WATER MANAGEMENT AND WATER USE STRATEGIES IN TURKEY

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Abstract

Water is a renewable but limited natural resource. Each drop should effectively be used to meet the water and food demands of ever-increasing populations. Agriculture is the largest water-consuming sector and the main target is to provide efficient water use and reduce the amount of water use in agriculture. Environmental impacts on water resources and ever-increasing water demands of domestic, industrial and agricultural sectors have made the water management a complex and a difficult issue. Therefore, water-saving modern irrigation technologies should be used, waste water should be re-used, deficit irrigations and water-harvesting practices should be implemented to provide efficient water use and water saving. In the present study, water management and water use strategies of Turkey were discussed along with the accession process of Turkey to European Union and recommendation were provided for effective water management and use.

Key words: Agriculture, efficient water use, water management, water saving.

Water is a basic and indispensable component of human life. It is a renewable but a limited natural resource. Secure water supply for ever-increasing populations is the most significant problem of world nations. Available water resources are getting limited in one hand day by day, the demand of water-using sectors are also continuously increasing every day. Thus, water resources management now is the key issue to meet the increasing demands with limited resources. Therefore, countries develop their own water-use strategies based on their current conditions.

Total annual precipitation of Turkey is 642.6 mm and such an amount corresponds to 501 billion m^3 water. Technically and economically available surface and ground water resources are 112 billion m^3. Of 28.05 million hectare agricultural lands of Turkey, 25.75 million hectare is irrigable. But considering the technical and economic conditions together with currently available water resources, only 8.5 million hectare of this sum is considered as irrigable. Today, about 5.61 million hectare land area have opened for irrigation and entire 8.5 million hectare is planned to be opened for irrigation by the year 2023. Turkey uses only 44 billion m^3 of currently available 112 billion m^3 resources and entire amount is planned to be used again by the year 2023 (Aküzüm T. et al. 2010).

Water-use strategies should be developed in water management practices of the country to meet the ever-increasing demands of different sectors. Water-saving technologies have a special place in these strategies. Currently in Turkey, agricultural water demands are sufficiently met by current resources but the yields and productions per volume of water are really at low levels. Excessive water is used in irrigations just because of insufficient irrigation infrastructure. Almost 50% of diverted water is lost along the way to the fields. Water deficit and water-related problems are at the door if the urgent measures are not taken soon to prevent such loses. Pressurized pipe systems instead of open canal systems, deficit irrigation, re-use of treated waste waters and similar measures should be taken to save water in agriculture. In present study, water management practices of Turkey were summarized and current water-use strategies were discussed.

INSTITUTIONAL AND LEGAL FRAMEWORK OF WATER MANAGEMENT

Water management is defined as planned development, distribution and use of water resources. Water resources policies of Turkey are created by taking economic and social development and water-food security priorities of the country, EU full membership negotiations and regional developments into consideration. Such policies are updated continuously based on changing conditions (SUEN, 2013). Turkish water

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management policies have been reconstructed along with the Turkish accession process of European Union. Policies are mainly based on integrated water management. Such management practices take into consideration the meeting current and future demands, providing food security, management of water resources based on not only physical but also social, economic and environmental factors. In integrated management, water is considered as both a natural resource and a commodity used based on quality and quantity.

In Turkey, state is responsible for water management, preservation and use and serve for various purposes and such services are provided as the public services of the State for citizens. Water-use and preservation activities are managed by different institutions and organizations of the state. In water management of Turkey, Administrative borders (province, town, village, municipality etc.), land utilizations (agricultural, forest etc.) and institutional responsibilities are set by the laws and regulations. Therefore, management is most of the time shared by more than one institution and organizations and turned into a partitioned fashion. Each institution or organization performs own tasks along with their responsibilities. They all work in a hierarchical structure created from the central authority to local authority.

Within Turkish accession process to EU, Turkey should create Framework Water Law between the years 2009-2013 along with the directives issued in EU Water Framework Directive (WFD). Ministries of Foreign Affairs, Energy and Natural Resources, Environment and Urbanization carry out technical works for Water Framework Directive. Water-related laws of Turkey are really old and scattered within various laws. There isn't any integrated water laws. Various attempts were made recently but none has been competed or finalized, yet. But in any case, an integrated law will be issued to comply with the WFD of European Union (Dalkılıç and Harmancıoğlu, 2008).

In WFD of European Union, member countries are obligated for an integrated watershed management with each other and member water framework directives constitutes a framework for integrated water management throughout the entire Europe. The basic principle of the directive defines the water as " …not a commodity but a heritage to be preserved, supported and behaved accordingly". Moving from this basic principle, the directive envisages a new and integrated approach aiming to improve and preserve entire European waters. The directive compiles the water policy of the Europe under a single legal framework (Kibaroğlu Y. et al. 2008). In brief, Turkey should realize serious institutional and legal regulations to meet the requirements of EU directives.

WATER USE AND STRATEGIES

Effective water use can be provided through reducing water losses along the way from the resource to plants in irrigation implementations. Water-users (farmers) in agriculture should be oriented toward the water-saving technologies and practices. Pressurized pipe systems, especially the drip irrigation, instead of open canal systems should be constructed and deficit irrigation practices should be implemented win regions with deficit water resources.

In Turkey, newly constructed systems are all pressurized pipe networks. Previously, irrigation schemes were composed of 44% classical open canal systems, 42% canalatte and 14% pipe networks. Now, the ratio of pressurized pipe networks increased to 55% in all irrigation schemes. Such an increase in pipe networks has provided significant water savings in irrigations since water losses throughout the water conveyance and distribution network are prevented. With regard to irrigation methods, the highest water losses are observed in surface irrigation methods (%35-%60) which are still common in Turkey and the least water losses are observed in drip and sprinkler irrigation methods (%5-20). Widespread of sprinkler and drip irrigation methods will reduce water losses provide significant savings in irrigation water. Such savings can be directed to other sectors with water deficits and water resources preservation and sustainability can be provided.

In Turkey, about 80% of irrigated lands are irrigated by surface gravity irrigation methods. The rest is irrigated by sprinkler and drip irrigation. While plants use only 30-35% of diverted water in surface irrigation methods, this rate reaches to 90-95% in sprinkler and drip irrigation methods. Therefore, water-use efficiency is really high in drip and sprinkler irrigation. Widespread of these modern water-saving technologies can provide about 10% saving in water used in agricultural sector and such saving corresponds to 50% increase in industrial and 100% increase in domestic water uses.

WASTE WATER-USE IN AGRICULTURE

The water coming from settlements, industrial facilities, energy facilities, agricultural and livestock production sites and containing hazardous biological and chemical materials are defined as waste waters. Waste waters are classified in general as domestic,

industrial waste waters and runoff waters. Increased populations, rapid urbanization and industrialization create huge amounts of waste waters and such waste waters should be removed or eliminated without creating any harmful impacts on environment. Discharge of waste waters without any treatment spoils up the quality of surface waters and makes them unavailable for other purposes. Re-use of treated wastewaters provides two basic benefits. The first one is the use of waste water as an alternative water resource and the second one is the prevention of pollution of water bodies receiving these waste waters.

Agricultural wastewaters are usually composed of drainage waters not used by plants. In irrigation implementations, large portion of applied irrigation water is not used by plants and removed as drainage water. Irrigation water is lost through seepage, evaporation, runoff and improper operation of irrigation systems. In a study carried out over irrigated lands of Konya Province of Turkey, 22% of farmers were using drainage water as the source of irrigation water (Çiftçi *et al.* 1995).

Industrial wastewaters have different characteristics based on the industrial sector. Process waters contain toxic metal, organic matters, biological pollutants and radioactive elements. Treatment of such wastes requires advanced technologies and expertise. In case industrial wastewaters are treated with domestic wastewaters, waste characteristics should fully be analyzed and total pollutant loads and their variation in time should accurately be estimated.

Domestic wastewaters come from settlements and business facilities. They are basically composed of washing, shower and toilet waters. Amount of wastewater created by a settlement is depending on the population and amount of water used per capita. Therefore, reliable estimation of the volume of wastewaters will only be possible with reliable population estimations and analyses.

WATER HARVEST TECHNIQUES

In arid and semi-arid regions, precipitations are either at very levels or unevenly distributed throughout the year. Beside, precipitations are lost through surface runoffs and evaporations and not able to be stored for dry periods. Therefore, new approaches have been developed to benefit from precipitations effectively. Although irrigation seems to be the best solution for drought, it is an expensive approach and water resources are not sufficient everywhere to implement the irrigation systems. Thus, water harvesting comes into scene as a low-cost alternative (Tarı and Çakır, 2009). Water harvesting is to collect and store precipitations to meet the water demands for various purposes. The collected amount is either stored to be used directly or used to recharge groundwater.

Collection of precipitation from a surface (roof), storage and deliver to users are defined as roof water harvest system (ICARDA, 2010). Re-use of gutter waters reduces water consumption and provides an alternative means of water saving. Either above or below ground storages can be used to store the collected waters. Such storages are highly beneficial especially in dry regions and in regions with low quality surface and ground water resources. The collected water can be used for cleaning activities, irrigations, washing, pools and small ponds, fire extinguishing, lavatory traps and car wash. In this way, significant water savings will be possible. Water harvesting is an easy and low-cost technology and can be applied at almost every slope. About 50% of domestic water needs may be supplied from water harvesting (Kantaroğlu, 2000). Again, about 90% collection of precipitation will provide 50% water saving (ÇOB, 2011).

DEFICIT IRRIGATION

Deficit irrigation is used for irrigations in regions with deficit water resources. In deficit irrigation, water is applied either later than the appropriate time or in less than the required amount or both practices are implemented together to put the plants into a little bit stress and allow them to use less water. In this case, rather than targeting maximum yields, a certain amount yield loss is allowed by taking water-yield relationships into consideration. But such yield loses are tried to be compensated by irrigating larger size of land area with the same amount of irrigation water. Amount and timing of deficits should carefully be arranged to minimize the yield losses and to get the optimum benefits from each drop of water. Significant savings can be provided when deficit irrigation programs are prepared in a technical fashion (Kodal, 2007).

Deficit irrigation can be applied in two fashions: continuous deficit through distributing the deficit evenly over the entire irrigation season; planned deficit by applying deficit amounts at certain plant growth stages. Continuous deficit can be applied by decreasing amount of irrigation water in each irrigation at certain levels, by applying irrigation water as to wet upper portions of plant root regions, by increasing irrigation intervals, by applying irrigation water always

toward the same side of plant rows. Such practices may sometimes provide almost 50% savings in irrigation water. Planned deficit are applied just by reducing the amount of irrigation water at certain plant growth stages. Such deficit is applied mostly at the period in which plants are resistant to water stress most.

CONCLUSION

Ever-increasing country population and consequently increasing water demands have made the planned and effective use of water resources. Lack of sufficient legal regulations about the allocation, use and management of limited soil and water resources let the waste of several resources. On the other hand, social and economic welfare of people and consequently increasing life standards also increase domestic water use per capita.

In Turkey, there isn't any institutional coordination about the use and preservation of water resources. Related ministries and local administrations have their own task to do along with the legal responsibilities. Accurate and reliable data is not available to implement the proper water management practices. Most of the water resources data are not updated, insufficient and owned by various institutions and organizations.

Initially, pressurized piped irrigation systems should be used instead of gravity surface irrigation methods in agriculture, which the largest water-consuming sector of Turkey. Beside these systems, alternative water resources should also be developed to save water in agricultural practices. For an effective water use and water saving, lands should be leveled; drainage, land consolidation and similar physical infrastructures should be carried out. In addition, water losses should be minimized, water management should be improved, agricultural support policies should be developed and farmers should be made conscious about water use and preservation. Since agriculture is the largest water-consuming sector in Turkey, effective water use practices should be initially implemented in agriculture. For an effective water use in irrigations;

- Excessive water use should be prevented,
- Environmental impacts of irrigations should be monitored and evaluated,
- Irrigation-related institutions and organizations should create water management guides for different climate scenarios,
- Irrigation systems should be designed as pressurized pipe networks,
- Alternative water resources (re-use of waste waters, diversion of surface waters toward the water-deficit regions, development of water saving methods and technologies) should be developed,
- Volume-based water pricing should be applied rather than plant-area based pricing,
- A coordination should be provided among the water-related institutions and organizations,
- Farmers should be made conscious about water use and saving,
- A broad-coverage water law should be issued for effective use and preservation of water resources.

REFERENCES

Aküzüm T., Çakmak B., Gökalp Z. 2010 - *Türkiye'de Su Kaynakları Yönetimi ve Değerlendirilmesi.* Tarım Bilimleri Araştırma Dergisi 3 (1): 67-74 (In Turkish).

Çiftçi N., Kara M., Yılmaz M., Ugurlu N., 1995 - *Konya Ovasında Drenaj Suları _le Sulanan Arazilerde Tuzluluk ve Sodyumluluk Sorunları*. 5. Ulusal Kültürteknik Kongresi Bildirileri, 471-481, Antalya (In Turkish).

Dalkılıç Y., Harmancıoğlu N., 2008 - *Avrupa Birliği Su Çerçeve Direktifinin Türkiye'de Uygulama Olanakları.* TMMOB İnşaat Mühendisleri Odası 2. Su Politikaları Kongresi. s. 415-424. Ankara (In Turkish).

Kantaroğlu Ö. 2000 - *Yağmur Suyu Hasadı Plan ve Hesaplama Prensipleri*. IX. Ulusal Tesisat Mühendisliği Kongresi s.1147-1151, İzmir (In Turkish).

Kibaroğlu A., Sümer V., Kaplan Ö., Sağsen İ., 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 (In Turkish).

Kodal S. 2007 - Sulama Programlama Teknikleri. Orta Asya Sulama Suyu Yönetimi Çalıştayı 12-14 Eylül 2007. *Toprak Gübre ve Su Kaynakları Merkez Araştırma Enstitüsü, 22s., Ankara*. (In Turkish).

Tarı A.F., Çakır R., 2009 - *Kurak Bölgelerde Su Yönetimi.* 1. Ulusal Kuraklık ve Çölleşme Sempozyumu: 368-378, Konya (In Turkish).

***** - ÇOB, 2011** - Sürdürülebilir Su ve Atıksu Yönetimi Su Tasarrufu Modellerinin Geliştirilmesi Projesi. *T.C. Çevre ve Orman Bakanlığı Özel Çevre Koruma Kurumu Başkanlığı www.ozelcevre.gov.tr* (In Turkish).

***** - ICARDA, 2010** - Turkey Water Harvesting *Booklet. Rain Water Harvesting. You can do it yourself. Allepo, Stria, 12p.*

***** - SUEN, 2013** - http://suen.gov.tr/tr/icerik/turkiye-su-politikasi/21 erişim tarihi:15.01.2013 (In Turkish).