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in

Camarda D. (ed.), Grassini L. (ed.).
Coastal zone management in the Mediterranean region

Bari : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 53

2002
pages 15-23

ASSESSMENT OF MUNICIPAL AND INDUSTRIAL WASTE LOADS IN TAHTALI WATERSHED AREAS IN IZMIR

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ABSTRACT

Tahtali Dam Watershed Area is one of the most important potable and usage water sources in Izmir. There are settlements, industries and animal farms in this watershed area. The pollution problem of İzmir Tahtali watershed areas has been mostly caused by municipal wastes, animal farms and industrial sources. In this study, domestic wastewater flowrates originating from the settlements in Tahtali Dam Watershed Area and from industries were calculated. However, processes waters of industries could not be examined, so, pollution loading of industries originating from processes could not be determined. Existing methods and required methods, which is suitable for disposal of wastewaters in Tahtali Watershed Area, are given.

INTRODUCTION

Rapid population growth and industrialisation within the borders of watershed areas create negative impacts on the environment. The control of pollution in sensitive areas depends on the definition and control of sources. Pollution control studies have been planned within the content of water quality management principles. The first step of the study is the sources characterization. Almost all types of waste sources including municipal, animal activities and industrial activities exist in these areas. Industrial sources are important because of their toxic wastes as well as the difficulty involved in their control, municipal and animal wastes are also important since a lot of farm and villages already exist in this watershed area. The Tahtali Dam Watershed area has been protected with the help of some regulations and legislations from illegal settlements, industries and animal farms. According to these regulations, watershed areas are divided into eight different categories. The categorisation of the watershed protection areas is shown in Figure1. These categories are defined as follows;

- Zone 1- it is defined as 0-300 m distance from maximum operating level of drinking water lake
- Zone 2- it is defined as 700 m distances from Zone 1.
- Zone 3- it is defined as 1 km distances from Zone 2.
- Zone 4- it is defined as distance, which is between Zone 3 and water collection area.
- Zone 5- it is defined as 0-200 m distance from both of river side
- Zone 6-it is defined as areas of out of protection zones

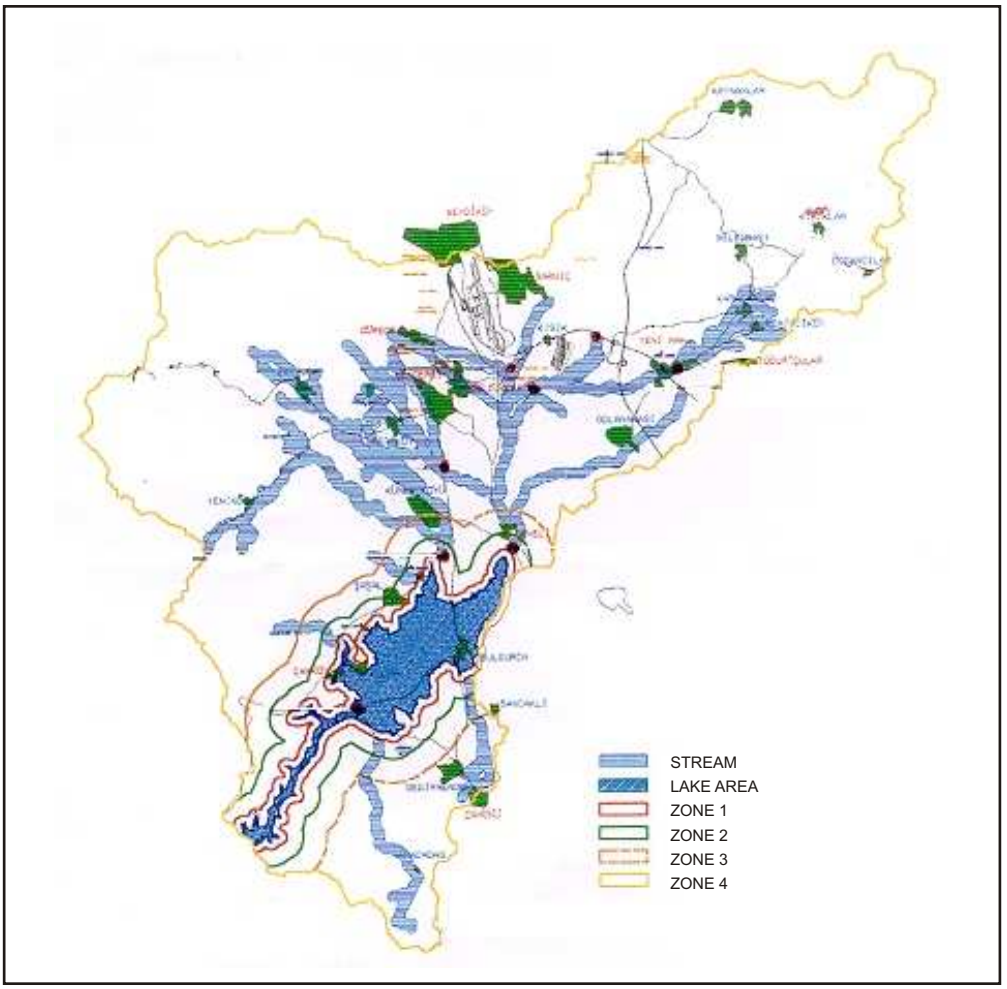

Figure1. Protection Zones of Tahtali Watershed Area

2. EVALUATION OF CURRENT SITUATION

In Tahtali Dam Watershed Area, three main groups of wastewaters are obtained. These groups are defined as follows:

Domestic wastewaters originating from the settlement areas and industrial activities.

Industrial wastewaters originating from the industrial activities.

Wastewaters originating from the animal farms.

2.1 Quantity of domestic wastewaters

The population of settlements in Tahtali Dam Watershed is determined according to the 1997 census. Thus, the flowrates of domestic wastewaters are calculated. In addition, domestic pollution loads originating from industries are determined by using the worker numbers data obtained from IZSU.

58000 inhabitants are existed in Tahtali Dam Watershed Area. Tahtali Dam Watershed Area includes the municipality of Menderes province, and Sarniç, Görece, Gölcükler, Kaynaklar, Degirmendere village municipalities. According to 1997 census, the populations of municipalities in Tahtali are given in Table 1.

Table 1. Population of Municipalities According to 1997 Census

Municipality	Population	Protection Zone
Sarnıç	14810	Zone 4
Kaynaklar	2535	Zone 4
Değirmendere	2064	Zone 4
Görece	6721	Zone 5
Oğlananası	1877	Zone 5
Menderes	15720	Zone 4
Akçaköy	331	Zone 5
Çamköy	345	Zone 1
Çatalca	661	Zone 5
Develiköy	1592	Zone 3
Keler	772	Zone 4
Kısıkköy	654	Zone 4
Küner	1473	Zone 5
Şaşal	858	Zone 2
Yeniköy	916	Zone 5
Çamönü	1022	Zone 4
Belenbaşı	693	Zone 4
Karaağaç	940	Zone 5
Kırıklar	651	Zone 4
Demirciköy	588	Zone 5
Yeşilköy	534	
Yoğurtçular	361	Zone 4
Doğancılar	222	Zone 4

One of the most important pollution sources in Zone 4 is the immigration houses in Görece. It is known that there are 2040 houses in Görece, 2100 houses in Gümüs Mestanli, 4000 houses in Sarniç villages. Görece immigration houses have an own sewerage system and a wastewater treatment plant. Treated wastewater is discharged indirectly into the Tahtali Dam Lake. There are septic tanks in the Gümüs Mestanli areas that consist of illegal houses in Menderes municipality. And the domestic wastewaters are collected in septic tanks, moreover, they remain in the Tahtali Dam Watershed Area. The sewerage network in Menderes has not been completed yet. The secondary canals are not existed. But municipality states that a connection to the main canal will be established in the next eight years. The domestic wastewaters in Menderes are collected in septic tanks belong to the houses. Many of the septic tanks in these areas are leaseproof tanks but some of these septic tanks are unleaseproof tanks. The wastewaters of Menderes and Görece immigration houses have already been kept in the Tahtali Dam Watershed. Domestic wastewater flowrates originating from the settlements in Tahtali Dam Watershed Area and from industries have been calculated. Domestic pollution loads are also calculated by using the values of parameters given in Table 2, and obtained pollution loads are summarized in Table 3.

Specific flowrate of domestic wastewaters originating from industries and specific flowrate of domestic wastewater from settlement area was accepted as 50 L/person/day and 200 L/person.day, respectively.

Table 2. Characteristics of Domestic Wastewaters Originating From Industries (Germirli *et al.*, 1997)

Parameters	Mean Concentration (mg/L)
BOD_5	400
COD	550
TSS	350
TKN	30
Total P	10
Oil &Grease	100
Surfactants	6

Table 3. Domestic Wastewater Flowrates and Total Pollution Loads originating from Industry and Settlements Areas in Tahtalý Watershed Area

Protection Zone	**W.water flowrate** (m^3/day)	BOD (kg/day)	COD (kg/day)	TSS (kg/day)	TKN (kg/day)	Total P (kg/day)	Oil & Grease (kg/day)	Surfactants (kg/day)
Zone 5 (settlement)	2	0.76	1.06	0.67	0.06	0.02	0.002	0.01
Zone 4 (settlement)	1618.3	647.32	898.16	566.41	48.55	16.18	161.83	9.71
Zone 3 (industry)	1.25	0.50	0.69	0.44	0.04	0.01	0.13	0.01
Zone 4 (industry)	225.3	90.12	125.04	78.86	6.76	2.25	22.53	1.35
Zone 5 (industry)	25	10	13.9	8.8	0.75	0.25	2.5	0.15
Zone 7 (industry)	16.2	6.48	8.99	5.67	0.49	0.16	1.62	0.1
Total	**1872.75**	**755.18**	**1047.84**	**660.85**	**56.65**	**18.87**	**188.61**	**11.33**

2.2 Quantity of Industrial Wastewaters

10 active and 7 inactive industries are existed in Zone 2 in Tahtali watershed area. Pinar Su is one of the active industry and its process wastewater was 7.2 m^3 / day according to IZSU data in 2000. This wastewater is transported out of the watershed area by using sewage trucks. Pinar Su and 9 animal farm constitute active industries in this area. These industries are not taken required precautions and they should be transported out of the watershed area according to the regulations.

12 active and 3 inactive industries are existed in Zone 3 in Tahtali watershed area. In this watershed area, industrial facilities which producing only domestic wastewater is given permission by IZSU, in case, preventive measures for their wastewater have been taken in order to meet the discharge parameters of Water Pollution Control Act is given in Watershed Directives.

46 industries exist in Zone 4. 17 of them have their own treatment plants and these industries are listed in Table 4. These are classified as metal, plastic, textile, wood processing, dairy industry, petroleum station, agricultural activities, animal feed industry, packaging, automotive, spring water industry, paint industry etc. Effluent wastewaters of treatment plant of ESTIM Wood and Metal Industry are discharged into watershed area. Effluent wastewaters of treatment plant of DHMI Adnan Menderes Airport are discharged into a small stream and remain in the watershed area. The capacity of treatment plant of DHMI Adnan Menderes Airport is 1000 m^3/day. It was accepted that maximum wastewater flowrate which is discharged from treatment plant, is 1000 m^3/day. The effluents of DHMI Adnan Menderes Airport contain domestic and industrial wastewaters. In Zone 4; domestic wastewater flow rates originating from settlement and industrial facilities are 10 973 m^3/day, and industrial wastewater flow rates are 1088 m^3/day. Totally 55 active industries exist in Tahtali watershed protection areas. Waste loads originating from these industries were calculated according to the capacities of sewage trucks that were given by IZSU, and these calculations are given in Table 5. Politeknik Machinery Production Industry is located in Zone 3, others are located in Zone 4. One of the major pollutant source is ESTIM Wood and Metal Industry Complex which discharge their wastewaters into the Tahtali watershed area. However, other industries such as TANSAS Meat Processing Industry and NURKÖY Dairy Industry discharge their effluent out of the watershed area with the help of discharge line. Wastewaters of some industrial facilities in Tahtali Dam Watershed area are transported out of the watershed area. The industrial wastewater flow rates were calculated according to the capacity of sewage trucks. If we compere the wastewater flow rates of industries and the capacity of their wastewater treatment plants which were taken from the documents of IZSU, approximately 10 times differences was seen between the flow rates. This situation indicates that all of the industrial wastewaters are not transported out of the watershed area by sewage trucks. However, pollution loads of 12 industries taken from EBSO documents were calculated according to the literature data in terms of unit loads and concentrations given in Table 6, and these results are given in Table 7.

Table 4. Treatment Capacities of Industrial Wastewater Treatment Plants in Tahtalý Watershed Area

Name of Industry	Protection Zone	Treatment Capacity (m^3/day)	Treated Wastewater flowrate (m^3/day)
DHMİ Adnan Menderes Airport	Zone 4	1000	1000
TANSAŞ meat processing industry	Zone 4	1760	1760
ESTİM	Zone 4	750	0
Günkol CO.	Zone 4	180	46
Çoban Meat Processing Industry	Zone 4	50	0
Sanfa Co	Zone 4	45	45
Özkul Textile Industry	Zone 4	40	10
CD Textile Industry	Zone 4	40	0
Nurköy Dairy Production	Zone 4	35	35
Tokullar Co	Zone 4	25	0
Politeknik Machinery Production	Zone 4	20	0
Meko Metal	Zone 4	20	0
Artkıy Leather Production	Zone 4	20	0
Egemer Automotive	Zone 4	15	0
Tüfekçi Agricultural Production	Zone 4	20	12

Table 5. Pollution Loads of Industries having Wastewater Treatment Plant

Number of Industries or Settlements	The Name of Industries or Settlements	Area	Protection Zone	Treatment Capacities (m^3/day)	Wastewater Flow rates* (m^3/day)	pH	TSS Loads (kg/day)	BOD Loads (kg/day)	COD Loads (kg/day)
374	Günkol Co	Görece	Zone 4	180	17.3	8.0	0.9	0.31	1.32
236	Tansas Meat Processing Industry	Kaynaklar	Zone 4	1760		7.8			
52	Tüfekçi Agricultural Production	Karacaaðaç	Zone 4		5.7	7.6	0,4	0,53	1.9
462	EGEMER Automotive.	Gaziemir	Zone 4	15	0.83	7.6	0,03	0.03	0.06
747	ESTIM	Oðlananasi	Zone 4	750		7.8			
197	Politeknik Machinery Production	Develiköy	Zone 3	20	0.33	7.6	0,01	0.008	0.02
628	Görece	Görece	Zone 4	3216		7.8			
461	Tokullar Co.	Gaziemir	Zone 4	25	1.67	7.8	0,06	0.05	0.12
21	CD Textile	Görece	Zone 4	40	5.06	7.8	0,12	0.07	0.19
463	MEKO Metal	Gaziemir	Zone 4	20	1.67	7.7	0,02	0.07	0.23
266	DHMI Adnan Menderes Airport	Görece	Zone 4	1000		7.8			
396	KÖYTÜR Broodyhouse	Demirciköy	Zone 4		12.3	7.7	0,43	0.16	1.3
464	Artkiy Leather Production	Gaziemir	Zone 4	20	1.3	7.4	0,02	0.05	0.11
440	SAN-FA Co	Gaziemir	Zone 4	45	4.5	7.8	0,09	0.24	0.8
212	Nurköy Dairy Production	Demirciköy	Zone 4	35		5.2			
220	Çoban Meet Processing Industry	Oðlananasi	Zone 4	50	3.2				
				7176	**53.86**		**2.08**	**1.52**	**5.33**

*Waste loads are calculated according to capacities of sewage trucks.

Table 6. Wastewater Characteristics of Various Industries according to the Literature (Meriç,S. and others, 1996)

Number	Kind of Production	COD (mg/L)	TSS (mg/L)	TKN (mg/L)	Oil & Grease (mg/L)	Surfactant (mg/L)	Phenol (mg/L)	Sulphide (mg/L)
1	Candied Fruit	2600	400	0	0	0	0	0
2	Plastics							
	Metal processing 1	410	1810	477	30	18,2	134	0
	Metal processing 2	241	17	0	21	0	140	0
3	Metal Plates	75	1000	0	50	0	0	0
4	Steel Industry	0	4200	0	29	0	3,4	4,5
5	Furniture Production	977	96	30				
6	Shoes Production	560	200					

Table 7. Calculated Waste Loads According to EBSO Data

Number	Name of Factory	Area of Factory	Protection Zone	W.water Flowrate (m^3/day)	COD (kg/day)	TSS (kg/day)	TKN (kg/day)	Oil & Grease (kg/day)	Surfactants (kg/day)	Phenol (kg/day)	Sulphide (kg/day)
1	Ali Galip Candied Fruit	Menderes	4	5	13	2	0	0	0	0	0
2	Hako Ceramic	Kisikköy	4	1	0,075	1	0	0,05	0	0	0
3	Akça Plastic Industry	Ayrancilar	unknown	2	0,82	3,62	0,954	0,06	0,04	0,27	0
4	Gözde Industry	Menderes	unknown	0	0	0	0	0	0	0	0
5	Açilim Industry	Menderes	4	0.7	0	0	0	0	0	0	0
6	Beşer Plastic	Menderes	4	0,7	0,169	0,012	0	0,015	0	0,01	0
7	Kavurlar Machine	Torbali	unknown	0,5	0,038	0,5	0	0,025	0	0	0
8	Doremi Furniture	Kisikköy	unknown	0,5	0	0	0	0	0	0	0
9	On-Ar Co	Kisikköy	unknown	2	0	0	0	0	0	0	0
10	Tosun Metal Industry	Menderes	unknown	0,2	0,015	0,2	0	0,01	0	0	0
11	Barlas Cooling	Kisikköy	4	1	0	0	0	0	0	0	0
12	Bilgi Co	Sarniç	4	100	0	420	0	2,9	0	0,34	0,45
			Total	**112,9**	**14,117**	**427,332**	**0,954**	**3,06**	**0,04**	**0,62**	**0,45**

3. RESULTS AND DISCUSSIONS

According to protection zones, the flowrates of wastewaters are presented in Table 8 and Table 9 in details.

Table 8. Wastewater Flowrates coming from Point Sources in Tahtali Dam Watershed Area.

Sources	Population	Domestic Wastewaters Flowrate (m^3/day)	Industrial Wastewater Flowrate (m^3/day)	Wastewater Flowrate originating from animals (m^3/day)
Zone 4 (settlement)	52239	10448		
Zone 4 (industry)	212	225	638	212
Zone 4 (Adnan Menderes Airport)		1000		
Zone 4 (ESTIM)		300	450	
Zone 5 (Gümüs Mestanli Settlements)	8400	1680		
Zone 4 and 5 (Menderes)	15720	3144		
Zone 6 (Gaziemir)	54245	10849		
Zone 4 (Görece)	6721	1608		
Zone 4 (Sarniç)	14810	2962		
Zone 4 (Kaynaklar)	2535	507		
Zone 5(Degirmendere)	2064	413		
Zone 2 (settlement)	345	69		
Zone 2 (industry)		17	7	36
Zone 3 (settlement)	2450	490		
Zone 3 (industry)		13	8	9
Zone 5 (settlement)	31946	6391		
Zone 5 (industry)		25	5	83
Zone 7(industry)		16	0	11

Table 9. Total Amounts of Wastewaters in Tahtali Dam Watershed Area

Sources	Flow rates of Domestic Wastewaters (m^3/day)	Flow rates of Industrial Wastewaters (m^3/day)	Flow rates of Wastewaters originating from Animals (m^3/day)
Zone 4 (settlement)	10448	-	
Zone 4 (industry)	525	1088	212
Zone 3 (settlement)	490		
Zone 3 (industry)	13	8	9
Zone 2 (settlement)	69		
Zone 2 (industry)	17	7	36
Zone 5 (settlement)	6391		
Zone 5 (industry)	25	5	83
Zone 7 (industry)	16	0	11
Total	**17994**	**1108**	**351**

In zone 2 of Tahtali Watershed Area, amounts of domestic wastewaters, industrial wastewaters, and other wastewaters originating from animals, are 86 m^3/d, 7 m^3/d, and 36 m^3/d, respectively. First of all, constructed institutions are nationalized, and some industries, which produce hazardous wastes, are closed according to Turkish Water Pollution Control Regulation and IZSU Watershed Protection Regulation. In addition to this, all wastewaters of other industries are storaged in leakproof tanks. These wastewaters are disposed out of Tahtali Watershed Area by transferring with sewage truck. Activities of agro-industries and stockbreeding are certainly unpermitted in this zone.

According to Turkish Water Pollution Control Regulation, settlement and all industrial activities are not permitted in zone 3 of Tahtali Watershed Area. Warehouses of fodder, and stockbreeding activities can be located in this zone. All of these activities are unpermitted in this zone according to Watershed Protection Regulation. In this zone, flowrates of domestic wastewaters, industrial wastewaters, and others are 503 m^3/d, 8 m^3/d, and 9 m^3/d, respectively.

According to Turkish Water Pollution Control Regulation, in zone 4, Governors shouldn't permit all new industrial activities, which produce liquid wastes, gas wastes, and solid wastes, and available industries should be removed out of Tahtali Watershed Area. If it is not possible, all wastewaters after treated by using advanced treatment technologies, should be discharged into a proper receiving media, which is located out of Tahtali Watershed Area. New settlement activities are unpermitted in this zone, but wastewaters of existed buildings and touristic plants should be storaged in leakproof tanks and should be removed to out of Tahtali Watershed Area.

According to Turkish Water Pollution Control Regulation, and Watershed Protection Regulation, wastewaters should not be discharged into the all surface waters feeding drinking water lake. In zone 5, all activities are unpermitted because of protection of drinking water lake. In this zone, there are a few factories, which have not taken any remediations for drinking water lakel. The most significant pollution for drinking water lakel is caused by these factories. According to regulations and legistations, all of them should be removed to out of Tahtali Watershed Area. In this zone, there are 48 of active industries and 49 of inactive industries. Amount of domestic wastewaters, which come from factories and buildings, industries, and other sources are 25 m^3/d, 5 m^3/d, and 83 m^3/d respectively.

In this study, processes waters of factories were not examined, so, pollution loadings of industries originating from processes were not determined. Theoretically, these loading factors can be determined, but calculated values are not given the exact values. These could be only possible values. Exact values can be higher than possible values. If production capacities and amount of process waters of industries when it will be reached, exact pollution loads of industries will be obtained.

According to the regulations and legistations, in order to go on their activities, all available settlements and industries should take the required remediations. Unless applying these remediations, all of them must be removed out of Tahtali Watershed Area. Some industries are active in present without permits, but they could not be removed out of Tahtali Watershed Area. Treated wastewaters of them have been storaged in both unleakproof tanks and leakproof tanks. Treated wastewaters, which are taken from leakproof tanks by using confirmed tankers of IZSU, are removed out of Tahtali Watershed Area. But, amount of them and capacities of treatment plants of these factories are different. Amounts of them are higher than capacities of their treatment plants. This situation shows that an important amount of wastewaters have been given to Tahtali Watershed Area.

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