Turkey's Water Policy

National Frameworks and International Cooperation

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Strategic Role of Water Resources for Turkey

Sahnaz Tigrek and Aysegul Kibaroglu

1 Introduction

Turkey's water policy can best be characterised by her desire to gain independence from imported energy sources, to increase production levels of agriculture and to achieve food security, to satisfy increasing water demand from industry and urban and rural populations, and to correct regional economic and social imbalances in the country, thus raising the living standard of the population (Kibaroglu et al. 2005). The inclusion of such social aims led to water resources planning and development being carried out by government agencies through public investment (Kibaroglu et al. 2009).

From the 1920s to the 1950s, Turkey was engaged in state consolidation efforts including, inter alia, the investigation, exploitation and management of natural resources, namely water and land resources. The new government institutions, established at the national level, investigated the development potential of water and land. That is, the Ministry of Public Works (1920) and the Electrical Power Resources Survey and Development Administration (1935) were established with missions to explore the country's hydropower potential, and to carry out civil works and land development as well conducting preliminary hydrological surveys.

As the Turkish State further consolidated in the decades between 1950 and 1980, more focused attention has been paid to socio-economic development, based on water and land resources. At the beginning of the 1960s, only 1.2 million hectares out of 8.5 million hectares of the irrigable land were irrigated. Hence, in the 1960s,

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the major objective was to irrigate the fertile lands in south-eastern Anatolia, which comprise one fifth of the irrigable land in Turkey, by using the huge water potentials of the Tigris and Euphrates rivers. In this context, the Lower Euphrates Project was implemented to build a series of dams on the Euphrates to increase hydropower generation and to expand irrigated agriculture. Later on, in the late 1970s, the Lower Euphrates Project evolved and expanded into a larger multi-sectoral development project called the South-eastern Anatolia Project (GAP, its Turkish acronym), which includes 22 large dams, 19 hydropower plants and irrigation schemes extending to 1.7 millions of hectares of land in the Euphrates and Tigris rivers system, which accounts for 28.5 percent of the surface water supply in Turkey (Kibaroglu et al. 2005).

Systematic water resource development started in the 1950s with the establishment of the General Directorate of State Hydraulic Works (DSI) (see Kibaroglu and Baskan in this volume). DSI, the central water agency, designated the major river basins, with their recorded potential for water and land resources, for large-scale development projects.

The adoption of the Constitution of the Turkish Republic of 1961[1] paved the way for state-induced economic and social development directed towards overcoming regional imbalances, with the western regions far ahead of the south-eastern and north-eastern provinces. This strategic orientation included the country's water resources being mainly developed from public sources. With the establishment of the State Planning Organization (SPO) in 1960, comprehensive planning activities have been undertaken in Turkey which comprised construction of physical structures to meet energy and food needs for increasing population as well as realizing socioeconomic development goals expected to provide welfare for the citizens. From then on, Turkey has made considerable progress in augmenting its water supply.

The oil crises of the 1970s, in particular, gave additional impetus to developing the country's hydropower potential. As one representative of the DSI stated: "Since the country suffered badly in the oil crises of the 1970s, the government has embarked upon a programme of indigenous resource development, particularly hydropower and lignite schemes to minimise the dependency of the national economy on imported oil."[2] However, population growth, urbanisation and industrialisation have widened even further the supply-demand gap.

The political and economic crises of the 1970s, 1980s and 1990s erupted in the country now and then, hindered these investments from being completed in a timely fashion. Moreover, water needs for drinking, agriculture, industry and energy purposes had increased exponentially in the second half of the 20th century.

[1]The 1961 Constitution of the Turkish Republic was replaced in 1982.

[2]Quoted in International Water Power and Dam Construction, vol 44, no 12, December 1992, 12. Turkey is also developing other renewable energy resources such as geo-thermal power, wind power, biomass energy, but hydropower will provide the greatest share to tackle the energy deficit (see Energy Information Administration 2002).

Furthermore, the physical structures which were built to increase water supply caused the degradation and depletion of natural resources such as water and land and ended up in certain regions of the country being detrimental to the ecology.

Since the early 1980s, however, neoliberal transformation of the Turkish economy has resulted in significant changes in water policy and management. Stemming from decisions made on 24 January 1980, Turkey became one of the first countries in the developing world to make the shift from state-led development strategies to a model of broad market liberalization and opening to the international economy. To illustrate this point, the introduction of a build-operate-transfer (BOT) model to the energy sector in 1984 under Law No. 3096, enabled the private sector to buy the right to generate, transmit and distribute electricity. This system was later modified and applied in other sectors including water, where it was extended to water supply and sanitation services in municipalities, and to the construction, operation and management of infrastructure, such as dams, hydropower plants and irrigation systems.

The new paradigm was reinforced by international frameworks and thus included in the reform packages of multilateral institutions. Hence, the key advocates of the policy change included the World Bank and other international actors such as the Organization for Economic Cooperation and Development (OECD) as well as private national and international corporations. The policy change specifically in the water sector was supported and carried out by bureaucrats from the ministries concerned and their affiliated institutions.

The real push for liberalization, however, came in the 1990s especially with the European Union (EU) process. After the Helsinki decision of the European Council in December 1999 to grant Turkey candidate status, Turkey hastened the process of liberalization in the water sub-sectors. Liberalization of the hydroelectricity sector was introduced in 1984, and reinforced by important legislation adopted in 2001. Commercialization of water services (drinking water and sewerage) has been underway since late 1980s with increasing roles assigned and played by local private business, transnational water companies and international credit agencies. The devolution of irrigation water management in the early 1990s with the guidance and partial financing of the World Bank serves to illustrate this point. Within the framework of an accelerated programme of management transfer, irrigation associations were established to operate and maintain almost all the irrigation systems in the country (see Topcu in this volume).

2 Geography, climate, water and land resources

Turkey lies between 26°-45° eastern longitudes and 36°-42° northern latitudes with land both in Europe and Asia. The Marmara Sea and two water straits form a natural boundary between two continents. Ninety-seven percent of the country is in Asia and called Anatolia, while the remaining three percent is Thrace (Armstrong and Hunkins 1989). Turkey, with a total area of 780,000 square kilometers, is surrounded by the Black Sea, Bulgaria in the north, the Aegean Sea and Greece in the west, the Mediterranean Sea, Syria and Iraq in the south, Iran in the east and Armenia and Georgia in the north-east (DSI 2009).

The average altitude of the country is about 1,100 to 1,200m. A further 80 percent of Anatolia is above 500m, the average height of Europe and Asia being 330m and 1,050m, respectively. Therefore Central and especially Eastern Anatolia, which consists of several high mountain ridges and high plateaus, receive heavy snow in winter.

Turkey has a subtropical, semi-arid climate with extremes in temperature. The average annual precipitation depth in Turkey is around 643mm, which is lower than 800mm, i.e. the average precipitation depth of the world (Usul 2005). Annual precipitation of Turkey is 501 billion cubic meters (BCM) and 274 BCM is assumed to evaporate from surface and transpire through plants.

Diversity of topography brings diversity in climate. As a result, large variations in precipitation occur, ranging from 250 mm in the south-eastern region to over 3,000 mm in the Black Sea coastal area (Republic of Turkey 2003). The construction of dams and reservoirs have been the main means of saving water during the short rainfall seasons to facilitate year round availability.

In hydrological terms, Turkey's territory features 25[3] large river basins (see Figure 1, Table 1) that exhibit a large variation in average annual precipitation, evaporation and surface run-off parameters. In total, average annual run-off is of approximately 186 BCM of which 112 BCM could be exploited at reasonable cost. Surface water contributes 98 BCM and groundwater 14 BCM. At present, Turkey is utilising 46 BCM (41 percent) of its overall capacity (DSI 2009).

The annual flows of many large basins fluctuate and show a high variability throughout the year. Further nearly every 30 years, a drought period occurs. Akkemik et al. (2005) analyzed drought periods in Anatolia over the last 350 years and reported that the duration of the drought is generally one year. Sometimes it lasts two years and occasionally three years. However, the number of drought years shows an increasing trend since 1960. The last drought was in 1994 and lasted five years (Komuscu et al. 2005).

Heavy snow falls in Eastern Anatolia in winter, and then in spring several small streams and brooks join and create two of the world largest rivers, namely the Euphrates and Tigris rivers. Total annual flow rate of these two rivers is about 52 BCM. The total drainage area of Euphrates is 127,304 square kilometers and has a total length of 2,800km. But only 971km of the river is within the Turkey's border. The Tigris has a total length of 1,900km of which 523km lie within Turkey corresponding with 57,614 square kilometers drainage. Both rivers join before discharging into the Gulf. From the face of the Eastern Anatolia Mountains one of the world's fastest rivers - the Coruh River - is born where it flows 150km within

[3]Many sources, including the official ones, had maintained that Turkey had 26 river basins. Yet, the recent documents such as the *Turkey Water Report*, General Directorate of State Hydraulic Works, DSI, 2009 as well as DSI's official website display that Turkey has 25 river basins, where the Euphrates-Tigris is considered as one single basin.

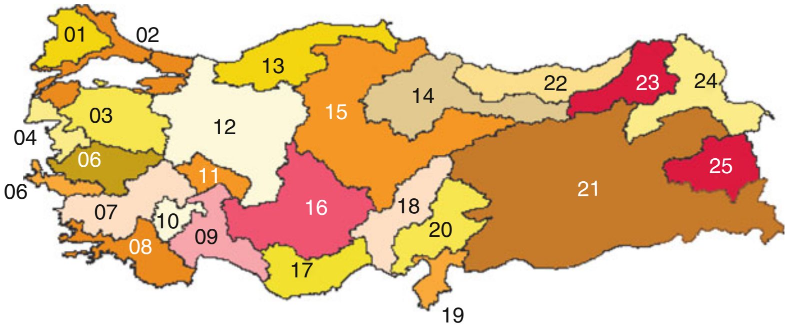

Fig. 1 Turkey's 25 river basins (see Table 1 for legend) (DSI website 2009)

Table 1 Catchment area and discharge of Turkey's 25 river basins (DSI website 2009)

River basins	Catchment area (km^2)	Mean annual discharge (BCM)	Contribution to total (percent)
(21) Euphrates-Tigris	184,918	52.94	28.5
(22) East Black Sea	24,077	14.90	8.0
(17) East Mediterranean	22,048	11.07	6.0
(09) Antalya	19,577	11.06	5.9
(13) West Black Sea	29,598	9.93	5.3
(08) West Mediterranean	20,953	8.93	4.8
(02) Marmara	24,100	8.33	4.5
(18) Seyhan	20,450	8.01	4.3
(20) Ceyhan	21,982	7.18	3.9
(15) Kizilirmak	78,180	6.48	3.5
(12) Sakarya	58,160	6.40	3.4
(23) Çoruh	19,872	6.30	3.4
(14) Yeşilirmak	36,114	5.80	3.1
(03) Susurluk	22,399	5.43	2.9
(24) Kura-Aras	27,548	4.63	2.5
(16) Konya	53,850	4.52	2.4
(07) Buyuk Menderes	24,976	3.03	1.6
(25) Lake Van	19,405	2.39	1.3
(04) North Ege	10,003	2.90	1.1
(05) Gediz	18,000	1.95	1.1
(01) Meriç-Ergene	14,560	1.33	0.7
(06) Kuçuk Menderes	6,907	1.19	0.6
(19) Orontes	7,796	1.17	0.6
(10) Burdur Lakes	6,374	0.50	0.3
(11) Akarçay	7,605	0.49	0.3
Total	779,452	186.86	100

Turkey and after flowing 26km before discharging into the Black Sea in Georgia. The Kura rises in Turkey and Georgia after some 210 km. After 390 km through mountainous terrain the river flows into the Azerbaijan steppes and finally

Table 2 Water potential generated in Turkey's transboundary river basins (DSI 2009)

Transboundary river basin	Catchment area in Turkey (km^2)	Mean annual flow generated in Turkey (BCM)	Share of total usable potential*)
Euphrates	127,304	31.61	17.0
Tigris	57,614	21.33	11.5
Coruh	19,872	6.30	3.4
Kura-Aras	27,548	4.63	2.5
Meric/ Maritsa/Evros	14,560	1.33	0.7
Asi/Orontes	7,796	1.17	0.6

*) The total usable potential is 112 BCM of which 98 BCM is surface water and 14 BCM is groundwater.

discharges into the Caspian Sea. The Aras also rises in Turkey and after 300 km the river forms several borders: between Armenia and Turkey, for a very short distance between Azerbaijan and Turkey, between Azerbaijan and Iran, between Armenia and Iran, and finally again between Azerbaijan and Iran. Eighty kilometers after crossing the border with Azerbaijan the Aras joins the Kura. Other transboundary rivers are the Meric/Maritsa/Evros River shared between Turkey Bulgaria and Greece, and the Asi/Orontes River which traverses Lebanon, Syria and Turkey. Table 2 shows the contribution of transboundary rivers to Turkey's available water resources; the Tigris and Euphrates rivers system alone account for 28.5 percent.

Almost one third of the total area of the country (78 million hectares) is classified as agricultural land which is about 28.05 million hectares. One third of 28.05 million hectares agricultural land can be classified as irrigable land. Hence, an estimated 8.5 million hectares (7.9 million hectares with surface water and 0.6 million hectares with groundwater resources) is economically irrigable under available technology. In other words, the agricultural area is 36 percent of total land, and 30 percent of the agricultural area can be irrigated technically and economically. Presently 5.28 million hectares of land are being irrigated.

3 Infrastructure development

Due to the high population and urban growth rates (4 percent), many regions of the country (south-east, Marmara, Aegean and Mediterranean) are already facing seasonal or even chronic water shortages therefore necessitating infrastructural development in the water sector. Today, an extensive network of dams and reservoirs is maintained of which the larger dams serve multiple purposes (e.g. flood control, irrigation, domestic water supply, and hydropower) (see Table 3).

Table 3 Multi-purpose water infrastructure in Turkey (in operation and planned as of March 2009) (DSI 2009)

	In operation	Under construction or in program
Dams	673 Large scale projects: 260 Small scale projects: 413	146 Large scale projects: 63 Small scale projects: 83
Hydropower plants	172	Under construction: 258
Capacity	13,700 MW	10,846 MW
Annual production	48,000 GWh	39,404 GWh
Irrigation (million hectares)	5.28	0.23
Domestic water (BCM)	3.16	0.50
Flood control (million hectares)	1.0	0.4

Box 1 History of water works in Anatolia

The need for storage facilities in Anatolia is not confined to the present. In many parts of Anatolia, the remains of water structures dating from early civilizations can be easily found. The Urartus and the Hittites used to build water structures including conveyance channels and dams. The Hittites (from 1,800 to 850 BC) practiced irrigation in Central Anatolia. The remains of at least six dams from Hittites were found in Central Anatolia. Among them Koyluotu Dam which has a height of 25-30m and a crest of 900m can be classed as a large dam according to present standards. It is believed that dams served for water supply, some for irrigation some for domestic usage (Ozis 1999). In the 13th century BC, the Urartus irrigated land around the city of Van. They built a 56km long Samran channel which has a capacity of 2-3 cubic meters per second in order to carry fresh water to the city (Belli 1997). Today, this channel is used to irrigate 2,000 hectares of land.

In the Byzantine and Roman era, water storage structures, aqueducts and different conveyance systems were built (Ozis 1999). Among the conveyance systems with a length of 240km the Pinarhisar-Istanbul conveyance system is the largest. Another remarkable system is Magradag-Pergamon which has a length of 195km and also included a lead-pipe inverted siphon under the largest pressure during the Hellenistic period. There are several remains of dams from Roman times. Especially those dams that include Roman concrete are classified as Roman dams. Among them the Cavlik Dam in Southern Anatolia can be distinguished from others by its function. It diverts a creek into a tunnel in order to prevent siltation of the antique harbour of Seleucecia Pieria.

The Seljukides built several impressive bridges in Anatolia, some of which are still in use. Among them the Malabadi Bridges in Batman has a 39m single span, and is believed to be one of largest masonry bridges in the world (Ilter 1978). Although Seljukides built several dams in Iran and in Central Asia, in Anatolia only two dams are found in the Konya region. The reign of

(continued)

Seljukides in Anatolia corresponds to conflicts and wars. That can be taken as the reason why they built many bridges and local water structures, but not big storage facilities. This trend continued during the Ottoman period as well. The Ottomans also built aqueducts, conveyance systems, cisterns, public fountains, but not large storage structures, with only some exceptions in Istanbul. Water supply for the capital city of Istanbul was a crucial question for the Ottomans, as it had been for the previous empires. During the Ottoman Empire, groundwater supplies were not sufficient and transmissions lines were built to divert water from springs to public fountains. Later facilities for water transfer from Lake Terkos in 1869 and Elmali-I Dam were built in 1888. Some of them are still in use (Altinbilek 2006). The first treatment plant was built in 1926 in Istanbul. However, there were no systematic irrigation activities during the Ottoman era. In 1875, a severe drought affected the Konya region. Consequently, the Ottoman government decided to build a diversion weir and irrigation channel. The project, which was named as the Cumra Irrigation and Drainage Project, is the first modern irrigation project in Anatolia being carried out between 1908 and 1914 in Konya (Demir 2001).

Hydropower generation has a much shorter history in Anatolia. In 1902, a small hydroelectric power plant with 60 KW for lighting was established in Tarsus. In 1914, the production and distribution of electricity in Istanbul was started by companies which were founded with the special permission of the Ottoman Sultan. In 1923, at the time of the foundation of the Republic of Turkey, electricity was available only in Istanbul, Izmir and Tarsus with a total installed capacity of 29.7 MW. Usage of electrical energy for purposes other than lighting began after 1930 when industrial development started (Altinbilek 2002).

4 Water use per capita and by sectors

Turkey still has a growing population despite the fact that the pace of population increase has slowed down considerably in the last several decades. While the population of Turkey has steadily grown, the rate of population growth has decreased from 2.52 percent to an annual rate of 1.31 percent.[4] The rise of the population has a two-fold impact:[5] population growth not only increases the demand for food, and thus of water, but also causes the decline of per capita

[4]As of December 31, 2008, http://www.tuik.gov.tr. Accessed 17 November 2009.

[5]A "water stress index" based on the approximate minimum amount of water per person necessary to maintain an adequate quality of life in a moderately arid zone, was developed by M. Falkenmark: "The massive water shortage in Africa: why isn't it being addressed?" Ambio. 18(2):112-18, 1989. The Falkenmark water stress index measures per capita water availability and considers that a per capita water availability of between 1,000 and 1,600 cubic meters indicates water stress, 500–1,000 cubic meters indicates chronic water scarcity, while a per capita

water resources. Due to population growth and urbanisation, water and energy demand is expected to increase as well. According to the DSI statistics, annual per capita water availability is 1,600 cubic meters with population of about 73 million in 2010. By the year 2023 this amount will decline to 1,125 m^3 per capita/year with an expected population of 100 million (DSI 2009).

As of 2009, water use, related to sectors, was as follows: the irrigation sector used 34 BCM/year (74 percent), domestic water 7 BCM/year (15 percent), and industry 5 BCM/year (11 percent). In total, 46 BCM/year (41 percent) of the usable water potential is utilised.

Although *agriculture*'s contribution to the Turkish economy is declining (from 35 percent in 1970 to 8.8 percent in 2008), agriculture is still vital to the national economy employing 30 percent of the country's work force. Crop production on the 5.28 million hectares of irrigated land creates the basis of agricultural exports to European countries and to Near East and North African regions. Export of agricultural and agro-industrial commodities were valued at US$ 4.4 billion and accounted for 16 percent of Turkey's total export value in 2001. According to DSI estimates, 8.5 million hectares of land are technically and economically irrigable and subject to further development. It is expected that the high share of water consumption in agriculture will decline from 74 percent at present to 64 percent in 2023 through the use of modern irrigation techniques. On the other hand, domestic and industrial use would increase to 16 percent and 20 percent in this period, respectively.

Domestic water use accounts for 15 percent of the water resources developed, showing high variations throughout the country. Domestic water use is highest in the Marmara Region, and far below the national average in north-eastern and eastern Anatolia. With more than half of Turkey's population living in urban areas, construction of water supply, sewerage and wastewater treatment plants has received high political attention. Population growth together with high internal migration from rural to urban areas over the last 30 years has caused domestic demand to increase. In urban areas, access to a drinking water supply was 83 percent in 1990 and 81 percent in 2000; in rural areas, it was 72 percent in 1990, and 86 percent in 2000 (Republic of Turkey 2003). In general, 83 percent of the population (urban 94 percent, rural 62 percent) of Turkey has access to improved sanitation. 40.2 percent of the total population is served by wastewater treatment plants. 78.4 percent of the total municipal population is connected to a sewage system. The other municipalities lack a treatment system or have only primary (physical) treatment, or they lack the capacity to operate the established sewage treatment plants.

water availability below 500 cubic meters indicates a country or region beyond the 'water barrier' of manageable capability. See Falkenmark and Widstrand (1992).

Box 2 Inter-basin water transfer projects for "thirsty" Istanbul

Istanbul has been challenged to meet water needs throughout its history. In its early years, water was supplied by groundwater, small springs and cisterns. In the Roman period four long gravity transmission lines were built, and during the Byzantine Empire one BCM storage capacity had been reached. During the reign of Sultan Mehmet the Conquerer (1453 AD), the city's population was estimated at around 100,000. After conquest five new transmission lines and eight dams with a capacity of 1.7 MCM were built. In 1869, a French company constructed necessary structures to bring water from the Terkos Lake to the European side, and another company was founded in 1888 for the Asian part. In 1933 private companies were abolished and water supply was transferred to the Istanbul Water Administration. Later in 1971, DSI prepared the Water Supply Master Plan for Istanbul (DAMOC 1971). In 1981 water and wastewater services were combined under the Istanbul Water Sewerage Administration with the responsibility of planning, construction and operation of water supply, sewage collection and treatment.

Today the population of Istanbul is around 11.5 million of which two thirds live on the European side. However, water sources on the European side dramatically decreased. In the interim, therefore 126 MCM per year is transported from the Asian to the European side by two under-marine pipelines. The 1971 Master Plan for Istanbul's water supply suggested developing eleven water sources, six of which have already been put into service. However, the remaining five could not be implemented due to geological problems, unsuitable water quality and because of low capacities. DSI has started two large water supply projects, namely the Yesilcay and the Greater Melen projects (Altinbilek 2006). The Yesilcay project has been designed to convey water from the Goksu and Canak rivers to Istanbul from Omerli Dam over a distance of 60 km, to meet the medium-term water need of Istanbul. 335 MCM will be supplied annually in order to meet the demand of 1.5 million inhabitants. Total investment of the Yesilcay system is estimated at US$ 271 million. The Greater Melen system which is divided into four stages, will supply 1.18 BCM, and is expected to secure Istanbul's water needs until 2040. Its source is the Melen River which is located 170km east to Istanbul. Raw water will be pumped to a treatment plant via a transmission line, and treated water will be conveyed to a service reservoir via a tunnel and a pipeline under the Bosporus. The first stage of the Melen system (25km tunnel, 180 km transmission line) will provide an additional 268 MCM/year of water to meet the potable and domestic water needs of an additional 2.75 million people. Its total cost is US$ 1,180 million. However, after 2040, no more inland water resources can be developed, and sea water will have to be desalinized.

Box 3 Domestic water crisis in Ankara

Ankara was chosen as the capital city of the new Turkish Republic gaining administrative importance and weight in the region. Since then it has continuously expanded in size and population. Geographically Ankara is situated between two large river basins, i.e. Sakarya to the west and Kizilirmak to the east. Long ago, Ankara itself was the birthplace of several small streams. However during the early planning stage of the city these water systems were not protected. In early 1920s Ankara had 20,000 to 30,000 inhabitants; and when the number climbed up to 300,000, the city faced serious water shortage problems between 1940 and 1950. As a consequence, the Ankara Water Administration was established.

The Ankara Water Administration searched for new water resources from both groundwater and surface water, and three more dams were built. In 1969 the Ankara Water and Wastewater Master Plan was prepared, which provided for the construction of the Camlidere Dam and the Ivedik treatment plant. During the rearrangement of the governance mechanism of large municipalities in the early 1980s Ankara Metropolitan Municipality and Ankara Water and Wastewater Works Administration were established. Two master plans which were commissioned by DSI, i.e. the 1969 Master Plan and the 1995 Master Plan, proposed to implement a system on the Gerede River North West of Ankara to meet future demand. The Kizilirmak River east of Ankara, was also evaluated as a long-term solution. However, the 1969 Master Plan did not consider the Kizilirmak because it contains high levels of salts. By 1995, the required reverse osmosis and other desalinization methods were marketable technologies, so Kizilirmak was fully assessed. The 1995 Master Plan advised Ankara to implement the Gerede system by 2003, and the Kizilirmak system in 2027 (Master Plan 1995).

Nevertheless, the municipality of Ankara did not follow the plan. Between 2006 and 2008 Ankara experienced a serious drought and water levels in the dams were lower than usual. In August 2007, the city had to cut off the water supply. The Municipality started with the Kizilirmak Emergency Plan which would transfer water from the Kesikkopru Dam on the Kizilirmak River to Ankara. The structure was constructed in haste from April 2007 to March 2008, and cannot be considered as a thoroughly planned project, let alone its financing. Water is pumped from the intermediary reservoir of the Kizilirmak system, Kesikkopru, and consists of three adjacent pipelines crossing a distance of 128km. The water travels 100km mainly northwest from Kesikkopru, and then due north 28km where it reaches the Ivedik treatment plant north of Ankara. According to the Master Plan another treatment plant should be constructed south or east of Ankara rather than north (where Ivedik is located). The total length of the transmission will then extend from 85km to 128km in order to reach the treatment plant. Costs will increase the overall project costs are estimated in the order of 572 million new Turkish Liras.

The percentage of water use in *industry* has not changed considerably over the past few years, being slightly over 11 percent (52 percent from surface water, 48 percent from groundwater). The major water consuming industries are steel, chemical, paper manufacturing, petroleum refining and agro-industry. In 2000, the greatest industrial demand came from the highly industrialised Marmara Region. Other industrial centres developing in the context of GAP will not change the overall percentage of industrial water use, and will only change the regional distribution.

The *annual per capita energy consumption*, which is at present far below the world average, is expected to increase from 1,840 kWh (1999) to 6,794 kWh (2020). To achieve this growth rate and reach energy consumption levels of the OECD countries, huge investments are envisaged (Altinbilek, no year). Currently, Turkey has 172 *hydroelectric power plants* in operation with a total installed capacity of 13,700 MW generating an average of 48,000 GWh/year, which is 35 percent of the economically viable hydroelectric potential. Annual energy consumption per capita in Turkey has reached 2,900 kWh which is above the world average of 2,500 kWh. The average energy consumption for the developed countries is 8,900 kWh, but it varies from 12,322 kWh in the USA to 827 kWh in China. Annual increase in energy consumption is 8-10 percent in Turkey except for the recession years (DSI 2009). In the 1970s Turkey was seriously hit by the energy (oil) crises and after 1997 became an importer of electricity. At present, hydropower provides about 40 percent of the total power generated, but there is more additional potential. The hydropower share is expected to increase in particular through the construction of power plants on the Euphrates and Tigris (see Sen in this volume).

Based on these overall water use and energy projections, Turkey considers herself not to be a water rich country. With 1,600 m^3 per capita per year (2008) and an expected decline to 1,125 m^3 in 2023, Turkey is moving from a relatively water-endowed country to one where water availability will reach critical levels. This projection explains why DSI argues in response to the World Commission on Dams' Final Report that: "dam construction is a vital and unavoidable programme for the country. [. . .] while the countries being in the leading positions of the [WCD] process have developed their water resources with about the level of 100 percent, the prejudiced findings of the report may probably prevent the water resources development projects planned by the developing countries, such as India, Turkey, with the development level of 30 percent, and China." (DSI 2001) Turkey, having developed only about 30 percent of her water potential would be in dire need of producing and providing cheap energy, and improving the living standard of her citizens by providing adequate water (DSI 2001).

While Turkey's major focus is on continuing water resource development because of their economic and social potential, protection of water-based ecosystems in rivers, lakes and deltas, and water pollution control is increasingly acknowledged, but has yet to reach satisfactory levels (Ministry of Environment 1998; Republic of Turkey 2003). However, both Turkey's National Environmental Action Plan and the Ninth Five Year Development Plan give top priority to these issues (State Planning Organisation 2007).

5 Strategic role of the Euphrates and Tigris rivers system: South-eastern Anatolia Project (GAP)

While Turkey intends to develop water resources all over the country, GAP is of particular importance for generating hydropower and producing agricultural commodities. Futhermore, 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, 600,000 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 percent; 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 (Kibaroglu 2002, see also Box 4).

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.

Although there are visible economic and social achievements,[6] 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 (the latter issue will be discussed in Part II).

Box 4 The South-eastern Anatolia Project (GAP) in brief

The GAP project area lies in south-eastern Turkey, covering nine provinces, corresponding to approximately 10 percent of Turkey's total population. The project area includes the watersheds of the lower Euphrates and Tigris rivers

(continued)

[6] See the evaluation of the actual impacts of the Ataturk Dam by Tortajada (2000).

and the upper Mesopotamian plains. Its centrepiece is the Ataturk Dam, which was completed at the beginning of the 1990s, with a total storage capacity of 48.7 BCM, and an installed electricity-generating capacity of 2,400 MW. There are 13 large sub-projects altogether, seven of which are on the Euphrates River[7] and six on the Tigris.[8] Major works are the Sanliurfa Tunnels, the Birecik and Karkamis dams on the Euphrates and the Ilisu and Cizre dams on the Tigris.

GAP's aim is to increase the irrigated land from 2.9 percent to 22.8 percent of the total area of the region, which subsequently would lead to a decrease of rain-fed agriculture from 34.3 to 10.7 percent. With the irrigation systems envisaged, Turkey is determined to develop agriculture and agro-industrial production for export and to raise the standard of living in the region, in that way also stopping migration from the region to metropolitan cities. To achieve these ambitious goals would require putting 100,000 hectares into production in the Euphrates basin each year beginning in 1993, and another 60,000 hectares per year in the Tigris basin (Unver et al. 2003).

Due to high investment cost, GAP is considered to be a very costly project: US$ 32 billion is the estimated total cost of which US$ 16 billion have been spent so far. Due to the transboundary flows involved, the Turkish Government was not able to secure international finance, an exception being German and Swiss credits which could be obtained for purchasing equipment. The severe economic and budgetary crisis in Turkey along with, for example, the slow pace of land redistribution caused a considerable delay in implementing the projects. Despite these drawbacks, Turkey is persistently pursuing its plans to harness the Euphrates and Tigris rivers. As of June 2008, some 272,972 hectares have been brought under irrigation. As of 2008, out of 22 dams 13 are operating, and out of 19 hydropower plants 9 are completed and in operation.

6 Conclusion

This chapter has aimed at introducing the political geography of water in Turkey, by highlighting the physical (climate, water, land resources) conditions and the political economic framework. Turkey is situated in a semi-arid climatic zone, with a limited amount of freshwater resources. Water demanding sectors have increased and diversified, such as environment, tourism, industry along with the traditional ones like agriculture and domestic uses. Nearly one third of the (surface) freshwater

[7]The Lower Euphrates Project includes the Ataturk Dam, the Sanliurfa Tunnels and five more sub-projects, i.e. Karakaya, Euphrates Border, Suruç-Baziki, Kahta-Adiyaman, Gaziantep, Gaziantep-Araban.

[8]Tigris, Kralkizi, Batman, Batman-Silvan, Garzan, Ilisu, and Cizre.

resources in the country are transboundary, which plays a decisive role in water policy and management. Water and land resources development had played a key role in consolidating the Turkish State during the early decades of the Republic. State-led economic planning and investment culminated in massive infrastructure (dams and irrigation systems) development since the late 1960s. Results and impacts of water-based regional socio-economic development manifest themselves in the GAP, which aims at harnessing the waters of the Euphrates-Tigris rivers system for "sustainable human development." Liberalization of the Turkish economy since the early 1980s enabled the involvement of the private sector in water resources development and management. Hence, water policy discourse and practice in modern Turkey can only be properly understood with due consideration of the macroeconomic context.

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