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MANAGING OF WATERSHEDS OF STANBUL (TURKEY)

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ABSTRACT: Istanbul is the largest city of Turkey with its current population of 12 million people and situated uniquely on both continents of Europe and Asia. Bosphorus strait which joins Black Sea and Sea of Marmara also divides Istanbul city as European and Asian sides. There are seven watersheds supplying the potable water demand of Istanbul. These watersheds are under the control of Istanbul Water and Sewerage Administration (ISKI). It is within the framework of the Greater Istanbul Metropolitan Municipality (GIMM). ISKI has taken precautions to protect these watersheds. Water Pollution Control Regulation of ISKI sets the protection zones about the lakes and rivers in these basins. These are namely the absolute protection zone, proximate protection zone, mediate protection zone, and remote protection zone. Within the context of watershed protection and management project, ISKI has environmental Protection and Control applications for the Ömerli, Buyukçekmece, Elmalı and Terkos watersheds. Apart from these, land acquisition, afforestation, observing the watershed by satellite from space, and special security organization are part of the watershed control and management studies. In this paper all above measurement issues have been introduced for the management of watersheds of Istanbul city.

INTRODUCTION

About 95% of the potable water demand of Istanbul is met from the surface waters. The rest is from ground water and from historical smalldams. The total area of the catchment basins is 6257 km_. The protection of the water resources against pollution is a significant but also a difficult task considering the huge area to be protected.

It is recognized that water resources are scarce and must be protected for sustainable water supply. It is also an agreed fact that “prevention is better than the treatment”. Thus, we have to apply every possible means to maintain the quality and the quantity of our water resources.

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Following the very severe water shortage problem in Istanbul in 1994, emphasis has been given to the development of water sources and the total capacity has been increased from 590 million m_/year in 1994 to 920 million m_/year in 2000. In 2001, 95~96% of the samples complied with the Turkish drinking water standards (TS 266) and the drinking water guidelines of World Health Organisation (WHO).

WATERSHED CONTROL MEASUREMENTS

Protection Zones

Figure 1 displays the watersheds of Istanbul. For the control of the water reservoirs and other water resources ISKI has set the protection zones (ISKI, 2000) They are given below.

Absolute Protection Zone:

This zone is a 300 m wide strip extending from the maximum water level of a drinking water reservoir. No settlement is constructed. The region, within the protection zone is expropriated by the ISKI Administration as authorized by law, and the existing buildings are subject to demolishing. Agricultural activities, animal farming and opening or operating a mine under no circumstances shall be permitted. Afforestation is encouraged in this area. No permission is granted for motor vehicles, and the use of fertilizers and pesticides.

Proximate Protection Zone

This is a 700m wide strip extending from the absolute protection zone surrounding a drinking watersupply. No industrial installations shall be permitted. Permission can be given to residences with a population density of 5 persons/hectare. Height of the residences should not exceed 6,5m. The remaining area is subject to afforestation. At least 1 tree for each 200 m_. Required infrastructure is to be performed for the residences. No grant shall be given to the discharge of solid and liquid wastes. Agricultural activities and animal farming are not permitted. Opening or operating a mining area is prohibited. The use of the land for cemeteries shall not be permitted.

Mediate Protection Zone

This is a 1 km wide strip extending from the boundary of the proximate protection zone surrounding a drinking water reservoir. Residences in 5000 m_ area or bigger than this parcel can be built with a density of 10 persons/hectare. Height should not exceed 6,5m. The remaining area is afforested with at least 1 tree for every 200 m_. In this area touristic facilities, industry, hospital, and any kind of storing depots (warehouses) can not be constructed. No chemical fertilizers and pesticides use shall be permitted. Grant is not given to opening and operating mining areas. In this area depositing of garbage and debris shall not be permitted. No permission is given to discharge of solid and liquid wastes. The use of the land for cemeteries shall not be permitted.

Remote Protection Zone

A remote protection zone is the whole of the water collection basin that falls outside the other protective zones surrounding reservoir. In these areas residences can be constructed with a density of 20 persons/hectare in a parcel with an area of 2500 m_ or bigger that this. Height should not exceed 6,5 m. There must be an afforestation in the remaining area with at least one tree for every 200m_. No grant is given to industrial establishments and touristic facilities. There will not be the use of chemical fertilizers and pesticides. No permission is given to construction of hospitals, chemistry laboratories, and medical faculties. No permission for the opening of stone, sand, clay, coal and mining areas. There could be permission for the land use of cemeteries to serve the area. Other than this depositing of garbage and debris and their disposal shall not be permitted. No chemical and fuel tanks can be installed.

Creeks

There are important creeks conveying water to the reservoirs in the watersheds. ISKI has defined strips with a width of 100m on both banks of these creeks. These banks are considered to be the absolute protection zones as well.

Water Treatment and Quality

The processes commonly applied for surface water treatment are pre oxidation (chlorination or ozonation), coagulation, flocculation, sedimentation, filtration, post disinfection. In 1994 three water treatment plants were under operation located at Buyukçekmece, Kagıthane and Ömerli. The treatment plant at Elmalı was abandoned due its inability to meet the drinking water standards. This plant was upgraded by renovating the facilities and adding ozonation and powdered activated carbon and has been taken into operation. Similarly, Kagıthane treatment plant was renovated and a new plant (Muradiye) was added to the existing ones at Ömerli. Fatih Sultan Mehmet treatment plant has been taken into operation since the end of 1998 (Eroglu et. al., 2002)
Figure 2 shows the potable water regions fed by the treatment plants. The water quality report of Istanbul for the year 2001 is presented in Table 1. The water quality is monitored and checked by water quality labs located at the treatment works, ISKI's central laboratory under the "Water Quality Control Department".

Wastewater Treatment

ISKI has environmental protection and control applications for the wastewater originating in the watersheds (ISKI, 2000). To protect the Omerli dam reservoir from the impact of unlicensed constructions, illegal settlements built before 1994, ISKI constructed a biological nutrient removal wastewater treatment plant (The Pasakoy Sewage Treatment Plant) to biologically eliminate C, N and P (see Figure 3). The effluent will be channeled through a tunnel to the Riva creek that flows away from the reservoir into the Black Sea. Ending flow rate is planned to be 500.000 m_/day for the plant.

Buyukcekmece is another important watershed from which about $70x10^6$ m_/yr water is supplied. Treated wastewater is discharged the Marmara Sea. Buyukcekmece

coastal collector and, west collector and wastewater treatment plant, and marine dischange are the components to remove the wastewater from the basin (See Figure 1).
In Elmalı watershed wastewater is collected by means of lower and upper Dudullu wastewater collectors and removed from the basin.
In Terkos basin wastewater is collected and then given to Terkos Advanced Biological Wastewater treatment system. Treatead water is given to wetland in the basin.

Land Acquisition

After 1994 in the absolute protection zones of Omerli, Terkos, Alibey, Sazlıdere, Buyukcekmece and Papucdere dam reservoirs and in the protection zones of the creeks feeding Omerli and Elmalı reservoirs a total of 4.023.822 m_ land has been acquired at a cost of 19 trillion TL (Eroglu et.al., 2002; ISKI, 2001)

Demolition of Illegal Housing

Starting from 1995 a total of 659 illegal house have been demolished within the first 300 m protection zone of the catchments. (Eroglu et.al., 2002; ISKI, 2001)

Local Basin Protection Directorates

They control illegal housing. Efforts for controlling and finding out unlicensed constructions carried out by Omerli, Darlık, Elmalı, Terkos, Buyukcekmece, Sazlıdere, Alibey drainage protection technical directorates being carried on, real persons and legal entities are being made to apply to ISKI administration in order to take advice in relation with their constructions (Eroglu et.al., 2002; ISKI, 2001)

Special Security Teams

Protection and Security of the dams and lakes comprising a drainage area of 3110 km_ is provided constantly by 504 personnel. Special security team is linked to basin protection directorates. (Eroglu et.al., 2002; ISKI, 2001)

Use of Satellite Images

ISKI Administration uses new technologies to control the wastersheds. Remote sensing is one of them. ISKI uses this technology to find out unlicensed constructions and also to trace the pollution (Eroglu et.al., 2002; ISKI, 2001). The expectations of ISKI from the project entitled “Spatial and temporal change of the land use analysis of the watersheds and its hydrodynamic structure” are as follows:

1. Tracing the illegal settlements in the watersheds spatially and temporally, and getting information to see how they comply with land use strategies of ISKI.
2. Finding out the unlicensed constructions with their coordinates in the protection zones of the reservoirs and submitting them to the court as an evidence.
3. Tracing the topologic structure change. The change: where, when, and at what level. Especially the forested areas. Identification of features by remote sensing is effective for global assessment of geometric characteristics and general appraisal of ground cover types.

Turksat is the satellite that ISKI cooperates with. As next step, studies within the concern of ISKI are:

1. Water management studies to prevent the damage of land cover and vegetation.
2. Mapping of the regions which are subject to soil erosion.
3. Early determination of the potential flooding problems in the watershed.
4. Water Resources Management studies
5. Irrigation of arid but fertile lands in the basins

GIS

Presently GIS technology is used by ISKI to trace the water quality in the watersheds, at treatment plants, along the water transmission lines, at water distribution reservoirs, and along the water distribution network.
When graphical and alphanumeric data are linked to each other then all sort of query, analysis (network topology, statistics, etc), modeling, thematic mapping and management studies are able to be done by using GIS technology. A web site is planned in order to present this design to end users in intranet/internet environment so that use of this system will be more easy and more functional. (Sarıkaya and Eroglu, 2001)

Wetlands

ISKI also supports research projects. Wetland is one of them. Making use of wetlands to diminish the pollution load from point and nonpoint source is important. One of the study performed for this purpose took place in Terkos watershed.

Afforestation

Afforestation is another effective study in the watersheds. Rebuilds the natural capacity of basins. Already 100.000 trees have been planted, and 300.000 trees planned to be planted (ISKI, 2000; ISKI, 2001)

CONCLUSION

ISKI preserves the water supply sources of Istanbul in accordance with the principles of the effective Law, Regulation and Directive principles.
Environmental protection projects implemented for the last seven years period cost to a magnitude of 177×10^6 US$.

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