2009	156 214	35 914	194 060	12 121	33.7	6.2

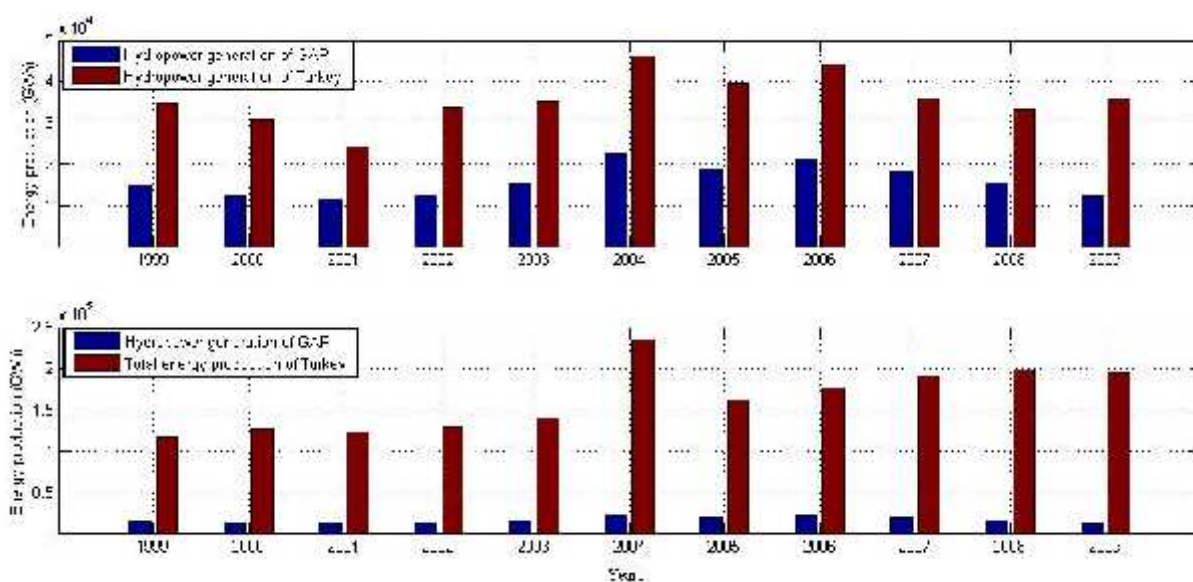


Figure 2 Energy Production Comparisons between GAP and Turkey

The development of the region was originally planned as relating to its water resources, which were later combined in a comprehensive water and land resources development package. For this purpose, total 12 groups of projects were planned on the Euphrates and Tigris rivers and their branches by the General Directorate of State Hydraulic Works (DSI) as shown in Table 5 [6, 13]. According to the predictions and goals of the GAP Master Plan, public financing requirement and cumulative expenditure of the GAP by the end of 2011 are about US\$ 24.6 billion and US\$ 21.3 billion, respectively, and thus, cash realization has been 86.6%. It is planned that upon completion, over 1.8 million hectare of land will be irrigated. Nowadays, only 20.3% (0.37 million hectare) of irrigable areas in the region is operational. 5.5% and 77.3% of the land in the rest are under construction and in the planned stage, respectively. Also, 15 dams

from the planned 22 dams are in operation. Constructions of 10 HEEPs from the planned 19 HEEPs were completed. The totally installed capacity of the completed HEEPs is 5580 MW, which presents 74.6% of the totally installed capacity of the planned HEEPs.

Water power has been utilized since the dawn of history, but only its transformation into electrical energy established the basis for its expansion today to around 44% of the country potential. And hydroelectricity will be continued in the future to be one of the most effective options because of the zero emission involved and domestic energy source. On the other hand, water is one of the most valuable resources, and a limiting factor for crop production.

Agricultural crops are the major consumer of water. Agriculture, with its social and economic aspects, has a dominant role in the nation's life in Turkey. It accounts for about 20% of gross domestic product, 10% of exports and 47% of civilian employment [4].

Table 5 Water and Land Resources Development Projects in the GAP Region [6, 13, 14]

Project	Capacity (MW)	Production (GW)	Irrigation area (ha)	Present stage
Karakaya Dam & HEPP	1800	7354		OP
Lower Euphrates Project:				
Atatürk Dam & HEPP	2400	8900		OP
anlıurfa HEPP	50	124		OP
anlıurfa Irrigation Tunnels			476000	OP
Siverek-Hilvan Pumped Irrigation			160000	E
Bozova Pumped Irrigation			70000	E
Border Euphrates Project:				
Birecik Dam & HEPP	852	3168		UC
Karkamıs Dam & HEPP	180	652		DD
Suruç-Baziki Plain Irrigation			146500	E
Adıyaman-Kahta Project:				
Adıyaman-Göksu Dam & Irrigation	7	43	71600	FS
Çamgazi Dam & Irrigation			7430	UC
Koçalı Dam & HEPP	40	120	21605	MP
Büyükçay Dam, HEPP & Irrigation	30	84	12322	MP
Kahta Dam & HEPP	75	171		MP
Pumped Irrigation from Atatürk Dam			29599	MP
Gaziantep Project:				
Hanca ız Dam & Irrigation			7330	OP
Kayacık Dam & Irrigation			14740	UC
Pumped Irrigation from Birecik Dam			66000	FS
Dicle-Kralkızı Project:				
Kralkızı Dam & HEPP	94	146		UC
Dicle Dam & HEPP	110	298		OP

Dicle Right Bank Gravity Irrigation			54280	UC
Dicle Right Bank Pumped Irrigation			75870	UC
Batman Project:				
Batman Dam & HEPP	198	483		OP
Batman Left Bank Gravity Irrigation			9570	UC
Batman Left Bank Pumped Irrigation			9180	FS
Batman Right Bank Gravity Irrigation			18600	DD
Batman-Silvan Project:				
Silvan Dam & HEPP	150	623		E
Kayser Dam & HEPP	90	341		E
Dicle Left Bank Gravity Irrigation			250000	E
Garzan Project:				
Garzan Dam & HEPP	90	315		E
Garzan Irrigation			60000	E
Ilisu Dam & HEPP	1200	3830		DD
Cizre Project:				
Cizre Dam & HEPP	240	1208		DD
Nusaybin Cizre Irrigation			89000	E

OP: in operation ; UC: under construction; E: Exploration; DD: detailed design completed; FS: feasibility study; MP: master plan

### Strategic role of the gap

While Turkey intends to develop water resources all over the country, GAP is of particular importance for generating hydropower and producing agricultural commodities. Furthermore, it is the government's aim to stabilise this under-developed region politically by significantly raising the population's standard of living.

GAP is Turkey's largest integrated development project and perceived as being vital to the Turkish economy. It has the potential to meet the rising demand for hydropower caused by population growth along with urbanisation and the country's impetus in industrialisation. Upon the completion of the GAP project 1.7 million hectares of land will be brought under irrigation (1.08 million hectares on the Euphrates, 600000 hectares on Tigris), accounting for nearly one-fifth of Turkey's irrigable land; energy production in the region will reach 27 billion kWh, per capita income will rise by 209%; and about 3.8 million people will be provided employment opportunities. This would be accomplished through the construction of 22 dams, 19 hydropower plants, and extensive irrigation and drainage networks [16].

Importantly, GAP was conceived and implemented as an integrated regional development project in one of the most backward and under-developed regions of Turkey. The basic development objectives of GAP are phrased as: to raise the income levels in the GAP region by improving the economic structure in order to narrow the regional income disparities; to increase the productivity and employment opportunities in rural areas; to enhance the assimilative capacity of larger cities in the region; to contribute to the national objective of sustained economic growth, export promotion, and social stability by the efficient utilisation of the region's resources. To these ends, GAP has shifted from a pure infrastructure development project into a project in support of sustainable development with additional investments made in

urban and rural infrastructure, agriculture, transport, industry, education, health, housing and tourism [17].

Although there are visible economic and social achievements, the GAP project and in particular the construction of large dams has come in for sharp criticism. The objections refer particularly to the resettlement issue, environmental and cultural aspects, and the implications of sharing water with Syria and Iraq.

## Conclusion

The GAP project is one of the largest power generating, irrigation, and development projects of its kind in the world, covering 3 million ha of agricultural land. This is over 10% of the cultivable land in Turkey; the land to be irrigated is more than half of the presently irrigated area in Turkey. The GAP project on the Euphrates and Tigris Rivers encompasses 22 dams and 19 hydroelectric power plants. When all projects are completed, 27 billion kWh of electricity will be generated annually, which is 45% of the total economically exploitable hydroelectric potential. As a multipurpose regional development project, the implementation of the GAP will be carried out as scheduled. The environmental impact assessment studies for the GAP will be put into effect. Similar studies for other regions will be carried out when required. In the GAP region, development work will be completed before the irrigation projects. Meanwhile the farmers of the region will be imparted extension services, especially training and land consolidation, with irrigation activities, will be handled on a faster pace.

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