

SUSTAINABLE DEVELOPMENT OF WATER RESOURCES IN TURKEY

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ABSTRACT

Sustainable development of water is considerably important as in all of the world, also in Turkey. Turkey is a water shortage country. According to datas of State Hydraulic Works of Turkey for 2005, all usable surface and groundwater supplies of Turkey is total of 112 billion m³ including 98 billion m³ surface waters and 14 billion m³ groundwaters. Precipitation regime of Turkey differs according to seasons and regions, annual mean precipitation is 643 mm. In 2020, Turkey's population will be reached 87 million and Turkey will be water-stressed country with per capita 1100 m³ usable water supplies. The paper analyzes the current situation and problems of water resources in rural areas in Turkey. Countermeasures to solve the problems are considered.

Keywords: Water resources, surface potential, groundwater potential.

1 INTRODUCTION

As a natural resources and component of the biosphere, water is a decisive life providing and environment conserving factor on earth. The exponential growth of the human population in the twentieth century was not the only force driving demand for water, for per capita consumption has grown even faster than human populations in most parts of the world (Dellapenna 1997; La Rivière 1989; United Nations Commission on Sustainable Development 1997). In recent years, due to the rapid development of economy and the concentration of population, more and more water is needed. Water shortage has seriously hindered the development of economy and brought a lot of inconvenience to people's life.

Economic developments, including increased irrigation for agricultural production, and high population growth rates have increased the industrial and domestic demand for water. These developments not only increase the demand for water but also threaten the existence and quality of water resources. Regarding surface waters, Turkey is geographically divided into 25 water basins. There are 200 natural lakes covering an area of about 1 million hectares. The total annual groundwater supply is 41 billion cubic metres, of which 12 billion cubic metres could be exploited. Currently 8 billion cubic metres are being exploited, of which 55 percent is used for irrigation and 45 percent for drinking and industrial purposes (Okumuş, 2002).

2 DISCREPTION OF STUDY AREA

Turkey extends for almost 1650 km from west to east. It lies between 36 ° N and 42 ° N latitudes and between 26 ° E and 45 ° E longitudes. A small part of the country is geographically located in Europe, Thrace. The rest of the country, Anatolia or Asia Minor, is in Asia.

Turkey, with a total area of 780.000 km², 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 (Fig. 1). The total length of border and coastline is 10.765 kilometers, of which 7.816 kilometers are coastlines.



Figure 1. Map of Turkey (DSI, 2009).

The climate of Turkey is semi-arid with some extremities in temperature. Climate and precipitation figures exhibit great variance throughout the country: in the higher interior Anatolian Plateau, winters are cold with late springs, while the surrounding coastal fringes enjoy the very mild-featured Mediterranean Climate. Average annual precipitation is 643 mm, ranging from 250 mm in the Central Anatolia, to over 2500 mm in the coastal area of north-eastern Black Sea. Approximately, 70% of the total precipitation falls during the period between October and April, and there is a little rainfall during summer months.

Three types of rainfall are observed in Turkey: the convective rainfall in Central Anatolia during spring and summer months, the frontal rainfall in all regions, mainly in winter and spring months, and the orographic rainfall on the seaward slopes of the Black Sea and the Mediterranean Sea.

3 WATER RESOURCES IN TURKEY

There are 25 hydrological basins in Turkey (Fig. 2). The rivers often have irregular regimes. Turkey's longest rivers, the Kizilirmak, the Yesilirmak and the Sakarya, flow into the Black Sea. The Dicle and Firat Rivers originate in Eastern Anatolia and flow south into the Persian Gulf. The 25 hydrological basins in Turkey have a total surface water run-off of 193 billion m³/year. 31% of the potential is constituted by the Euphrates (Firat) and the Tigris (Dicle) rivers both of which have their sources in the eastern part of the country (DSI, 2009).

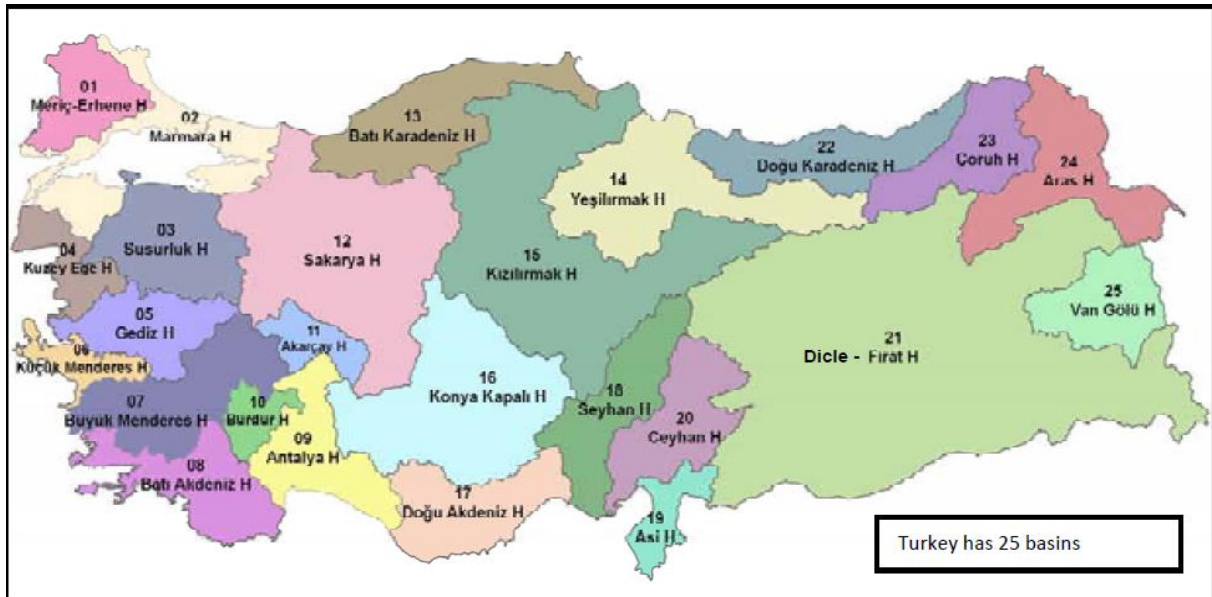


Figure 2. Hydrological basins in Turkey (DSI, 2009).

The total annual groundwater supply is 41 billion cubic metres, of which 12 billion cubic metres could be exploited. Currently 8 billion cubic metres are being exploited, of which 55 percent is used for irrigation and 45 percent for drinking and industrial purposes.

A water budget was calculated from the data of the years between 1935 and 2008 by State Hydraulic Works of Turkey (Fig. 3). Considering the average surface water run-off which is 186 billion m^3 /year with the surface runoff of 7 billion m^3 /year coming from neighboring countries, the total surface run-off within the country reaches to the amount of 193 billion m^3 /year. On the other hand, the average amount of ground-water leakage is 41 billion m^3 /year. However, not all the renewable water resources can be utilized because of economic and technical reasons. Exploitable portions of surface run-off including in flow from bordering countries and groundwater are 98 and 14 billion m^3 /year, respectively. Thus, the total of economically exploitable water resources potential amount to 112 billion m^3 /year (DSI, 2009).

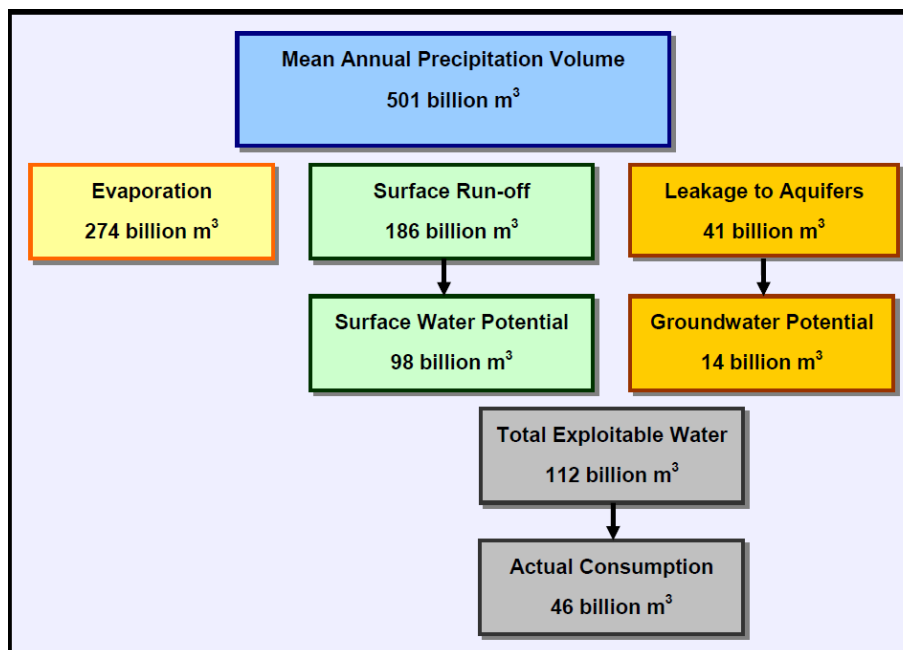


Figure 3. Annual water budget in Turkey between 1935 and 2008 (DSI, 2009).

4 WATER PROBLEMS IN TURKEY

Taking into consideration the population of 2007 which is 70,6 million, the quantity of water per capita per year is 1,586 m³ (DSI, 2009). Countries regarded as being rich in water resources have 8-10 thousand m³ water per capita per year. The available water per capita per year in Turkey is about 1/5 of the water-rich countries. It should be noted that Turkey, contrary to the prevailing belief, is not a water-rich country. Furthermore Turkey is not the richest country of the region in terms of water resources. The available water per capita in Turkey is less than the world average. Furthermore, it is estimated by the experts that, in 2023, the amount of available water will likely to be less than 1000 m³/capita/year.

In 1996 total water consumption was 34 billion cubic metres. It is calculated that 95.20 percent of the municipal population (2,113 municipalities) is served by a drinking water network, 2.45 percent (312 municipalities) by supply water from wells, 1.67 percent (333 municipalities) by water from public fountains and 0.65 percent (232 municipalities) by water from natural springs (Okumuş, 2002).

Annual consumption of drinking water was almost 74 cubic metres per capita when the Europe average was about 100 cubic metres. Water consumption increased 8 percent between 1980 and 1997. Among rural residents, 62 percent of have access to safe drinking water and nearly 70 percent of the urban population is connected to safe drinking water. It is significant that 50 percent of the total drinking water potential is lost in the supply networks. The population of Turkey is expected to reach 87 million in 2020 and the total capacity of consumable water resources per capita is foreseen as 1,042 cubic metres per year. It was estimated that a drinking water network served 91.34 percent of the municipal population, i.e. 69.60 percent of the total population, in 1996. In terms of drinking water treatment plants, those ratios are 31.93 and 24.33 percent respectively. According to the same evaluation, 71.82 percent of the municipal population, i.e. 54.73 percent of the total population is connected to sewerage; 13.78 percent of the municipal population, i.e. 10.50 percent of the total population, is connected to a wastewater plant (Okumuş, 2002).

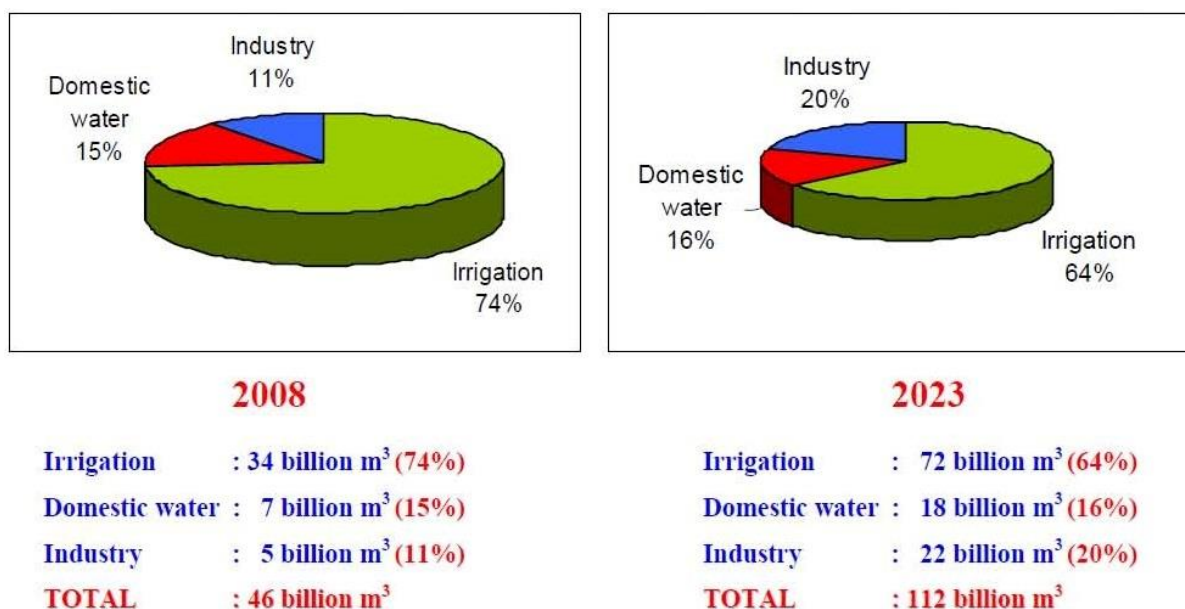


Figure 4. Water consumption in 2008 and projection for 2023 (DSI, 2009).

5 THE SUSTAINABLE DEVELOPMENT AND UTILIZATION OF WATER RESOURCES

Water shortages are divided into four types: resource-based water, pollution-based water, waste-based water, developing-based water (MaPingSheng, Yan hua and YangXian-wei, 2009). Five measures can be taken to overcome water crisis: economic measures, engineering measures, technical measures, administrative measures and legal measures (Ning Ling-ling, 2010). There are a lot of reasons of water shortage of urban and rural areas.

For sustainable development, water pollution control, water consumption control, water reuse, water saving propoganda, reservoir projects are important factors. In Turkey, especially in mega cities such as Istanbul, Ankara and Izmir, industrial development has continued and that effects water resources. Not only industrial factors but also wastes have polluted groundwaters and surface waters. For example, there is a project about transporting water from Bolu (Melen Basin) to İstanbul and that is a serious problem for İstanbul. Because water in Melen Basin is polluted by medical wastes. So legal measures can be taken for water pollution control. So much water is used up for domestic water and industry and water consumption control should be made. Water reuse is an economic measure for sustainable development of water. Because reusing water can decrease water price and wastewater reuse can reduce pollution and relieve stress of water supply. Also for saving water, water propogandas are important. Televisions, posters, radio and others are taken to propogandize water protection laws for people, especially for the villagers. With improving irrigation should be made technical measures for overcome water crisis. As connection to seasons and inter-annual variability in rains, reservoir projects can be made carefully. All of preventions and measures can provide sustainable development of water.

6 RESULTS AND DISCUSSIONS

Water resources in Turkey have decreased and for sustainable development of water resources must be taken preventions. In 2020, Turkey's population will be reached 87 million and Turkey will be water-stressed country with per capita 1100 m³ usable water supplies. In first, water resources must be save and must be provided water consumption control. In Turkey, most important factor for sustainable development is exceeded water consumption and isn't be controlled water reservoirs as connection to seasons. For saving water resources, people should be educated by experts. Because if people learns how does water use, they can be controlled water resources. On the other hand for using water effectively, water should be managed truly. Especially, some projects about water such as Melen Basin should be reconsidered. Because water pollution problem is another important factor for mega cities and water is so important for all organisms.

7 CONCLUSIONS

Water is the source of life and anyone can't survive without water. Water resources have affected human survival and development in both urban and rural areas. To solve water shortage in Turkey, people must save water, prevent and control water pollution, develop new water resources and strengthen water resource management. People should live in harmony with water resources and environment, respect the nature rules, improve effectively water supply-demand balance, solve water crisis and realize water sustainable development.

ABBREVIATIONS

DSI State Hydraulic Works

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