Pesticides Concentration and Some Quality Parameters of Surface and Underground Water in Specially Protected Area of Salt Lake, Turkey

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Abstract

Specially Protected Area of Salt Lake is of about 7414 km^2 which is located geographically in latitude 39^o 30^l 00^{ll} to 38^o 00^l 00^{ll} and longitude 32^o 30^l 00^{ll} to 34^o 30^l 00^{ll} in Central Anatolia. Wastewater reaches the Salt Lake through 150 km long Konya main drain channel and the other small creeks. Brackish marshes have formed where channels and streams enter the Lake. Rainfall in the surrounding area is as low as 250 mm per year, average temperature and annually total evaporation are 11.8^{o}C and 1372.7 mm, respectively. The lake is surrounded by cereal fields in the north, east and west. The Salt Lake also includes a unique ecosystem with its natural attractive environments and habitats for biota.

Pesticides have been commonly used for cereals to protect from subsoil pests. In order to determine pesticide pollution in the Specially Protected Area of Salt Lake, 30 total set of water samples (15 surface and 15 underground samples) were collected from the study area. Four pesticides due to their extensive usage were analyzed. These pesticides are Chlorpyriphos, Chlorpyriphos-methyl, Atrazine and Simazine. Pesticide concentrations of surface waters varied from 0,00018 to 1,5 mg Simazine L^{-1}, negligible to 0,35 mg Atrazine L^{-1}, negligible to 0,062 mg Methyl-Chlorpyrifos L^{-1} and negligible to 0,062 mg Chlorpyrifos L^{-1}. Simazine, Atrazine, Methyl-Chlorpyrifos and Chlorpyrifos were around 0,40 mg L^{-1} 0,063 mg L^{-1}, 0,05 mg L^{-1} and 0,08 mg L^{-1} in underground water, respectively. Some water quality parameters such as pH, salinity, sodium absorption ratio (SAR), anions and cations were also analyzed.

Key Words: *Water, pesticide, surface, underground, Salt lake*

Introduction

The current environmental situation has become a major concern in political, social, cultural and academic communities in nearly all countries (Barandela, 1997). In order to supply the food requirements of a steadily increasing world population, pressure on natural resources has been raised by human activities that cause decreasing of productivity, quality and biodiversity. These ecological changes affect not only the quality of life of current world population but also more alarmingly existence or next generations of living creatures.

The pollution of surface and underground water bodies by several toxic chemicals as a result of rapid industrialization requires suitable modification of conventional treatment methods depending upon the nature of pollutants. Pesticides are a group of such hazardous materials having potential risk to human health Ayranci and Hoda (2005). It can be also say that pesticides are of concern to water quality managers and environmental risk regulators to maintain and achieve a good water quality status. Examples of point sources of pesticides are sewage plants, sewer overflows and losses due to bad management practices of farmers. As diffuse input pathways runoff, drain flow, drift, deposition and a contribution through groundwater can be distinguished (Holvoet et al. 2007).

European legislation, through the recently issued Directive (Council Directive, 1998), has fixed the maximum acceptable level of total pesticides in drinking water at 0.5 µg/l, and for individual compounds at 0.1 µg/l. Being these values quite strict, it was considered of interest to carry out an extensive pesticide

monitorization program of the ground waters (Garrido et al, 2000). Under this scope, the areas to be prospected, should combine a significative agricultural activity (thus involving a definite potential risk of pesticide pollution) with an use of the aquifers for human consumption. Therefore, the aim of this study is to determine whether water quality guidelines specifically for surface and groundwater ecosystems are needed and to provide a preliminary risk assessment for surface and groundwater ecosystems in the Specially Protected Area of Salt Lake.

Material and Method

The Study Area Description

Specially Protected Area of Salt Lake is of about 7414 km^2 which is located geographically in latitude 39^o 30^l 00^{ll} to 38^o 00^l 00^{ll} and longitude 32^o 30^l 00^{ll} to 34^o 30^l 00^{ll} in Konya plain border and occupied a depression in the dry central plateau (Central Anatolia) of Turkey, 105 km northeast of Konya (Figure 1). The study area includes three provinces, Ankara, Aksaray and Konya, and lies at an elevation from sea level 905 m. The middle part of the study area, located north east of Salt Lake is mountainous (Dengiz, 2007).

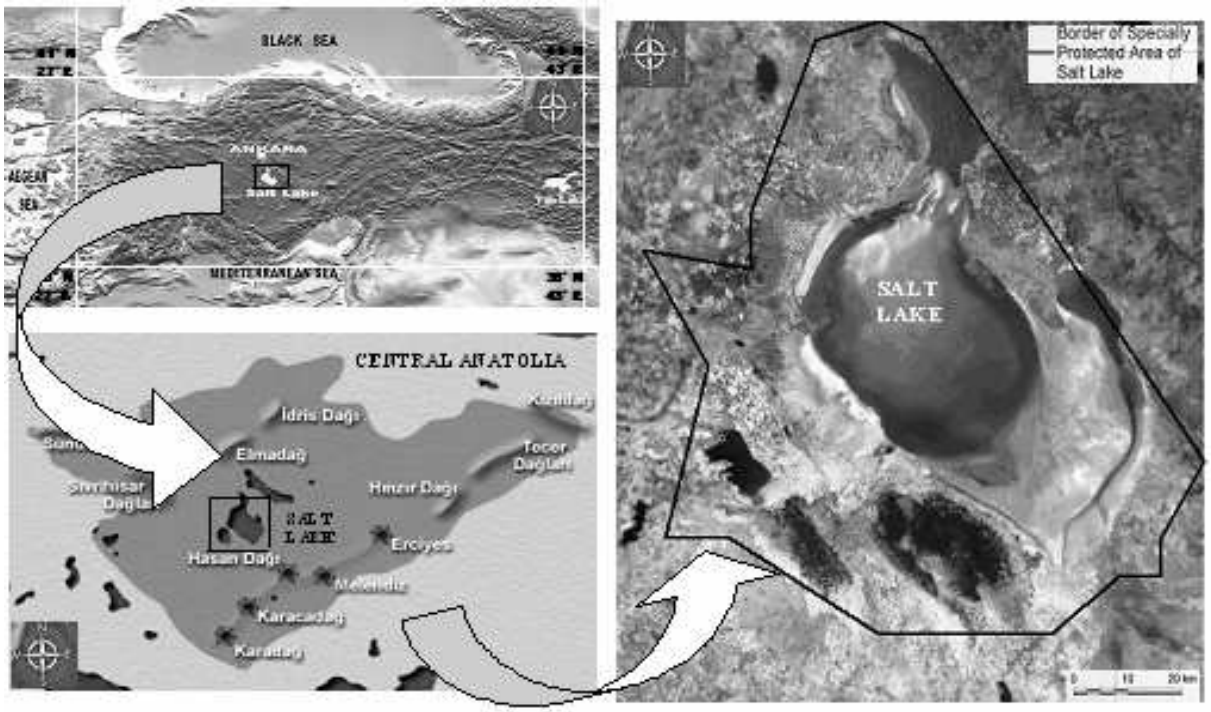

Figure 1. Location of the study area

Salt Lake has an area that covers 24.7% of the total area (about 1831 km^2). Normally it is about 80 km north to south and 50 km east to west. It recedes each summer to leave a desolate expanse of encrusted salt. The lake has no outlet, but it has two major streams**:** Groundwater and surface water feed the lake. An unnaturally constant input is the wastewater, which reaches the lake through the 150 km long Konya main drain channel. Brackish marshes have formed where channels and streams enter the Lake; rainfall in the surrounding area is as low as 250 mm per year, average temperature and annually total evaporation are 11.8 ^{o}C and 1372.7 mm, respectively. In addition, according to the Soil Survey Staff, (1999), soil moisture and soil temperature regimes were found as aridic and mesic. Salt Lake is the second largest lake in Turkey. Its extent varies greatly with a maximum of depth 1.5 m in spring and most of the lake dries up in summer (except some small areas, especially a 3500 ha area south of Sereflikochisar). The east west track at the bottleneck (reinforced with stones in the 16th century) is only passable in summer. The lake is surrounded by (only partially irrigated) cereal fields in the north, east and

west; however, extensive seasonally flooded salt steppe occur, particularly to the southwest (Dengiz, 2007).
The Salt Lake and its vicinity are covered with Oligocene formations having gypsium and salt strata. Although salinity level changes with seasonal fluctuations (on 24-30 April, on 1-9 July and on 18-26 August 2003), this lake water is extremely saline with a salt ratio of 32% (http://cdb.gov.tr/docs/IPAs.doc). The lake bottom is covered with a 1 to 30 cm thick salt layer, which has given rise to a local salt industry providing 55% of all Turkish salt. On average 750000 tons salt is produced annually at three (state owned) saline plots, covering 1200 ha. The Salt Lake also includes a unique ecosystem with its natural attractive environments and habitats for biota.

Method

In the study area, main water resources that are used in agriculture are deep wells, rivers, irrigation schemes and drainage channels (both urban and agriculture). We evaluated these resources as ground water and as surface water. In order to determine the quality of water resources, 35 surface and 34 ground water samples were collected from the study area on 24-30 April, on 1-9 July and on 18-26 August 2003 and coordinated using GPS (Figure 2). Analyses of electrical conductivity, pH, sodium, potassium, calcium, magnesium, carbonate, bicarbonate, chlorine, sulfate, boron, Sodium Absorption Rate (SAR), ammonium, nitrate, organic matter, phosphate, and pesticides parameters were done according to Eaton et al (1995). Ground water and surface water were evaluated according to Table 1.

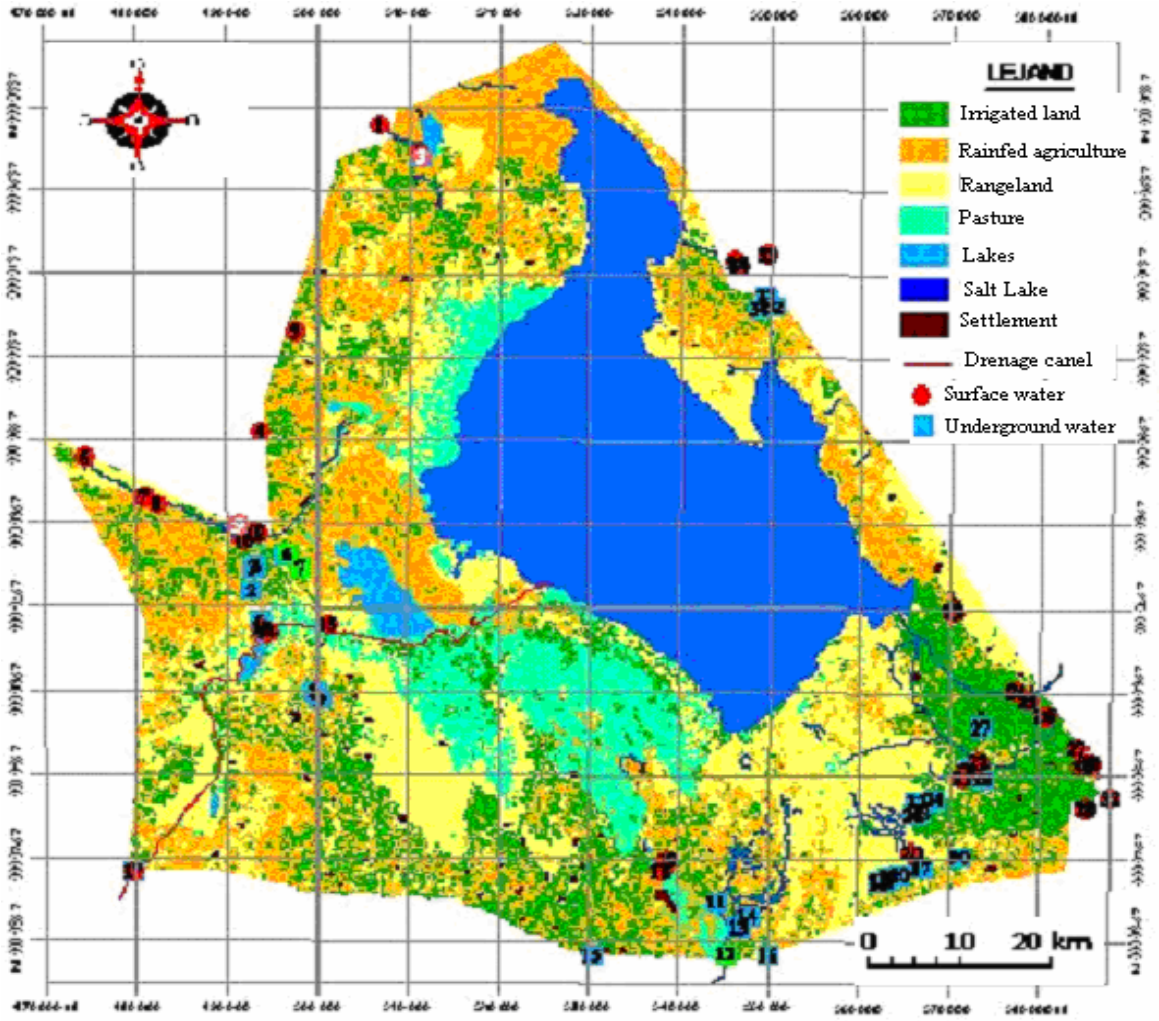

Figure 2. Surface and underground water samples places

Table 1. Irrigation water quality parameters and classification according to RCWP 1991

Water Quality Parameters		Irrigated water class				
		I. (very good)	II. (good)	III. (suitable)	IV. (marginal suitable))	V. (unsuitable)
EC, $dS.m^{-1}$		0-0.25	0.25-0.75	0.750-2.00	2.00-3.00	>3.00
Exchangeable sodium (Na), %		<20	20-40	40-60	60-80	>80
Sodium adsorption ratio (SAR)		<10	10-18	18-26	>26	
Chlorine(Cl^-),	me L^{-1}	0-4	4-7	7-12	12-20	>20
	mg L^{-1}	0-142	142-249	249-426	426-710	>710
Sulphate (SO_4^{2-}),	me L^{-1}	0-4	4-7	7-12	12-20	>20
	mg L^{-1}	0-192	192-336	336-575	576-960	>960
Boron (B),	mg L^{-1}	0-0.5	0.5-1.12	1.12-2.0	2.0	
NO_3^- or NH_4^+	mg L^{-1}	0-5	5-10	10-30	30-50	>50
Phosphate (PO_4),	mg L^{-1}	0-2				
Irrigated water class		C_1S_1	C_1S_2 - C_2S_2 C_2S1	C_1S_3 -C_2S_3 C_3S_3 –C_3S_2 C_3S_1	C_1S_4 -C_2S_4 C_3S_4 –C_4S_3 C_4S_3 - C_4S_2 C_4S_1	
pH		6.5-8.5	6.5-8.5	6.5-8.5	6.9	<6 or >9
Total pesticide (mg/l)		0.001	0.01	0.1	>0.1	

Results and Discussion

Quality of irrigation water

Results showed that the surface water samples taken from Kulu, Cihanbeyli, Sereflikochisar districts and Duden and Bolluk lakes, Pecenek river and Konya main drainage channel include high cations and anions concentrations (Table 2). However, we have defined little increase in cations and anions from beginning to end of irrigation season at all water resources. Salt concentration was defined as EC (electrical conductivity $dS.m^{-1}$). While EC values of Duden-Bolluk lakes and Corca River were found at very high level (37.6, 168.9 and 33.2 $dS.m^{-1}$, respectively), Pecenek River and Konya main drainage channel have high EC values (6.3 and 3.2 $dS.m^{-1}$). EC values of other surface water samples collected from Degirmenozu, Insuyu, Karasu, Ekecik, Uluirmak rivers and Cihanbeyli irrigation channel range from 0,5 $dS.m^{-1}$ to 2.4 dS m^{-1}. In the end of the irrigation season there has been a little increase at EC values of Degirmenozu Stream, Bolluk Lake, Konya-Cumra Main Drainage Channel, Karasu and Pecenek streams. In addition high pH (> 8.5), boron (42.5-142 mg L^{-1}) and SAR (82-129) were detected in Duden and Bolluk Lakes. Furthermore, according to Table 1, most of the surface water resources were classified between C2S1 and C4S1 except Bolluk, Duden Lakes and Corca River**,** which were classified as C_4S_4. Heavy metal toxicity was not found in all surface water. Organic matter was determined in all samples and varies between 0.2-431 mg L^{-1}. Especially, owing to waste water of Konya has been drained to Duden and Bolluk Lakes, Konya main drainage channel, Karasu and Pecenek Rivers, they include high Organic Matter, phosphate, NH_4^+ and NO_3^- concentrations that were evaluated as microbiological pollution at the same time that were a clear evidence of the pollution caused by wastewaters (Anonymous, 2004).

Almost all of groundwater samples were classified as within the C_3S_1 irrigation water quality category and found suitable for irrigation but few wells located vicinity of Cihanbeyli, Gunyuzu and Yenikent districts are not suitable for irrigation (C_4S_1) due to their high salt and boron concentration. There was not any problem in all ground water samples in terms of ammonium, organic matter, phosphate, nitrate concentrations (Table 3). It was also determined that particularly basic cations and anions concentrations were changing and increasing from the beginning to the end of irrigation period due to excessive irrigation practices that lead to accelerating salinization in the study area.

Table 2. Surface water samples analysis results

Samples Number	Cations, me L^{-1}				Anions, me L^{-1}				Total cations or anions	EC $dS.m^{-1}$	B, mg L^{-1}	pH	SAR	Irrigation water class
	Na^+	K^+	Ca^{2+}	Mg^{2+}	CO_3^-	HCO_3^-	Cl^-	SO_4^{2-}						
	2.87	0.09	3.03	3.44	1.21	6.12	0.87	1.24	9.43	0.799	0.80	8.30	1.59	C_3S_1
1	4.23	0.18	3.38	3.63	2.16	6.48	2.01	0.77	11.41	0.993	1.14	8.58	2.26	C_3S_1
	3.80	0.10	2.92	3.68	0.00	6.99	1.55	1.96	10.50	0.922	0.89	7.80	2.09	C_3S_1
2	327.57	0.73	0.37	12.50	62.94	18.18	181.82	78.24	341.18	37.588	42.54	9.80	129.09	C_4S_4
	196.29	0.41	0.37	15.42	40.77	27.00	104.38	40.35	212.50	22.518	30.67	9.42	69.85	C_4S_4
3	211.45	0.58	0.86	19.30	54.16	32.36	126.51	19.15	232.18	19.507	39.05	9.53	66.61	C_4S_4
	279.28	0.61	3.88	21.54	64.94	33.97	151.30	55.10	305.31	23.125	35.81	9.56	78.35	C_4S_4
4	231.53	0.15	23.80	45.32	2.33	1.29	195.77	101.42	300.80	33.012	14.00	8.85	39.8	C_4S_4
5	11.74	0.20	2.52	4.87	2.55	6.28	4.04	6.45	19.33	1.758	2.39	8.85	6.11	C_3S_1
6	1.36	0.04	2.00	3.01	0.00	3.31	0.87	2.23	6.41	0.555	< 0.5	7.52	0.86	C_2S_1
	1.60	0.05	2.45	2.66	0.63	3.30	1.35	1.48	6.76.	0.606	< 0.5	8.62	1.00	C_2S_1
7	1.55	0.06	2.48	2.92	2.16	2.52	1.63	0.69	7.00	0.621	< 0.5	8.54	0.94	C_2S_1
	1.66	0.05	2.59	2.87	0.91	3.06	1.26	1.94	7.17	0.623	< 0.5	8.37	1.00	C_2S_1
	1.79	0.05	2.44	2.68	0.85	3.19	1.20	1.72	6.96	0.615	< 0.5	8.81	1.12	C_2S_1
8	1.55	0.06	2.29	2.37	1.60	2.11	1.49	1.06	6.27	0.559	< 0.5	8.72	1.01	C_2S_1
	1.66	0.04	2.75	2.61	1.74	2.65	1.31	1.36	7.06	0.604	< 0.5	8.73	1.01	C_2S_1
	2.04	0.07	2.72	2.77	0.49	3.26	1.46	2.36	7.60	0.715	< 0.5	8.50	1.23	C_2S_1
9	1.87	0.07	2.61	3.24	2.40	2.53	1.91	0.95	7.79	0.695	< 0.5	8.74	1.09	C_2S_1
	1.66	0.08	2.71	2.81	1.15	3.18	1.36	1.58	7.26	0.639	< 0.5	8.33	1.00	C_2S_1
	1.96	0.06	2.18	3.02	0.49	2.97	1.68	2.08	7.22	0.641	< 0.5	8.55	1.21	C_2S_1
10	2.13	0.08	1.79	3.17	1.24	2.40	2.29	1.23	7.16	0.665	< 0.5	8.83	1.35	C_2S_1
	1.57	0.08	1.81	3.54	0.95	2.55	2.08	1.42	7.00	0.693	< 0.5	8.81	0.96	C_2S_1
	3.23	0.06	3.26	3.54	1.25	3.39	2.07	3.37	10.09	1.076	< 0.5	8.88	1.75	C_3S_1
11	2.50	0.10	3.22	3.59	2.24	3.05	2.38	1.74	9.41	0.848	0.73	8.70	1.36	C_3S_1
	3.04	0.11	4.34	5.10	0.00	6.33	2.57	3.70	12.59	1.065	< 0.5	8.10	1.40	C_3S_1
	2.69	0.08	3.65	4.21	0.94	3.84	2.55	3.30	10.64	0.907	< 0.5	8.46	1.36	C_3S_1
12	2.55	0.10	3.15	3.87	1.88	3.20	2.62	1.98	9.67	0.867	< 0.5	8.33	1.36	C_3S_1
	2.52	0.12	4.25	5.23	0.00	6.15	2.61	3.36	12.12	1.093	< 0.5	7.88	1.16	C_3S_1
	523.4	0.96	28.71	557.52	21.32	4.88	835.98	248.36	1110.54	121.62	115.2	8.73	30.57	C_4S_4
13	1057.2	0.87	39.10	982.91	53.60	1.22	1369.5	655.70	2080.05	186.05	92.57	9.23	46.77	C_4S_4
	2711.4	0.82	47.94	2133.8	89.61	2.10	1495.4	3306.9	4893.96	399.46	168.9	8.45	82.09	C_4S_4

Table 2. continue

Samples Number	Cations, me L^{-1}				Anions, me L^{-1}				Total cations or anions	EC $dS.m^{-1}$	B, mg L^{-1}	pH	SAR	Irrigation water class
	Na^+	K^+	Ca^{2+}	Mg^{2+}	CO_3^-	HCO_3^-	Cl^-	SO_4^{2-}						
14	14.67	0.69	26.88	17.45	0.00	12.66	14.67	32.36	58.69	4.928	1.61	6.90	3.12	C_4S_1
15	21.56	1.01	17.16	22.93	0.00	8.49	19.53	34.64	62.66	5.027	2.07	7.76	4.82	C_4S_1
	24.44	1.19	29.02	21.54	0.00	11.72	23.91	40.56	76.19	6.326	2.72	7.59	4.86	C_4S_1
16	9.13	0.38	3.96	8.04	0.00	4.97	7.31	9.23	21.51	1.948	<0.5	7.58	3.73	C_3S_1
	15.20	0.73	27.76	18.73	0.00	12.51	16.07	33.84	62.42	5.116	1.50	6.84	3.15	C_4S_1
17	21.01	0.43	5.14	12.45	0.00	5.56	15.73	17.74	39.03	3.330	0.60	7.54	7.08	C_4S_1
18	4.93	0.21	6.12	5.53	0.00	6.28	6.54	3.96	16.79	1.661	0.7	8.26	2.04	C_3S_1
19	6.30	0.25	6.37	8.56	0.85	4.38	7.41	8.85	21.49	1.994	1.61	8.37	2.31	C_3S_1
20	22.43	0.82	2.46	7.64	3.90	7.30	16.50	5.65	33.35	2.827	4.96	8.79	9.98	C_4S_1
21	9.65	0.49	1.72	5.16	3.64	6.07	6.72	0.59	17.01	1.654	3.23	8.89	5.20	C_3S_1
22	9.65	0.50	2.95	5.66	4.84	6.30	6.99	0.62	18.76	1.901	3.52	8.98	4.65	C_3S_1
	9.85	0.57	5.30	6.23	0.00	10.37	6.62	4.96	21.95	1.879	2.62	8.08	4.11	C_3S_1
23	1.52	0.24	1.90	1.59	0.63	3.26	1.30	0.06	5.23	0.508	0.80	8.49	1.15	C_2S_1
24	6.28	0.33	3.76	3.19	0.00	7.93	3.48	2.16	13.56	1.260	1.74	7.99	3.37	C_3S_1
25	2.00	0.25	2.26	1.61	0.76	3.43	1.25	0.67	6.11	0.502	0.82	8.56	1.44	C_2S_1
26	2.11	0.32	2.80	3.54	1.04	2.79	1.70	3.23	8.76	0.662	0.62	8.74	1.18	C_2S_1
27	1.96	0.24	2.28	1.70	0.72	3.57	1.25	0.63	6.17	0.536	0.87	8.53	1.39	C_2S_1
28	4.20	0.41	2.65	7.92	2.11	8.30	4.71	0.06	15.18	1.307	1.32	8.41	1.83	C_3S_1
	7.34	0.91	2.95	5.51	2.16	6.49	7.50	0.57	16.71	1.821	1.77	8.86	3.57	C_3S_1
	9.26	1.08	10.89	6.20	0.00	15.89	7.97	3.56	27.47	2.415	2.09	6.72	3.17	C_3S_1
29	7.32	0.59	7.59	5.95	0.00	11.82	6.16	3.48	21.45	1.836	1.54	6.84	2.81	C_3S_1
30	1.68	0.29	2.70	1.95	0.88	3.87	1.84	0.03	6.61	0.663	1.17	8.62	1.10	C_2S_1
31	2.02	0.24	3.00	2.42	1.72	2.84	1.75	1.37	7.68	0.667	0.75	8.84	1.22	C_2S_1
32	2.11	0.24	3.29	2.87	1.60	3.09	1.93	1.88	8.50	0.712	0.76	8.85	1.20	C_2S_1
33	6.30	0.11	26.63	8.72	0.64	1.42	4.83	34.86	41.75	3.091	0.51	8.24	1.50	C_4S_1
	7.04	0.00	29.57	7.74	0.00	4.62	4.73	34.99	44.35	3.314	0.69	7.50	1.63	C_4S_1
34	22.51	0.32	3.17	7.88	1.64	3.63	19.96	8.64	33.88	3.223	0.74	8.70	9.58	C_4S_1
35	1.68	0.09	2.28	3.07	0.54	3.24	1.64	1.71	7.12	0.777	<0.5	8.21	1.03	C_3S_1
	5.81	0.25	6.49	6.64	4.64	6.16	4.14	4.24	19.18	1.686	0.68	9.04	2.27	C_3S_1

Table 3. Some other pollutant parameters of surface water

Samples number	NO_3, mg L^{-1}	NH_4, mg L^{-1}	Organic Matter, mg L^{-1}	Phosphate, mg L^{-1}
	0-10	0-5	-	0-2
1	21.65	-	1.81	< 0.2
	4.96	3.00	8.57	2.80
	14.99	3.05	6.64	1.68
2	1.55	-	1.81	< 0.2
3	1.83	-	13.57	1.98
	2.17	-	20.25	1.61
	12.64	-	24.57	1.06
4	55.74	-	10.36	< 0.2
5	1.64	-	5.93	< 0.2
6	26.65	-	2.11	< 0.2
7	33.35	-	0.94	< 0.2
	31.30	-	1.52	< 0.2
	32.33	-	3.00	< 0.2
8	27.87	-	1.16	< 0.2
	29.73	-	0.25	< 0.2
	31.65	-	2.46	< 0.2
9	25.40	-	2.11	< 0.2
	26.17	-	2.23	< 0.2
	32.43	-	5.21	< 0.2
10	19.64	-	1.67	< 0.2
	11.13	-	2.94	< 0.2
	7.94	-	3.43	< 0.2
11	32.25	-	1.71	< 0.2
	21.56	3.75	5.14	< 0.2
	17.34	1.61	6.54	0.54
12	21.65	-	1.80	< 0.2
	20.60	1.92	4.47	< 0.2
	174.39	3.66	4.75	1.36
13	2.56	-	42.50	4.64
	3.39	-	153.57	2.43
	6.07	-	431.43	< 0.2
14	1.76	-	1.71	< 0.2
15	1.46	50.00	11.43	3.40
	1.22	-	4.59	< 0.2
16	1.64	356.00	8.36	6.45
	2.16	-	2.00	< 0.2
17	1.10	22.00	1.71	6.08
18	7.04	-	6.02	< 0.2
19	1.83	-	8.57	< 0.2
20	2.19	-	5.35	< 0.2
21	4.39	-	2.32	0.60
22	3.99	-	3.14	0.60
	6.37	0.64	4.22	2.53
23	5.76	-	1.68	< 0.2
24	14.84	1.23	4.71	< 0.2
25	4.93	-	1.73	< 0.2
26	1.04	-	5.21	0.20
27	4.48	-	2.00	< 0.2
28	4.48	-	1.72	< 0.2
	0.80	2.97	8.85	4.72

Table 3. continue

Samples no	NO_3, mg L^{-1}	NH_4, mg L^{-1}	Organic Matter, mg L^{-1}	Phosphate, mg L^{-1}
28	1.01	8.02	31.02	10.49
29	2.19	-	10.19	3.42
30	0.92	-	4.96	0.52
31	1.28	-	2.33	< 0.2
32	2.40	-	8.49	0.27
33	31.15	-	2.35	< 0.2
	29.84	0.55	0.97	0.30
34	12.30	-	6.18	0.36
35	15.44	-	2.02	< 0.2
	6.31	0.70	6.11	0.38

Table 4. Some other pollutant parameters of ground water

Samples number	NO_3, mg L^{-1} 0-10	NH_4, mg L^{-1} 0-5	Organic Matter, mg L^{-1} -	Phosphate, mg L^{-1} 0-2
	100.51	-	0.79	< 0.2
1	66.94	-	1.00	< 0.2
	77.99	-	3.04	< 0.2
2	12.34	-	1.66	< 0.2
3	49.03	-	1.80	< 0.2
	53.30	-	2.21	< 0.2
4	33.03	-	1.30	< 0.2
5	2.56	-	0.66	< 0.2
6	9.96	-	1.09	< 0.2
7	13.80	-	2.86	< 0.2
8	1.47	-	1.43	< 0.2
9	23.81	-	1.57	< 0.2
10	3.20	-	0.69	< 0.2
11	6.49	-	0.90	< 0.2
12	4.93	-	0.64	< 0.2
13	4.75	-	0.85	< 0.2
	5.76	-	1.50	< 0.2
14	1.28	-	2.15	< 0.2
	1.26	-	3.01	< 0.2
15	6.49	14.00	0.68	< 0.2
16	8.13	-	0.81	< 0.2
17	85.70	-	2.81	< 0.2
18	24.47	-	0.66	< 0.2
19	44.09	-	1.99	< 0.2
20	23.36	-	2.27	< 0.2
21	30.02	-	1.82	< 0.2
22	1.55	-	2.63	0.69
23	20.28	-	1.09	0.47
24	17.52	-	1.31	1.79
25	11.23	-	1.28	< 0.2
26	3.99	-	1.93	< 0.2
27	23.72	-	0.88	0.30
28	3.99	-	1.43	0.23
29	29.12	-	0.73	< 0.2
30	2.00	-	2.51	< 0.2
	2.60	-	2.48	0.29
31	60.76	-	1.14	< 0.2
32	46.27	-	1.46	< 0.2
33	97.87	-	1.45	< 0.2
	101.42	-	0.8	< 0.2
34	9.10	-	1.96	< 0.2

Pesticides Concentration

Pesticides have been commonly used for cereals to protect from subsoil pests. In order to determine pesticide pollution in the Specially Protected Area of Salt Lake, 30 total set of water samples (15 surface and 15 underground samples) were collected from the study area. Four pesticides due to their extensive usage were analyzed. These pesticides are Chlorpyriphos, Chlorpyriphos-methyl, Atrazine and Simazine. Pesticide concentrations of surface waters varied from 0,00018 to 1,5 mg Simazine L^{-1}, negligible to 0,35 mg Atrazine L^{-1}, negligible to 0,062 mg Methyl-Chlorpyrifos L^{-1} and negligible to 0,062 mg Chlorpyrifos L^{-1}. Simazine, Atrazine, Methyl-Chlorpyrifos and Chlorpyrifos were around 0,40 mg L^{-1} 0,063 mg L^{-1}, 0,05 mg L^{-1} and 0,08 mg L^{-1} in underground water, respectively (Table 5 and Table 6).

Table 5. Pesticides concentration of surface water samples

Water samples number	**Pesticides, mg L^{-1}**					
	0.0005	**0.1**	**0.09**	**0.09**	**0.09**	**0.1**
	Simazine	Atrazin	Methyl-Chlorpyrifos	Chlorpyrifos	Methyl-Chlorpyrifos+ Chlorpyrifos	Total Pesticide
1	0.0080	-	-	0.0314	0.0314	0.0394
3	0.0310	-	-	0.0750	0.0750	0.1060
6	0.0200	0.1200	0.0052	0.0150	0.0205	0.1602
7	0.0210	0.0800	0.0073	0.0210	0.0283	0.1293
8	0.0013	0.0020	-	0.0020	0.0020	0.0531
9	0.0024	0.0039	-	0.0110	0.0110	0.0173
10	0.0310	0.0580	0.0620	0.0310	0.0930	0.0680
11	0.0380	0.0150	-	0.0220	0.0220	0.0750
12	0.0420	0.3500	0.0022	0.0750	0.0772	0.4692
13	1.5000	-	-	-	-	1.5000
16	0.6500	-	-	0.0128	0.0128	0.6628
22	0.0042	0.0080	0.0420	0.0150	0.0570	0.0692
24	0.0300	0.0014	-	0.0280	0.0280	0.0261
28	0.0011	-	-	0.0250	0.0250	0.0261
30	0.0002	-	-	0.0280	0.0280	0.0282

Table 6. Pesticides concentration of ground water samples

Water samples number	**Pesticides, mg L^{-1}**					
	0.0005	**0.1**	**0.09**	**0.09**	**0.09**	**0.1**
	Simazine	Atrazin	Methyl-Chlorpyrifos	Chlorpyrifos	Methyl-Chlorpyrifos+ Chlorpyrifos	Total Pesticide
1	0.0200	0.06200	0.008	0.0615	0.0695	0.1515
2	0.0620	-	-	0.0310	0.0310	0.0930
3	0.0470	0.06300	-	0.0060	0.0060	0.1160
9	0.4000	-	-	-	-	0.4000
14	-	-	-	0.0318	0.0318	0.0318
17	0.0980	0.01250	-	0.0800	0.0800	0.1905
18	0.0250	0.00125	-	0.0250	0.0250	0.0513
19	0.0410	0.02800	-	0.0380	0.0380	0.1070
23	0.0030	0.00430	-	0.0250	0.0250	0.0323
24	0.0040	0.02000	-	0.0125	0.0125	0.0365
25	0.0410	0.06250	-	0.0550	0.0550	0.1585
27	0.0842	0.02500	-	0.0310	0.0310	0.1402
30	-	-	-	0.0200	0.0200	0.0200
32	0.0003	0.00015	0.033	0.0250	0.0580	0.0585
33	0.0012	0.03000	0.050	0.0400	0.0900	0.1212

Chlorpyripos, triazine pesticides commonly used in study area analysis were done both surface and ground water samples. Pesticides were only found between 0.106 and 0.662 mg kg^{-1} in Insuyu River and Bolluk Lake. Moreover, ground water samples collected from Cihanbeyli, Sereflikochisar, Günyüzü, Sultanhani, Yenikent, Yesilova districts include 0.107-0.400 $mg.kg^{-1}$ pesticide concentration. Therefore, according to Turkish Water Pollution Control Regulation (RCWP, 1991), these waters were classified as IV class and must not be used for irrigation.

Conclusion

We have accomplished for the first time a systematic survey of the some quality parameters and pesticies concentrations of surface and underground water in Specially Protected Area of Salt Lake, Turkey. A total of 69 water samples (35 surface and 34 underground samples), selected pesticides (Simazine, Atrazin, Methyl-Chlorpyrifos and Chlorpyrifos) and some water quality parameters (Na, K, Ca, Mg, CO_3, HCO_3, Cl, SO_4, B, NH_4, NO_3, PO_4, organic matter, pH, EC and SAR) were determined in terms of their concentrations based on the extension of their use, their environmental harmful and water quality criteria. The results obtained in the area prospected indicate the presence of pesticides in a substantial number of the sites analyzed (42.9%), thus the study results showed that pesticide contaminated in groundwater caused from intensive agricultural practice in the study area.

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