

The Importance of Irrigation Projects in Turkey Within the Framework of the Food Crisis: A Case Study of Southern Anatolia Project

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Abstract: The Southern Anatolia Region is one of the seven geographical regions of Turkey with its wide and fertile agricultural areas and very important water resources (The Euphrates and Tigris rivers). The Southern Anatolia Project (SAP) Master was developed in 1989 for using those resources efficiently. This Region occupies 11.7% of (3.290.575 ha) Turkey's area and it was intended to irrigate 1.822.000 ha of this region according to the Southern Anatolia Project. According to SAP Management data, only 15% of the (272.972 ha) SAP area could be irrigated at the end of 2007. In recent years there has been a decrease in agricultural productivity and an increase in the prices of agricultural products because of global warming and the other climate related problems both in the world and Turkey. Consequently SAP is evaluated in this study from a drought and food crisis point of view.

Key words: Southern Anatolia Project (SAP) • Agriculture • Irrigation • Food crisis • Drought

INTRODUCTION

Projections about agriculture and food security suggest that most of the world will be faced with food crises in the future because of climate change, population increase, land use change and water scarcity [1]. Semi-arid and arid areas (e.g., the Mediterranean Basin, western USA, southern Africa, north-eastern Brazil, southern and eastern Australia) are particularly exposed to the impacts of climate change on freshwater. Climate change will increase the number of people at risk of hunger, with respect to overall large reductions due to socio-economic development [2].

Improving agricultural productivity is very important for economic development in undeveloped and developing countries, because lower food prices can directly raise living standards, especially for poor people who spend most of their incomes on food [3]. Therefore, many international efforts have been launched to improve agricultural productivity in developing countries. However, in recent years it has begun to be realized that without good governance, the achievements brought about by these efforts will be severely limited [4].

The most adverse impacts of climate change are predicted for the developing world, because of geographic exposure, reliance on climate-sensitive

sectors, low incomes and weak adaptive capacity [5]. Several national and international water reports have stated that many countries, including Turkey, will face drought-related important problems in the next 50 years. It has been stated that 100 million ha of fertile agricultural areas will be lost because of deforestation and drought every year [2]. It was also declared that this issue will affect the food needs of 1,2 billion people on the planet. According to data from the International Agricultural Research Consultation Group, one third of the world's population will face water scarcity by the year 2025 if freshwaters of the world continue to be consumed at today's level.

Atalay [6] mentioned that if the temperature increased 2°C toward the middle of the 21st century, there will be a grand change in the climate in Turkey and in the Southern Anatolia region, which will receive less precipitation. Furthermore, the increase in temperature will cause an increase of the drought effect in Southern Anatolia region. The number of heat waves and dust storms, coming from the Sahara and Arabian Deserts, will increase as well. Thus the region will become hotter and drier.

Global and regional-scale climate changes will affect precipitation and temperature. There was a drought at the natural disaster level caused by high temperatures and low precipitation in the Southern Anatolia Project region

in the year 2008 [6]. This drought propelled Turkish citizens and their Government to finish irrigation projects around the region; the Southern Anatolia region action plan (2008-2012) of May 27, 2008 includes the Diyarbakir irrigation project.

Southern Anatolia Project (SAP) was developed for to increase the socio-economic level of the region, to eliminate imbalances between regions of Turkey and to speed up national development. Eliminating the structural problems of agriculture has been delayed because of incompleteness of agricultural development projects, especially irrigation projects in southern Anatolia. Therefore, differences in development levels between regions have not decreased; they have actually increased. For this reason, irrigation projects of SAP that are in the planning stage should be implemented as soon as possible, considering the drought problems of the region.

This study was designed to evaluate the agricultural potential of the Southern Anatolia Project region, the initial and developing stages of the Southern Anatolia Master Plan and its realization level and the irrigation importance of SAP. The questions listed below were selected for the research:

- What is the agricultural potential of the Southern Anatolia region?
- What is the Southern Anatolia Project?
- What is the implementation stage of the Southern Anatolia Project?
- What is the importance of the Southern Anatolia Project?

MATERIALS AND METHODS

Agricultural Potential of the Southern Anatolia Project:

The total area of the provinces located in the Southern Anatolia Project region is 75,000 km² and it occupies 9.7% of Turkey (779,452 km²). The agricultural areas occupy 3,290,575 ha in the Southern Anatolia Project region. This amount represents 43.6% of the total area of the region and it is higher than the agricultural area rate of Turkey (36%). The Southern Anatolia Project region encompasses 11.7% of the agricultural areas, 6.2% of the forest areas, 10.3% of the grasslands and 11.4% of the other areas in Turkey (Table 1).

Geographical properties of an area determine the width of agricultural areas in a geographical space. Geomorphologic and climate properties, vegetation cover and hydrographic conditions affect the distribution of agricultural areas. The agricultural areas of Turkey are

located on valley bottoms, tectonic plains, shoreline plains, delta plains, karstic plains, plateaus, erosion plains and low slope areas [8].

Natural environment properties affect distribution of agricultural areas widely in Turkey. Thus, it is important to examine the topographical structure of the region before evaluating the distribution of agricultural areas. The area that lies between the southern Anatolia Taurus Mountains and the Mesopotamia is not very rough. The biggest and widest plains lie on the slopes of the Taurus Mountains [9]. Therefore, the Southern Anatolia Project region appears as a wide plateau and has a crinkly and partially faulty geological structure. This plateau is composed of watersheds and mid-altitude dome-style mountains and hills, it displays a gradually decreasing altitude and it reaches the Mesopotamia plains. Very large limestone formations evolved into a ground with interesting karstic forms in the region. Great volcanic formations have edge foldings and basalt fluxes emerging from big tectonic faults between the Syrian and Arabian plates [10].

There are some plains-covered alluviums, less than 500 m high, around some towns of Southern Anatolia such as Birecik, Suruc, Akcakale, Ceylanpinar and Kiziltepe. Young alluvium deposits fill the storages of these plains. Furthermore, there are other factors that affected the formation of these plains. For example, fault zones affected the formation of the Harran plain. These plains lie from the Syrian border to inner areas and are covered by very large, low-slope plains and plateaus carved by rivers. The plateaus have karstic plains and erosion plains and are one of the largest geomorphologic units in the region. Their heights increase from south (600-700 m) to north (800-900 m). One of the largest mountain units of Turkey, the south east Taurus Mountains, is located on the north of those plateaus [11-13].

Agricultural activities are dense on the plains (depression, karst and valley bottom) and plateaus (karst and basalt). Therefore, it is possible to categorize these plains in four different classes according to their formations and surface materials. These are depression plains, karst plains, valley bottom plains and basalt plains.

Depression Plains: The Harran plain is the most important plain located in the Southern Anatolia Project region. It is one of the most important agricultural plains of Sanliurfa, of the region and of Turkey, because of its very large area and fertile soils. The plain is covered by

Table 1: Total area and land use

Kind of Area	SAP Region		Turkey		SAP/Turkey
	Area(Ha)	Ratio(%)	Area(Ha)	Ratio(%)	Kind of Ratio (%)
Agricultural Area	3290575	43.6	28059397	36.0	11.7
Grassland	2214473	29.4	21506028	27.6	10.3
Forest	1451185	19.2	23248297	29.8	6.2
Other	584767	7.8	5131478	6.6	11.4
Total	7541000	100.0	77945200	100.0	11.4

Source: Turkish Statistical Institute [7]

the Germus plateau (800 m) on the north, the Tektek plateau (801 m) on the east, the Fatik plateau (800 m) on the west and the Turkey-Syria border on the south. The plain has a triangular shape, with its 60-km-wide base in the south, its point between Tektek and Fatih plateaus and its height is 65 km. The length of the plateau is 65 km. The total area of the plain is 200,506 ha and its average height is 400 m; the elevation ranges between 360 and 500 m [14].

The other important plain in the region is the Ceylanpinar plain. It is covered by red-brown heavy structured soils and it is healthy in lime. There are no erosion and stoniness problems in the plain. The Ceylanpinar plain has appropriate irrigation and its slope is 0-2% [15]. The plain is located on the south east of Sanliurfa province and is covered by the Siverek-Viransehir plateau on the north, the Mardin-Midyat Mountains on the east and the Abdulaziz Mountains on the south. The largest portion of the plain is located in Syria; the Turkish portion is located at the intersection of the Sanliurfa-Mardin province border and the Turkey-Syria border. The Ceylanpinar county center and villages are located on the Ceylanpinar plain. Most of the agricultural areas on the Ceylanpinar plain are irrigated by underground waters.

The Kiziltepe plain is located south of the Ceylanpinar plain, at the intersection of the Buyukdere valley and Gumus Cayi valley bottoms. It is 35-km long and 20-km wide. The Mardin and Nusaybin plains lie parallel to the Syria border; they are 90 km in length and 5-10 km in width.

The Suruc plain is located in the north of the region. General Directorate of State Hydraulic Works [16] stated that the Suruc plain was made from young geologic formations. It is covered by young alluvial soils and its total area is 71,000 ha. It has red-colored soils like the Harran plain. There are some Eocene karsts under the fertile soil cover on the plain.

Valley Bottom Plains: The other important morphologic unit for agricultural production is the valley bottom plains of the Euphrates - Tigris Rivers and their arms. The most distinct samples of those plains are located on the Euphrates valleys in Birecik County. There is a thick alluvial area formed from conglomerates, sands and clays, located in the north (Altinova) and south (Mezra Plain) of Birecik. Those alluvial soils were brought by the Euphrates River from the north and partially by seasonal creeks from the plateau, especially in winter and spring seasons. Generally pepper, tomato, eggplant, cucumber and other vegetables are produced on these plains.

Karst Plains: There are large plateaus (Gaziantep, Sanliurfa, Adiyaman, Mardin-Midyat) that lie between the south east Taurus mountains in the north and the southern plains. Flat areas (with dense agricultural activities), hills and mountainous areas exist on those plains. The Gaziantep, Sanliurfa and Adiyaman plateaus generally have karstic soils and the surrounding areas of the Karacadag Mountain have basaltic-karstic soils.

Karstic formations are very even on Gaziantep and Sanliurfa plateaus because of the existence of a large limestone area on the region. There are several karstic formations such as caverns, cisterns and dolines formed by dissolving limestone in the area. Some of these cavities developed substantially and became a plain. One of the most beautiful examples of those plains is the Yaylak Plain located on Bozova County on the north of the Euphrates River. There are several karst plains in the region that are being used for intensive agricultural activities.

Basalt Plains: The Karacadag volcanic mountain is located in the middle of the Southern Anatolia region and plays a role as a watershed border between the Euphrates and Tigris rivers. Stony areas with combined black stones and debris of stones are common on the slopes of the Karacadag Mountain and these areas cover basaltic soils in the region. Those stony areas are

cleared and opened to agricultural activities, especially in the Siverek-Viranşehir plateau in late years. This plateau has fertile soils and many artesian wells because of the higher level of underground waters. Very large and important barren soils are opened to agricultural activities because of those artesian wells.

Agriculture is defined as the whole process for production of necessary and beneficial vegetables from the soil and it includes processing and handling of the soil, planting seeds, irrigation, hoeing, trimming, fertilizing, pest control and harvesting of mature agricultural products [17].

Soils of the Southern Anatolia region are less exploited than the other geographical regions of Turkey. While the soil balance has deteriorated in the other regions of Turkey, the Southern Anatolia region has virgin and unconstrained fertile soils [18]. Regarding the soils of this region, it was realized that particular types of soils cover different large areas. Red limestone soils and terra-rose are common around Sanliurfa, Diyarbakir and Gaziantep. Vertisols around the Harran plain and andosols on the basalt plains around Gaziantep and Karacadag are examples of intrazonal soils formed by the main rocks. Furthermore, alluvial soils are widespread where rivers created bottom valleys [12].

Many alluvial covered tectonic plains and horst style high mountains were formed by tectonic activities in Neocene and Quaternary periods [19]. The southern Anatolia region is located inside of a folding zone that lies from north to south and is composed from anticlinals. This folding zone is located on the south of the outer arc of the southern Anatolia Taurus Mountains. These foldings are extensions of Syrian, Iraqi and Iranian geomorphologic structures. Most of the region is covered by tertiary sediments and late Pliocene basalt fluxes [10].

Soils of the SAP region are usually in the red-brown big soil group. There are some soils with ABC horizons located on flat and low-slope areas. Those soils are usually rich in calcium and their main materials are thin-texture limestone soils. The levels of organic material and phosphorus are low; in contrast, the clay level is high (43-62%) in the soils [20].

Plains are usually south-sloped; this is an advantage for irrigation and drainage in the region. There is no salinization because there are impermeable dense clay layers deep in the soils in alluvial plains and deltas and due to the lack of near-sea plains; furthermore the underground sea level is low in the region. This issue is very important for the agricultural productivity of the SAP region.

Consequently, the lower Euphrates plains, some parts of which are irrigated, are very different from the other irrigated plains of Turkey. While Cukurova, Aksu, Buyuk Menderes, Kucuk Menderes, Gediz, Meric, Sakarya, Bafra, Carsamba and Aras plains are young deltas and plains, SAP plains are formed of materials moved from mountainous areas and they usually have genetic layers. Alluvial soils are very rare in the region [21].

Southern Anatolia Project: Turkey, due to its natural, social and economical features, was divided into seven regions in the 1st Geography Conference held in 1941 [22]. Southern Anatolia is one of these seven regions. According to this division, the South Eastern Region is surrounded by the Mediterranean Region in the west, Eastern Anatolian Region in the north and northeast and Syria in the south (Fig. 1).

There are two different opinions about the area it occupies. According to Sozer, the area of the region is 66,000 km² [10]. According to Darkot, it is 57,171 km² [23]. Until 1990, when the region was to be re-named, the Southeastern Anatolian Region Term was used. However, in order to utilize the natural resources, the master plan of the Southeastern Anatolian Project was prepared and it was put into application in the same year; since then, the name SAP (Southeastern Anatolian Project) region has been used. Scientifically, the area of the SAP region is not the same area as that of the South Eastern region. However, all the related counties were included within the SAP boundaries in order not to modify their areas. According to this, the SAP region includes the counties of Adiyaman, Batman, Diyarbakir, Gaziantep, Kilis, Mardin, Siirt, Sanliurfa and Pınar and it covers an area of 75,358 km² (Fig. 2).

The SAP is continuously improving; its methods and purposes have been reshaped according to the changing conditions of the country and the world [24]. We can divide this process into four steps.

The First Step: The Euphrates River Basin Development Report of 1964 was prepared in connection with the project started in 1961 in the Euphrates basin by the General Directorate of State Hydraulic Works of Turkey, to develop the soil and water resources and the Euphrates River Development Report was prepared in 1966. Later, similar studies were conducted in the Tigris basin. In 1980 these two projects were joined and transformed into the "Southeastern Anatolian Project" [25].

Thus, in the beginning, SAP was prepared as a regional development project in order to utilize the soil

and water resources for the development of the region and to improve the welfare level of the population.

The Second Step: The project continued with aims similar to those of the first step, but after analyses and evaluations, their coverage was increased and the master plan for the SAP was prepared in the year 1989. The SAP Master Plan was transformed into an integrated project with many sectors. It came into existence with the projected dams on the Euphrates and Tigris Rivers, with investments in urban and rural infrastructure, transportation, industry, education, health, housing, tourism and other sectors, along with hydroelectric and irrigation systems. Its aim was to further the socio-economic development of the whole region and it was considered as a regional development project with an integrated development hope. In the same year, the Southeastern Anatolian Project Regional Development Administration (SAP-RDA) was established based on the authority given by the Ministry Board.

The Third Step: The SAP Master Plan was reconsidered and revised according to new necessities due to the economic crises in the second half of the 1990's and the developments related to those crises and it was reshaped with the decision of the Ministry Board taken on July 4, 1998. In this respect, the SAP master plan was prepared taking into account the principles of Participatory Planning study plans. Thus, SAP was re-projected according to participatory and maintainable development approaches.

With this aim, the SAP master plan has, theoretically, been a development project centralized on the improvement of human life conditions. The project aims to fully activate the preferences and the potentialities of the people in the region and to eliminate the differences between developed and undeveloped regions. In other words, SAP is an initiation based on the integrated and maintainable improvement of soil, water and human resources for the full socio-economic development of the population.

The Fourth Step: This step is the SAP activity plan initiated by the Prime Minister, Recep Tayyip Erdoğan, in Diyarbakir on May 27, 2008. There are four developmental aims, including 1) The realization of the economical development, 2) The provision of the social development, 3) Development of the infrastructure and 4) Development of the foundational structure. The cities and the activities are mentioned under the main headings.

The SAP irrigation plan was revised. The projects for the source of ready water and the main channel have been completed to a great extent. The project for the water pumps, which was considered more economic and the aim to irrigate 1,060,000 acres of land, are planned to be completed by 2012. The project will be built by both governmental and private sector cooperation [26].

Consequently, the main aim of the SAP is to develop the agricultural production and variety by irrigation of the dry areas, to develop the resources in the region and to help the regional population to maintain these developments. With the increase in agricultural production, the industries dependent on agriculture will improve, the economy will be enlivened and there will be new employment opportunities in the region. Thus the migration from the region to other cities will be prevented and the differences between the people in the SAP region and in other regions will be reduced by the increased income and welfare levels [27].

To summarize the aims of SAP:

- To irrigate the dry lands
- To increase the agricultural production and variety
- To develop the resources in the region and to assist and encourage the regional people to participate in the maintenance of these developments.

The SAP master plan has outlined the development of the region, it has scheduled the development of water and soil resources with regards to economical and technical capacities, it has provided the changes that will ignite the economical and social sectors, it will employment opportunities and will increase the settlement of the population in rural and urban areas; it has also determined the needs for educational, health services, housing and urban infrastructure at a macro level and it has outlined the annual financial needs. The SAP master plan is contributing to the integration of development efforts of several governmental foundations and to the coordination of their aims by guiding the application of the SAP and additionally, it functions as a guide for the programs and projects for the development of the region and the pace for the necessary improvements. The SAP master plan determined five principal strategies, which complement one another and constitute a comprehensive program. These are:

- To develop and administer the water and land resources for better irrigation, housing and industrial utilization

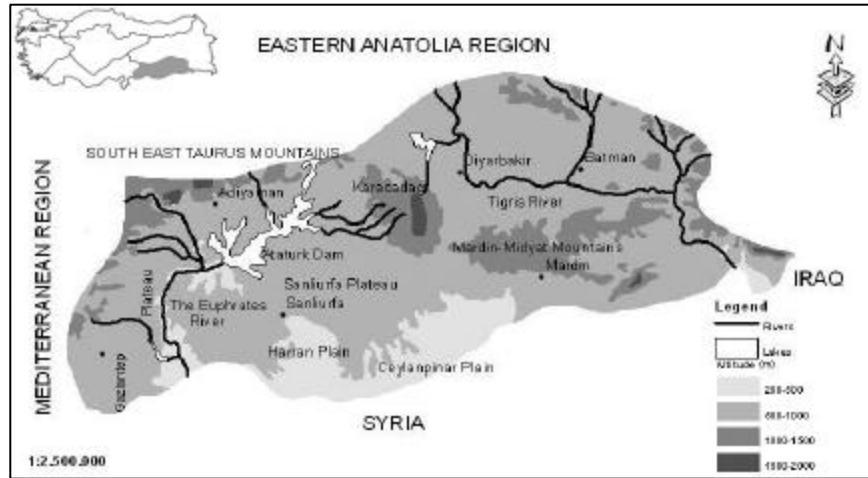


Fig. 1: Physical Geography map of the South Eastern Anatolia Region of Turkey

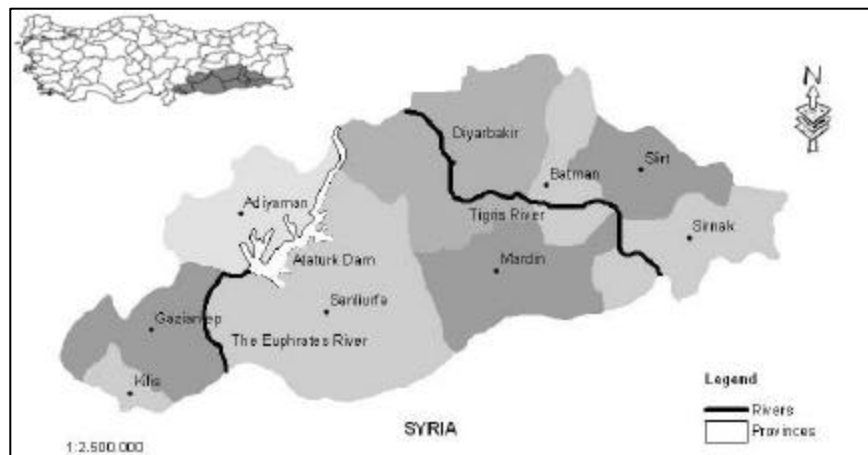


Fig. 2: Provinces of SAP region

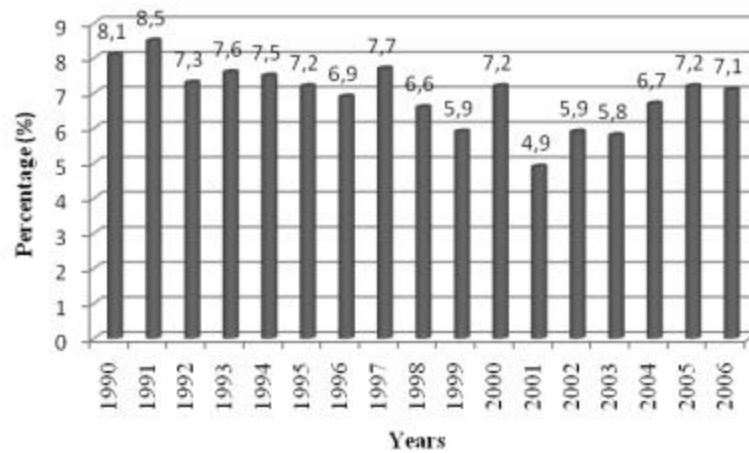


Fig. 3: Development of the governmental investments in the SAP region (1990-2006)
(Source: SAP-RDA [27])

- To develop the utilization of land by applying better agricultural administration, practices and plantation
- To support the industries by focusing on production of regional resources related to agriculture.
- To meet the needs of the local people and to improve social services and urban infrastructure in order to avoid migration from the region.

Taking these strategies into consideration, the aims of the SAP can be listed as follows:

- The irrigation of 1.82 million acres of land
- The production of 27 billion kilowatts of electricity per hour
- The increase of income by 209%
- The opportunity of employment for 3.8 million people [26].

A three-level development model in the geographical place dimension has been accepted for the SAP master plan. The first level aimed to improve the corridor that includes the centers of the Gaziantep-Sanlıurfa-Diyarbakir counties, so called the “broken development line”. In the second and the third levels, development was directed towards the surrounding areas or the nearby counties [28]. Thus, the achievement of SAP is bound to a centralization of the infrastructure, industry and services in a few centers, in the long and medium terms. In 2005 it was estimated that the SAP master plan project would cost 32 billion US dollars.

The cost of the SAP has averaged 7% of the annual national budget in the 17 years between 1990 and 2007, ranging from 8.5% in 1991 and 4.9% in 2001 (Fig. 3).

RESULTS

The Realization of the Irrigation Projects in the SAP:

Investments based on agriculture and on industries unrelated to agriculture are both needed to evaluate the expected increase in agricultural products in the SAP area. The establishment and development of industries based on agriculture, the demand for agricultural products, the increase in employment and pioneering other industrial developments will play an important role in the elimination of the difference between regions. The integration of the agricultural and industrial sectors in the SAP is very important since these two sectors affect one another and interact with each other. The economy of the region is dependent on agriculture to a great extent and the majority of the population -approximately 60%- works in

agriculture. Development in every sector was started by a gradual building of the irrigation system and its application to agriculture, which resulted in great developments in agriculture and this in turn has contributed to the development of the industries dependent on agriculture. All these developments affect not only the region's economy but also the country's economy. The region has been defined as *the base for export* related to agriculture and the industries dependent on agriculture [29].

Irrigation projects and the affected agriculture sector comprise the main part of the SAP master plan (1989). The SAP was supposed to be finished in 17 years (1989-2005) according to the SAP master plan but this has not happened yet. However 59.3% of the money has been allocated and 15% of the land has been developed for agricultural applications (1.822.000 ha) which will be irrigated (Table 2). When the distribution of the irrigated lands is analyzed according to cities, 72.3% of irrigated areas (188666 ha) are in Sanliurfa, 11.6% (30316) in Diyarbakır, 7.5% (19652) in Gaziantep, 4% (10460) in Mardin, 2.1% (5432) in Batman, 1.4% (3689) in Adıyaman and 1% (2741) in Pınar. Of the land supposed to have been irrigated in Sanliurfa, only 34.6% (545561 acres) have been completed where the irrigation will take place the most in the project of the SAP Water Resources Development Program (Table 3).

Drought, Food Crises and the SAP: The changes in the climates will affect the fertility in agriculture. By the increase in the drought, the decrease in the agricultural products will be equalized by the increase of the photosynthesis level of CO₂ which is high in the atmosphere. With this, it is estimated that there will be a 5% decrease in the production of agricultural products globally and in semi-dry lands. This is not expected everywhere but in the countries middle regions of the world there will be changes in the amount of rainfall and there will be a little increase because of the increase in the temperatures and therefore there will respectively be increasing undernourishment problem in the developing countries [6].

The predicted 2% increase in carbon dioxide caused by climate change will lead to increases of some products and decreases of others. Studies about this issue report that there will be a 5% decrease in fertility of crops, globally and regionally. According to those studies, increased production will occur in countries in warm climate regions, while a 10% decrease might affect developing countries if decreases in population are taken into consideration. A decrease in agricultural production

Table 2: The Program for the Development of the Soil and Water resources in the SAP and its final stage [28]

A-SAP the projects for the Development of the Soil and Water Resources		C- the situation at the end of the completion of the project
The The Euphrates Basin	The The Euphrates Basin	The number of dams : 22
1. Karakaya Dam / HES	The Tigris Basin	The number of HES: 19
2. The down - The Euphrates	1. Tigris -Kralkizi Dam	Produced energy: 7474 MW
3. The Border of The Euphrates	2. Batman The total land of the field that will be irrigated (ha): 1.820.000	
4. Suruç-Baziki	3. Batman-Silvan	The total cost of the SAP: 39.287.353.000 TL
5. Adiyaman-Kahta	4. Garzan	
6. Adiyaman-Göksu-Araban	5. Ilisu	
7. Gaziantep	6. Cizre	
B- The situation of the monetarily realization of the SAP according to the sectors		D- The project's completion situation till the end of 2007
The situation of the monetarily realization of the SAP according to the sectors		The number of dams: 13 (59%)
Agriculture: 26,0		The number HES: 8 (42%)
Energy: 83,6		Produced energy: 5513 MW (74%)
Transportation/correspondence: 45,3		Irrigated lands (in industry): 272972 ha (15%)
Tourism: 31,9		The lands under construction: 11406 ha (6%)
Totally: 59,3		Remaining lands: 1499508 ha (80%)
		The amount spent: 23.313.874.000 TL (59,3%)

Table 3: The Irrigation distribution in the counties in the SAP

Provinces	The name of the irrigation	Irrigated fields	Its ratio according to the SAP	Provinces	The name of the irrigation	Irrigated fields	Its ratio according to the SAP
Sanliurfa	1. Pumping Irrigation of Bozova I. Step	8669	72.3%	Gaziantep	23.Irrigation of Keysun YAS	2400	7.5%
	2. Irrigation of Yaylak Plain (partial)	18322			24. Irrigation of Araban	130	
	3. Pumping Irrigation of Bozova City	1080			25. X. Study Region: Small Water Affairs	3258	
	4. Irrigation of Sanliurfa-Harran Plain (partial)	133195			26.XV. Study Region: Small Water Affairs	900	
	5. Irrigation of Upper Harran	6065			27. XX. Study Region: Small Water Affairs	4939	
	6. Irrigation of Akcakale YAS	10255			28.XV. Irrigation of Pasabag	400	
Diyarbakir	7. Irrigation of Ceylanpinar YAS	9000	11.6%	Batman	10. Irrigation of Kayacik Plain	680	2.1%
	8. Irrigation of Hacıhıdır	2080			15.Hancagız Sulaması	6945	
	13. Irrigation of Silvan I. and II.	8790			11. Irrigation of Batman Left Side	855	
	14. Pumping Irrigation of Kralkizi-Dicle I. step (partial)	6692			12. Irrigation of Batman Right Side	604	
	20. Irrigation of Devegeçidi	10600			22. Irrigation of Garzan-Kozluk	3973	
Adiyaman	21. Irrigation of Cinar-Goksu	4234	1.4%	Mardin	16. Irrigation of Derik Dumlucu	1860	4.0%
	9. Irrigation of Camgazi (partial)	3689			18. Irrigation of Nusaybin Çag	8600	
Şırnak	19. Irrigation of Silopi-Nerdus	2740	1.0%				
Total						272972	100.0

Resource: SAP-RDA [26]

will increase the hunger risk in African and Asian countries, where populations increase at a fast rate [6].

Drought can be caused by several factors, including lack of rain and can last a few months or several years. Drought can be experienced in dry or semi-dry regions in the world, as well as in humid areas. A drought or water shortage can be caused by heat, evaporation and perspiration (evapotranspiration) due to the drying effect

of the wind and insufficient rainfall to replenish moisture in the soil. There are three different kinds of drought: meteorological drought, agricultural drought and hydrological drought. Agricultural droughts, the main subject of this study, are related to meteorological droughts to a great extent and are defined as the lack of water in the soil to meet the needs of plants. This in turn causes a decrease in the production of crops, changes in their growth and danger to animals [30].

Atalay has assessed the probable climatic changes in Eastern and Southeastern Anatolia in relation to irrigation projects in the region. According to this assessment, the convectional rainfall that occurs at the end of spring and at the beginning of summer in the Eastern Anatolian region, which is caused by the rise of air due to the warmth in the surface of the earth, will help to increase the overall rainfall. This in turn will increase the flow of the Euphrates and Tigris rivers, which spring from that region. This situation will lessen the effect of the drought caused by rising temperatures in Southeastern Anatolia and will ensure the continuous irrigation of agricultural areas with water collected by dams on those rivers [6].

In recent years, there have been important developments in some countries where remarkable deterioration of the social life has taken place due to rising food prices and spreading of famine. With respect to this matter, the United Nations issued a warning against rebellions in many countries in the world. For example, in recent years Pakistan has taken serious precautions to protect its wheat soils and wheat delivery lorries, in Haiti six people, two of whom were women, died in an attack to a ship carrying food products, farmers stand guard in rice fields 24 hours against looters in Thailand, lorries carrying humanitarian food to the 2 million people in refugee camps were kidnapped in the Darfur region of Sudan in the first three months of the year 2008. In this context, in Turkey there was a 200% increase in the price of rice, 160% for beans, 175% for chick-peas and 100% for ground wheat in the first half of 2008.

There are different opinions about why food prices are increasing in Turkey and in the world. These include:

- The shrinkage in agricultural production due to droughts caused by the unstabilized balance of carbon dioxide related to the release of global warming and greenhouse gases
- The shrinkage in the amount of land available for agriculture
- Investments withdrawn from the finance of immobile goods because of the global economic crisis and for speculative purposes
- The changes in eating and nourishing habits, caused by the risen welfare situation in China and India, the two countries with the fastest growing population in the world

Drought was seriously felt in Central Anatolia in 2007 and in the Southeastern Anatolian region in 2008. The

drought was natural disaster in the SAP region, where serious decreases in the agricultural products were experienced because the meteorological drought turned into agricultural drought. The combine harvesters could not even enter the fields in the region. The Agricultural Chambers Association of Turkey (TZOB) claims that the cost of the drought in Turkey was 5 billion Turkish Liras in 2008. The aims in the SAP region have not been achieved at the desired level yet, mainly because of problems experienced in the structural projects. Moreover, despite the proposed development in the SAP master plan, only 15% of the projects of irrigation of agricultural areas were completed, compared to 59% in the whole SAP. This situation is delaying the modernization of agriculture. Because of this, the developmental differences between the SAP region and the other regions have not been lessened; on the contrary, they have increased [31].

It should not be forgotten that there exist plentiful raw materials and agricultural products in the SAP region, providing a fertile ground for the development of a big industry. This should be an igniting factor in the development of agriculture and products related to agriculture in the region of the SAP. From this point of view, we can say that the agricultural, industrial and service sectors will gain importance as a whole integrated program by means of the SAP and the prompt completion of the irrigation projects, which are still on the agenda, has great importance.

As mentioned above, global warming and local conditions played an important role in the drought in Turkey. This situation naturally caused a decrease in agricultural production. Considering those conditions and in order to avoid a food crisis in Turkey, more planting fields should be watered and the methods and techniques for surface watering (to achieve 95% of irrigation) should be increased.

CONCLUSION

In 2008, there was such a drought that it could be called a “natural disaster” in the SAP region due to high temperatures and very little rainfall. This drought has triggered the feeling that the irrigation projects in the region should be completed as soon as possible. Therefore, in May 2008, the Government initiated the SAP Activity Plan (2008-2012), which also include the irrigation projects. The irrigation projects in the SAP Water Resources program should be completed urgently. Turkey should develop its water policy, which should primarily be

in the SAP region, related to “water management” that has been a strategic issue in the world and in Turkey and this policy should be activated soon.

The completion of the irrigation projects as soon as possible, which has not been completed or which is on agenda, is very important both for Turkey and the world. Specifically in the region;

- The irrigation projects under the construction or planning phase should be completed,
- The farmers in the fields where irrigation has been started should be educated about the agriculture done with irrigation,
- The saltiness situation of the lands of the agriculture done with irrigation should be prevented and solutions for the factors causing this matter should be developed.
- The irrigation system should be applied more commonly instead of the primitive watering system, which is very common in the region.

REFERENCES

1. Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, 2008. Climate Change and Water. Technical Paper, International Panel on Climate Change (IPCC) Secretariat, Geneva.
2. IPCC (Intergovernmental Panel on Climate Change), 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Cambridge University Press.
3. USAID (US Agency for International Development), 2002. Foreign Aid in the National Interest. USAID.
4. Lio, M. and M. Liu, 2008. Governance and agricultural productivity: A cross-national analysis. Food Policy, 33: 504-512.
5. Heltberg, R., P.B. Siegel and S.L. Jorgensen, 2009. Addressing human vulnerability to climate change: Toward a ‘no-regrets’ approach. Global Environmental Change.
6. Atalay, I., 2008. Ecology and geography of ecosystems, Volume 2, Meta Publication.
7. TSI (Turkish Statistical Institute), 2006. Agricultural structure of Turkey in 2004, Ankara-Turkey.
8. Ozcaglar, A., 1988. Relationship between geographical distribution of agricultural areas and environment. J. Geograp. Rev., 11: 131-151.
9. Atalay, I. and K. Mortan, 2006. Regional Geography of Turkey, Extended 3. edition. Inkilap Publications.
10. Sozer, A.N., 1984. A general review of the natural environment of South Eastern Anatolia. Aegean Geograph. J., 2: 8-30.
11. GDMRO (General Directorate of Mineral Research of Exploration), 1975. 1/500.000 scale geological map of Turkey-Hatay section, Ankara-Turkey.
12. Gurgen, G., 2002. Climate of Southern Anatolia Region, D.U. Ziya Gökalp Education Faculty Publications, No. 12, Diyarbakir-Turkey.
13. Kalelioğlu, E., 1972. Physical Geography of Gaziantep region. J. Geograph. Rev., 3-4: 139-200.
14. GDSHA (General Directorate of State Hydraulic Affairs), 1968. The reports of land use planning of Sanliurfa-Harran Plain, Volume 2, Ankara-Turkey.
15. DBT (Development Bank of Turkey), 1998, Southern Anatolia Project and Financial Solutions. (http://www.tkb.com.tr/data/file/raporlar/ESA/GA/1998-GA/GA-98-02-06_GAP_ve_Onerilen_Finansman_Yontemleri.pdf).
16. GDSHA (General Directorate of State Hydraulic Affairs), 1970. Hydro-geologic survey report of Suruc Plain, Ankara-Turkey.
17. Ozcaglar, A., 2006. Introduction to Geography, Hilmi Usta Publications, Ankara-Turkey.
18. Gulcan, E., S. Aksoy, F. Kuhnen, E. Olhan and W. Winkler, 2002. Effects of development of agricultural technologies on behaviors of producers and environment. CESAV, Ankara-Turkey. (<http://www.cesav.org/tr/content/view/36/33/lang.turkish/>).
19. Ardos, M., 1996. Kuaterner geomorphology of Turkey, Cantay Publication.
20. EFT (Environment Foundation of Turkey), 1994. Vegetation and Forest cover in Southern Anatolia Project Region. onder Publication, Ankara-Turkey.
21. Akalan, I., 1990. Some problems of soils of SAP Region. J. Bilim ve Teknik, 270: 43-46.
22. MNE (Ministry of National Education), 1941. Reports, negotiations, decisions. The First National Geography Congress of Turkey, 6-21 June, 1941, Istanbul.
23. Darkot, B., 1955. About geographical regions of Turkey. Turkish Geograph. Rev., 12: 13-14.
24. Benek, S., 2006. Analysis of SAP Region comparing development of the other Regions of Turkey, Proceedings of 4th National Geography Symposium, 25-26 May, 2006, Ankara-Turkey.
25. Ozaslan, M., 2005. Southern Anatolia Project and socio-economic development. Proceedings of 4th SAP and Industry Congress, 23-24 September, 2005, Diyarbakir-Turkey.
26. SAP-RDA (Southern Anatolia Project-Regional Development Administration), 2008. SAP Action Plan for 2008-2012, Ankara-Turkey.

27. Erkan, 2003. Agricultural researches, new research topics and development of the action plan in SAP Region, Sanliurfa-Turkey.
28. SAP-RDA (Southern Anatolia Project-Regional Development Administration), 2007. The handbook of administrators, Ankara-Turkey.
29. Karli, B., 2008. Agriculture and agricultural industries: The case study of SAP. Conference of Change/Development of Hilvan on SAP axis, 24-25 May, 2008. Hilvan-Sanliurfa, Turkey.
30. GDO (Global Disasters Organization), 2009. The reasons of drought. (<http://www.kureselfelaket.com/kuraklik/1482-kurakligin-sebepleri-nedir-genel-bilgiler.html>).
31. Benek, S., 2007. An evaluation of effect of civil society foundations on development of modern agriculture in SAP Region, Proceedings of SAP 5th Agriculture Congress, 17-19 October, 2007, Sanliurfa-Turkey.