Original Research

Pollution in Melendiz Water Basin Groundwater

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Abstract

In our study, samples were taken from the groundwater that is used for drinking and irrigation in the Melendiz Water Basin, and the quality of water and the factors causing pollution were determined by evaluating them according to "Continental Water Sources Quality Classification Criterions" (Republic of Turkey Ministry of Environment and Forest/Regulation for Water Pollution Control). When the analysis results of samples taken between 2006 and 2009 were compared, it was determined that the amount of pollution increased in time. Moreover, the seasonal variations of ground water quality criterions were determined and the precautions that should be taken to minimize this pollution were discussed.

Keywords: quality of groundwater, seasonal variation, Aksaray, environmental pollution

Introduction

Materials mixing in water change its physical, chemical, and biological properties and cause "water pollution." These aforesaid changes also affect living things in the water. Thus, water pollution can disrupt balances and cause a gradual decrease or even terminate water's own cleaning capacity in the nature [1].

Depending on rapid increases in the world's population and developing technology, the importance of water as an indispensable factor for living things increases day by day as a result of widespread environmental pollution. From this respect, it is important to trace the quality of water in the natural cycle. Recently, the environmental pollution event with its significant dimension puts forward for consideration that the use of water sources is not only limited by quantity but also by quality of water. Therefore, it is necessary to trace the amount of water as well as its quality in terms of protecting "Utilizable Water Potential" [2]. For this reason, studies related to the tracing of water quality and wastewater treatment all over the world have increased every passing day [3-11]. Pollution in water sources not only results in important economical losses but also directly threatens living things and the lives of human beings, depending on the type and intensity of the pollution. Understanding how the properties of water sources change with respect to location

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and time necessitates the presence of data showing water quality and collecting it continuously. This is possible with the data of water quality measurements:

- to trace the variations in water quality variants with respect to time and location
- to determine how water quality is affected by natural and anthropogenic interference
- to determine the degree of effectiveness of the precautions taken for the protection and control of water quality
- to trace the accordance of water quality to the applied standards
- to obtain the required information in order to evaluate environmental effect
- to evaluate the properties of water quality within the general scope in a certain region or to get the document for the present situation
- to investigate mass transfer in the rivers
- to prompt necessary precautions by modelling water quality [12].

It is predicted that approximately one third of the world's population uses ground water as drinking water [13]. It is assumed that natural and unpolluted water taken from deep wells is clean and healthy [14]. The main reason for the pollution of groundwater is the discharge of urban and industrial wastewater to the environment without any treatment. After discharge of solid, liquid, and gaseous wastes to the environment, they are carried to groundwater depending on the situation of the climate, the structure of the soil, type of waste and time. One of the other important causes for pollution in groundwater is excess drafting. In addition, agricultural pesticides have recently gained importance as a pollutant factor. One of the most important reasons for pollution in groundwater in Turkey is the direct discharge of the domestic wastes to the soil. The water leaking from septic tanks that are commonly used in places where there is no sewer system may be carried to groundwater. The pollutants that easily reach shallow aquifers cause serious problems [15]. Irrigation with wastewater, fertilizing, anthropogenic activities, and dissolutions in soil may be the main effects of groundwater pollution [16]. The use of nitrogenous fertilizers for soil in agriculture absolutely affects groundwater. The processing of soil and fertilizing are the main reasons behind nitrate pollution on a regional scale [17].

In our study area covering the Melendiz water basin, Melendiz stream as well as the wells present along this stream are the main sources for drinking, potable, and irrigation water of the region. Since rainfall is low and most of the region is the private environmental protection region, this increases the value of water potential one more fold. The average annual rainfall in Aksaray plain is quite below average rainfall of Turkey. While the total average annual rainfall in Aksaray was 22.6 mm in 2007, it degraded to 19.6 mm in 2008. For this reason, irrigation is obligatory in order to sustain agricultural activities in Aksaray plain. Since the surface water and groundwater potentials of the region are not enough, just 20% of the area can be irrigated. In 80% of the area, on the other hand, dry agriculture is performed [18, 19].

In this study, the samples were taken from groundwater used for drinking and irrigation in Melendiz (Aksaray) Water Basin. The quality of water and the factors causing pollution were determined by evaluating them according to "Continental Water Sources Quality Classification Criterions" (Republic of Turkey Ministry of Environment and Forest/ Regulation for Water Pollution Control, Table 1). Moreover, the seasonal variations of ground water quality criterions were determined and the precautions that should be taken to minimize this pollution were discussed.

Experimental Procedures

Melendiz watershed (Aksaray) is between 34º10'-34º36' east longitudes and 38º04'-38º22' North latitudes in the Central Anatolian Region. Within the scope of this research, 7 wells present in the Melendiz water basin, continuously open ad licenced by State Hydraulic Works (SHW), were determined as sampling stations and the samples were taken. The coordinates of sampling wells were determined using Garmın GPS 12CX equipment. The locations of Melendiz water basin and sampling stations of groundwater are shown in Fig. 1. The continental water sources quality classification criterions are given in Table 1. The sampling stations and their properties are given in Table 2. The samples were taken from the wells after pumping them for 10 to 15 minutes and then they were collected in polyethylene bottles.

The analyses were carried out both in the area and in the laboratory. The values of temperature and pH were measured by WTW pH 330i/SET equipment; total suspended solids, salinity by WTW LF 330i/SET equipment; turbidity by WTW TURB 355 IR (Portable Turbidimeter/0-1100 NTU) equipment in the area and the following analysis were carried out in the laboratory. Major anion-cation analyses were carried out using a Perkin & Elmer model 2280 atomic absorption spectrophotometer (±0.001 mg/l) and Therme Elemental X7 ICP-MS (≥0.1378 ppb) equipment, while major ion analysis was carried out by HP trademark IC equipment in the laboratory. Titration method (Alkalinity (2320)/Titration Method S. 2-35 Standard Methods) was used in the measurements of HCO_3, and CO_3. In the analysis for the measurements of total organic carbon (TOC) and total nitrogen (TN), and Apollo 9000 TOC – TN Analyzer (measurement range 100 ppb-25,000 ppb measurement sensitivity ±3%) was used. Analyses for total suspended solids (TSS) and total solid materials (TSM) were carried out gravimetrically by Total Suspended Solids 2540 D and Total Solids 2540 B, Standard Methods, respectively.

Results

Results for the analysis of samples collected in February, June, September, and December 2006 and 2009 from 7 (well) sampling stations opened by SHW are given in Tables 3 and 6. While evaluating the quality parameters of groundwater in terms of drinking water quality parameters, the quality criterions according to continental water

Table 1. Continental water sources quality classification criterions [21].

Parameters (mg/L)	Water quality class			
	I	II	III	IV
Temperature	25	25	30	>30
pH	6.5-8.5	6.5-8.5	09-cze	<6-9<
Cl^-	25	200	400	>400
SO_4^{-2}	200	200	200	>400
NH_4^+-N	0.2	1	2	>2
NO_2-N	0.002	0.01	0.05	>0.05
NO_3-N	5	10	20	>20
PO_4^{-3}-P	0.02	0.16	0.65	>0.65
TDM	500	1,500	5,000	>5,000
TOC	5	8	12	>12
TN	0.5	1.5	5	>5
Cd	0.003	0.005	0.01	>0.01
Pb	0.01	0.02	0.05	>0.05
Cu	0.02	0.05	0.2	>0.2
Zn	0.2	0.5	2	>2
F^-	1	1.5	2	>2
Fe	0.3	1	5	>5
Mn	0.1	0.15	3	>3
B	1	1	1	>1

sources classification were taken into consideration (Republic of Turkey Ministry of Environment and Forest/Regulation for Water Pollution Control, Table 1).

The evaluations of variations between stations and seasons from a statistical point of view are given in Table 7 and Table 8.

Discussion of Results

As a result of this research, the seasonal water quality variations of groundwater were determined. When Tables are examined, it was observed that it had class IV water property in terms of nitrite, nitrate, and total nitrogen in the periods of February, June, and December, according to the continental water sources classification. February, June, and December had worse property in terms of water quality than September depending on the rainfall and snowmelt. This situation was caused by the presence of a dense agricultural area around the wells and excess usage of nitrogenous fertilizers (around 65,000 tons). Especially the DK7 well in Dogantarla, which was a dense agricultural area and had class IV water quality property in all four months. Research performed by Elhatip showed thermal water resources of Aksaray contained higher contents of Boron, SiO_2, NO_2, NO_3, and NH_4 [22].

Class IV water property of sampling wells in terms of nitrogenous substances in groundwater was caused by transport of fertilizers to the aquifer after being washed by rainfall and snowmelt. In September, all wells except DK7 had class II water property in terms of total nitrogen and nitrate parameters. This resulted from less rainfall and excessive temperature and vaporization. Therefore, transport from surface to aquifers by water was at lower levels when compared with other months.

When the variations between stations and seasons were evaluated from a statistical point of view (Tables 7 and 8), it was observed that there was a significant difference between stations and seasons in terms of TN and NO_3 parameters (ANOVA, $p<0.05$). This shows why DK7 well had class IV water in all months and more qualified water was supplied in September than other months.

In the research of Kavurmacı et al. [23], the data have been evaluated for the groundwater samples taken from Aksaray, one of the agricultural areas of Turkey that borders the southern and eastern shores of the Salt Lake. Aksaray groundwaters (of southern and eastern shores of the Salt Lake), waters of the pond and dam (C2S1) generally have

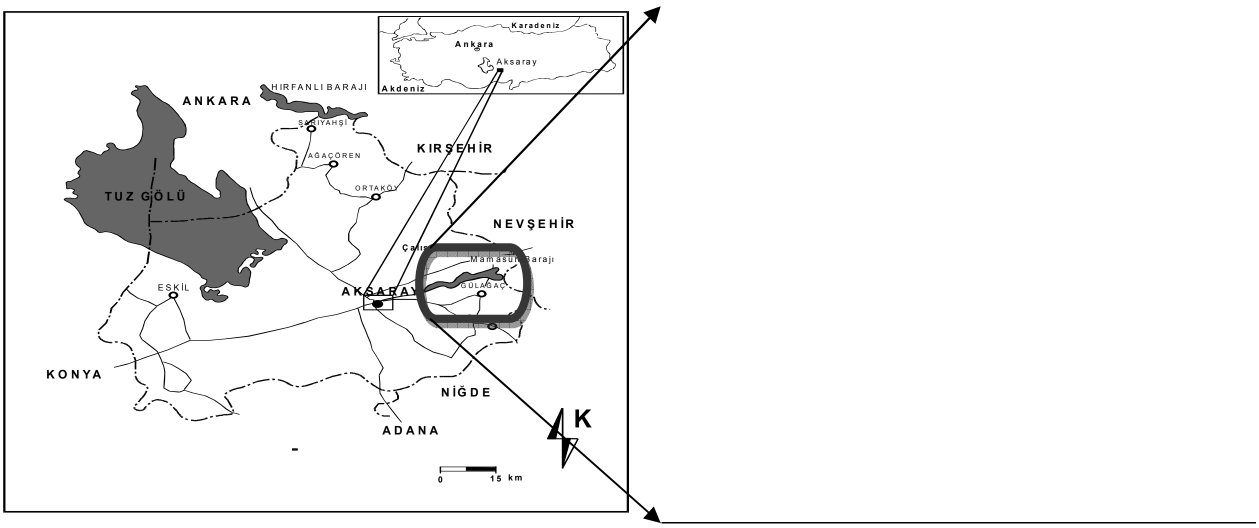

Fig. 1. The location of Melendiz water basin in the region [20], and sampling stations for groundwater.

Table 2. Groundwater sampling stations and their properties.

Sampling stations and their properties				
No.	Name	Coordinates	Distance*	Property
D1	Ihlara	38º13'12" / 34º18'12"	3,600	For the aim of irrigation and usage, agricultural area is present. Q**(l/s) = 13.1 D(m)= -
D2	Belisırma-1	38º16'12" / 34º17'24"	300	For the aim of irrigation, agricultural area is present. Q(l/s) = 9.1 D***(m) = 8
D3	Belisırma-2	38º16'48" / 34º17'60"	1,300	For the aim of irrigation and usage, a dense agricultural area is present. Q(l/s) = 3.5 D(m) = 108
D4	Yaprakhisar	38º17'60" / 34º16'12"	2,000	For the aim of irrigation and usage, agricultural area is present. Q(l/s) = 18 D(m) = 85
D5	Selime	38º18'36" / 34º15'36"	500	For the aim of irrigation and usage, agricultural area is present. Q(l/s) = 5 D(m) = 140
D6	Kızılkaya	38º21'36" / 34º13'48"	750	For the aim of irrigation, agricultural area is present. Q(l/s) = - D(m) = 38
D7	Dogantarla	38º20'24" / 34º10'48"	3,800	For the aim of irrigation and usage, a dense agricultural area is present. Q(l/s) = 37 D(m) = 30

*Distance of the wells to Melendiz stream in meters, **Flow rate, ***Depth, "-" No information available

Table 3. Results for analysis of Melendiz water basin groundwater in February 2006 and 2009.

Parameters (mg/L)	Measurement points – 2006							Measurement points – 2009						
	DK1	DK2	DK3	DK4	DK5	DK6	DK7	DK1	DK2	DK3	DK4	DK5	DK6	DK7
Temperature	-	22.1	18.7	11.5	21.3	9.6	13.5	15.1	22.7	19.2	12.7	21.9	10.1	13.8
pH	-	6.3	7.0	7.0	6.8	6.9	7.5	7.0	6.5	7.3	7.4	6.9	7.0	7.4
Cl^-	-	16.88	6.82	28.08	6.67	3.75	4.30	4.70	17.04	7.14	33.27	7.48	4.11	4.58
SO_4^{-2}	-	7.33	6.37	14.70	9.55	9.14	14.58	5.42	7.68	7.10	15.24	11.07	11.45	16.21
NH_4^+-N	-	0	0	0.042	0.034	0	0	0.15	0.015	0.010	0.055	0.065	0.048	0.061
NO_2-N	-	0	0	0	0	0.007	0	0.03	0.018	0.003	0.005	0.001	0.001	0.002
NO_3-N	-	9.72	14.10	12.70	17.25	22.42	43.19	12.20	9.85	15.23	13.35	18.42	23.11	42.18
PO_4^{-3}-P	-	0.063	0.058	0	0	0	0	0.030	0.072	0.060	0	0	0	0
TDM	-	322	221	322	244	260	286	167	335	260	349	280	273	291
TOC	-	1.46	5.59	0.18	0.05	3.78	0.16	5.28	1.87	5.69	2.25	2.34	3.89	3.12
TN	-	3.60	4.42	5.38	6.65	4.72	12.63	2.19	3.79	4.65	5.40	6.50	4.85	12.87
Cd	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pb	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cu	-	0.002	0.011	0.002	0.013	0.002	0.002	0.002	0.006	0.013	0.006	0.014	0.004	0.005
Zn	-	0.014	0.016	0.009	0.014	0.005	0.006	0.005	0.017	0.018	0.012	0.016	0.009	0.008
F^-	-	0.22	0.12	0.04	0.14	0.30	0.36	0.25	0.27	0.18	0.09	0.16	0.35	0.41
Fe	-	0.004	0.029	0.039	0.021	0.004	0.004	0.010	0.012	0.033	0.042	0.031	0.012	0.009
Mn	-	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003
B	-	0.1	0.1	0.1	0.1	0.1	0.1	0.12	0.14	0.13	0.17	0.18	0.15	0.13

TDM – total dissolved matter, TOC – total organic carbon, TN – total nitrogen, "-"– No analysis for sampling

Table 4. Results for analysis of Melendiz water basin groundwater in June 2006 and 2009.

Parameters (mg/L)	Measurement points – 2006							Measurement points – 2009						
	DK1	DK2	DK3	DK4	DK5	DK6	DK7	DK1	DK2	DK3	DK4	DK5	DK6	DK7
Temperature	18.5	27.9	21.9	22.1	23.1	21.7	16.1	19.0	28.2	22.5	23.1	23.8	22.0	17.2
pH	7.9	6.9	7.3	7.5	7.4	7.9	7.9	8.0	7.3	7.5	7.7	7.5	8.0	7.9
Cl^-	4.65	20.42	108.6	36.3	8.63	4.92	4.80	8.36	22.14	110.2	42.4	12.32	6.34	7.55
SO_4^{-2}	5.35	9.80	16.10	19.12	13.93	14.88	22.24	6.78	11.23	18.43	21.20	17.52	16.82	24.86
NH_4^+-N	0.11	0.25	0.54	0	0.43	0.41	0.14	0.17	0.34	0.67	0.21	0.54	0.58	0.27
NO_2-N	0.06	0.31	0.42	0	0.37	0.04	0.08	16.21	13.87	7.41	17.63	25.21	38.45	63.67
NO_3-N	14.57	13.42	5.88	15.81	24.86	36.52	62.56	17.49	15.28	9.741	16.51	25.01	38.23	64.17
PO_4^{-3}-P	0	0	0	0	0	0	0	0.01	0	0	0	0.01	0	0
TDM	156	318	222	296	239	262	279	151	322	237	312	245	265	284
TOC	5.06	4.59	6.37	4.22	0.29	4.58	5.24	5.33	4.76	6.90	4.59	1.16	4.82	5.10
TN	6.36	5.55	9.13	4.81	5.62	13.34	21.84	6.75	6.12	7.42	5.24	5.97	14.17	21.90
Cd	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Pb	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cu	<0.001	0.011	0.005	0.007	0.022	0.005	0.006	<0.002	0.012	0.006	0.008	0.024	0.007	0.007
Zn	<0.001	<0.001	<0.001	<0.001	<0.004	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
F^-	0.28	0	0.16	0.28	0.14	0.35	0.30	0.30	0.12	0.18	0.29	0.17	0.37	0.37
Fe	0.022	0.016	0.018	0.007	0.07	0.014	0.004	0.019	0.020	0.021	0.012	0.08	0.017	0.008
Mn	<0.001	<0.001	0.003	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
B	0.06	0.48	0.07	0.57	0.17	0.20	0.16	0.08	0.36	0.14	0.48	0.29	0.25	0.19

TDM – total dissolved matter, TOC – total organic carbon, TN – total nitrogen, "-"– No analysis for sampling

medium salinity hazard rate and a low sodium (alkali) hazard rate in terms of irrigation water use according to the USA Salinity Laboratory Irrigation Water Classification Diagram. While an increase in salinity has shown the presence of saline water in the southern and the southeastern shores of the Salt Lake, it has decreased the quality of fresh waters with respect to drinking and water use [23, 24]. In the research of Alas and Cil, which was carried out in the sources feeding Mamasun Dam Lake (Melendiz and Karasu streams), it was determined that the sources had generally class I water quality [25]. In our study, on the other hand, Melendiz stream had class III and IV water in terms of nitrate, nitrite, and total nitrogen, while it had class II water in terms of other parameters. This situation aroused the suspicion that surface waters of Melendiz stream were exposed to pollution by point and common sources and its water quality decreased gradually [9]. When the analysis results of samples taken between 2006 and 2009 were compared, it was determined that the amount of pollution increased in time. The water pollution parameters observed in the Aksaray groundwater in our study showed parallelism with the research of Karadavut et al. [26]. Around 55,966 decares area is used for agriculture in the Melendiz water basin and approximately 65,000 tons of nitrogenous fertilizer is used. The quality of the groundwater in the region is degraded to the class IV due to nitrate and total nitrogen concentrations. This situation became evident especially in February, June, and December. This was caused by the transport of nitrogenous compounds as a result of fertilizing agricultural activities to the aquifers by rainfall and snowmelt.

Conclusions

Most of the area used for research is known as a private environmental protection region. Approximately 32,735 decares of the area is used for agriculture in the region. Depending on the use of fertilizers, agricultural pollution was determined in the groundwater. Seven licenced wells opened by SHW are present in the research region and they are under the control of municipalities and mukhtars. However, there are more than 100 unlicenced wells in the region and that number may increase. Urgent precautions should be taken to protect groundwater potential, and the opening of unlicenced wells should not be permitted.

Table 5. Results for analysis of Melendiz water basin groundwater in September 2006 and 2009.

Parameters (mg/L)	Measurement points – 2006							Measurement points – 2009						
	DK1	DK2	DK3	DK4	DK5	DK6	DK7	DK1	DK2	DK3	DK4	DK5	DK6	DK7
Temperature	15.2	28.0	21.3	23.6	24.3	-	14.8	16.0	28.0	21.5	23.3	23.9	21.8	15.3
pH	7.2	6.5	7.3	7.5	7.4	-	7.8	7.3	6.7	7.3	7.5	7.6	7.1	7.6
Cl^-	4.45	16.88	8.46	62.32	8.23	-	6.09	6.36	17.56	10.28	51.82	11.29	6.80	8.70
SO_4^{-2}	4.34	8.91	9.20	21.10	12.28	-	18.93	5.78	9.86	11.26	25.12	13.45	12.31	19.34
NH_4^+-N	0.013	0	0.049	0	0	-	0	0	0	0	0.028	0	0	0
NO_2-N	0	0	0	0	0	-	0	0	0	0	0	0	0	0
NO_3-N	4.42	3.93	7.32	5.24	6.77	-	18.78	7.42	5.35	8.41	7.41	8.37	9.78	22.56
PO_4^{-3}-P	0	0	0	0	0	-	0	0.010	0.005	0	0	0	0	0
TDM	148	301	218	405	229	-	272	152	309	226	345	241	255	269
TOC	4.57	4.12	2.98	9.34	4.59	-	7.42	4.70	4.22	3.45	4.75	4.89	4.16	6.75
TN	1.82	1.99	1.75	2.07	4.14	-	11.18	2.38	2.21	2.12	2.23	3.79	5.28	9.78
Cd	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Pb	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cu	0.003	0.004	0.003	0.005	0.008	-	0.004	0.004	0.005	0.004	0.006	0.008	0.007	0.006
Zn	<0.001	0.13	<0.001	0.007	0.003	-	<0.001	<0.001	<0.001	<0.001	0.008	0.004	0.003	0.003
F^-	0.38	0.56	0.31	0	0.44	-	0.09	0.41	0.58	0.43	0.23	0.52	0.51	0.23
Fe	0.05	0.14	0.049	0.055	0.039	-	0.06	0.08	0.15	0.010	0.064	0.045	0.065	0.05
Mn	<0.001	0.002	0.002	<0.001	<0.001	-	0.002	<0.001	0.003	0.003	<0.001	<0.001	<0.001	0.002
B	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

TDM – total dissolved matter, TOC – total organic carbon, TN – total nitrogen, "-"– No analysis for sampling

Table 6. Results for analysis of Melendiz water basin groundwater in December 2006 and 2009.

Parameters (mg/L)	Measurement points – 2006							Measurement points – 2009						
	DK1	DK2	DK3	DK4	DK5	DK6	DK7	DK1	DK2	DK3	DK4	DK5	DK6	DK7
Temperature	-	24.2	18.8	7.7	21.5	-	14.9	16.0	24.5	19.1	18.0	21.7	20.0	15.3
pH	-	6.5	7.5	7.4	7.4	-	7.8	6.7	7.4	7.5	7.6	7.4	7.5	7.9
Cl^-	-	14.46	7.10	30.24	5.96	-	3.94	5.28	15.24	9.18	31.42	9.15	5.50	5.60
SO_4^{-2}	-	6.70	7.16	13.16	9.69	-	14.95	4.67	6.82	9.12	14.22	10.21	9.27	16.34
NH_4^+-N	-	0	0.30	0.38	0.32	-	0.16	0.10	0.18	0.39	0.41	0.37	0.28	0.22
NO_2-N	-	0	0	0	0	-	0	0	0	0	0	0	0	0
NO_3-N	-	9.60	16.97	13.05	18.36	-	44.05	9.36	10.42	17.23	14.05	18.45	15.20	37.67
PO_4^{-3}-P	-	0	0	0	0	-	0	0	0	0	0	0	0	0
TDM	-	327	235	339	242	-	288	321	287	328	257	248	262	291
TOC	-	0.25	0.31	1.09	1.12	-	0.12	0.42	0.65	1.23	1.43	1.76	1.38	1.20
TN	-	2.78	5.08	5.02	7.14	-	11.45	2.85	3.12	5.05	5.13	8.12	6.28	10.23
Cd	-	0.14	0.78	0.18	0.18	-	0.38	0.22	0.32	0.55	0.24	0.28	0.34	0.42

TDM – total dissolved matter, TOC – total organic carbon, TN – total nitrogen, "-"– No analysis for sampling

Table 7. Statistical evaluation of TN values of groundwater in Melendiz water basin in terms of variations between stations and seasons.

Variance source	SS	df	MS	F	P-value	F criterion
Station	300,95	4	75,2375	16,82298	7,32E-05	3,25916
Season	65,60482	3	21,86827	4,889709	0,019057	3,4903
Error	53,66766	12	4,472305			
Total	420,2225	19				

Table 8. Statistical evaluation of NO_3 values of groundwater in Melendiz water basin in terms of variations between stations and seasons.

Variance source	SS	df	MS	F	P-value	F criterion
Station	3000,005	4	750,0013	14,55398	0,000149	3,25916
Season	709,6713	3	236,5571	4,590456	0,023144	3,4903
Error	618,3885	12	51,53238			
Total	4328,065	19				

Approximately 62,971 decares from Ilisu to the entry of Mamasun dam covering the whole study area is used for agriculture, and annually approximately 65,246 tons of nitrogen, 50,444 tons of phosphorous and 1,374 tons potash fertilizers were used. The main reason for the nitrate pollution of surface and especially ground water is the agricultural applications and fertilizing of soil. In order to minimize this situation, the authorized organizations should take fertilizer usage under control with scientific approaches. Moreover, it should be encouraged to use groundwater that has high nitrate content as inorganic fertilizers.

The soil being heavy-texture and salty structure in the region and the level of ground water being high were caused by lack of adequate drainage system. For this reason, good and adequate drainage system should be configured in order to provide no increase in salt accumulation in the soil, to get an opportunity for more appropriate land use and to increase the yield per unit area [27].

An education program should be organized for the local community by efforts and attempts of local governments and educational studies by experts should be performed. The importance of surface and ground waters, their use and protection should be taught. Education should be provided about protection and careful use of water, irrigation, agricultural activities, and fertilizing, and the required precautions should be taken by local governments, with legal sanctions, if necessary [9].

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