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Anthropogenic Impacts on Beysehir Lake National Park: Infrastructure Problems and Management Issues

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ABSTRACT

Watershed of Beysehir Lake, with an overall surface area of 88 750 ha, was selected as the case study area, since it is under the pressure of potential pollutants arising from human-induced activities such as settlements, insufficient infrastructure, agricultural activities and excessive water traffic due to fishery boats. Even though the study area surrounding Beysehir Lake is ecologically vulnerable and taken under protection as a "national park"; domestic and industrial sewage collection and treatment is insufficient contributing to contamination of surface and groundwater resources. Solid wastes are another source of pollution; the waste is dumped into unsanitary landfills without taking any protection measures in most of the settlements. Additionally, scarcity of drinking water and insufficient supply is another issue regarding the public health. Present infrastructural status of the study area was assessed in this study to lead to recommendations and some specific actions for the municipalities and (mukhtars) for rehabilitation and improvement of infrastructure. "Watershed Management" alternatives are proposed. The main target is protection and conservation of wetlands and sustainable utilization of Beysehir Lake National Park.

Key Words: *Beysehir Lake National Park, drinking water, union, watershed management, wetland.*

1. INTRODUCTION

The recent trend in the world is to increase protected areas and several international agreements and guidelines have been adopted for the protection of vulnerable areas [1]. Special emphasis has been placed on the urgent conservation and management of fragile ecosystems such as mangroves, coral reefs, tropical forests and wetlands. Several international organizations such as the World Conservation Union (IUCN) and United Nations Environment Programme (UNEP) have urged nations to increase conservation areas and take measures to protect and manage them in a sustainable manner.

Turkey is situated at a biogeographically important transition territory with a number of endemic flora and fauna far exceeding the totals in Europe. Turkey is also on the major bird migration routes of Palearctic [2] and hence very important among wetlands of its geographic area. Wetlands are under ever-increasing pressure from human-induced activities [3, 4, 5].

Beysehir Lake, one of the important wetlands of Turkey, is heavily influenced by anthropogenic pollution sources arising from residential and agricultural areas. The study area is located administratively within the boundaries of 2 different cities namely, Konya and Isparta, and within the boundaries of 2 different National Parks, namely; Kızıldağ and Beyşehir Lake National Parks. It has geologically tectonic formation with a total surface area of 74600 ha [6] when water level is maximum 1125.50

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m. It is the 3rd largest lake in Turkey following Van Lake (brackish lake) and Salt Lake (saline lake) and largest freshwater lake and drinking water reservoir in Turkey. It has a length of 45 km and width of 26 km at the widest point [7].

Wetlands surrounding the Beyşehir Lake and its 33 small islands are very important for breeding and migrating birds [8]. Three of the 33 islands are inhabited, others are farmed, and the majority is deserted. Examples of ecosystems are forests, steppes, fresh water riverbank, narrow reed beds (*phragmites*) and lake ecosystems. The settlements are 2 major towns (municipalities) with a total population of 61 196, other 36 smaller municipalities with a total population of 125 562 and 68 rural settlements (villages) with a total population of 22 237 according to 2008 general census.

In the study, the aim was to assess the impacts of anthropogenic pollution sources on the quality of Beyşehir lake as a drinking water reservoir, present the infrastructure status, provide an overall picture of the environmental impacts, and develop the mainframe for future management tools and conservation guidelines for this valuable wetland, freshwater resource and National Park. Additionally, recommendations for the improvement of infrastructure are referred.

2. MATERIALS AND METHODS

2.1. The Study Area

Beyşehir Lake National Park located at the southwest of Konya Province is the Turkey's largest closed watershed with an overall area of 88 750 ha. There are several creeks (27 creeks) and streams coming from Dedegöl Mountain at the west and springs from the Sultan Mountain at the east feeding the Beyşehir Lake. Other infiltration sources are, Mesozoic limestones cracks rooted springs in south and west of the lake, the sources at the bottom of the lake and direct precipitation [9].

The lake has several "protection statues"; it is declared as a Class A Ramsar Site Wetland and two areas in the study area, namely Lake Beyşehir itself and Kızıldağ are designated as National Park. There are conservation statutes as "I., II. III. degree Natural Protected Areas" and "Archeological Protected Areas" in the Basin. Lake Beyşehir has the statute of "Important Plant Area- IPA. Beyşehir Lake acquires IBA (Important Bird Areas) status by its major number of wintering water birds. The Lake is also declared as a "Drinking Water Protection Zone" since its water quality is high enough to be used as a drinking water resource in addition to its other "protection status". Beyşehir Lake and surrounding settlements are shown in Figure 1.

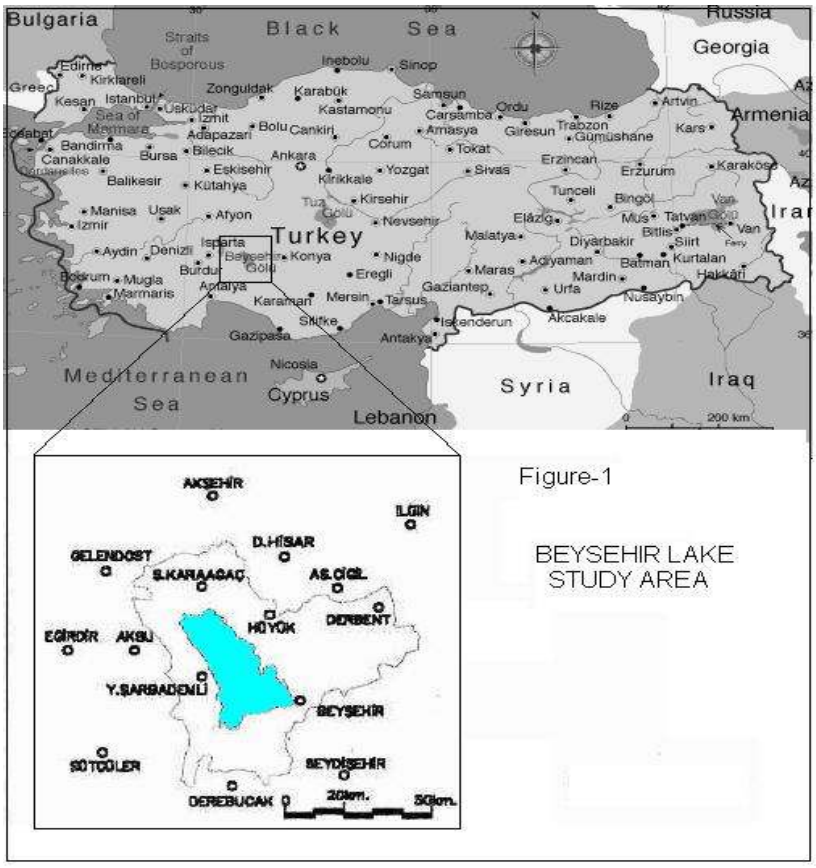

Figure 1. Location of the study area.

The climate of the study area is continental. Winters are cold and rainy, whereas summers are hot and dry. Precipitation regime represents semi-arid conditions. General physical characteristics of the Beyşehir Lake and the study area are given in Table 1.

Table 1. General features of Beyşehir Lake and watershed.

Attribute	
Origin	Tectonic
Latitude	37^0 45' North
Longtitude	31^0 36' East
Average elevation (m)	1122
Lake area (ha)	74,600
Mean depth (m)	5
Maximal depth (m)	10
Watershed area (ha)	88,750
Human population	208,995 (2008 General census)

2.2. Methodology for Data Collection and Evaluation

Topographic maps of 1/100.000 scale were obtained from General Command of Mapping-Turkey. This base map was used to carry out field studies and to draw the surface watershed boundaries. Population and settlement data were obtained from the local authorities.

Questionnaires were prepared to obtain data on regional administrative units, cooperatives and NGOs; additionally data were obtained related with drinking water resources and supplies, status of drinking water treatment facilities, disinfection techniques; amount of wastewater produced by domestic and industrial sources, sewerage systems and their sufficiency, status of domestic and industrial wastewater treatment facilities; amount of solid waste generated by each settlement and waste disposal methods.

The questionnaires were dispatched to village heads (mukhtar in Turkish), mayors and other administrative officers. A deadline was given and after the arrival of all questionnaires in our office, we travelled to the study area, to confirm the collected data first by interviewing each officer individually and later by field studies. The field studies were carried out several times.

Lake water quality data were obtained from the companion study group from Hacettepe University, Ankara, Turkey.

3. RESULTS AND DISCUSSION

The study area consists of a total number of 106 settlements; serving a population of 208 995. Among the settlements the 2 major towns, Beyşehir and Şarkikaraağaç are with populations of 32 799 and 28397, respectively. The settlement types can be categorized into three main groups such as, 'urban settlements' which are administratively governed as municipalities (38 in numbers), 'rural settlements' which are villages (68 in totals) and 'coastal settlements' (15 in total) are located around lake's shore. This classification was adopted to aid the assessment process and to better differentiate between rural, urban and coastal settlements.

3.1. Assessment of Drinking Water Systems and Recommendations for Infrastructure Improvement

Present situation of the overall drinking water systems of the study area, including the treatment status and population served, are given in Table 2.

Table 2.Watershed based overall drinking water status in the study area.

	DRINKING WATER RESOURCES					DRINKING WATER SUPPLY SYSTEM		DRINKING WATER TREATMENT			
	Surface Water		Groundwater								
	Lake	Creek	Deep well	Artesian well	Spring water + Captage	Sufficient	Insufficient	Conventional Treatment	Disinfection by $CaCO_3$	Disinfection by Chlorination	None
Number of Settlements	3	1	32	58	12	49	57	1	7	11	87
Settlements (as %)	2.83	0.94	30.19	54.72	11.32	46.23	53.77	0.94	6.6	10.38	82.08
Population (as %)	19.6	1.01	29.66	35.23	14.50	55.77	44.23	18.95	13.28	30.07	37.7

Main drinking water resources have been classified as surface waters (lakes and creeks) and groundwaters (deep wells, artesian wells and spring water + captage). "Artesian waters" are from a well that taps a confined

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aquifer (a water-bearing underground layer of rock or sand) in which the water level remains at some height above the top of the aquifer. "Spring waters" are derived from an underground formation from which water flows naturally to the surface of the earth. Spring water must be collected only at the spring or through a bore hole tapping the underground formation finding the spring. Spring water collected with the use of a pump and must be stored in a tank called 'captage' in order to prevent its pollution, to keep temperature stable, to provide homogenity in chemical composition of water and discharge rate, and to prevent escape of beneficial gases in the water. As given in Table 2, about 30% and 54.7% of the settlements use deep wells and artesian wells as drinking water resource, respectively. Although only three of the settlements (out of 106) use the lake as a drinking water resource; it corresponds to 19.6% of the total population. One of these settlements is Beyşehir, the major town mentioned with the highest population in the study area. Drinking water supply system is sufficient in 46% of the settlements. However, 53.8% have insufficient supply. When population is considered in terms of sufficient water supply; 55.8 % of the population have sufficient water supply while about 44.0% receive insufficient drinking water.

As it can be seen from Table 2, there exists only one settlement served with conventionally treated water. That means about 19% of the overall population are served treated water. When the other settlements are investigated; 18 settlements (out of 106) with 43.35% of the total population received only chlorinated water either by chlorine or $CaCO_3$. However, about almost 38% of the total population are still obliged to use raw drinking water.

The only mentioned "conventional drinking water treatment plant" in operation in the study area is in Beyşehir. It was constructed in 1993. Daily routine analysis of basic parameters such as pH, color, turbidity, total Fe, total Mn, Al, taste and odor, *E. coli* and residual chlorine are carried out in the plant. Analysis results are compared with the Turkish Drinking Water Standards (TSE 266) for compliance with Council Directive 98/83/EC of November 1998 on the quality of water intended for human consumption.

3.2. Current Status of Drinking Water Supplies and Treatment According to Urban and Rural Settlements

Urban settlements

Present situation of drinking water system of urban settlements, including the treatment status and population served, are given in Table 3.

Table 3. Drinking water status in urban settlements.

	DRINKING WATER RESOURCES					DRINKING WATER SUPPLY SYSTEM		DRINKING WATER TREATMENT			
	Surface Water		Groundwater								
	Lake	Creek	Deep well	Artesian well	Spring water + Captage	Sufficient	Insufficient	Conventional Treatment	Disinfection by $CaCO_3$	Disinfection by Chlorination	None
Number of Settlements	1	1	12	16	8	16	22	1	7	11	19
Settlements (as %)	2.6	2.6	31.6	42.2	21.0	42.1	57.9	2.6	18.5	28.9	50.0
Population (as %)	21.78	1.16	29.76	31.46	15.83	56.29	43.71	21.78	15.26	34.55	28.40

There are a total of 38 urban settlements with a total population of 186 758. Most widely used water resource is artesian well. Usage ratio of artesian wells is 42.2% of the settlements and 31.5% of inhabitants in urban areas. Second major water resource are deep-wells. Since more than half of the urban population use groundwater resources, it should be kept in mind that, almost 60% of the study area has $CaCO_3$ geological formation with higher soil permeability, and therefore face high risk of organic/inorganic pollution of groundwater resources.

Only half of the total population (56.3%) is served by drinking water with sufficient water distribution system. However, most of the municipalities (22 out of 38) declared that their water supply systems are worn out and insufficient.

As mentioned above, a water treatment plant in Beyşehir provides treated water to a population of 32 799 inhabitants out of a total of 182 554 (21.78%). Almost 50% of the total population is served disinfected water with chlorine. Finally, 28.4% of the population has been receiving untreated water eversince.

Rural Settlements

Present situation of drinking water systems of rural settlements and population served are given in Table 4.

Table 4. Drinking water status in rural settlements.

	DRINKING WATER RESOURCES					DRINKING WATER SUPPLY SYSTEM	
	Surface Water		Groundwater				
	Lake	Creek	Deep well	Artesian well	Spring water + Captage	Sufficient	Insufficient
Number of Settlements	2	-	19	42	5	33	35
Settlements (as %)	2.94	-	27.94	61.76	7.35	48.53	51.47
Population (as %)	4.99	-	28.13	61.60	5.27	52.61	47.69

There are 68 rural settlements in the study area ranging in population from 73 to 1404 inhabitants with a total of 27 237 inhabitants. 61.6% of the rural population use artesian wells and 28.13% use deep wells as water resources.

In all settlements, pipelines for drinking water distribution exist, but 51.47% of the network is insufficient; especially in the scattered settlements. Additionally, water supply systems in most of the rural settlements are worn out and need to be rehabilitated.

Due to financial and technical difficulties, the presence and availability of freshwater resources are among the main problems of rural settlements. High quality water resources located far away from the settlements require high distribution cost. Other available water resources are not potable; thus require high investment costs. In addition, in areas geographically located far away from the lake; groundwater levels are changing seasonally.

Water reservoirs used in the rural settlements are not sufficient in terms of quality and quantity. Additionally, water is distributed to the villagers in the untreated form even without practicing any disinfection. Therefore, bacteriological analysis conducted from time to time by the Ministry of Health, Konya Regional Office, indicated intrusion of sewage to rural drinking water resources. Inhabitants supported these findings during interviews and claimed that the number of infectious diseases such as jaundice and diarrhea were increasing in time due to untreated water supplies. Coastal rural areas settled around the lake have sufficient drinking water resources and supplies. However, they have the same problem of being served by untreated water.

3.3. Assessment of Domestic and Industrial Wastewater Systems and Recommendations for Future

Domestic Wastewater

General overview of the present situation of wastewater sewerage system and treatment status, according to settlements served, is given in Table 5.

Table 5. Watershed based overall wastewater status in study area.

	Septic Tanks		Sewerage System		Sewerage System + Primary Treatment (Sedimentation)
	Percolated	Impercolate	Sufficient	insufficient	
Number of Settlements	59	3	7	3	34
Settlements (as %)	55.66	2.83	6.60	2.83	32.07
Population (as %)	22.09	1.51	6.19	1.77	68.44

Uses of septic tanks are a common practice in the study area. 23.6% of the total population in 62 settlements live in unsewered areas and rely on on-site systems for wastewater disposal such as septic tanks. Some of these tanks have been constructed with concrete walls either impercolated or not (percolated).

Only 10 of the settlements with a population of 16 710 (7.96% of total) have sewerage systems. Wastewater collected by these systems from each settlement is discharged to receiving water bodies like small creeks in the area without any treatment. Finally 68.44% of the

total population is served by sewerage system with primary treatment (sedimentation) after collection.

At present, there exists one conventional wastewater treatment plant in Beyşehir which is put into operation in 2005. However, after 2 years of operation, it has not been operated so long because of economical constraints. That is treatment plant is not operated now.

3.4. Current Status of Wastewater and Treatment According to Urban and Rural Settlements

Urban Settlements

Sewerage systems of most of the settlements (27 out of 38) were constructed by the municipalities using their own financial resources. Unfortunately, Table 6 shows that 6 of these sewered settlements have no treatment facilities and discharge their wastewater directly to land without taking any sanitary measures.

Table 6.Wastewater situation in urban areas.

	Septic Tanks		Sewerage System		Sewerage System + Primary Treatment (Sedimentation)
	Percolated	Impercolated	Sufficient	insufficient	
Number of Settlements	10	1	5	1	21
Settlements (as %)	26.32	2.63	13.16	2.63	55.26
Population (as %)	15.27	1.41	7.38	1.30	74.64

Most of the urban settlements in the study area (74.64% of the total population) have sewerage collection pipelines, but the network terminates at a primary treatment facility of sedimentation. Others (16.68% of total population) have no sewerage system. Houses have septic tanks in their yards. Only 7 settlements out of 38 have a chance to have their wastewater collected in impercolated septic tanks and 31 of the settlements discharge their untreated water directly.

Rural Settlements

General overview of rural area wastewater situation is given in Table 7.

Table 7.Wastewater situation in rural areas.

	Septic Tanks		Sewerage System		Sewerage System + Primary Treatment (Sedimentation)
	Percolated	Impercolated	Sufficient	Insufficient	
Number of Settlements	50	1	3	2	12
Settlements (as %)	73.53	1.47	4.41	2.94	17.65
Population	18.852	219	1.150	1.333	5.683

70% of the total rural population lives in unsewered areas mostly having percolated septic tanks. 17 of the rural settlements covering approximately 30% of the population are provided with wastewater collection systems. Primary treatment exists in 12 of them. Since quality and quantity of these septic tanks are of poor quality, they pose risk of infiltration to groundwater resources. Related problems have been mentioned above under the heading **"**Current Status of Drinking Water Supplies and Treatment According to Urban and Rural Settlements**".**

When urban and rural settlements are compared in relation to wastewater situation; uses of septic tanks in rural areas (75% of the settlements) dominate; whereas 55.26% of the settlements in the urban areas have a combined sewer system together with primary sedimentation.

3.5. Industrial Wastewater

In addition to pollution loads from domestic uses and agricultural activities around Beyşehir Lake, different industries also contribute as point sources of pollutants to the study area.

Weaponry industry

Almost 70% of the weaponry production of Turkey is from factories in the study area; examples are Üzümlü and Huğlu. As a result of metal plating processes in manufacturing, Cr^{+6} concentrations are relatively high in

the wastewater of these factories. In Üzümlü weaponry factory; wastewater is disposed to a sedimentation tank, then discharged together with domestic sewage without any additional treatment to small creeks in Asartepe and Soğukpınar. The problem of Cr^{+6} as an inorganic pollutant is quite different from organic pollution and poses greater health risks [10]. Since inorganics move easily through the soil and once introduced are removed with great difficulty. Therefore, Beyşehir Lake is threatened by Cr^{+6} pollution. The effects of such pollution may continue for indefinite periods because of poor natural dilution.

There are 3 weapon manufacturing facilities and one plating factory in Huğlu. Wastewater from these factories is discharged to the town's sewer system without any treatment. Collected wastewater is discharged to Kuruin Cave as untreated with a high risk of groundwater pollution by Cr^{+6}. A representative of the largest factory claimed that they have contracted Environmental Engineering Department of Selçuk University in Konya to design Wastewater Treatment Plant Project for the arms industries. However, the project is in the prefeasibility phase presently; far away from implementation in the near future.

Textile industry

The only textile factory is located very close to Beyşehir Lake. Heavily polluted wastewater carrying organic loads are biologically treated with trickling filter process in a treatment plant operated by the factory. Monthly routine analysis of effluent for certain parameters such as pH, BOD, COD, SS, Cr^{+6} are being carried out by the Provincial Directorate of the Ministry of Environment and Forestry settled in Konya.

Other medium sized industrial pollution sources

There are 5 small scale slaughterhouses with 40–50 heads processed on a daily average. Their wastes are discharged directly to open land near the factory. One of these slaughterhouses is very close to Beyşehir Lake, having a high risk of organic pollution. Additional medium sized industries are biscuits factory, dairy and mining.

3.6. Solid Wastes Status in the Study Area

Solid waste produced in each settlement and years in use of the dumpsites are depicted in Table 8. In all the settlements at the study area, domestic wastes are dumped wherever convenient in a disperse manner together with medical and industrial wastes without taking any sanitary measures. Waste collections in these disperse plots and their transportation to dumping sites is carried out by the municipalities using tractors (open vehicles).

Table 8. Solid wastes status in the study area.

Urban Settlements	Daily Amount of waste produced (ton)	Distance from dumping site (km)	Years in use
BEYŞEHİR	5	4	8
Kurucaova	2	2	10
Sadıkhacı	3	3	3
Üstünler	2	5	10
Yeşildağ	5	5	10
DOĞANBEY	8	3	20
Yenidoğan	2	2.5	10
ÜZÜMLÜ	12 m^3/day	1	4
Akçabelen	75 kg/day	1.5	10
Huğlu	1.5	1.5	10
Kayabaşı	1	2	15
DERBENT	10	1	1
Çiftliközü	1	2	0
DEREBUCAK	2	3.5	5
Gencek	5 m^3/day	2	2
HÜYÜK	2	3	4
Çavuş	1.5	2	5
İlmen	3 m^3/day	2	5
İmrenler	6	2	7
Kıreli	6	6	8
Köşk	2	1	3
Mutlu	1	2	8
Kızılören	2 ton/week	1	2
Sağlık	500 kg/day	5	5
ŞARKİKARAAĞAÇ	35-40 m^3/day	5	5
Çarıksaraylar	5	3	9
Çiçekpınar	5	5	15
Göksöğüt	600 kg/day	2	14
YENİŞARBADEMLİ	2	1.5	4

Organic matter content of solid waste is relatively low, since in rural areas local people use the waste as animal feed or compost it and use it in agricultural fields. Composition of most of the solid wastes is ash, garden waste, etc. Due to reuse by the local rural people, the solid waste is no longer of economical value for recycling. In conclusion, the amount of solid waste is quite low. The major problem seems to be environmental and health risks posed by dumping of the waste even by the largest settlement of Beyşehir. Here, the solid wastes are dumped together with medical wastes in close vicinity of the lake. No impermeability measures are applied [11]. Beyşehir Lake provides drinking water for the area and the dumping area of Beyşehir town lies within the 'absolute protection zone' [12].

4. CONCLUSIONS

As a conclusion, Beyşehir Lake and its wetlands are confronted with several environmental threats; the lake is polluted by untreated domestic and industrial waste discharges, agricultural run-off, over pumping of water from lake, wetlands and aquifers for agricultural purposes (2000 illegal wells) [13] and unsanitary solid waste dumping, which in turn, resulted in a decrease in the lake water quality by time.

These discharges especially from the weaponry industries resulted in an increase in heavy metal concentrations of the lake. According to the heavy metal concentrations, the water of Beyşehir lake was included in the Class 3 category with respect to Cd and Pb concentrations according to Turkish Water Pollution Control Regulation (1988) and found to be above the permissible level of drinking water in international criteria such as WHO, EU, EPA standards, but Hg and Cr concentrations were almost in the permissible levels for drinking water purposes [14]. The pollution load coming from the agricultural activities resulted in an increase in the nitrate levels of the lake [15]. Moreover, as a result of uncontrolled pesticide and fertilizer usage, 85% of the fish samples were found to be contaminated by one or more HCH isomers, 63% of the organochlorinated pesticide is DDT and its metabolites [16]. According to the chemical analysis and physical measurements carried out in order to determine the limnological structure of the lake according to the water quality values, the trophic level of the lake is on the ultra-oligotrophic level, while phytoplankton, zooplankton and micro-invertebrate species are in beta-mesosaprobic level. As a result, the lake was found to be in a mesotrophic level [17].

Depending on the existing water uses and quality degradation status, the following recommendations have been drawn up for minimum impact to the environment of Beyşehir Lake National Park.

4.1. Drinking Water

Drinking water supply is insufficient all over the study area. Access to available sources poses a problem due to technical and financial reasons. When the watershed is considered in a general context, drinking water network is insufficient regarding the settlements. In addition to the problems in drinking water supply system, water scarcity is also another problem. Overuse of lake water and wetlands for irrigation purposes caused decrease in groundwater levels, increase in soil salinity; that lead to infertile lands and habitat loss. To overcome this situation, municipalities in urban settlements should contact the State Planning Organization (SPO) and Bank of Provinces (Iller Bank) to canalize infrastructure investment funds for rehabilitation (substituting PVC or other environmentally friendly pipes instead of asbestos pipes) of the current drinking water systems in the short-term. In the rural settlements, the village heads (mukhtar) should start a similar coordination and collaboration with the General Directorate of Rural Affairs [18, 19]. In the long-term "Beyşehir Lake Management Plan for the Surface Water Infiltration Basin" should be revised and put into implementation.

4.2. Monitoring of Drinking Water Quality

Beyşehir Lake National Park Management should initiate a water quality monitoring program for closely following up drinking water resources to improve public health [20, 21]. There is an urgent need to come out with a regular water quality monitoring program on the lake and its tributaries within the context of "watershed /basin management plans" to be able to make an impact assessment.

To this end, first remedy could be at least disinfection of drinking water. The Regional Directorate of Public Health in Konya should provide technical support for implementation and coordination of a short period training program to educate the park management personnel.

4.3. Wastewater Discharge to Beyşehir Lake

Beyşehir Lake is in "Class I: High Quality Water" according to the Turkish Water Pollution Control Regulation [12], therefore the Lake is within the "absolute protection zone" of the watershed. Untreated wastewater discharges should be stopped immediately. The unsanitary disposal area next to the Lake shore should be rehabilitated and no more dumping should be allowed. Project design and implementation of a sanitary landfill should be initiated at a site selected in accordance to the Turkish Solid Waste Disposal Regulation [11].

4.4. Sewer System Implementation

Sewer system and corresponding treatment facilities should be planned, designed and implemented to serve to both types of settlements; urban and rural. The use of percolated septic tanks should be abandoned (in a stepwise fashion), since the geological properties of the area are not convenient.

4.5. Regionally Based Settlement Groups

The neighboring settlements have been grouped in this study based on their closeness to each other either

geographically or administratively. Thus, the settlements in the same group will have the same types of infrastructural problems and generally under the same administrative district. Future project implementation and management actions can be solved by alternative institutional organizations based on this grouping model. This "regions model" may provide realistic financial solutions and resources for solving the infrastructural problems. Implementation on a regional basis can be managed by establishing "Unions".

As it is well known, drinking water supply and discharge of wastewater are among the responsibilities of the municipalities in Turkey. However, due to the regional conditions and difficulties, this responsibility might be transferred to Unions. Therefore, instead of searching for individual solutions by each local community, establishing unions will be more effective in terms of operation and cost. Since the unions are responsible for individual watersheds, the investments shall be executed for the area with priority demand so as to provide the maximum benefit in terms of environment and water quality. Basin institution and unions have very important functions in supplying productive and effective services to the inhabitants since they are serving to larger populations and geographical area. Industries take place in the member of the unions [22].

In accordance to the above explanations, in Local Management Union's Law recently entered into force in 2005 in Turkey (Law on Local Administrative Unions, Law No: 5355), [23], it is envisaged that local managers cooperate with each other, and accordingly establish unions to carry out their joint services. The aim of the Union will be to take the necessary precautions to prevent the pollution that occurs in the study area including lake, streams and creeks feeding the lake and settlements, executing some necessary studies to reduce erosion in the region, to regulate the flow regime, to carry out all kinds of activities for social, cultural and economical development of the settlement units located in the study area and, in accordance with this purpose, coordinating with related public and private institutions and organizations.

Common treatment facilities on a regional basis may be implemented and operated by the Unions. Similarly, following site selection for sanitary landfill sites, implementation and operation of these common sites may be conducted by the Unions.

4.6. Priority Regions

Coastal settlements should be given priority for sewer system implementation and rehabilitation. Secondly, remaining settlements can be included in the infrastructural improvement programs.

Integrated measures involving local and national levels of management with significant coordination and collaboration among all responsible institutions are urgently needed for protection and rehabilitation of this vulnerable natural resource and fragile ecosystem first by alleviating anthropogenic pollution sources to a minimum, then ensuring sustainable development of Beyşehir Lake National Park and environs. All programs should seek the support and active participation of all parties including NGOs through public awareness and environmental education programs [23, 24, 25]. Presently, increasing the total area under protection status and freshwater resource protection as much as possible are internationally set goals. Additionally, Beyşehir Lake National Park is a very valuable reservoir where international, technical, educational and financial support towards a sustainable development of the area awaits interest of the international community.

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