

Full Length Research Paper

The importance of forests in a sustainable supply of drinking water: Istanbul example

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Istanbul has administrative, social and economic, drinking water problems. The forest areas of Istanbul are more important to drinking water than any other of the forest's activities, because most of the drinking water dams are located in forest areas. This study is aimed at determining the differences between past and present forestry applications concerning drinking water production in Istanbul for a 600 year period. The level of future drinking water problems in Istanbul was also estimated. Using descriptive analysis method similarities and differences between past and present forestry applications in producing drinking water were identified. Furthermore, the trend of Istanbul's water demand and supply for the 2010 and 2030 term was also predicted with a scenario. This study indicates that Istanbul city has historically experienced drinking water and forest resources shortages. In the past administrators were very keen to conserve forest areas and drinking water resources for the city. Various regulations to protect and improve the utilization of water resources have been created throughout the history of Istanbul. These measures today are not as effective as they once were which causes exploitation and destruction of water resources.

Key words: Forestry, drinking water, traditional use, Istanbul, Turkey.

INTRODUCTION

Over the past 100 years, as the world population has grown by three times Turkey's population has grown about seven to eight times. In 1927 Turkey's population was 13 million, and today it is 72 million. Istanbul has the highest migration rate and is the most crowded city in Turkey, with a population of 12.9 million people (TSI, 2010). Besides the rapid population increase, a huge migration from villages to the city center is also being experienced in Istanbul.

Istanbul's booming economy is driving a rapid rise in water pollution so severe that the densely crowded city could be left without adequate supplies of drinking water. A high population, limitations in terms of preventing soil and water pollution and less precipitation than the world

average requires authorities and people to pay more attention to available water resources.

Relation between forest areas and drinking water

Forests have profound effects on water resources and it is essential that water resources be jointly considered with forests wherever in the world these assets are valuable for national development or for environmental balance (Newson and Calder, 1989). Drinking water is generally produced in the watershed where natural forests are located. Across the globe, there are numerous examples of the vital role that forest watersheds play in protecting fresh water supplies (Geray, 2004; Dudley and Stolton, 2003). Forests can also store water and delay its flow towards the lowlands and to the sea. Forest soils act as a reservoir as they usually have a higher water storage capacity than non-forest soils. Moreover, forest

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Figure 1. Study Area: Istanbul.

Table 1. Population growth rates in Istanbul and Turkey (TSI, 2010).

Year	Population		Growth Rate (%)	
	Turkey	Istanbul	Turkey	Istanbul
1950	20947183	1166477		
1970	35605176	3019032	70.0	158.8
1990	56473035	7309190	58.6	142.0
2010	72950000	12915000	29.2	76.7

vegetation keeps water back and delays soil saturation. Evapotranspiration from forests of a certain age can remove a considerable proportion of storm rainfall. Surface run-off can therefore be prevented or slowed down, even in high precipitation events. The effect of flood reduction is particularly relevant at the local scale for small watersheds (UNECE, 2004).

Forests and wetlands tend to slow down the passage of water and encourage the deposition of sediments, thus reducing sediment transport, sedimentation of waterways and water pollution (Saefl et al., 2002; Hebda, 1992). In forests, high infiltration rates, interception of rain by forest canopies, the developed root systems and coverage of soils by forest vegetation and leaf litter counteract soil erosion and reduce the risk of landslides. Sediment retention and erosion reduction also have positive effects on infrastructure, such as decreasing deposition of suspended soil particles in water treatment installations, storage structures, pumping equipment and turbines, which in turn increases their operating lives and reduces their operation and maintenance costs (UNECE, 2004).

Most of the world's water supply is saltwater stored in the oceans, but converting saltwater to fresh water is generally too expensive to be used for industrial, agricultural or household purposes. Citizens need clean water at reasonable cost and in many parts of the country; ground water is the only economical water source available (EPA, 1998).

In this paper, the status concerning legal actions and forestry management approaches in relation to drinking water supplying in Istanbul is explored. Furthermore, the objective of the study is to explain how in the past and the present understanding of forestry in relation to drinking water production has changed.

Study area

Istanbul, which was once known as Constantinople, is the old Roman city of Byzantium, located on the natural boundary between Europe and Asia (Figure 1). It was re-founded by the emperor Constantine in AD 330 as the eastern capital of the Roman Empire. Medieval Byzantium was renowned and admired as a center of Christian art and culture until the 15th century when the city finally fell to the Ottoman conqueror Mehmet II. During these times Istanbul continuously expanded and flourished in both cultural and physical wealth, providing a secure urban setting during the eras when Byzantium and Ottoman culture prevailed (Bono et al., 2001; Eroglu, 2000).

Although it lost capital city status at the beginning of the Turkish Republic, it continues to be the center of economic, social, and cultural activity in Turkey (Eroglu, 2000). Istanbul has been the most populous of Turkish cities from the past to present-day. By referring to Table 1, except for 1950, the population of Istanbul has increased faster than the population of Turkey. Between 1950 and 2005, Istanbul's population has grown about ten times, from 1166477 people, to 12915158.

The increase in Istanbul's population is closely related to rapid industrialization and urbanization. Every year about 300000 to 400000 people have immigrated to Istanbul. The net migration rate plays an important role in Istanbul's population increase (Eroglu, 2000). Experts say, "The trend in Istanbul is being driven by immigrants who come for jobs." However, Istanbul's residential and industrial areas have been unable to keep pace with the city's staggering population increase. The crisis is affecting watershed and forest resource efficiency throughout the city. Since alternative uses of forest and watershed lands usually promise higher short-term economic benefits, these areas are converted to residential and industrial areas, sometimes illegally. As new arrivals pour into the city its water supply begins to suffer. The process of immigration has a clear and discernible impact on drinking water supply and demand. These developments are creating increasing pressure on

the Ministry of the Environment and Forestry to justify the continued protection of forest areas. Reservoirs within Istanbul are becoming surrounded by illegal settlements. Inadequate sewage facilities also threaten Istanbul's drinking water. The impact of mass migration on the city's infrastructure is enormous (Eroglu, 2000).

MATERIALS AND METHODS

The material of this study constitutes forestry applications concerning drinking water production in the past and present in Istanbul. Data about the subject were collected from the State Hydraulic Works and the Istanbul Forest District Directorate.

The findings of this study were obtained without using any statistical methods or quantitative tools, instead they were obtained with a qualitative analysis method. Mainly, tracer and stakeholder analysis, case study method, oral history and focus group methods are applied under the qualitative analysis method. Two fundamental analysis techniques are used in qualitative studies. These are descriptive analysis and content analysis techniques. In the descriptive analysis research data are summarized and interpreted on the predetermined subjects (topics). Content analysis is another technique for summarizing any form of content by counting various aspects of the content (Altunisik et al., 2005).

This study includes descriptive analysis technique in order to pose the importance of the forests in drinking water in Istanbul. For this reason, documents and reports about drinking water production and forestry applications during the Ottoman (1453 to 1920) and the Turkish Republic (1920 to 2010) periods were examined. The period in this study covers 600 years beginning from Ottoman Era till the present. Using descriptive analysis method in the study identified similarities and differences between past and present forestry applications in producing drinking water. In the statistical analyses one scenario was prepared for the production and consumption of drinking water of Istanbul. The trend of Istanbul's water demand and supply for the 2010 and 2030 term was predicted with this scenario.

RESULTS

Forestry problems

At the beginning of World War 1 heavy tree cutting occurred in order to provide railway-ties, fuel wood and other timber material for the army and city. In addition heavy tree cutting continued to increase during the sovereignty period of the occupying powers between 1918 and 1923 (Eker and Ok, 2005). After the establishment of the Turkish Republic in 1923, agriculture, forestry and raising livestock were seen as the fundamentals of the national economy. Certain measures were taken to improve these sectors for the development of the nation. In 1924 forest regulations were legislated and then a forest protection organization was established. A general directorate attached to the Ministry of Economics was administered to all of forestry works between 1920 and 1923. But the name of the general directorate was changed to "The General Directorate of Forestry (GDF)" in 1937, and in the same year, the basis of current modern forestry of Turkey was

formed by the implementation of a forest law, No. 3116. Later, this law was changed and the new forest law No. 6831 was drawn up in 1956. Between 1950 and 1960 four different laws were passed which forgave those who committed forest crimes (GDF, 2010). This accelerated the destruction of the forests and caused an increase in the number of forest crimes. Because of this it was understood that compulsory codes must be added to the constitution to protect forests against political interventions. In this way forest issues took a place in the constitution.

Currently the Istanbul Forest District Directorate (IFDD), which is attached to GDF, is responsible for the management of Istanbul forests. GDF is working under the umbrella of the Ministry of Environment and Forestry (MEF). 242420 ha forest area is located north of Istanbul (Figure 1) (IFDD, 2010; MEF, 2010; MEF, 2005). Five Directorate of Forest Enterprises were established to manage the forests of Istanbul. There are 9 watersheds within the boundaries of these to provide water for Istanbul (Figure 2). These watersheds are Terkos (619 km²), Buyukcekmece (620 km²), Sazlidere (165 km²), Kucuk Cekmece (160 km²), Alibeykoy (170 km²), Bahcekoy (60 km²), Elmali (85 km²), Omerli (859 km²), and Darlik (95 km²). There were no forest watersheds. Forest reduced speed in Elmali watershed. There are seven small historical dams, which these dams built in Byzantine, Roman and Ottoman periods, on Bahcekoy (Cecen, 1999). The primary management objective of forests located in the other watersheds is timber production. The secondary objectives are water production, scientific research, and recreation and wildlife protection. However, the forest management plans, which were designed for these areas only dictate timber production, related forestry activities.

Drinking water problems

The rapidly increasing population of Istanbul has caused more demand for water. Besides the historical reservoirs, during the historical period new water dams were built after the establishment of Turkish Republic. The water holding capacity of dams (Figure 2) is about 863770000 m³. Terkos of this dams long term has been the largest drinking water supply. Because of this "Terkos" in the sense of drinking water is used in Turkish (IWSW, 2000). They cannot supply enough water when the amount of precipitation and snow decrease during the dry seasons. Therefore people in Istanbul area faced with water problems. Even with the dams running at full capacity the population projections indicate that the dams will not be able to meet the water needs of Istanbul in the near future. The primary authorized organization for water management, the Directory of Water and Sewage Works (DWSW), started a new project in 2003 to supply water



Figure 2. Istanbul consists of drinking water dams (Planlama.org, 2008).

from the Melen River in Bolu city, which is 200 km distant from Istanbul, with the first stage of this project being completed in 2010 (Eroglu, 2000). With the final completion of this project Istanbul will be receiving water from 7 surrounding cities (Bolu, Duzce, Kocaeli and Sakarya in the Anatolian section and Kırklareli, Tekirdag and Edirne in the European Section). When a comparison is made with the historical period it is clear that the potable water problem of Istanbul has considerably increased in scope today. Many of the water reservoirs, which were previously established, are now working at reduced capacity. Many cisterns and water channels were damaged in various catastrophes and improper urbanization has made restoration now impossible.

The understanding of forestry and drinking water production in the Ottoman era

The lack of large rivers in the region led to the supply of water coming from small streams. Small dams were built within the boundaries of the Belgrade Forest. Beginning in Byzantine times iron or marble filters were used in order to prevent the water collection pools from collecting stones, tree leaves and branches that were carried by the rivers during the peak rainy season. During the 16th century, a command was made against establishing houses near water resources in the forest areas and a team was charged to control and monitor these areas (IWSW, 2010; Kutluk, 1948; Nirvan, 1953). At one time all the drinking water in Istanbul came from the Belgrade

Forest on the European side of the city. At the time of Suleyman the Magnificent the Belgrade Forest was important strategically as the main source of water for the city. Water from the numerous springs and streams in the forest was channeled into the city, and as the demand increased over the centuries small dams called “Turkish bent” were built to collect the water. There are 7 Bents today and although they are still in use they no longer play a crucial role in Istanbul's water supply due to the rapidly increased population of the city (Figure 2 Watershed No 6). The protected status of the forest granted in the 16th century has continued until the 20th century. Between 1554 and 1564 existing waterways were extensively repaired and new aqueducts were established in order to provide water for the increasing needs of Istanbul city (Kutluk, 1948; Nirvan, 1953; Cecen, 1999).

Despite the relative abundance of forest resources, drinking water resources have always been scarce. Therefore, an organization called the “Ministry of Water”, which was responsible for drinking water, was established 300 years before the Directorate of Forests during the reign of Suleyman the Magnificent (1520 to 1566). At first the Ministry of Water worked with the Sultan. Later on it continued working under the umbrella of a municipal organization called the Sehremaneti (Gultepe, 2000). The “Minister of Water” directed the Ministry of Water. Maintenance and repair of the waterways during this period was given to the “water watchmen”. This duty was passed from father to son by inheritance like the forest watchmen (Eroglu, 2000).

During the Ottoman era, free public use of the forest, a

Table 2. Drinking water supply-demand and deficit of Istanbul (IWSW 2010).

Year	Population	Demand m ³ /year (million)	Supply m ³ /year (million)	Deficit m ³ /year (million)
1995	8417000	771.0	451.0	320.0
2000	10019000	939.0	757.0	182.0
2005	11332000	1298.0	762.0	536.0
2010	12915000	1635.5	952.5	682.0

perception that the forest was a financial resource and its management for profit with the introduction of planned management stages can be identified (Bekiroglu and Ok, 1997). During this period forestlands were abundant and no organization was responsible for the management of forests. Therefore, no rules existed with regard to the use of forestlands. The decrease in forest vegetation in time led the Empire to establish the Directorate of Forests in 1839. This organization is connected to the Ministry of Trade (GDF, 1992). Forest watchmen, who were graduates of the Forest School, were given responsibility for the protection of the forests. This duty has traditionally passed from father to son by inheritance.

During the 19th century efforts to establish a forest organization by the Ottomans began. In 1839 GDF was established and, in 1857 the first Forest High School was established and, in the 1858 Land Act was passed, and in 1870 the Forest Regulations were established. During this development process the protection of the forest was taken from the Water Administration and given to a team consisting of forest engineers and some supporting armed forces. This team carried on working under the umbrella of the Istanbul Forest Head-Engineering, which was attached to GDF.

The understanding of forestry and drinking water production in modern times

Currently forests in Turkey are managed using the multiple use principle. It is accepted that the forests are managed for the production of timber and non-timber goods, provision of environmental and biological services such as watershed and soil protection, conservation of genetic diversity, regulation of climate and carbon sequestration, recreational and aesthetic benefits, and others. Since 1992 management plans for the Istanbul forests have been specifically managed under the functional planning technique that arranges for different types of management classes in the plans. In these plans, the forests were divided into different uses (such as landscape, water and soil conservation, etc) by taking management classes into account (GDF, 1992). However, when both classical and current management plans are compared it is observed that the only economic output provided for from the forest is wood products. The recent management plans prepared for different forest

management groups under functional management do not recognize water as an economic output of the forest. In these recent management plans some recreational areas were allowed in water production areas. Due to a high demand for recreation in Istanbul the sites allocated for this purpose are being heavily used. However, the recreational use of these areas adversely affects the water production function of the forest. Forest managers are not concerned with the fallen trees that block the water flow on the site because the forest enterprises do not gain an economic benefit from the water produced in their management boundaries. Forest managers do not make an effort to promote a sustainable hydraulic function for urban forests due to a lack of profit to be gained from their intervention. On the other hand the IWSW collects the water from the dams and makes a profit without incurring any cost (Cinar, 2006). Today, the protection of drinking water resources is undertaken by contractual or perpetual forest staff/workmen. However, their work regions are often changed for political reasons.

Importance of drinking water production for Istanbul

Today there is a 9500 km water distribution network, which supplies the potable and domestic water needs of Istanbul. This network produces its water from 15 dams and 5 potable water discharge units. However, these investments are not adequate to provide for the full needs of Istanbul (Table 2).

From Table 2, the average water deficiency of Istanbul can be calculated at 346 million cubic meters per year. It can also be seen that water demand and supply increased 68.4 and 34.6%. So there is approximately a 100% water deficiency between water demand and supply. According to projections the population of Istanbul will reach about 16.5 million in 2020, 17.7 million in 2030 and 18.7 million in 2040. In Table 3 water demand and supply were compared by assuming that the water need of a person living in Istanbul would not change from that at the beginning of the year 2010 and the water supply would be increased by 25% every five years. The data shows that the water deficiency level would be drastically high. In fact, the accepted current water consumption level per capita is quite low. Moreover, the possibility of increasing the current water level by 25% every five years is considered difficult.

Table 3. Drinking water supply-demand projection of Istanbul.

Year	Population	Demand m ³ /year (million)	Supply m ³ /year (million)	Supply Deficit m ³ /year (million)
2005	11332000	1298.0	762.0	473.2
2010	13000000	1635.5	952.5	682.0
2020 (projected)	16500000	1798.5	1190.6	607.9
2030 (projected)	17700000	1929.3	1488.3	441.0

At the municipal level, the production and transport of drinking water, collection and removal of wastewater and protection of water resources for Istanbul is carried out by Istanbul Water and Sewage Works (IWSW). Istanbul water and sewage works' original authorization and service area was limited to the area of the metropolitan municipality of Istanbul. However, the demand for water with the increasing population in Istanbul caused IWSW to seek more water from outside the boundary of the city and by a decision of the Ministry Committee, IWSW's work and service area was extended outside of the Istanbul's border (Water Foundation, 2006). Currently there are 15 dams with 9500 km water network in Istanbul (IWSW, 2010). However, these huge investments are not adequate to meet the needs of Istanbul residents. Even with the investment within and outside of the city borders IWSW cannot increase the size of the water supply to the desired level.

Another major problem is the lack of coordination between the organizations managing forest and water resources. The General Directorate of Forestry has reserved the areas where water production is supplied in "steady protected lands" status. The General Directorate of Nature Conservation and National Parks is responsible for protecting these areas while IWSW is responsible for the management of the dams and lakes on these protected forestlands (MEF, 2005). As a rule these two organizations must be in collaboration. However, there is no agreement between these organizations on water production and protection. There are also some recreational areas within the boundaries of these protected forestlands that are managed by the General Directorate of Nature Conservation and National Parks. Heavy use of these areas by people for recreation causes damage to both the forest and water resources and also restrain the water production function of the forests.

The selection of forest and grassland areas around Istanbul by migrants to build new settlements is an old habit that has continued throughout history. Most of the migrants are rural villagers. They believe that settlement in these areas is their natural right. This belief encourages more migrants to come to the city and establish new illegal houses (Inalcik, 2000). The most dramatic example of green space loss has occurred with the illegal establishment of a settlement area called Sultanbeyli District in the Asian Section of Istanbul. In five

years (1985 to 1990) its population increased by 2100%. This district expanded by exploiting natural resources on its periphery and has become one of the most crowded regions in Istanbul.

Today people who live close to water resources have no rights or responsibilities towards them. Having no obligation for the care and protection of water resources encourages them to exploit and damage these resources. However, the most important threat comes from the conversion of watersheds and forestlands to other uses. For instance the area of Belgrade Forest was 15000 ha in 1920. However, 2/3 of its areas have been converted to other uses (TMMOB, 2006). Currently, the Belgrad Forest supplies 2.6 million/m³ of water to Istanbul (Destan, 2000; Eker, 1997).

Due to rapid population growth and rural poverty, forests and grasslands are being heavily damaged in Turkey. The natural watershed balance has deteriorated and the amount of sedimentation has reached 500 million tones per year, reducing the life span of some dams from 100 to 15 to 20 years. In order to regulate water functions and avoid soil erosion, afforestation operations are being applied to the environs of recently established dams (PMSARDA, 2002).

To resolve this unfavorable situation the General Directorate of Forest designated 378875 ha as "protected areas". However, authorities point out that technically the amount of protected areas in Turkey is approximately 3042489 ha. The General Directorate of Nature Conservation and National Parks is the organization responsible for the conservation of "protected areas" in Turkey (SPO, 2001).

Turkey has various problems related to the management of freshwater resources produced in watershed and forested areas. Among these unplanned and heavy construction for residential purposes is the most common problem. Historically politicians have tolerated these illegal settlements for political expediencies, and eventually made legislation to legalize these illegal occupations. Amnesties have been declared for illegal forest area occupations four times through laws prepared by the Turkish Grand National Assembly. A proposed fifth amnesty for forestland squatters has been an important subject of debate on the political agenda for the last five years. These facts continuously encourage the illegal settlement activities on the forestlands. Investigations show that the 158,000 illegal constructions,

which were counted in the watershed areas of Istanbul in 2003 had grown to 200,000 by 2007. Among the 7 watersheds of Istanbul, the Omerli watershed has the highest number of illegal constructions at 68459. This is followed by Elmali, Buyukcekmece and Alibeykoy watersheds with the highest number of illegal constructions. Although the Darlik watershed is believed to be the most peaceful one of those near Istanbul, it also has 1617 constructions near it. Whereas the illegally occupied land amounted to 3% of the Darlik Watershed in 1996 it approached 10% in 2007. This finding also indicates that the watershed will be subject to a rapid illegal occupation (WWF, 2008; Cinar, 2006).

Conclusion

A great amount of fresh water is provided from forest areas and the protection of forestlands and watersheds has a special importance. But today people are settling in and near forest and watershed areas, while other parts have been allocated to other uses which promise higher short term profits than watershed and forest uses. Historically, the watershed resources in Istanbul have not met the full demand for drinking water. However, with the traditional and district measures these watersheds once produced more water when compared with the current situation.

Under socio-economic pressures the watersheds and forests of Istanbul were legally or illegally allocated for residential and industrial uses, causing degradation to these resources. Therefore the forested areas in Istanbul were considerably reduced and some watersheds were polluted. This caused Istanbul to depend on more distant water production resources. As a result Istanbul has not been able to sustainably use its nearby water resources. Besides this, Istanbul residents also have negatively impacted neighboring cities' forest resources and biodiversity by causing the establishment of huge dams in the watersheds of these cities.

Today providing an adequate drinking water supply is one of the most critical problems for Istanbul, as it was in the past. This problem will continue to grow in the future. One of the main reasons for this problem is the lack of integration at the watershed scale between the organizations responsible for the management of water and forest resources (WWF, 2008; Cinar, 2006).

While in the past the primary and the most important product of these forests was freshwater, today this has been replaced with wood production and recreational activities. This situation has come about because the freshwater production of the forests is not recognized as an output of those forests while the planning of forest resources is concerned mainly with wood production, and some forest managers have given in to political pressures to compromise forest protections.

A decrease in the number of people who hold similar

beliefs or an increase in the number of people who have conflicting values and economic goals will lead to increased pressures on the environment. A belief, which in previous times was put forward for the purpose of resource protection and then accepted by the public, may no longer be valid today. Water is no longer accepted as a sacred resource as it once was. This is partly because of the number of people who have entered the city by migration has increased dramatically. These outsiders often do not share the values and beliefs of long-term city dwellers and they usually lack understanding of these issues. One instance, for example, ancient water sources with a variety of minerals were believed to have medical healing properties and were revered as sacred waters by local city residents. However, these sources today are not well protected, and have in fact sometimes been deliberately destroyed by new migrants.

Currently, people who live near the water sources have neither rights nor responsibilities for these water resources. However, historically these same people earned their livelihood from protecting the water. Therefore, people who once did the protecting today do not care, and are often the ones doing the most damage. The increasing number of buildings and other constructions at the edge of and into the forestlands, and the pressures of rapid population growth have resulted in an increased scarcity of water sources. Because Istanbul cannot provide satisfactory and good quality water out of its own watersheds, it gradually loses the sustainability of its natural resources. Therefore, hazardous development activities in the protected forests must be restricted and the water produced in the forests considered the main resource output. Forest enterprises should benefit monetarily from the water output of the forests they manage. The conversion of forest and watershed areas to other uses must be prohibited and the planned development of the city must be enforced. Finally, illegally constructed residential areas in the protected forestlands must be expropriated and then removed and a systematic approach should be considered in natural resource management. The ecological and economic added value provided from the natural cycle and flow of water should be considered and this must also benefit the forestry sector. As a result, the following measures should be urgently taken in order to provide sustainable use of water resources of Istanbul. These are:

- (i) Organizations responsible for water and forest resources management should be integrated at the watershed scale (Eker and Bekiroglu, 2007; CCP, 2007).
- (ii) Protected areas networks must be built up (CEE, 2007).
- (iii) Application for potable water amount increase methods should be developed in the forest practices within the boundaries of the watershed (Destan, 2000).
- (iv) Adoption of development minimizing the adverse effect of land use on surface waters and other

environmental values should be strengthened (CEE, 2007).

(v) Illegal settlements near to the watershed and forest areas should be restrained and the crimes related to this subject should not be forgiven. And historical water structures must be protected (Eroglu, 2000).

(vi) The price of potable waters brought into city from other ecosystems should be paid for (Cinar, 2006).

(v) Employees should be protected from political pressure.

With changes in the understanding of the management of forest areas and watersheds for the drinking water supply for Istanbul, the protection and improvement of supply are affected in a negative direction. Currently the drinking water supply for the city is one of the most critical problems for Istanbul, as it has been for most of its past. This problem will continue to grow in the future.

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