

## AGRICULTURAL WATER MANAGEMENT IN TURKEY: PAST-PRESENT-FUTURE

Zeki Gökalp\*, Belgin Çakmak\*\*

\* Erciyes University Agricultural Faculty, Biosystems Engineering Department, Kayseri, Turkey

E-mail: [zgokalp@erciyes.edu.tr](mailto:zgokalp@erciyes.edu.tr)

\*\* Ankara University Agricultural Faculty, Agricultural Structures and Irrigation Department, Ankara, Turkey

### **Abstract**

*Water is an essential element in ensuring food safety. It is not possible to obtain food without water. The importance of water is gradually increased and nowadays raised to the top ranks among strategic resources. The use and increasing environmental threats by different sectors are increasingly limited available water resources. In the past years water was seen as an abundant and unlimited resource, and was used randomly. However today, global warming and drought have brought the importance of the water agenda, and has taken on a particular importance to the management of water resources. Therefore, one of the most important goals of agricultural water management is to ensure the efficient use of water by preventing water waste. Water management has quite a wide range of services included necessary activities in order to develop, distribute and use of water resources. Today this point of agricultural water management is to search the ways of saving water and put into practice. In the future such techniques virtual water use, water footprint of products will come to the fore in order to provide water saving in water management. In this study, the past, present and future of water management in agriculture are discussed and given suggestions.*

*Keywords: Water management, agriculture, irrigation*

### **1. INTRODUCTION**

Water is not only the indispensable part of human life, but also an essential component of agricultural activities. Majority of world food demand is met by irrigated fields. Production of plants and animal products are totally depending on water. Therefore, water use in agriculture is the key issue for food security of the world. Food safety is to provide sustainability of production of healthy and secure foods with physical, chemical, biological and hygienic controls in every step of production processes from field to tables.

Water resources management is defined as planned development, distribution and use of water resources. Initially, current potential should be assessed for water resource development. Therefore, type, location, quantity and quality of the resources should initially be determined. Beside management, preservation, pollution prevention and water saving are the other significant issues of water resources management (Çakmak, 2012).

In Turkey, agriculture is the greatest water consuming sector (with about 73%). Turkey is geographically located within the focus of the world and Middle Eastern countries. Water is the most critical issue of the world agenda in 2010s. The first international meeting pointing out the significance of world was the Conference on Environment and Development so called "Earth Summit" held in Rio on 3-14 June 1992 with the participation of 17 thousand people from 178

countries. At the end of this meeting, an action plant so called “Agenda 21” was accepted. The plant includes some measures to be taken for a reliable balance between water and environment. Then, “World Water Day” was accepted to be held in 22nd of every March.

To draw the attentions to water, UN Human and Environment Conference was held in Stockholm in 1972, UN Water Conference in Mar del Plata in 1977, UN Development Program Symposium: Capacity Building in Water Sector in in Delf in 1991, Water and Environment International Conference in Dublin in 1992 and UN Environment and Development Conference in 1992. Then, world water council was established in 1995. Since then, the council organizes World Water Forums in every three years. The first one was held in Marrakesh, Morocco in 1997.

With the 7 World Water Forums held up to now, significance of water was pointed out and water was placed among strategic resources. The basic target of agricultural water management is to prevent water wastages ad losses. Sensitivity of surface and groundwaters resources to environmental impacts, ever-complexing agricultural, domestic and industrial demands are the significant issues of agricultural water management. Since water management had a wide range service network, it is related to several disciplines. Recent droughts and environmental problems together with global warming and climate change exerted a special emphasis on water resources management. In this study, past, present and future of agricultural water management were assessed and recommendation were provides for potential drawbacks in water management.

## 2. AGRICULTURAL WATER USE IN TURKEY

Annual average precipitation of Turkey is 642.6 mm and such amount corresponds to a water resource of 501 billion m<sup>3</sup>. Technically and economically available water resources are 112 billion m<sup>3</sup>. Of this amount, 95 billion m<sup>3</sup> originated from national rivers, 3 billion m<sup>3</sup> is originated from foreign rivers and 14 billion m<sup>3</sup> is supplied from groundwaters. Turkey has 28.05 million ha agricultural land area and about 25 billion ha of it has irrigable characteristics. With the current water potential, Turkey is able to irrigate only 8.5 billion ha of this irrigable land resource.

According to Turkish State Hydraulic Works (DSI), Turkey is currently using 44 billion m<sup>3</sup> of its available water resources. Such a quantity corresponds about 40% of 112 billion m<sup>3</sup>. About 74% of currently utilized capacity is allocated to agriculture. Surface irrigations are still common is Turkey and these methods have quite low irrigation water use efficiencies and thus have quite high water losses.

Nowadays, pressurized piped systems have been used in irrigation networks to prevent water losses and to improve water use efficiencies. Piped irrigation networks ratio will increase with recent irrigation projects from 14% to 55%. Current irrigation networks re composed of 44% classical canal (paved open canal), 42% canalatte and 14% piped systems. Use of piped networks instead of open canals in water conveyance and distribution will significantly prevent water losses and ultimately will provide significant water savings.

In Turkey, it is foreseen that all of 8.5 million ha irrigable land resource of the country will be opened for irrigation by the year 2023. The target with modern irrigation techniques is to reduce the water consumption levels in irrigation to 65%. In this way, 72 billion m<sup>3</sup> water will be used in agriculture (Figure 1). Current population increase ratio of Turkey is 2% and the population is projected to be 100 million by the year 2023 (DSI, 2014).

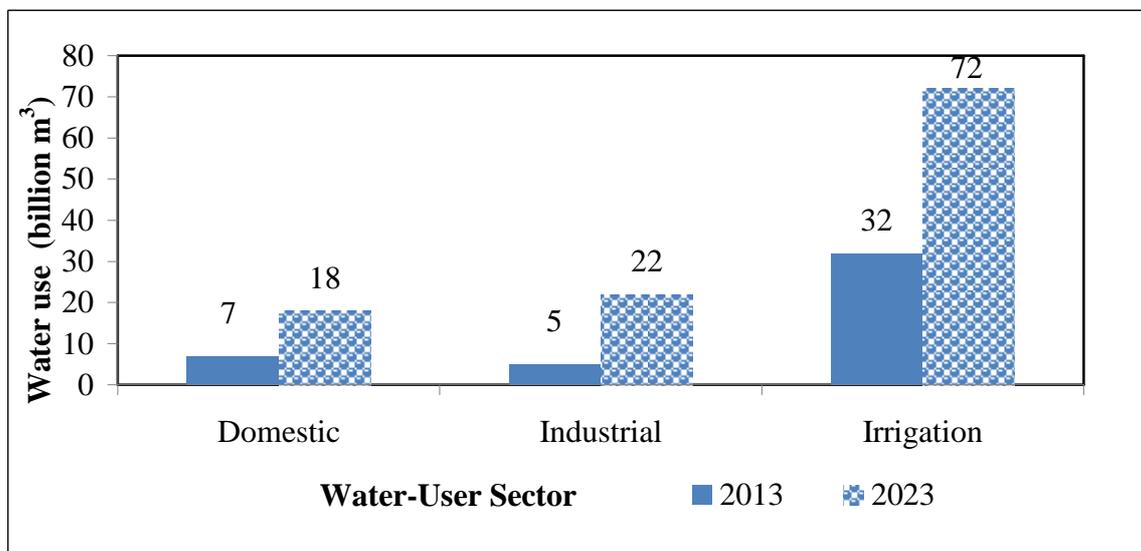


Figure 1. Water use in different sectors

World Wildlife Fund (WWF) recommend several countries to change their water use policies in agriculture, to adapt integrated watershed management based on water demands, to support modern and water-saving irrigation techniques and to prevent illegal water uses (WWF, 2014). According to WWF, maize, cotton, sugar beet-like hydrophilic plants are cultivated in Mediterranean countries and those crops are also supported by European countries, and water resources are significantly distorted in some countries with flooding irrigation. Widespread of sprinkler and drip irrigation systems will greatly enhance water use efficiencies and reduce water use and losses in irrigation. Such methods will also provide great contributions to sustainability of both water resources and agricultural activities (Aküzüm et al 2010a; Aküzüm et al., 2010b).

Annual renewable fresh water resource is the most significant indicator of the sufficiency of water resources in a country. Countries are classified in three categories based on their available fresh water resources: “Water-poor” countries with annual water consumption per capita of less than 1000 m<sup>3</sup>; the countries experiencing “water-deficits” with annual water consumption per capita of between 1000-3000 m<sup>3</sup>; “water-rich” countries with annual water consumption per capita of over 10000 m<sup>3</sup>. Turkey is not a water-rich country. While the fresh water resource per capita was 1652 m<sup>3</sup> in the year 2000, the value decreased to 1422 m<sup>3</sup> by the end of 2015 with a population of 78.5 million. The population is expected to be 100 million by the year 2030, thus the water resource per capita will then decrease to 1120 m<sup>3</sup>/year by the year 2030. Therefore, Turkey will experience great water problems in future years.

### 3. LEGAL AND INSTITUTIONAL FRAMEWORK IN WATER MANAGEMENT

An integrated water management approach should be adapted in Turkey to meet the current and future demands and to provide water safety and sustainability. The base of integrated management lies under accepting water both as a natural resource and a commodity with various uses based on the quantity and quality. The services for water resources management, use, distribution and preservation in Turkey are implemented by several state institutions and organizations (Table 1). Administrative boundaries, land uses and institutional authorities are all specified by relevant laws and regulations. Sometimes, administration is shared by more than organization and these organizations act along with their authorities. They are organized in a hierarchical structure from the center to rural.

**Table 1. Organizations responsible for water resources management (Çakmak et al., 2013)**

Organization	Area of responsibility
<b>Ministry of Forestry and Water Affairs</b>	
General Directorate of DSİ	Water collection, Conveyance investments, water allocation (domestic, industrial, agricultural), Groundwaters, flood control.
General Directorate of Water Management	Policy development for water resources preservation, improvement, use, National and international coordination in water management, River basin management plans, Flood management plans, National water database, Sectoral coordination for water resource allocation.
<b>Ministry of Food, Agriculture and Livestock</b>	
General Directorate of Agricultural Reforms	Irrigation Land consolidation and in-land services
<b>Ministry of Health</b>	
Turkish Public Health Organization (Ankara Directorate of Public Health Laboratory)	Physical, chemical and bacteriological analyses of waters and relevant measures to be taken for contagious diseases.
<b>Ministry of Energy and Natural Resources</b>	
General Directorate of Renewable Energy	Hydraulic, wind, geothermal, solar, biomass and other renewable energy resources
<b>Ministry of Environment and Urbanization</b>	
General Directorate of Environmental Management	Procedures and principles about Surface, ground water and soil preservation, pollution prevention.
The Bank of Provinces	Financing the investments for domestic water supply, sewage and water treatment for municipalities.
<b>Ministry of Interior</b>	
General Directorate of Local Administrations	Village water supplies and small water supplies Village infrastructure Supports Project (KÖYDES)
<b>Special Administrations, Associations and Villages Department, Municipal Services Department</b>	Irrigation Investments for domestic water supply, distribution, collection Preservation of agricultural and water basins.

#### 4. WATER MANAGEMENT AND ITS FUTURE ALONG WITH EU ACCESSION PERIOD

Efficient use and preservation of water resources have been pointed out along with the EU accession process of Turkey since the year 2000. During this accession period, implementation of Water Framework Directive (WFD) has been accelerated. WFD is the main document of EU water regulation and aims the pollution prevention in surface waters, shore waters and groundwaters over EU grounds. Majority of water management laws and regulations of Turkey is quite old-dated and separated in various laws. There aren't any comprehensive single water laws. A framework water law was drafted, but hasn't been put into effect, yet. This law was tried to comply with EU Water Framework Directive. The Directive targets the following implementations (Kibaroglu et al., 2008):

- a) Integrated preservation of above and underground waters,
- b) Bringing water to "well-state" by the year 2015,
- c) Integrated river basin management,
- d) Together assessment of water quality standards and emission control and removal of primary hazardous substances,

- e) Proper water pricing as to have rational water use,
- f) Participation of all stakeholders and citizens in water management.

The EU aims an integrated water management and foresees cooperation among different organizations. Turkey should initially implement relevant institutional and legal legislations to meet EU targets and requirements (Aküzüm et al., 2010b). These legislations include coordination and cooperation among state institutions, definition and delegation of responsibility and authorities in regional scale, water resource and user-oriented integrated water management, information share and dissipation, public consultancy and stakeholder participation, economic supports and measures (Çakmak and Gökalp, 2013a; 2013b).

Efficient water use comes to forefront along with the EU accession process of Turkey. Therefore, virtual water and water footprint works have started to be implemented for the first time in Turkey. Varying amount of water is used in production processes of goods and commodities (agricultural, industrial). In places where the goods are consumed, the water used in production of that good is also assumed to be consumed and this assumption is defined as virtual water (Hoekstra and Hung, 2002; Hoekstra, 2013). In places with water deficits, food imports can be done for virtual water transfer and to eliminate water deficits. Water footprint is defined as the amount of water directly and indirectly consumed ( $m^3$ ) for the production of per unit good. The water footprint of every agricultural commodity is different in every country. It is generally lower in developed countries. In other words, less water used in developed countries for the production of unit agricultural commodity. Water footprint can guide planners, investors and decision makers about water management (Çakmak and Gökalp, 2014; 2015)

## 5. CONCLUSIONS AND RECOMMENDATIONS

Prevention of water losses, efficient water use and water-saving technologies are getting prominent in water user sectors of the 21st century. Ever-increasing populations exert a great pressure over constant water resources. These limited, wasted and polluted water resources then exert serious threats for all living organisms. Therefore, significance of fresh water resources should be pointed out in every platforms and awareness should be raised in public. Besides awareness, consumptive habits of the people should also be changed and water savings should be encouraged.

Since it is hard to carry water, direct commerce of it is also quite hard business. Therefore, virtual water was brought to agendas to make the commerce of water easier. Countries with insufficient water resources may import the goods which they cannot produce of produce with high costs. Water-poor countries can secure their water resources with virtual water trade.

Current global warming and climate change and resultant droughts and desertification have also great impacts on water resources of Turkey. Therefore, water-saving technologies should be implemented, physical infrastructure problems should be solved and alternative water resources should be developed to reduce water footprint in agriculture. Water management should be so implemented as to reduce water footprint. In this way, both an efficient water use will be provided and more goods and services will be supplied.

## 6. REFERENCES

- Aküzüm, A., Selenay, F., Çakmak, B. (2010a). Sulama Yönetimi ve Sürdürülebilir Su Kullanımı. 1. Sulama ve Tarımsal Yapılar Yapılar Sempozyumu 27-29 Mayıs 2010. Kahramanmaraş Sütçüimam Üniversitesi Ziraat Fakültesi Tarımsal Yapılar ve Sulama Bölümü. Cilt:1 s. 262-278 , K.Maraş.
- Aküzüm, A., Çakmak, B., Gökalp, Z. (2010b). Türkiye’de Su Kaynakları Yönetimi ve Değerlendirilmesi. Tarım Bilimleri Araştırma Dergisi 3 (1), 67-74.
- Çakmak, B. (2012). Türkiye’de Su Kaynakları Yönetimi. Köy Kahvesi Dergisi.Yıl:2, sayı:15 Eylül-Ekim, s.36-39, İzmir.

- Çakmak, B., Gökalp, Z., Kendirli, B. (2013). Sürdürülebilir Tarımsal Su Yönetimi. 3.Uluslararası Bursa Su Kongresi ve Sergisi, Merinos Kültür Merkezi, Cilt:1, s.110-118, Bursa.
- Çakmak, B., Gökalp, Z. (2013a). Tarımda Su Kullanımı ve Su Tasarruf Teknikleri. 3. Ulusal Toprak ve Su Kaynakları Kongresi, 22-24 Ekim, Tokat:733-741.
- Çakmak, B., Gökalp, Z. (2013b). Kuraklık ve Tarımsal Su Yönetimi. Gaziosmanpaşa Üniversitesi Fen Bilimleri Enstitüsü Gaziosmanpaşa Bilimsel Araştırma Dergisi Fen Sayı: 4, Yıl: 2013, s.1-11.
- Çakmak, B., Gökalp, Z. (2014). Agricultural water use in turkey and water footprint. International Agriculture Congress 2014 September 2-6.The University of South-East Europe. Lumina, Romanya.
- Çakmak, B., Gökalp, Z. (2015). Agricultural water management in Turkey and concept of virtual water. 50<sup>th</sup> Croatia & 10<sup>th</sup> International Semposium on Agriculture, 16-20 February, Opatija, Croatia.
- DSİ, (2014). Devlet Su İşleri Genel Müdürlüğü 2014 Yılı Faaliyet Raporu. Orman ve Su İşleri Bakanlığı DSİ Genel Müdürlüğü. 303s. Ankara.
- Hoekstra, A.Y., Hung, P.Q. (2002). Virtual Water Trade: A Quantification of Virtual Water Flows Between Nations in Relation to International Crop Trade, Value of Water Research Report Series No: 11, UNESCO-IHE, Delft, The Netherland, pages 116.
- Hoekstra, A.Y. (2003). Virtual water trade Proceedings of the International Expert Meeting on Virtual Water Trade, IHE Delft Value of Water Research Report Series No. 12, 248p. The Netherlands.
- Hoekstra, A.Y. (2008). Chapagain AK. *Globalization of Water:Sharing the Planet's Freshwater Resources*. Oxford:Blackwell Publishing.
- Kıbaroğlu, A., Sümer, V., Kaplan, Ö., Sağsen, I. (2008). Türkiye'nin Su Kaynakları Politikasına Kapsamlı Bir Bakış: Avrupa Birliği Su Çerçeve Direktifi ve İspanya Örneği. . TMMOB İnşaat Mühendisleri Odası 2. Su Politikaları Kongresi. s.184-194. Ankara.
- WWF (2014). Türkiye'nin Su Ayak İzi Raporu Su, Üretim ve Uluslararası Ticaret İlişkisi. 72s. Ankara.