# Agricultural Water Pricing: Turkey

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# *Note*

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## Executive Summary

Irrigated agriculture currently consumes 75 percent of total water consumption which corresponds to about 30 percent of renewable water availability. However incidents such as increasing urbanization, climate change and changing agricultural world commodity prices are expected to increase the sectoral competition for water resources and raise the need for major changes in water policies in the medium and the long run. Turkey is one of the world leaders in the transfer of irrigation schemes to water users organizations. The transfer of almost all large surface irrigations schemes (half of the total irrigated area) developed by the state to water users associations has been completed. However, the price of the irrigation water is still based on operation and maintenance costs in all irrigation schemes and it is charged on per hectare basis, differentiated according to the crop. The recuperation of capital costs has been low and remains to be law because of the legal framework. There is almost no volumetric pricing system in irrigation, whereas volumetric charges are common in domestic and industrial use. The user organizations determine the water charges based on expected operation, maintenance and investment cost for the year. The farmers using pumping water face 2.5 times higher water charge per hectare then the gravity water users. The change of management from DSI to water users organizations had two important effects in financing the operation and maintenance expenditures. Both the real water charges and collection rates increased. The increasing burden of the operation and maintenance costs to the government until mid-1990s has been reduced drastically through the accelerated transfer of the operation and maintenance activities to irrigation associations. However, the reluctance of the government to recover even the nominal investment expenditures persists. Turkey is resistant towards making any radical changes in water management policies. However, unfavorable global climate and economic conditions may further increase the stress in the water sector. Agriculture consuming about two thirds of water resources will bear the burden of adjustment to water scarcity. Fast implementation of the necessary policy measures at all levels will achieve more efficient use of public resources and water. The project stock in the irrigation sector remains to be large compared to the allocated financial resources. Priority should be given better use of existing water infrastructure and proper ranking of the unfinished projects. The first one requires improvement in irrigation management practices. More resources can be allocated to restrict water losses from irrigation infrastructure starting from the high evaporation regions. There have been improvements in adopting more efficient water application technologies induced by government subsidies. The uptake of these technologies by irrigators can be further increased by shifting towards volumetric pricing practices. The determination of irrigation fees proportional to the actual amount used will increase the efficiency in the use of irrigation water.

## Introduction: Background, scope objectives

The irrigation sector is using 75 percent of total water consumption in Turkey. The average per capita availability of water is shrinking due to relatively high growth rate of population. The demand for water in the non-agricultural sectors is increasing at a fast rate as a result of high rate of urbanization and industrialization. The limit of arable land was reached in 1960's, and one of the important factors to improve the production performance of the agriculture sector is to increase the area under irrigation. Most of the investments on irrigation infrastructure involve moving the surface water from natural bodies to the fields. Large capital investments necessary to expand the irrigated area have been undertaken by the government. This situation puts pressure not only on the consumptive use of water resources, but also on the allocation of public capital investments.

Regulations and pricing in the irrigation sector remain as the most controversial issues to tackle to achieve efficient use of water in agriculture and public investments. The approach to water pricing policy does not differ according to the source of irrigation water. When the water is taken from the aquifers, most of the capital investments are undertaken by the users and the price paid for the water use covers both the capital and service charges. Large infrastructural investments are necessary to convey surface water from the dams to the fields. The price paid by the users should at least cover the investment and service costs as it is the case for the use of water from the aquifers. Especially recuperating the capital costs gains importance in the case of public investments since irrigation increases the asset value of the land. Furthermore, the price of irrigation water is expected to reflect the possible competition from non-agricultural sectors and environmental externalities.

Turkey is one of the world leaders in the transfer of irrigation schemes to water users organizations. The transfer of almost all large surface irrigations schemes (half of the total irrigated area) developed by the state to water users associations has been completed. However, the price (fee) for the irrigation water is still based on operation and maintenance costs in all irrigation schemes and it is charged on per hectare differentiated according to the crop. The recuperation of capital costs has been low and remains to be law because of the legal framework. The rest of the irrigated area consists of small schemes that are developed either by the farmers or by now abolished General Directorate of Rural Services (GDRS). Most of the necessary infrastructural investment is undertaken by the farmers. They are managed and operated by the farmers.

The candidacy of Turkey to the EU adds a new dimension to the issues in the irrigation sector. Under the EU Water Framework Directive (WFD) many member states are required to move toward full cost recovery in their pricing policies of water including irrigation. Membership process should pave the way toward the adoption of the WFD.

Analysing pricing practices in the irrigation sector requires the necessary data on the regional prices and water use, estimation of irrigation water costs including the capital costs, cost recovery and clear definition of irrigation water costs. State Hydraulic Works (DSI) continues to collect data on pricing and water use on the irrigation schemes transferred to Water User Associations (WUA) as part of its monitoring and evaluation framework. The data on the rest of the currently irrigated area are scanty and not readily available.

The dominant pricing practice is per hectare charge differentiated according to the crop. This pricing scheme may be appropriate as an agricultural policy targeted to increase the income of the farmers and boost the contribution of agriculture to the overall development. However, the approach disregards several factors that may improve the performance of the agricultural sector and possible externalities that may arise because of irrigation development. Volume independent price may cause overuse of water with a negative impact on the yields of irrigated crops even if water is abundant. Water allocation problems will arise within agriculture and pressure for inter-sectoral transfers of water will augment when water is scarce. Irrigation related environmental externalities will further create social and economic costs. Pricing and efficient use of water for irrigation remain to be as major issues not only for the irrigation schemes to be developed in the future, but also for the already irrigated areas.

The key objective of the study is to provide an empirical study of irrigation water pricing in Turkey, examining the recent trends in irrigation costs to the farmers, regional agricultural water price ranges and characteristics. The extent to which the price paid by irrigators for water recovers operation and maintenance costs and capital costs for water delivery to the farm will be discussed. It includes institutional arrangements for water allocation and agricultural water pricing in Turkey.

## Brief review of recent literature on agricultural water pricing relevant to Turkey

The literature on the analytical aspects of agricultural water pricing in Turkey is poor. There are few analytical studies on pricing of irrigation water. The value of water can be estimated using different approaches such as the opportunity cost of water, benefit to the farmers. The benefits provided from the availability of irrigation water can be identified using mathematical programming models of farming operations (Malik, 2008). The value of water can be identified by the changes in the availability of water for irrigation and/or by the availability of the irrigated land. Kasnakoglu and Cakmak (1997) attempted to determine the opportunity cost of water using a regional non-linear optimization agricultural sector model for Turkey with a comprehensive coverage of agricultural production, consumption and trade. The model is highly disaggregated in land types (i.e. several irrigation projects, land classes etc.) and it includes water use for high number of crop production activities. The model is constructed to simulate and analyze the developments in the agricultural sector of South-eastern Anatolia Project Region (known as the GAP) and the rest of Turkey between the next two decades covering various stages of the irrigation component of the GAP.

Various shadow prices of land reported in the study show the marginal values of land in terms of their contributions to producer and consumer welfare. The shadow prices also reflect the scarcity as well as the crop value added of a specific land group. Project specific irrigated land shadow values differ significantly by regions, crop pattern and the quality of land (Kasnakoglu and Cakmak, 1997). This information can be used to differentiate the price of water in the different project regions.

Land value indices aggregated according to land quality and land type are presented in Table 1. On the average, the shadow price of irrigated first class land is 50 percent higher than that of the second class land. The marginal value of the third class land is one third of the marginal value of first class land. Furthermore, the average value of the irrigated land is projected to be nearly three times that of the non-irrigated areas in the GAP Region by the estimated completion date of the project.

**Table 1. Land value indices in the GAP region for 2010 by land classes (Irrigated Land Value=100)**

| | **Land class** | | | **Weighted average** |
|---|---|---|---|---|
| Land type | I | II | III | |
| Irrigated | 148 | 93 | 53 | 100 |
| Dry | 62 | 43 | 23 | 35 |

*Source:* Kasnakoglu and Cakmak (1997).

The model used in the study provides the possibility to assess the value of water for smaller sub-regions and for different time periods in a single year. It is also possible to estimate the value of water for different crops and/or rotation activities. The price projections of the agricultural products, agricultural and trade policies are the major drivers in determining the values of land and water.

Annual area-based fee differentiated by crops is the dominant irrigation water pricing mechanism used in Turkey. Tsur (2004) constructed a linear programming model of crop production for an irrigation district in the South-eastern Region of Turkey. The model incorporates the data on area, irrigation requirements, costs of production and prices of the main crops (cotton, wheat, corn and pepper) grown in the Harran Plain. The district specific derived demand for water is obtained by varying the price of water. Tsur (2004) calculates the net value of water to irrigators by considering the difference between the area under the derived demand and the total actual water charges.

The Harran district is part of a large-scale irrigation project with heavy fixed investment component. In addition, the conveyance infrastructure for additional irrigated land using the reservoir has been delayed. Hence, the district does not face any scarcity of water and the conveyance facilities impose no capacity constraints. This situation implies two-part tariff for water price (Tsur, 2004). Non-volumetric part is required to cover fixed costs. Volumetric component based on marginal cost is necessary to achieve efficiency. Per-area prices cover the non-volumetric component. Volumetric part is missing leading to efficiency losses as measured by the surplus accruing to the farmers. Implementation costs of volumetric pricing should be compared with the gain in efficiency (Tsur, 2004).

In another study dealing directly with water pricing issue in Turkey, Unver and Gupta (2003) indicate that the water pricing in Turkey should aim to cover full organization and management cost for irrigation water supply. They recommend the establishment of a volumetric pricing system instead of the current crop and area system, in view of the expanding large irrigation infrastructure in the South-eastern Anatolia Project Region of Turkey.

They claim that the operation and maintenance costs range between two to six times of the charges paid by the farmers for various years considering the accounting costs of operation and maintenance for DSI. The disparity may go up to 31 times then the water charge if the drainage, land leveling and financing costs of the capital asset are taken into account (Unver and Gupta, 2003). The method used to determine the ability to pay for the farmers is not clear. The base charges used in the study correspond to the newly irrigated areas. It is possible that the gestation period of the irrigation scheme is still ongoing. For instance, the current operation and maintenance charges collected by the irrigation associations (IAs) in the region is close to the amount mentioned in the study (USD 100/ha). Of course, the coexistence of private investment in the tube wells with the subsidized irrigation water conveyed from reservoirs causes the irrigators to view the benefit as a right, and hence reduces the willingness to pay (Unver and Gupta, 2003). This situation which is valid in all publicly developed irrigation schemes makes it necessary to estimate the subsidy involved providing irrigation water. The irrigators should be aware of the amount of transfers through irrigation water to achieve the agricultural development objective.

The rest of the recent literature on irrigation are concentrated on the performance of the participatory operation and maintenance in the large irrigation projects developed by DSI and transferred to IAs. Cakmak *et al*. (2004) present the benchmarking analysis of irrigation districts in the $10^{th}$. Region of DSI. Comparative analysis of water delivery and output per area and volume of water of 5 irrigation districts in the region between 1996 and 2000 is provided. They conclude that the transferred schemes are performing well in general, however they point out the variability in management, maintenance and operations expenditures of the IAs (Cakmak *et al*., 2004). Murray-Rust and Svendsen (2001) and Yercan (2003) compared the performance of irrigation schemes before and after the transfer of operation and maintenance activities from DSI to IAs in the Gediz Basin. Farmers complaint about the increase in the irrigation charges after the transfer is worth to mention (Yercan, 2003). However, the transfer program has not reduced system performance and has been able to support the ongoing shift to higher value crops and continuing growth in crop yields. It has accomplished this at significantly lower cost than when schemes were under DSI management and it has also shifted the cost of irrigation services from public to irrigators (Murray-Rust and Svendsen, 2001).

Cakmak *et al*. (2006) selected four large IAs from different regions based on cropping pattern diversities to trace the path of their post-transfer performance in operation and maintenance (O&M) activities. Results suggest that irrigation associations are able to fulfill irrigation tasks to a large extent with enhanced equipments. Fee collection rates are at improved levels. Cotton dominant cropping patterns lead higher and increasing O&M expenditures compared to cereals. Although the transfers increased the adjustment ability of farmers to exogenous factors, the findings suggest that it is still too early to decide on the sustainability of the transfer program (Cakmak *et al*., 2006).

## The definition and components of the costs of supplying water for irrigation in Turkey

Pricing irrigation water in publicly developed schemes should be compatible with the stated goals, in addition legal framework should be consistent with the goals. An abundant literature on water pricing theory as well as applications exists. Few are going to be mentioned here before discussing the case for Turkey.

Pricing water can be defined as helping to allocate scarce water resources among competing uses and users, as Dinar *et al*. point out (2003), and while doing so, conflicting goals in allocation may arise. These goals vary from economic efficiency to equity concerns, from cost recovery to revenue maximization of the water supplying institution, or the ability of users to pay to environmental cost avoidance. The diversity of goals of pricing policies also explain the great number of pricing schemes currently in practice, and the differences in pricing schemes even within areas with similar geographical conditions (Monteiro, 2005).

Economic efficiency is defined as the equalization of marginal benefits from the use of the resource across sectors to maximize social welfare (Dinar *et al*. 1997). First best allocations are referred as the allocations of water that maximize net benefits under absence of taxes and other distortionary constraints (informational, institutional, or political). In order to achieve economic efficiency, price is adjusted so that marginal benefit of a unit of water is equal to marginal cost of supplying that unit (Johansson *et al*., 2002). This condition makes marginal cost pricing the best pricing method for attaining efficient allocation of water.

Another important goal in pricing water could be achieving equity or fairness in allocation. Due the vagueness of fairness concept, many approaches have been developed to attain a "fair" allocation of water. Examples can be maximizing welfare of society's least well off individuals (Sampath, 1991), and ability of users to pay principle. Government subsidies for provision of water or other pricing policies (such as discriminating between water users) can be used to meet the aimed water allocation.

A good example of conflicting criteria in pricing is seeking economic efficiency and equity at the same time. It is accepted that marginal cost pricing is the pricing method that achieves economic efficiency (Monteiro, 2005). However, charging every member of the society with the same price puts pressure especially on the users with low incomes. Conversely, an equitable distribution of water among users in the society does not lead to maximization in social welfare of the society, which makes this allocation inefficient. Therefore, a tradeoff between equity and economic efficiency occurs when choosing between marginal cost pricing and a pricing that promotes equity.

Cost recovery of the supply may be considered as a goal for most of the publicly owned water supplying agency. When it is considered that governments are not only dealing with water related issues but also issues related to health care, education, infrastructure, economic development, agriculture etc., cost recovery could be a minimum requirement for a government, when adopting water pricing policies. However, if the water supply project is privately owned, the issue of revenue from a water supply project is expected to be much more important, such that maximizing revenues may have priority over supplying water to the society.

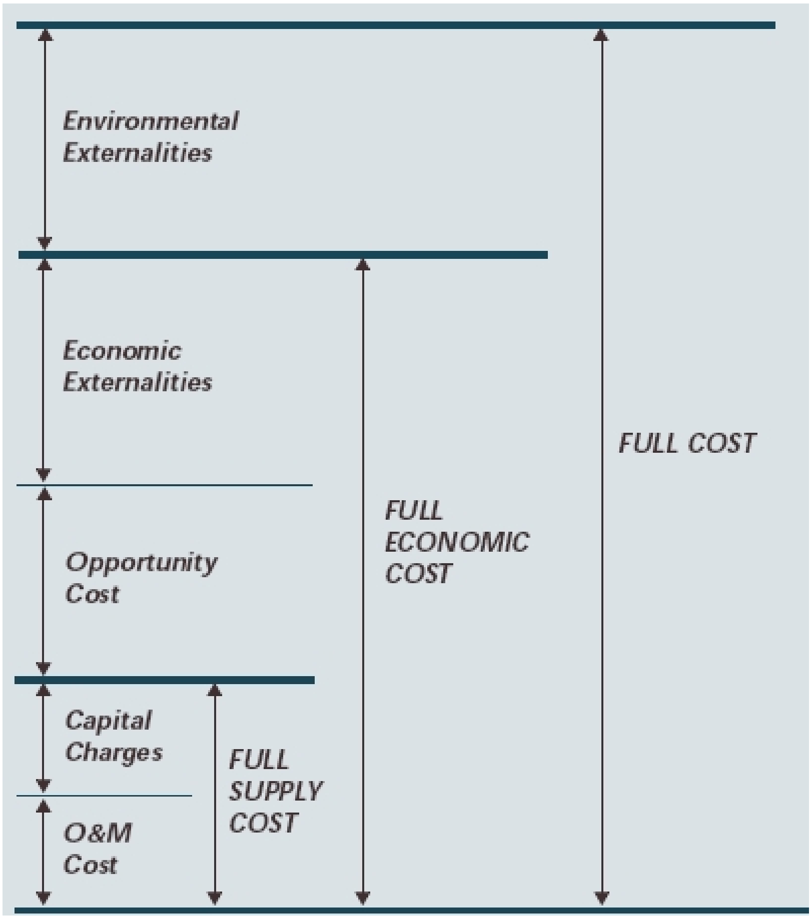
Cost recovery of a water supplying institution is related with average cost pricing concept. However, it is possible that marginal costs of supplying water can sometimes be higher than average costs (despite the fact that water supplying agencies are commonly viewed as a natural monopoly due to capital costs). The argument is that cheaper sources of water are naturally used before it is passed on to other and more expensive sources, and thus marginal cost can rise above the average cost of supplying water. Therefore, it is also possible for a water agency to not only cover its costs but generate excessive profits (Collinge, 1992).

Recently, there has been a tendency to move towards full-cost recovery pricing in irrigation (OECD, 2002) and pricing of urban water (OECD, 1999). While this reduces the dependency of water supplying agency on tax revenue, it also shifts costs back onto water users, which makes water users responsible for their environmental impacts (OECD, 2002). While the definition of full cost recovery is not universal, full cost recovery of water can be thought of being the sum of supply costs, (such as operation and maintenance and capital costs of supplying water), opportunity costs (related to the alternative use of water), economic externalities (related to the use of water) and environmental externalities (taking scarcity of water, environmental damage costs, and social costs into consideration) (Rogers *et al*. 1998). The components of the costs of supplying water can be introduced by using Figure 1. It shows the composition of the various components of full cost recovery and is reproduced from Rogers *et al*. (1998).

It is necessary to consider the institutional distribution of irrigation development to define and determine the cost components of supplying water in Turkey. About 60 percent of the total irrigated area (5.2 million hectares) is developed by DSI, the rest by the farmers and by now abolished General

Directorate of Rural Services (GDRS)[1]. There are basically two related common principles determining the cost components. First, water pricing intends to cover the costs of services from the users, hence the maximum that the users will pay is limited to full supply cost in Figure 1. Consequently, irrigation water does not have a price and any cost items other that full supply cost are not included in the water charges.

**Figure 1. Composition of full recovery cost**




*Source:* Rogers *et al*. (1998).

The only available information about the irrigation schemes developed by farmers is the estimate of total area (1 million hectares). This total has not changed during the last two decades. The farmers are expected to incur all costs of supplying irrigation water.

GDRS responsibilities were restricted to develop small irrigation schemes. GDRS did not have a department dealing with O&M. The irrigated area developed by GDRS had to be fully transferred to the farmers. Water users or their organizations are responsible for the management, operation and maintenance of the schemes. In addition, the schemes are taken over by the irrigators free of charge since there was no legal basis to recover any investment costs incurred by GDRS. If a tube well is necessary, it is generally installed by DSI, and DSI is reimbursed for the expenses. The conveyance canals from the source to the

1 As a result of the decentralization efforts of the government, the responsibilities of GDRS (small scale irrigation projects, rural roads, potable water for villages and other rural services) are transferred to Special Provincial Administrations.

field are constructed by GDRS. The responsibility of providing water services lies fully on the farmers organizations. It is necessary to obtain a license from DSI if the water is coming from the aquifers. The license provides the right to use water. The water use right cannot be transferred or sold. There exists no special law governing the rights of surface water. Private consumptive uses of surface water are not subject to any prior authorization. The costs components for the irrigation developed by GDRS are O&M and investment costs. Investment costs are partly paid by the users. The tariffs are expected to cover all management, operation, maintenance and renewal costs, hence covering only full supply costs. Since the right to use is not transferable, the price will not cover the opportunity costs and any externalities arising from irrigation.

O&M responsibility for the 96 percent of the total area developed by DSI has been transferred to the IAs. The transfer contracts between DSI and IAs are based on the DSI law, hence the pricing practices used by the IAs should be compatible with the DSI law. As a result, similar cost components are valid for both DSI and IAs in determining the water charges.

Articles 24-28 of the DSI law define the various cost components relevant for the pricing of irrigation water. "All expenditures for the construction of [irrigation] works shall be paid by the beneficiaries…" is dictated in Article 24 of the DSI law. Per hectare payment for the investment costs are determined by dividing the total investment costs by the total irrigated area and the number of the years in the pay-back period. The investment costs (including the share of irrigation for the multi-purpose projects), the starting year of investment payments and the pay-back period are determined by the DSI. The final decision is made by the Prime Minister with the recommendation of the Ministry responsible for DSI (currently, The Ministry of Environment and Forestry).

Although the law dates back to 1953, it establishes the principle to cover full capital cost. Article 25b states that "The payments for the [construction of the] works shall be subject to interest. However, the payments should be exempt from interest payments if the derived benefits of the works cannot bear the burden of the interest payments. The rates of interest to be applied shall be determined by the General Directorate, and shall be decided by the Council of Ministers upon the proposal of the Ministry of [Environment and Forestry]. Eventually, the irrigation projects are categorized as the "works" that cannot bear interest payments.

"All expenditures incurred for the operation of the [irrigation] works shall be paid by the beneficiaries" according to the Article 26. The total to be reimbursed by the beneficiaries are based on the previous year's O&M expenditures incurred by DSI and per hectare payments are determined by dividing the previous years expenditures by the irrigated area of the scheme. Per hectare payments can be differentiated according to the crop.

Operation costs include the total wages of all permanent and temporary personnel used in operations, to total costs of vehicles, energy expenditures for irrigation and drainage, all other necessary expenditure for the office of management. Periodical maintenance expenditures, such as damage repair, weed control, to sustain the expected services are considered as the maintenance costs.

There was no allowance for inflation adjustments in the O&M expenditures of DSI. The penalty for late payments was only 10 percent which resulted as very low fee collection rates. The burden of O&M expenditures contributed towards increasing the budget deficit. This problem has been resolved by the accelerated transfer of O&M activities to the IAs. Currently, 96 percent of the irrigated area developed by DSI is managed by IAs. The IAs base their annual per hectare charges on the estimated costs of O&M. Any investment expenditures, such as purchase of the durable equipment, by IA are treated separately, and recovered from the members as a separate per hectare charge.

## Country case study: Turkey

Irrigation development in Turkey has been remarkable during the last 40 years. Irrigated area increased by about 2.5 times since 1970s. The share of the area developed by public agencies is 80 percent. The rest is developed by the farmers themselves. The objective of DSI is to increase the irrigated area from 5.2 to 8.5 million hectares of irrigated land by 2023 (DSI, 2008a). However, considering high state of irrigation development and increasing demand from non-agricultural use, priority may be given be given to better use of existing water infrastructure (SPO, 2008) rather than full use of water and land resources in Turkey.

More efficient and equitable use of irrigation water requires taking necessary steps in water pricing. Although Turkey accomplished an accelerated transfer of O&M activities to the farmers, the pricing practices have not changed. The price of water comprises of two parts: O&M costs and capital costs. Almost all irrigation schemes[2] are now managed by the farmers. O&M activities are undertaken by the water user organizations and the costs are recovered from the beneficiaries. However, recovering the cost of capital for the publicly developed schemes was always problematic. The situation has not improved after the transfer of management transfer. Almost all public capital costs are not incurred by the farmers.

### *Overview of water supply and irrigation*

Turkey's climate is moderated by both the Mediterranean and continental weather patterns which displays geo-climatic diversity when combined with a highly varied topography. The average annual temperature is 18-20$^oC$ on the southern coast, 14-15$^oC$ on the west coast, and fluctuates between 4 to 19$^oC$ in the interior regions, depending on their distance from sea level. The annual average precipitation is 643 mm, yet varies from 250 mm in the central part to 3000 mm in the Eastern Black Sea region. Seventy-five percent of annual rain falls during the winter season. Annual rainfall is less than 500 mm in the inland Thrace and in the Eastern Anatolia regions. This diverse precipitation structure emphasizes the crucial importance of irrigation.

Generally, agricultural production is adversely affected by the shortage and inconsistency of rainfall during the growing season. Solar energy makes it possible to grow arid and semi-arid crops such as bananas and citrus. Moreover, it is possible to grow 2 to 3 different crops in irrigated areas that have crop growing seasons for a period of 270 days. However, some crops may be harvested before maturation, particularly in Eastern Anatolia with its 60 to 90 growing days. The southeast region has a very low humidity level. The coastal regions are humid with high precipitation rates. Inevitably, the topographic features are main factors shaping the distribution. The long-term annual evaporation rates indicate a high rate, particularly in the southeast region, which receives almost no rainfall during the summer, and reaches more than 2000 mm per year in the South-eastern region (Kanber *et al.*, 2005).

The average annual precipitation of the country corresponds to a water potential of 501 $km^3$ per year, of which 274 $km^3$ are lost to evapotranspiration, 69 $km^3$ feed aquifers and 158 $km^3$ flow through the rivers to the sea or lakes. The gross total surface and ground water potential of Turkey amounts to 234 $km^3$ (Table 2).

**Table 2. Turkey: Water resources potential and use**

| Surface water | Groundwater | Total |
|---|---|---|
| Surface flow<br>158 $km^3$ | Feeding groundwater<br>69 $km^3$ | Mean annual precipitation<br>501 $km^3$ (603mm) |
| Surface runoff [a]<br>193 $km^3$ | Recharge<br>41 $km^3$ | Renewable water potential<br>234 $km^3$ |
| Usable surface runoff[b]<br>98 $km^3$ | Safe yield<br>14 $km^3$ | Usable (net)<br>112 $km^3$ |
| Consumption<br>31 | Consumption<br>12 | Consumption<br>43 |

[a] including the flow from groundwater and neighbouring countries;
[b] including the usable flow from neighbouring countries.
*Sources:* DSI (2008a).

The amount of surface water utilized for consumption purposes is in the range of 98 $km^3$ per year, including the contributions from the neighboring countries. According to the studies based on groundwater resources, the total safe yield of groundwater resources is estimated to be 14 $km^3$. Thus, the total potential available water resources from surface flow and groundwater would amount to 112 $km^3$ per year.

[2] The area managed by DSI is only 82 420 ha. It corresponds to 4% of the area developed by DSI (DSI, 2008b).

The country's surface runoff is unevenly distributed in both time and place, consistent with precipitation. Surface and ground water resources are limited in the Aegean, Thrace and Central Anatolia regions where the demand for water is higher than the rest of Turkey. The Aegean and Thrace Regions are highly urbanized and industrialized, and have soil resources suitable for irrigation. They have 10.5 percent of total surface water resources for the country while covering 19.3 percent of the entire area. Almost 30 percent of the total surface water for the country flows through two rivers, the Tigris and Euphrates (Table 3). An irregular regime of rivers requires reservoirs to regulate the water. It is estimated that 98 $km^3$ of surface water (51 percent of total surface water) can be consumed by technically and economically feasible projects. The actual utilizable water amount in Turkey is around 1 700 cum/person/year in 2007.

**Table 3. Water potential and land distribution by basins**

| No | Water Basin | Area (km²) | Annual Basin Efficiency (l/s/km²) | Average Annual Flow ($km^3$) | Farming Land (1,000 ha) | Irrigable Land (1,000 ha) |
|---|---|---|---|---|---|---|
| 1 | Maritza-Ergene | 14,560 | 2.9 | 1.33 | 1,095.3 | 1,078.0 |
| 2 | Marmara | 24,100 | 11.0 | 8.33 | 865.7 | 730.0 |
| 3 | Susurluk | 22,399 | 7.2 | 5.43 | 850.0 | 755.9 |
| 4 | North Aegean | 10,003 | 7.4 | 2.09 | 367.6 | 316.3 |
| 5 | Gediz | 18,000 | 3.6 | 1.95 | 667.2 | 623.4 |
| 6 | K.Menderes | 6,907 | 5.3 | 1.19 | 222.4 | 194.8 |
| 7 | B.Menderes | 24,976 | 3.9 | 3.03 | 1,044.3 | 907.4 |
| 8 | West Mediterranean | 20,953 | 12.4 | 8.93 | 437.4 | 406.6 |
| 9 | Antalya | 19,577 | 24.2 | 11.06 | 451.2 | 448.1 |
| 10 | Burdur Lakes | 6,374 | 1.8 | 0.50 | 251.4 | 249.5 |
| 11 | Akarcay | 7,605 | 1.9 | 0.49 | 364.4 | 359.9 |
| 12 | Sakarya | 58,160 | 3.6 | 6.40 | 2,814.3 | 2,681.1 |
| 13 | West Black Sea | 29,598 | 10.6 | 9.93 | 855.0 | 640.8 |
| 14 | Yeşilırmak | 36,114 | 5.1 | 5.80 | 1,617.2 | 1,401.2 |
| 15 | Kızılırmak | 78,180 | 2.6 | 6.48 | 4,049.8 | 3,761.1 |
| 16 | Konya inland | 53,850 | 2.5 | 4.52 | 2,182.8 | 2,134.9 |
| 17 | East Mediterranean | 22,048 | 15.6 | 11.07 | 438.3 | 327.8 |
| 18 | Seyhan | 20,450 | 12.3 | 8.01 | 764.7 | 714.0 |
| 19 | Orontes | 7,796 | 3.4 | 1.17 | 376.2 | 331.7 |
| 20 | Ceyhan | 21,982 | 10.7 | 7.18 | 779.8 | 713.7 |
| 21 | Euphrates[a] | 127,304 | 8.3 | 31.61 | 4,293.8 | 4,111.3 |
| 22 | East Black Sea | 24,077 | 19.5 | 14.90 | 712.6 | 350.7 |
| 23 | Çoruh | 19,872 | 10.1 | 6.30 | 326.2 | 303.4 |
| 24 | Aras | 27,548 | 5.3 | 4.63 | 642.0 | 641.1 |
| 25 | Lake Van | 19,405 | 5.0 | 2.39 | 436.5 | 433.3 |
| 26 | Tigris[a] | 57,614 | 13.1 | 21.33 | 1,148.2 | 1,137.6 |
| | Total | 779,452 | 209.3 | 186.05 | 28,054.3 | 25,753.6 |

[a] These two river basins have been merged recently. Officially, it is named as Euphrates-Tigris River Basin (SPO, 2007).
*Source:* DSI (2007).

Sectoral consumption of water is presented in Table 4. Total human and utility water consumption is increasing steadily with population and income growth, totaling 6.2 $km^3$ per annum in 2004. The share of the population served by adequate water from the network connected at home or standpipes, reached 85 percent in rural areas, and 98 percent in urban areas. Annual water allocated to industry is about 4.1 billion $m^3$ supplied mainly from groundwater resources.

The total irrigated area was 5 million hectares in 2007 (Table 5) with 75 percent of the water allocated to irrigation. The irrigated area has already reached 60 percent of the total "economically irrigable" area of 8.5 million hectares. Water consumption per hectare amounts to more than 7,000 $m^3$.

Marmara and Aegean Regions are more populated and industrialized compared to the rest of the country. In addition, the river basins in these regions are estimated to have already exceeded their long-term capacity utilization rates (World Bank, 2007).

**Table 4. Sectoral water use in Turkey**

| | Irrigation | | Domestic | | Industry | | Total use ($hm^3$) |
|---|---|---|---|---|---|---|---|
| | Use ($hm^3$) | % of total | Use ($hm^3$) | % of total | Use ($hm^3$) | % of total | |
| 1990 | 22,016 | 72 | 5,141 | 17 | 3,443 | 11 | 30,600 |
| 2000 | 29,300 | 75 | 5,800 | 15 | 4,200 | 10 | 39,300 |
| 2004 | 29,600 | 74 | 6,200 | 15 | 4,300 | 10 | 40,100 |
| 2023[a] | 72,000 | 64 | 18,000 | 16 | 22,000 | 20 | 122,000 |

Sectoral and total use figures vary depending on the source.
[a] Target mentioned in DSI (2007) implies full utilization of all usable water supplies.
*Sources:* SPO (2007); DSI (2007).

**Table 5. Irrigation development by regions, 2007 (1 000 ha)**

| | DSI Region | Geo.R | DSI | DSI (IC) | GDRS | Farmers | Total |
|---|---|---|---|---|---|---|---|
| 1 | Bursa | Mar. | 58 | 5 | 31 | | 95 |
| 2 | Izmir | Aeg. | 122 | 15 | 50 | 147 | 334 |
| 3 | Eskisehir | Cent. | 77 | 26 | 68 | | 171 |
| 4 | Konya | Cent. | 190 | 187 | 163 | 95 | 635 |
| 5 | Ankara | Cent. | 53 | 4 | 81 | | 138 |
| 6 | Adana | Med. | 323 | 17 | 86 | 34 | 461 |
| 7 | Samsun | BSea | 88 | 20 | 67 | 51 | 226 |
| 8 | Erzurum | East | 84 | 16 | 96 | 154 | 350 |
| 9 | Elazig | East | 82 | 5 | 103 | 101 | 291 |
| 10 | Diyarbakir | SEast | 43 | 0 | 20 | | 63 |
| 11 | Edirne | Mar | 61 | 21 | 55 | 40 | 176 |
| 12 | Kayseri | Cent. | 82 | 20 | 100 | 58 | 260 |
| 13 | Antalya | Med. | 80 | 6 | 21 | | 107 |
| 14 | Istanbul | Mar. | 0 | | 6 | | 6 |
| 15 | Sanliurfa | SEast | 189 | 0 | 22 | | 212 |
| 17 | Van | East | 66 | 1 | 67 | 43 | 177 |
| 18 | Isparta | Med | 109 | 61 | 83 | 46 | 299 |
| 19 | Sivas | Cent | 23 | 1 | 35 | 73 | 132 |
| 20 | K.Maras | SEast | 48 | 6 | 49 | | 103 |
| 21 | Aydin | Aeg. | 199 | 18 | 59 | 130 | 406 |
| 22 | Trabzon | BSea | 13 | 1 | 35 | 23 | 72 |
| 23 | Kastamonu | BSea | 13 | 2 | 28 | 2 | 44 |
| 24 | Kars | East | 71 | | 20 | 37 | 128 |
| 25 | Balikesir | Mar | 62 | 7 | 38 | | 106 |
| 26 | Artvin | BSea | | | 11 | | 11 |
| | Total | | 2,136 | 438 | 1,394 | 1,034 | 5,001 |

*Sources:* DSI (2008b), GDRS (2007), SPO (2007).

About 90 percent of irrigation methods depend on gravity systems with low water efficiency. The significant role of irrigation for improving the performance of the agricultural sector is recognized in the Ninth National Development Plan for 2007-13 (SPO, 2007). However, the Plan establishes the priority for more efficient use of water resources in agriculture and completing the irrigation projects under construction.

Following the macroeconomic crisis in 1994, the transfer of the irrigation schemes managed by State Hydraulic Works (DSI) gained momentum. Another push of transfers occurred during the subsequent stabilization program in 2000 (Table 6).

**Table 6. Area Transferred to Irrigation Associations by DSI, 1999-2008.**

| | Transferred Area (1,000 ha) | Percent Transferred |
|---|---|---|
| 1999 | 1,304 | 66 |
| 2000 | 1,609 | 80 |
| 2001 | 1,664 | 82 |
| 2002 | 1,687 | 83 |
| 2003 | 1,826 | 90 |
| 2004 | 1,861 | 92 |
| 2005 | 1,922 | 95 |
| 2006 | 1,976 | 95 |
| 2007 | 2,037 | 96 |
| 2008 | 2,090 | 96 |

*Source:* DSI (2009).

The transfer of operation and maintenance of the schemes developed by DSI is completed (Table 7). However, the sustainability of transferred schemes to the beneficiary is questioned in the recent development plan. The Plan recommends to develop participatory mechanisms together with the necessary legal provisions for efficient and sustainable use of soil and water resources.

**Table 7. Management of irrigation schemes, 2008**

| | Number | Area (1,000 ha) |
|---|---|---|
| Developed by DSI | 2101[a] | 2,638[a] |
| Managed by DSI | 61 | 88 |
| Transferred to users' organizations | 682 | 2,090 |
| Transferred to ICs | 1,329 | 444 |
| Developed by GDRS and managed by the farmers | 18,887 | 1,394 |
| Developed and managed by the farmers | n.a | 1,034 |
| Total | n.a | 5,066 |

[a] including 29 irrigation schemes (16,066ha) developed by DSI with full-cost recovery.
*Source:* DSI (2009), GDRS (2007).

As it is implied by the availability of surface water and groundwater, the share of the area irrigated by surface water is close to 80 percent (Table 8). The distribution of the water sources for the irrigation developed by the farmers is unknown.

Almost all irrigation is done through gravity irrigation. At their own expense, the farmers use sprinkler and drip irrigation systems, depending on the crop, water availability, soil conditions and productivity. The most recent data about the distribution of the area according to irrigation technologies are available for the irrigation schemes developed and transferred by DSI. The shares of sprinkler and drip irrigation were 6 and 2 percent, respectively. The use of water savings technologies is more extensive in Southern Marmara and Cukurova regions (DSI, 2008d).

**Table 8. Sources of water in the irrigation schemes, 2007 (1,000 ha)**

| Source of Water | Developed by DSI | Developed by GDRS | Total |
|---|---|---|---|
| Surface | 2,059 | 1,038 | 3,097 |
| Groundwater | 515 | 356 | 871 |
| Total | 2,574 | 1,394 | 3,968 |

*Source:* DSI (2008a), GDRS (2007).

### *Legal and organizational aspects*

Development of water resources is under the responsibility of the state, except some privately owned small springs and waters. The use of groundwater resources (more than 10 meters below the ground) is arranged by a special law. Groundwater licenses are issued by DSI upon the request of the users for each reservoir. The licenses cover only right to use and they can neither be transferred nor sold.

Several legislations and regulations address specific issues, but they are far from forming an integrated framework for effective management of water resources. The existing laws and regulations do not provide proper definition of water rights. Extended drought periods caused full development of water resources in the western and central regions involving transfer of water from irrigation to domestic and industrial use. This situation may further increase the uncertainty in the availability of irrigation water, and without any compensation mechanism, farmers will be major losers. Naturally, the legislative arrangements should at least cover priority determination for the intra- and inter-sectoral (irrigation, municipalities, industry, recreation, fishery etc.) allocation of water, proper pricing policy to recover the costs of water projects.

Large number of governmental and non-governmental organizations has direct and indirect interest in the aspects of water resources development and conservation. Institutional framework has three levels such as decision making, executive and users. Prime Ministry, State Planning Organization and ministries are at the decision making level. Governmental organizations under the ministries are at the executive level. Following the abolishment of General Directorate of Rural Services (GDRS), DSI is left as the sole central agency for irrigation development. The responsibilities GDRS have been decentralized and transferred to Special Provincial Administrations. The impact of this transfer to local level on the irrigation development is yet to be seen.

Village legal entities, municipalities, associations and cooperatives are the organizations at the water users level for the operation and maintenance of the projects. Any one of these legal entities may be used depending on the size of irrigation schemes and preference of the farmers. Users' organizations are responsible for O&M of irrigation transferred schemes according to the transfer agreement signed by DSI. DSI is also responsible for the monitoring and evaluation of the O&M activities undertaken by the transferred institutions.

Almost all of the total irrigated area is managed by the users' organizations. The area developed by the GDRS and farmers themselves have been managed by the farmers. The transfer of O&M of the schemes developed by DSI has been completed. The transfer of O&M has been accomplished according to the law of establishment of DSI. The users' organizations are supposed to recuperate the estimated costs of O&M and fulfill the obligations for the investment costs if the area is developed by DSI.

### *Irrigation Water Pricing*

There is almost no volumetric pricing system in irrigation, whereas volumetric charges are common in domestic and industrial use. The user organizations determine the water charges based on expected operation, maintenance and investment cost for the year.

There are basically three major water user groups in Turkey. Irrigation associations took over the O&M responsibility of the DSI managed schemes using surface water. Irrigation cooperatives were the preferred legal entity for the transfer of the management for the irrigation facilities using groundwater. DSI collects data on several aspects of irrigation on the transferred schemes, including pricing, water use, yields, budgets of the IAs. The transferred area developed by DSI makes about 60 percent of the total irrigated area in Turkey. The data on the area developed by GDRS and by the farmers are scanty. The following description of water pricing reflects the situation in the irrigation schemes developed by DSI and transferred to various water users' organizations.

Irrigation organizations calculate the fee per hectare by simply dividing the expected costs of O&M expenses during the following to the total area irrigated. Depending on the heterogeneity of the crop pattern, the irrigation organizations can determine a flat fee per hectare or depending on the cultivated crop. The determined charge is expected to cover just the O&M expenditure. The expenditures on durable equipments (i.e. trucks, other equipments) are charged separately depending on farmers' area of irrigated land.

Real water charges for gravity irrigation increased by almost 30 percent between 2001-06, whereas the same figure for gravity was 12 percent (Table 9).[3] As expected the disparity between gravity and pumping water charges is significant. The farmers using pumping water face 2.5 times higher water charge per hectare then the gravity water users. The schemes using pumping are usually transferred at the early phase of development. The IAs are generally responsible for schemes using gravity conveyance and most of them may be considered to be at a transition phase in terms of management abilities which explains partly the high increase in real water charges.

The trends in the water charges are displayed in Figures 2, 3 and 4 for gravity, pumping irrigation and for the overall national average, respectively.

The increasing trend in real water charges is leveling off in the recent years. Water Users' Organizations (Irrigation Associations and Irrigation Cooperatives) have been satisfied in keeping up the charges with the rate of inflation.

**Table 9. Water charges of the transferred irrigation organisations, 1999-2006.**

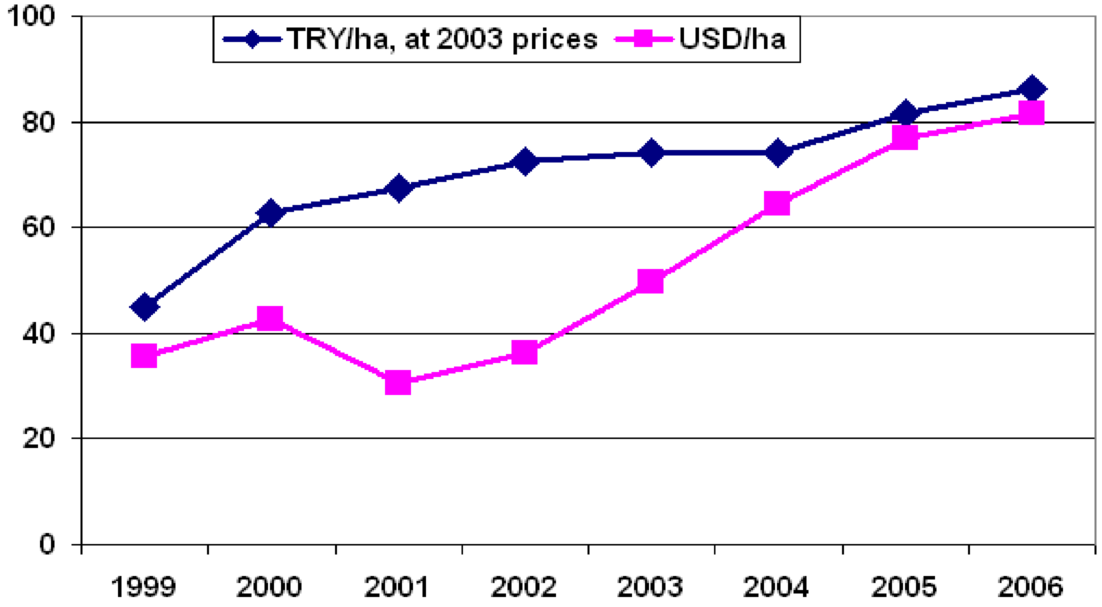
| | Gravity | Pumping | Average[a] | | Gravity | Pumping | Average[a] |
|---|---|---|---|---|---|---|---|
| | (Real TRY/ha, at 2003 prices)[b] | | | | (USD/ha)[c] | | |
| 1999 | 45 | n.a. | n.a. | | 36 | n.a. | n.a. |
| 2000 | 63 | n.a. | n.a. | | 43 | n.a. | n.a. |
| 2001 | 67 | 197 | 81 | | 30 | 89 | 37 |
| 2002 | 73 | 213 | 88 | | 36 | 106 | 44 |
| 2003 | 74 | 221 | 93 | | 50 | 148 | 62 |
| 2004 | 74 | 188 | 89 | | 65 | 164 | 77 |
| 2005 | 82 | 230 | 98 | | 77 | 216 | 93 |
| 2006 | 86 | 221 | 103 | | 82 | 209 | 97 |

[a] Area weighted average; [b] Deflated by producer price index, 2003=1 (TurkStat, 2008); [c] Exchange rate from CB, 2008; n.a. not available.
*Source:* DSI ( 2008c).

3 National, regional and crop specific water charges are area weighted averages.

**Figure 2. Water Charges for gravity irrigation, 1999-2006**[a]

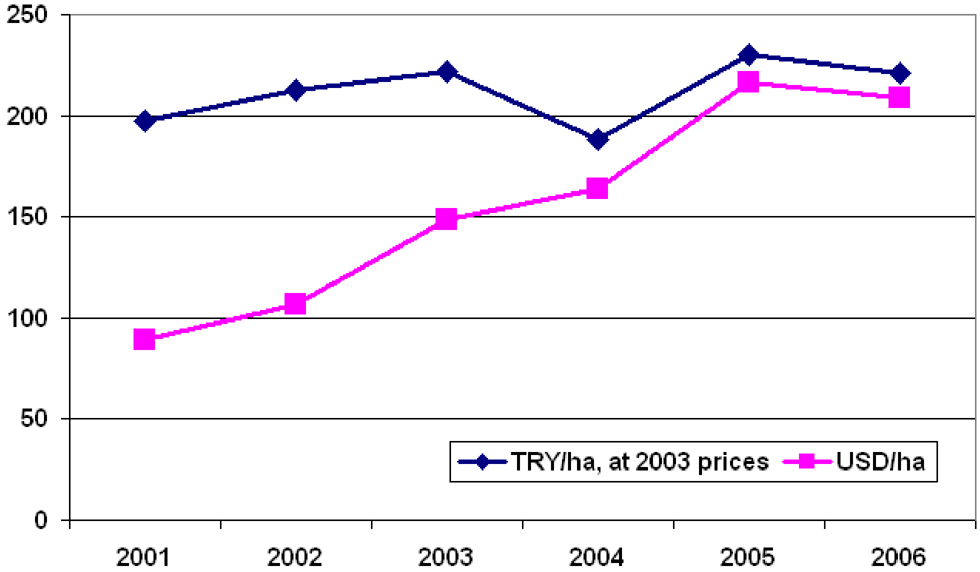
(TRY/ha, at 2003 prices and USD/ha)




[a] Covers the irrigation schemes developed and transferred by DSI.
*Source:* Table 9.

**Figure 3. Water Charges for Pumping Irrigation, 2001-06**[a]

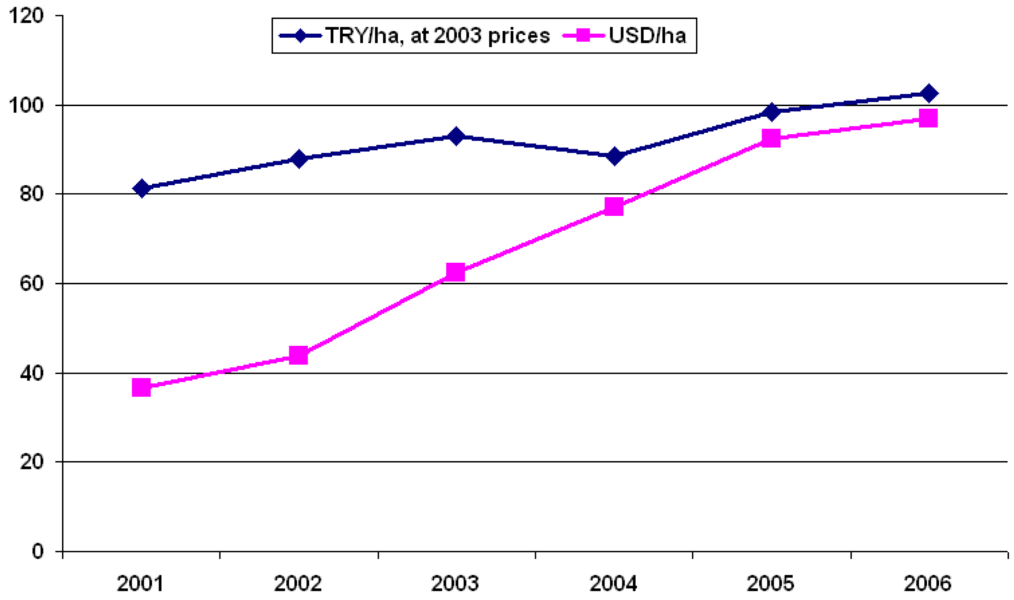
(TRY/ha, at 2003 prices and USD/ha)




[a] Covers the irrigation schemes developed and transferred by DSI.
*Source:* Table 9.

**Figure 4. Average Charges for Irrigation Water, 2001-06[a]**

(TRY/ha, at 2003 prices and USD/ha)




[a] Covers the irrigation schemes developed and transferred by DSI.
*Source:* Table 9.

Regional water charges per hectare by crops are presented in Table 10, 11 and 12 for gravity, pumping and overall average, respectively. The reported water charges are area weighted averages of the schemes developed and transferred by DSI to WUOs.

Regional gravity charges vary widely between USD64 and USD147 (Table 10). The charges seem to reflect the relative scarcity of surface water, and also they are highly dependent on the crop pattern. In addition, recently developed schemes have relatively lower charges, as indicated by the average charge of the Southeast. Marmara Region with the highest water charge has a small share in total gravity irrigated area. However, paddy cultivation occupy a quarter of the total, followed by maize and vegetables. The share of gravity irrigation in the Central Region in total is 20 percent, almost half of this area is occupied by cereals, followed by sugar beet. Close to 60 percent of the gravity irrigated area in Southeast is allocated to cotton.

As expected the variation in pumping water charges is lower than gravity irrigation (Table 11). Cotton continues to be the dominant crop in the Southeast. The cropping pattern in the pumping area of the Marmara Region is similar to the gravity. In most of the other regions high value cash crops, such as fruits, vegetables and citrus have relatively higher share in pumping area compared to area irrigated by gravity.

**Table 10. Regional gravity irrigation charges by WUOs, 2006 (USD/ha)**

| | Marmara | Aegean | Central | Mediterra-nean | Black Sea | East | Southeast | Turkey |
|---|---|---|---|---|---|---|---|---|
| Cotton | | 84 | | 86 | | | 72 | 78 |
| Cereals | 49 | 52 | 49 | 36 | 52 | 49 | 42 | 47 |
| Maize | 158 | 93 | 87 | 65 | 86 | 86 | 72 | 80 |
| Sugar beet | 105 | 178 | 112 | 128 | 95 | 93 | 91 | 107 |
| Fruits | 135 | 111 | 126 | 90 | 105 | 106 | 96 | 110 |
| Vegetables | 160 | 104 | 93 | 119 | 103 | 90 | 92 | 119 |
| Feed crops | 135 | 94 | 94 | 63 | 81 | 65 | 134 | 86 |
| Citrus | | 114 | | 127 | | | 56 | 126 |
| Sunflower | 63 | 93 | 64 | 44 | 65 | 69 | 100 | 70 |
| Paddy | 185 | 161 | 83 | 121 | 162 | 280 | 74 | 171 |
| Grapes | 77 | 83 | 55 | 52 | 119 | 103 | 30 | 81 |
| Maize-2.crop | 53 | 64 | 70 | 59 | 58 | 0 | 57 | 60 |
| Melons | 73 | 86 | 81 | 67 | 99 | 91 | 42 | 73 |
| Seedlings | 92 | 64 | 110 | 62 | 94 | 69 | 15 | 68 |
| Dry beans | 122 | 163 | 89 | 62 | 54 | 113 | 99 | 95 |
| Potatoes | 104 | 80 | 91 | 92 | 79 | 56 | 161 | 83 |
| Olive | 46 | 112 | 59 | 91 | | | | 106 |
| Greenhouse | 114 | 197 | 427 | 203 | | | | 172 |
| Average | 147 | 85 | 76 | 80 | 87 | 75 | 64 | 82 |

Average exchange rate in 2006 is TRY1.4301/USD (CB, 2008).
*Source:* DSI (2008c).

**Table 11. Regional Pumping Irrigation Charges by WUOs, 2006 (USD/ha)**

| | Marmara | Aegean | Central | Mediterra-nean | Black Sea | East | Southeast | Turkey |
|---|---|---|---|---|---|---|---|---|
| Cotton | | 109 | | 230 | | | 154 | 138 |
| Cereals | 60 | 79 | 72 | 134 | 84 | 85 | 73 | 78 |
| Maize | 191 | 138 | 215 | 234 | 271 | 195 | 179 | 182 |
| Sugar beet | 216 | 211 | 268 | 134 | 253 | 350 | 308 | 275 |
| Fruits | 293 | 162 | 313 | 190 | 370 | 290 | 173 | 271 |
| Vegetables | 225 | 174 | 280 | 340 | 309 | 185 | 161 | 239 |
| Feed crops | 233 | 217 | 257 | 206 | 249 | 210 | 134 | 221 |
| Citrus | | 67 | | 449 | | | | 445 |
| Sunflower | 39 | 128 | 130 | | 91 | 175 | 198 | 139 |
| Paddy | 251 | | | | | | | 251 |
| Grapes | 386 | 133 | 292 | 297 | 322 | 378 | 105 | 163 |
| Maize-2.crop | 88 | 163 | 0 | 312 | 146 | 0 | 119 | 141 |
| Melons | 162 | 80 | 304 | 149 | 171 | 157 | 175 | 164 |
| Seedlings | 229 | 219 | 184 | 292 | 298 | 270 | 91 | 229 |
| Dry beans | 108 | 161 | 206 | 146 | 231 | 248 | 217 | 165 |
| Potatoes | 188 | 175 | 195 | 283 | 201 | | 161 | 249 |
| Olive | 371 | 219 | 205 | 167 | | | | 357 |
| Greenhouse | | 210 | | 832 | | | | 830 |
| Average | 237 | 133 | 253 | 322 | 248 | 237 | 159 | 209 |

Average exchange rate in 2006 is TRY1.4301/USD (CB, 2008).
*Source:* DSI (2008c).

**Table 12. Regional Average Irrigation Charges by WUOs, 2006 (USD/ha)**

| | Marmara | Aegean | Central | Mediterra-nean | Black Sea | East | Southeast | Turkey |
|---|---|---|---|---|---|---|---|---|
| Cotton | | 87 | | 72 | | | 81 | 82 |
| Cereals | 51 | 56 | 48 | 28 | 54 | 51 | 43 | 48 |
| Maize | 167 | 98 | 102 | 66 | 96 | 106 | 73 | 86 |
| Sugar beet | 130 | 200 | 125 | 132 | 104 | 140 | 215 | 130 |
| Fruits | 196 | 133 | 205 | 122 | 152 | 118 | 109 | 152 |
| Vegetables | 177 | 119 | 125 | 143 | 129 | 102 | 107 | 143 |
| Feed crops | 153 | 118 | 104 | 82 | 92 | 70 | 134 | 100 |
| Citrus | | 112 | | 185 | | | 56 | 177 |
| Sunflower | 62 | 120 | 70 | 44 | 67 | 76 | 158 | 95 |
| Paddy | 180 | 161 | 83 | 121 | 155 | 280 | 74 | 172 |
| Grapes | 372 | 87 | 91 | 125 | 120 | 263 | 101 | 93 |
| Maize-2.crop | 72 | 75 | 70 | 58 | 62 | | 60 | 67 |
| Melons | 82 | 84 | 102 | 70 | 106 | 108 | 133 | 85 |
| Seedlings | 145 | 78 | 166 | 115 | 108 | 88 | 34 | 118 |
| Dry beans | 114 | 162 | 92 | 64 | 64 | 130 | 148 | 101 |
| Potatoes | 105 | 81 | 94 | 144 | 81 | 56 | 161 | 92 |
| Olive | 328 | 96 | 171 | 133 | | | | 222 |
| Greenhouse | 114 | 197 | 427 | 311 | | | | 251 |
| Average | 169 | 94 | 92 | 94 | 100 | 88 | 75 | 97 |

Average exchange rate in 2006 is TRY1.4301/USD (CB, 2008).
*Source:* DSI (2008c).

The change of management from DSI to WUOs had two important effects in financing the O&M expenditures. First, water charges increased both in real terms and in terms of USD. More important outcome was the increase in the collection rates of O&M expenditures. The first column in Table 13 shows the ratio of collected to accrued water charges for the transferred schemes.[4] The collection rates of the WUOs are usually higher than 80 percent, whereas the collection rates of DSI operated schemes in mid-1990s were around 40 percent (Cakmak, 2004).

**Table 13. Collection rates and irrigation ratios of the transferred**

Irrigation Schemes, 1999-2006 (%)

| | Collection rates of the charges | Irrigation Ratios | Total Irrigation Ratios[a] |
|---|---|---|---|
| 1999 | 82 | 76 | 84 |
| 2000 | 86 | 66 | 76 |
| 2001 | 85 | 64 | 73 |
| 2002 | 83 | 68 | 79 |
| 2003 | 80 | 67 | 76 |
| 2004 | 82 | 69 | 79 |
| 2005 | 83 | 66 | 76 |
| 2006 | 85 | 65 | 77 |

[a] Includes the area irrigated by farmers and the area outside the Scheme.
*Sources:* DSI (2008c), DSI (2008d).

[4] The payments of accrued charges for a specific year may be delayed by the farmers. The numerator of the ratio is the total payments for the corresponding year of the accrued payments.

The last two columns in Table 13 show the irrigation ratios of the transferred irrigation schemes. Especially, the irrigation ratios are alarming. About 35 percent of the transferred irrigated area are allocated to rainfed agriculture (Table 13). This is equivalent to more than 700,000 hectares of installed area with irrigation infrastructure that are not actually irrigated. Furthermore unavailability of water is cited as the top reason for the shift to rainfed agriculture (DSI, 2008a).

### *The extent of cost recovery in the Turkish irrigation sector*

Various definitions have been proposed to measure subsidies to irrigation provision. The most recent comprehensive coverage is provided by Malik (2008).

Malik (2008) basically evaluated two approaches. First is based on the comparison between farmers' water value and water total costs. Farmers' water value can be based either on willingness-to-pay or on water productivity. The second one is based on the comparison between total charges paid by the farmers and the total costs of water services including the capital costs. The later approach is similar to Wateco (2003) Guidelines for the implementation of the Water Framework Directive. The difference between farmers' total payments and total water service costs, with a detailed definition of financial (capital) costs, including a return to capital is accepted as the amount of subsidy to the water sector. In short, the difference between full supply cost in Figure 1 and the total payments by the farmers can be considered as a relatively easier, practical and narrow definition of subsidy to the irrigation sector excluding all opportunity costs, economic and environmental externalities.

The costs components of irrigation water supply in Turkey comprise of O&M and capital costs. The recovery rate of O&M charges is quite high. Both O&M costs and if any, capital costs are incurred by the farmers for the irrigated area developed by the farmers. The O&M costs of the area developed by GDRS fall fully on the farmers. Following the accelerated transfers of the area developed by DSI, the IAs became responsible for O&M activities. The costs should be fully paid by the farmers. Apart from the O&M of water reservoirs, part of the main and secondary canals the costs of O&M are paid by the irrigators. Hence, the burden of O&M costs is almost fully transferred to the farmers.

There are both legal and political constraints to recover the capital costs of irrigation schemes developed by public institutions. Area developed by now abolished GDRS were taken over by the irrigators free of charge since there was no legal basis to recover any investment costs incurred by GDRS. If a tube well is necessary, it is installed by DSI, and DSI was supposed to be reimbursed for the expenses in compliance with the DSI law. The conveyance canals from the source to the field were constructed by GDRS without any pay back requirements for the farmers.

DSI is the main investment state agency responsible for the development of water resources. More than 60 percent of the total irrigated area is developed by DSI. Hence the recovery of the capital costs incurred by DSI is the main determinant of the total subsidy to the irrigation sector.

Although the DSI law dates back to 1953, it requires that the farmers pay back all expenses for the construction of irrigation works. Per hectare payment for the nominal investment costs are determined by dividing the total investment costs by the total irrigated area and the number of the years in the pay-back period. The investment costs (including the share of irrigation for the multi-purpose projects), the starting year of investment payments and the pay-back period are determined by the DSI. The final decision is made by the Prime Minister with the recommendation of the Ministry responsible for DSI (currently, The Ministry of Environment and Forestry).

It also establishes the principle to recover fully the capital cost. According to the law, the payments for the construction of the works are to be subject to interest. However, it also provides a waiver. The payments are exempt from interest payments if the derived benefits of the works cannot bear the burden of the interest payments. There is only one-time 10 percent penalty for all delayed payments.

The first political constraint for the recovery of the capital costs is related to the waiver above. The irrigation projects are categorized as the "works" that cannot bear interest payments. The second political constraint is related to the publication frequency of Council of Ministers decrees determining the annual payments for the investment costs. Three decrees in 1978, 1986 and 2002 are put in the force in the last 30 years. The farmers benefiting from the irrigation areas developed since 2002 are not liable to pay any capital charges.

The responsibility to pay the capital charges is transferred from the farmers to irrigation associations. Table 14 is produced to give an idea about the unwillingness to pay back the capital charges by the irrigation associations, facilitated by the legal framework and political reluctance of the government. The first column shows the share of accrued investment charges of the IAs in their total charge collection. The shares are small, fluctuate around 2 percent. The second column is the total cost recovery rates of DSI. Available data did not allow to differentiate O&M and capital charges. However, the management of almost all irrigated area developed by DSI (96 percent in 2008) is transferred to IAs. The share of O&M is almost nil. Hence the recovery rates basically reflect the collection of the accrued investment charges. For instance, only 7 percent of the accrued investment charges are collected from the irrigators.

**Table 14. Recovery of the investment costs, 1999-2007 (%t)**

| | Investment charges/collected water charges ratio of WUOs | Total collection/assessment ratio of DSI |
|---|---|---|
| 1999 | 1.5 | 37 |
| 2000 | 0.4 | 40 |
| 2001 | 2.5 | 40 |
| 2002 | 4.1 | 38 |
| 2003 | 2.4 | 40 |
| 2004 | 2.6 | 28 |
| 2005 | 2.4 | 14 |
| 2006 | 1.2 | 14 |
| 2007 | 1.2 | 7 |

*Sources:* DSI (2008c), DSI (2008a).

The increasing burden of O&M costs to the government until mid-1990s has been reduced drastically through the accelerated transfer of O&M activities to irrigation associations. However, the reluctance of the government to recover even the nominal investment expenditures continues.

## Main policy conclusions

Agriculture remains an important source of income and employment in Turkey. Agricultural production is heavily dependent on water availability for increasing productivity and decreasing volatility in production. Half of the crop production in Turkey relies on irrigation. Irrigated agriculture currently consumes about 75 percent of total water consumption which is about 30 percent of renewable water availability. However incidents such as increasing urbanization, climate change and changing agricultural world commodity prices are expected to increase the sectoral competition for water resources and raise the need for major changes in water policies in the medium and the long run.

Several legislations and regulations address specific issues, but they are far from forming an integrated framework for effective management of water resources. The existing laws and regulations are also far from defining appropriate water rights. Extended drought periods resulted in the full development of water resources in the western and central regions involving the transfer of water from irrigation to domestic and industrial use. This situation will increase the uncertainty of irrigation water allocation adversely affecting farmers' welfare. The legislative arrangements should, at least, cover priority determination for the intra- and inter-sectoral (irrigation, municipalities, industry, recreation, fishery etc.) allocation of water, and a proper pricing policy to recover full cost of water supply from the beneficiaries.

Pricing and cost recovery policies vary among sectors. There is almost no volumetric system for irrigation, whereas volumetric charges are common in domestic and industrial use. Almost all water users' organizations determine the per hectare fee for the operation and maintenance based on expected operation and maintenance costs. The government has been reluctant to recuperate the investment costs. The participatory approach that has been limited to O&M activities should be extended to recovery the capital costs to achieve efficient and equitable use of water and land resources. Involving farmers in the planning and implementation stages may provide additional incentive to increase the recovery rates of investment expenditures.

Water stress in Turkey is predicted to increase with the demographic changes and unfavorable global climatic and economic conditions. Fast implementation of the necessary policy measures at all levels will achieve more efficient use of public resources and water. The project stock in the irrigation sector remains to be large compared to the allocated financial resources (SPO, 2008). Priority should be given better use of existing water infrastructure and proper ranking of the unfinished projects. The first one requires improvement in irrigation management practices. More resources can be allocated to restrict water losses from irrigation infrastructure starting from the high evaporation regions. There have been improvements in adopting more efficient water application technologies induced by government subsidies. The uptake of these technologies by irrigators can be further increased by shifting towards volumetric pricing practices. SPO (2008) points out the importance of increasing the efficiency in the use of irrigation water by the determination of irrigation fees proportional to the actual amount used.

Turkey is resistant towards making any radical changes in water management policies. However, unfavorable global climate and economic conditions may further increase the stress in the water sector. Agriculture consuming about two thirds of water resources will bear the burden of adjustment to water scarcity.

# Appendix Tables

**Appendix Table 1. Institutional framework for agricultural water pricing policies in OECD countries**

| Country | Types of water rights | | Pricing criteria/ Agency | Recovered costs | Differential charges based on: | | | | Other factors | | Perfor-mance | Other economic instruments | Inter-sector water compe-tition | On-going reforms |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Surface | Ground water | | | EQ | LQ | HR | IT | ATP | AP | | | | |
| Turkey | Use rights | Licenses | WUAs and National Government | O&M (+small percent of capital costs) | ✓ | 7 | ✗ | ✓ | ✓ | ✓ | Fair | Agric. Policy | Increasing in some areas | |

*Key to Table :*

- ✓= Yes; ✗= No; n.a. = not available.
- EQ: equity considerations (are prices adjusted in order to avoid wide differences among irrigators?)
- LQ: Do land quality considerations justify different price levels?
- HR: Do historical rights explain any price variations (holding other factors constant)?
- IT: Is irrigation technology taken into account when setting charges?
- ATP: "Ability-to-pay"
- AP: Is general agricultural policy taken into account when setting charges.
- Performance is rated by comparing the objectives of each country's charging systems with their accomplishments.

*Source:* OECD, 1999, *Agricultural Water Pricing in OECD countries*, Paris, www.olis.oecd.org/olis/1998doc.nsf/LinkTo/env-epoc-geei(98)11-final

**Appendix Table 2. Agricultural water price ranges and characteristics in selected OECD Countries**

| Country | Region (year) | Supply characteristics | Type of charge | Price (in $)<br>Surf. (per ha) | Vol. ($m^3$) | Cost-recovery | Comments | Sources |
|---|---|---|---|---|---|---|---|---|
| Turkey | See Tables 8-10 in the text<br>All for the year 2006. | Wholesale+Retail<br>Wholesale+Retail<br>Wholesale+Retail<br>Wholesale+Retail | See Tables 10-12 in the text | See Tables 10-12 in the text | -<br>-<br>-<br>- | 80% O&M<br>80% O&M<br>80% O&M<br>80% O&M<br>Note: Collection rates of the WUAs. They are fully responsible for the O&M. | WUA transferred from DSI<br>WUA transferred from DSI<br>WUA transferred from DSI<br>WUA transferred from DSI | DSI (2008c) |

TRY is converted to USD using the exchange rate of Central Bank of Turkey, CBT (2008).

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