GROWTH OF WATER CONFLICTS IN THE GEDIZ BASIN, TURKEY

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ABSTRACT

Since 1988 the Gediz basin in western Turkey has changed from a water-abundant to a water-short basin. This has resulted in a series of water conflicts. The first conflict occurred during the drought of 1989-1994 when priorities for water use in the basin changed from flood control and hydropower to irrigation. The second results from perennial water shortages caused by development of groundwater resources that have led to lack of water for nature reserves at the end of the basin. The third is due to pollution of surface water by industrial developments that restricts crop choice in the delta. Response to these conflicts has been five-fold: development of a powerful NGO-led lobby to save the Gediz, federation of Water User Associations, a special association for protection of the bird sanctuary, the establishment of a governor-level committee with particular emphasis on environmental concerns, and consideration of a basin-level water management agency. At present no satisfactory mechanisms for dealing with current water conflicts has yet emerged.

RESUME

Depuis 1988 le basin versant Gediz en Turquie de l'ouest a changé d'un bassin eau-abondant à un basin fermé. Cela a résulté en une série de conflits de l'eau. Le premier conflit s'est produit pendant la sécheresse de 1989-1994 quand priorités pour usage de l'eau dans le bassin ont passée de contrôle de l'inondation et hydropower à irrigation. Le deuxième s'agit de pénuries d'eau causées par le sur-développement de ressources d'eaux souterraines qui ont causé un manque d'eau pour les reserves natureelles à la fin du basin versant. Le troisième problème est dû à pollution des eaux de surface par le développement industrielle, qui restreint le choix de récolte dans le delta. Cinque approches ont été developpées pour faire face à ces conflits: développement d'un'lobby' mené par un ONG pour sauver le Gediz, une fédération des associations pour utilization deeau; l'établissment d'une association pour l'emanagement du sanctuaire des oiseaux, l'établissement d'un comité au niveau du gouverneur de la région avec accentuation particulière sur les inquiétudes concernant la protection de l'environnement, et considération d'une agènce de gestion d'eau À présent aucun mécanisme approprié à emergé qui fera face ces conflits d'eau.

Keywords: drought, groundwater depletion industrial pollution, basin level management, environmental protection, water quality.

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INTRODUCTION TO THE GEDIZ BASIN

The Gediz Basin in western Turkey has long been an important center for agricultural production, dating back to the earliest civilizations of the Lydian kingdoms in the pre-Hellenic period. It has a total area of some 17,000 km^2. Its boundary are mountain ranges exceeding 3,000 m on both the southern and northeastern edges delineating a flat and fertile central valley, and a delta that reaches into the Mediterranean Sea just north of Izmir (IWMI and GDRS, 2000)

Climatically it is ideally suited for irrigation development. During the winter months precipitation exceeds 700 mm, falling as snow at elevations above 1000m. In the spring the combination of stored soil moisture and snowmelt has facilitated a long tradition of irrigated agriculture both from the main Gediz River and from tributary streams. Before the development of modern water resources infrastructure, there were several areas subject to flooding during winter months which were used for summer rice cultivation, and considerable areas of winter wheat and barley that received some irrigation. Normally too little water was available for substantial summer cultivation or perennial agricultural crops. In tributary areas irrigation is small-scale and totals some 20,000 ha, with extensive areas of fruit orchards and vegetables, plus wheat and barley cultivation. Since 1945 large-scale irrigation systems totaling some 105,000 ha have been constructed in the main valley, which is now dominated by cotton (50%) and grapes (35%). The Gediz basin is one of the largest producers of raisins in the world. Other commercial crops such as fruits and vegetables are exported throughout Turkey as well as directly to the European Community.

The basin also serves as the source of much of the drinking water for the city of Izmir, now the third largest city in Turkey with a population exceeding 2m, as well as supporting a population within the basin of up to 1.0 m.

DEMANDS FOR WATER IN THE GEDIZ BASIN

There has been a steady sequence of water resources developments in the Gediz basin from 1945 onwards. Initially the development focused on surface water resources, but increasingly groundwater exploitation is playing an important role. These developments are discussed separately below, while an overview of total water demands from different sectors is presented in Table 1.

Surface Water Resources Development

Although there had been substantial small-scale development of surface water resources for thousands of years, the first modern developments occurred in 1945 with the construction of barrages at Adala and Emiralem (Figure 1). Each of these barrages has a Left Bank and Right Bank canal to serve traditionally designed surface irrigation systems. The total area initially commanded by these barrages was approximately 40,000 ha. However, the total command area could not be irrigated throughout the

summer due to low natural flows in the Gediz River from July to November.

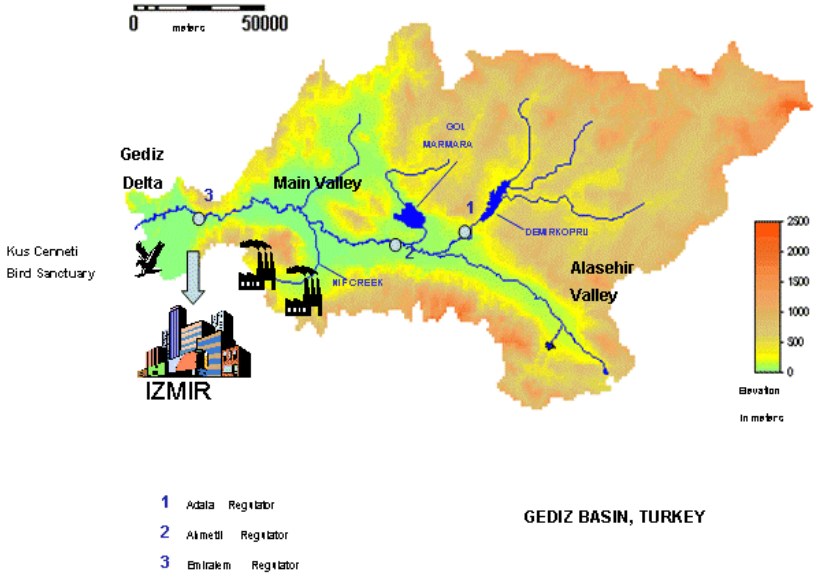

Figure 1: General location of water resources development, Gediz Basin, Turkey

In 1970 a substantial reservoir was constructed at Demirkopru, just upstream of Adala Regulator (DSI, 1995). The capacity of the reservoir is 1200×10^6 m^3 compared to an estimated annual flow in the river of 960×10^6 m^3. Demirkopru was designed as a multi-purpose reservoir, providing flood control, hydropower and irrigation. Two smaller reservoirs were also constructed in the head reaches of the Alasehir River providing irrigation supplies for the three irrigation systems in the Alasehir Valley.

In parallel with the construction of Demirkopru Reservoir, two other water resources developments occurred. The first was drainage installation in the Adala area, particularly in the area below the natural lake of Gol Marmara which was enlarged with construction of an embankment, so that waterlogging was eliminated in the main valley. A third barrage was constructed at Ahmetli, replacing traditionally constructed barrages, and irrigation was extended in the delta. Much of the irrigated area below Ahmetli barrage was constructed with raised parabolic canalets, some of which were also installed in the upper and right hand side of the delta systems. By the time all of these works were completed, the total command area of the large-scale systems exceeded 100,000 ha, and irrigation throughout the summer was possible in all parts of the area.

From 1972 until 1988 there were no serious problems with water availability at basin level. Demirkopru reservoir spilled on several occasions, power generation continued throughout the winter months so as to maintain sufficient storage for flood control, and irrigation water was available throughout the growing season. There were, however, some distributional problems within the larger irrigation systems that led to conflicts among different water users. This appears to have been the consequence of a design that relied on very long main canals with a large number of small offtakes. This type of design is hard to monitor and control, and head end water users find it relatively easy to extract more than their designed share of water. However, these internal conflicts are not within the scope of this paper.

In 1989, however, the situation changed dramatically with the onset of a four-year drought that precipitated permanent alterations in the water conditions of the Gediz Basin (Turkes, 1997). The drought had two major impacts: the start of disputes between different sectors (power, irrigation, flood

control, urban and domestic supply), and the onset of significant groundwater exploitation. We will discuss the latter point first.

Groundwater Resources Development

Groundwater resource development in the basin has been for a variety of different purposes. The first large-scale developments were well fields to provide drinking water for Izmir, some near Sarikiz, others near Manisa. The total capacity of these well fields is 108×10^6 $m^3 y^{-1}$. However, as this is a transbasin diversion, there are no return flows within the Gediz basin. However, plans exist to divert up to 5 m^3 sec^{-1} of treated wastewater back to the Gediz delta for irrigation purposes in the summer months. All of the municipalities in the basin also rely on groundwater for drinking supplies, but much of this comes back as return flows, which are estimated to be just over 80% of total extractions. Western Turkey is one of the fastest-growing parts of Turkey, exceeding a rate of at least 6% for the past 15 years and even more in Izmir itself, so that demand for drinking water continues to increase more or less exponentially.

The second use of groundwater has been for irrigation purposes. In response to the drought of 1989-1994, massive investments were made both by government and private individuals, either alone or in groups, to compensate for the lack of adequate surface flows. The exact number of pumps and their total annual pumping for irrigation is not known, but it is possible to deduce the impact. In 1988, the last year before the drought, the State Hydraulic Works Organization (DSI) reported a total cropped area of some 70,000 ha. In 1998 an almost identical cropped area was reported by the various Irrigation Associations in the basin (67,500 ha). However, satellite image analysis showed that actual cropped area in the 11 major systems totaled just over 110,000 ha. The difference of just over 40,000 ha is attributed to private groundwater use which is not recorded by the Irrigation Associations, findings supported by field surveys in different parts of the basin. Despite the costs of pumping, farmers find groundwater use profitable (Ray and Gul, 1999). Long term water use trends are shown in Figure 2.

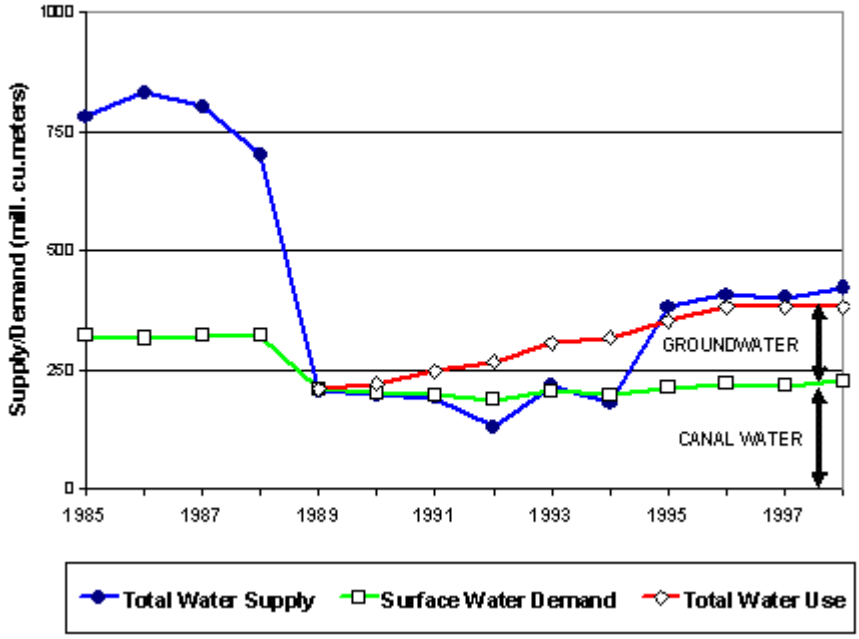

Figure 2: Long term water use trends in Gediz Basin, Turkey

The third use of groundwater has been for industrial expansion, mostly in the Nif Valley. Since about 1990, and particularly since 1995, Izmir has expanded out of its own small catchment and is now encroaching into the Gediz basin. East of Izmir this is largely industrial expansion. Again there are no

precise estimates of total number of wells or total volume pumped by the industrial sector, but pumped volume is estimated to be $50x10^6$ m^3y^{-1}. The impact of the industrial development on groundwater levels is a matter for some concern, but the real impact is that return flows from industries enter the Nif Creek and are a major source of contamination of surface waters in the basin, both in the Nif valley itself and in the main Gediz downstream of the confluence in Manisa.

THREE-PHASE DEVELOPMENT OF WATER CONFLICTS

Historical understanding of water resources developments allows us to better understand the nature of the growth of water-related conflicts among different sectors within the Gediz Basin. We can identify a three-phase development of such conflicts, each of which is related to a different cause: drought, over-development of water resources, and industrial pollution of surface waters.

Conflicts created by drought

The inter-sectoral conflicts created by drought focus largely on the use of Demirkopru as a multi-purpose reservoir. Originally the priority for reservoir operation was for flood control, secondarily for hydropower and thirdly, at least in the summer months, for irrigation. While hydropower generation can occur in conjunction with both flood control and irrigation objectives, some releases were made specifically for hydropower when there were no other demands for water, making less water available for these purposes at other times of the year.

The drought changed all of this. From 1989 onwards irrigation has been the priority for determining reservoir operation rules, even when there was an increase in flow into the reservoir after 1995. Hydropower generation was restricted to the amount of water required for irrigation (a maximum of 75 m^3 s^{-1}), and no releases have been made since that time solely for hydropower. Flood control releases have only been made once, in 1999, when the reservoir was completely full before the end of the spring floods. These releases exacerbated downstream flooding but were required to keep the reservoir safe. Cotton farmers were hurt particularly severely as soils were too wet to enable proper planting and large areas had to be replanted. Despite a full reservoir at the start of the 1999 irrigation season, the austere irrigation timetable developed during the drought was maintained.

While TEDAS, the state electricity generating company, has from time to time wanted to increase releases for hydropower, this has been overruled at national level. The impact of the conflicting priorities for water versus electricity is thus not directly felt at basin level. Water users continue to irrigate crops with an estimated annual value of some $240 million, but presumably there is economic loss due to reduced generation from a low-cost facility whose capital costs are paid off.

Conflicts created by overexploitation of water resources

A second cause of conflict has been the general over-exploitation of water resources. The primary reasons for this appear to be the general increase in demand for water from urban and industrial users and the expansion of public and private groundwater exploitation. The effects of this over-exploitation started during the drought but have persisted.

From the agricultural perspective, it is possible to estimate that without groundwater development (i.e. the conditions that prevailed before 1989) only some 70,000 ha of large-scale irrigation and possibly 15,000 ha of small scale irrigation would exist. Groundwater has expanded these totals to 110,000 ha of large-scale and 20,000 ha of small-scale irrigation, an increase of some 45,000 ha of irrigation. If we assume an average demand of 500 mm y^{-1} to meet water requirements of grapes and cotton, we estimate that there is a groundwater depletion of close to 225 10^6m^3 y^{-1}. Without pumping much of this water now depleted would be return flow to the Gediz, and base flows would probably be in the order of 10-15 m^3 s^{-1}.

Further, releases from Demirkopru reservoir have been very carefully matched to irrigation requirements from the onset of the drought. From 1990 onwards, the maximum discharge from

Demirkopru has been fixed at 75 $m^3 s^{-1}$, the capacity of the turbines at Demirkopru, plus 15 $m^3 s^{-1}$ from Gol Marmara. More importantly, releases from Demirkopru have been limited to a maximum of 60 days in the year during the peak irrigation season from late June to early September. The combined effect of restricted discharges and limited days when releases are permitted is that the total volume closely matches estimated crop water demand for the major irrigation system so there is little excess entering the river system. From mid-May to late-June, and from mid-September onwards, farmers either have to pump or use residual soil moisture for cotton cultivation, further reducing natural flows into the lower parts of the basin.

Water availability for irrigation systems changed from a regime where discharges were nominally matched to estimated crop demand to one where canals were run at full supply level whenever irrigation water was delivered. Because there was a published schedule of when water would be delivered conflicts among irrigators actually fell during and after the drought because it was widely recognized that everyone was suffering equally.

Literature searches reveal a rapid increase in the number of conflicts between irrigation, environment and health (Harmancioglu et al., 2001). The main conflict that developed in this period in the Gediz was between irrigation demand and water requirements for the bird sanctuary (Kus Cenneti) situated between the Menemen irrigation systems and the Mediterranean (de Voogt et al., 2000). Kus Cenneti is a Ramsar site which means that Turkey is committed to preserve the overall habitat of the area. This in turn imposes certain obligations on water managers to ensure that bird habitats are maintained. Some of the freshwater reed beds of the reserve are nesting sites for rare birds and these were severely damaged by lack of water during the height of the drought from 1992-1994. At the same time there were also severe agricultural losses during this period when only one or two irrigations were provided during the entire season, so it was by no means a clear case of agricultural demand taking complete priority over the needs of the bird sanctuary. Nevertheless, from 1995 onwards, water diversions to the bird sanctuary have been small and there are reports the fresh water sanctuary areas have continued to shrink.

Conflicts created by industrial pollution

The third conflict has been caused by the persistent discharge of highly polluted wastewater from the industrial park around the town of Kemalpasha in the Nif Valley. There has been extremely rapid industrial expansion along the main highway from Izmir towards Ankara, all of which is dependent on groundwater extraction. The industries are diverse but include tanning, ceramics, and chemical industries. Industrial concerns have become accustomed to dumping wastewater directly into the Nif Creek, and at the confluence of the Nif and Gediz rivers close to Manisa the polluted Nif water is readily discernable in terms of color and smell.

The polluted waters flow downstream to the Emiralem regulator and are then diverted into both Menemen Left Bank and Right Bank canals. Farmers in those systems claim the water “burns” their skin, and will only use groundwater to grow vegetables and strawberries. Cotton, grapes and fruit trees remain the main commercial crops irrigated using surface water. However, despite the widespread recognition of the low quality of water below Emiralem regulator, it is all used for crop production because most of the lower delta is underlain with unusable saline water.

RESPONSE TO WATER CONFLICTS IN THE GEDIZ

The response to these conflicts has been four-fold: public outcry and growth of NGOs, federation of WUAs, establishment of a basin-level consultative body at governor level, and contemplation of a basin level management organization. At present, overall responsibility for managing the water in the basin still lies with DSI. DSI has tried to respond to quantitative issues where they have direct control, but DSI has very limited responsibility for water quality and pollution monitoring. Because these are some of the primary public concerns, this has placed DSI in sometimes adversarial relationships with

Department of Environment, NGOs and other agencies which have more direct interests and responsibility but less authority (Svendsen et al., 2001).

NGO reactions

Two main NGO reactions have occurred. The first came through the Turkish Society for Protection of Birds which reacted strongly to the damage of fragile habitats. It has established a visitor center with the aim of raising awareness of the general public over the water needs of the bird sanctuary, and has been able to induce DSI to provide some additional water to the sanctuary from the canal system in the order of 700 l/sec.

The second major NGO activity has been the establishment of the "Save the Gediz" campaign. This is a public interest group trying to raise awareness over issues of water quality and water shortages. It holds public events and lobbies various departments to deal with the restoration of satisfactory water conditions. It has had strong links with the Gediz Soil Conservation Society (GEMA)

Federation of Water User Associations

Initially the 11 Water User Associations in the Gediz basin dealt individually with DSI on matters of water allocations and irrigation calendars. However, from 1999 onwards there has been a move towards federation of the WUAs so that they meet as a body with DSI to address issues of water shortages and water allocation between different WUAs served by a common main canal. This represents a significant departure from the original concept of individual WUAs. (Svendsen and Murray-Rust, 2000)

Basin-level consultative body

In reaction to perceptions that DSI had not done as much as it could have with respect to water quality issues, a basin-level consultative committee was established by the three involved Provincial governors (Izmir, Manisa, Usak). This body has close links with the Department of Environment and NGOs, but little direct action has resulted. This is because the governors have little direct authority over enforcement of water quality regulations, and because the polluting industrialists are well organized and influential.

Association for the Protection and Management of Bird Paradise

This association ewas established in 2002 as a joint venture between regional and provincial governors, municipalities and village headmen, all related government bodies, and Dokuz Eylul and Ege Universities to manage the bird paradise, cover all expenses and ensure adequate water supplies.

Basin level water management body

Because the Gediz is not the only water scarce basin in the country, there is growing interest in creating basin level water management bodies that can deal with the types of issues that have emerged in Gediz (Cakmak, 1997). However, these discussions are so far inconclusive because it would require considerable reorganization of public agency responsibilities and would result in the emergence of a powerful new actor in the water resource field. DSI takes the view that if it were given more powers in areas of water quality and environmental protection, it could effectively play the role of a basin level organization. However, other agencies do not share this view and do not see DSI as sufficiently sensitive to the needs of the environment. They favor a more independent body with a stronger willingness and capacity to enforce water quality. This debate continues.

CONCLUSIONS

The Gediz basin changed from a relatively water-abundant basin to a water short basin within the span of only about 10 years, starting with the drought that began in 1989. This appears to have been due to intensification of water resource exploitation in the upper catchments, soil degradation leading to reduction in water holding capacity, and reduced rainfall. However, as water resources diminished, water abstractions increased, particularly groundwater abstractions, so that flows in the lower portion of the Gediz decreased. During the drought this directly affected fragile ecological habitats, a problem that was many assumed would disappear once the drought ended.

In reality, adaptive responses to reduced water availability during the drought led to persistent over-extraction of water by pumping and continuation of somewhat draconian (but popular) restrictions on total water deliveries for irrigation. This reduced in-stream flows to very low levels for long periods of time, a situation that exacerbated the impact of increased dumping of industrial pollution into Nif Creek.

To date, responses have been somewhat confrontational, and management, monitoring and evaluation, and enforcement of existing legislation have been piecemeal and uncoordinated. Only recently has an institutional rearrangement that might manage water resources more holistically been considered. Ultimately such rearrangements are the only realistic long-term solution for water short basins such as the Gediz.

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Table 1: Estimated Water Use by Sector

Water User	Estimated Consumption		Notes
	[million m^3]	Share	
Surface Water			
Large Scale	550	62%	From Demirkopru and Gol Marmara
Irrigation	60	7%	Alasehir Valley
	50	6%	
Small Scale	0	-	No priority for hydropower
Irrigation	4	-	Current releases only; needs more
Hydropower			
Bird Reserve			
Groundwater			
Pump Irrigation	30	3%	Only those outside surface irrigation
Groups	5	1%	area
Private Irrigators	26	2%	
Urban within the	108	12%	18% of extraction, remainder is
Basin	50	6%	return flow
Transfer to Izmir			Trans-basin transfer, no return flow
City			Estimated by DSI
Industry			
Totals			
Annual	833	100%	
Summer (4 months)	760		