

# Evaluating Water Resources Quality and Water Pollution in Karabuk, Turkey

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# Introduction

- Water is an essential component for life on Earth, which contains minerals extremely important in human nutrition.
- However, the dramatic increase in population resulted in an enormous consumption of the world's water reserves.
- Water issues are multi-dimensional including economical, social, political and cultural aspects.



# Introduction

- Rapid urbanization and increasing populations have accelerated the consumption of water resources and caused serious environmental problems in the last few decades.
- Numerous studies have shown severe water pollution, as well as adverse effects caused by exploitation, such as land subsidence, water ecosystem degradation, land desertification, drinking water pollution and associated human health risk.



# Introduction

- The United Nations Millennium Declaration adopted the goal of reducing by half the proportion of people without access to safe drinking water by the 2015.
- The supply of safe potable water has a significant impact on the prevention of water transmissible diseases.
- The abundance of organic compounds, toxic chemicals, radionuclides, nitrites and nitrates in potable water may cause adverse effects on the human health.

It is essential to constantly monitor water quality used for drinking purposes. Contamination of potable water with chemical pollutants has a considerable impact on the Turkey population health.

## Study Area Description

- Karabuk, Zonguldak and Bartın are in the western black sea region of the Turkey, about 220 km from Ankara.

# Karabük City...

- Karabük is a town and the capital district of Karabük Province in the Black Sea region of Turkey. According to the 2009 census, population of the city is 108 167. The district covers an area of 760 km<sup>2</sup>, and the town lies at an elevation of 354.
- Karabük was built in the 1930s as the seat of the iron and steel industry of Turkey. Karabük lies in a location near Filyos River formed by the merge of Araç and Soğanlı rivers.

# Sampling Area

The drinking water samples were collected from 3 different cities, 12 different locations in western black sea, Turkey.

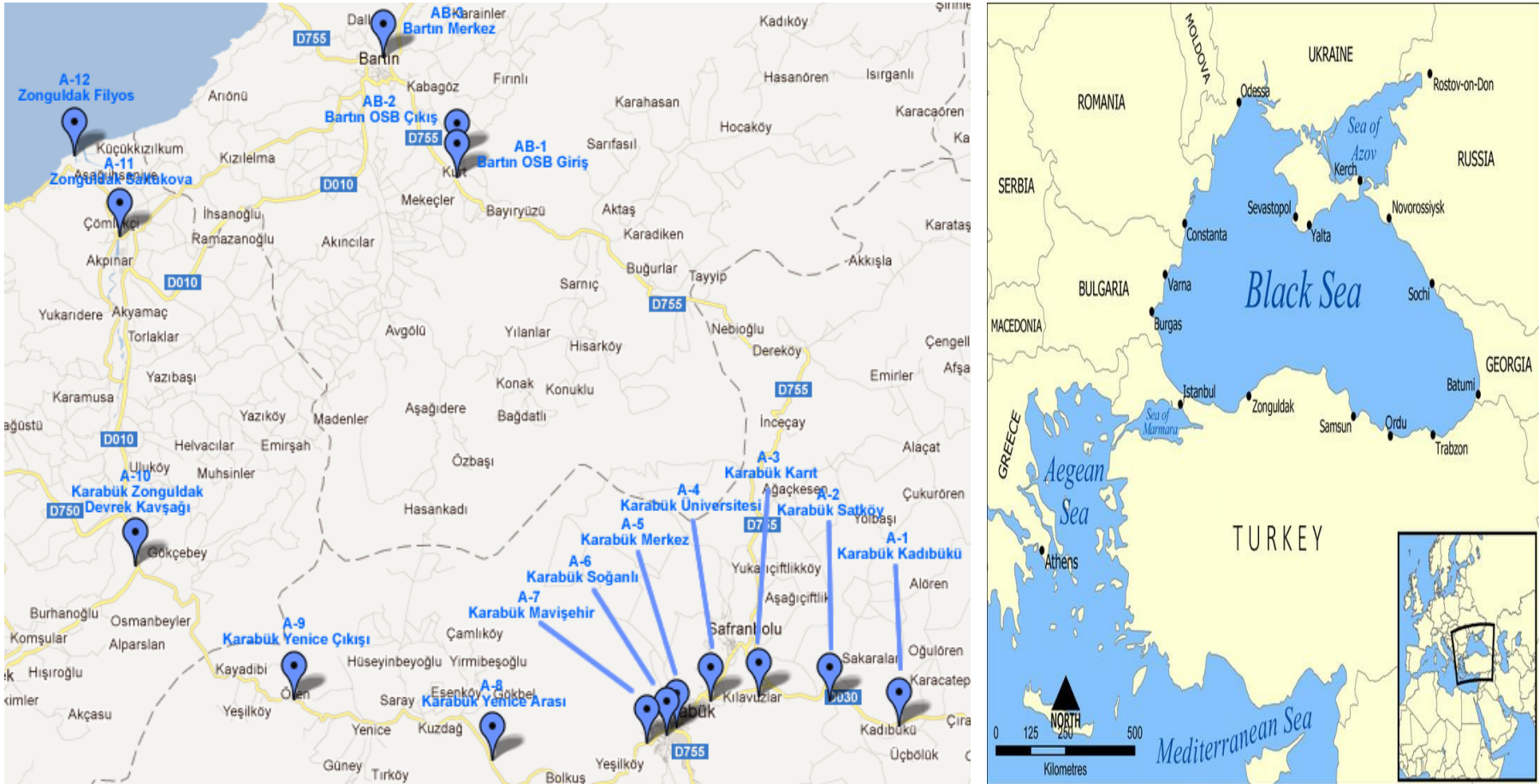


Fig. 1. Map of a sampling area in the western black sea, Turkey.



# Results (Surface Water)

PARAMETER	SAMPLE ID														
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	AB-1	AB-2	AB-3
Oil- Gres, ppm	0,600	0,400	0,600	<b>2,400</b>	0,800	2,000	0,600	<b>2,800</b>	0,800	1,800	0,800	2,000	<b>1,800</b>	<b>2,400</b>	<b>1,000</b>
Colour, Pt-Co	3,125	<b>5,510</b>	4,188	4,601	<b>5,283</b>	4,136	9,136	4,752	6,629	4,143	<b>8,138</b>	8,233	<b>5,418</b>	2,770	<b>11,972</b>
pH	8,17	8,16	8,3	8,33°	8,1	8,03	<b>8,55</b>	8,39	8,46	8,37	8,44	8,47	8,48	8,45	<b>8,54</b>
SS, ppm	0,850	0,900	0,700	3,200	2,450	1,750	0,400	2,850	3,450	1,250	1,050	11,750	3,750	0,700	0,200
P, ppm	0,018	0,017	0,010	0,015	0,025	0,022	0,026	0,136	0,091	0,012	0,055	0,021	0,011	<b>0,036</b>	<b>0,033</b>
NH <sub>4</sub> <sup>+</sup> , ppm	0,006	0,006	0,025	0,020	0,030	2,115	1,857	2,376	0,970	0,001	0,009	0,172	0,009	0,193	0,074
COD, ppm	5,300	1,400	5,300	1,000	0,900	0,700	0,800	14,100	6,800	1,500	1,300	7,700	5,300	5,100	6,400
Y.A.M, ppm	0,002	0,003	0,003	0,003	0,005	0,004	0,005	0,008	0,003	0,002	0,004	0,008	0,002	0,004	0,002
Cr 6+, ppm	0,029	0,011	0,005	0,006	0,006	0,001	0,002	0,002	0,001	0,008	0,014	0,008	0,005	0,003	0,007
Cd, ppb	1,962	1,411	0,950	0,854	0,652	0,271	0,389	0,509	0,442	0,408	0,493	0,840	0,444	0,387	0,395
Co, ppb	1,543	0,482	1,744	0,404	1,319	0,643	0,486	1,533	0,797	0,824	0,232	1,161	1,270	0,126	0,819
Cr, ppb	2,291	1,594	2,878	1,529	1,968	1,755	2,401	1,599	1,967	1,275	1,117	0,942	0,666	0,387	1,086
Cu, ppb	0,574	0,360	0,310	0,172	0,468	2,854	1,118	1,524	0,732	0,607	0,756	0,138	0,835	0,209	0,135
Fe, ppb	8,849	9,514	1,716	5,389	6,301	63,273	28,920	23,970	28,338	2,055	82,783	23,571	457,240	5,375	43,686
Ni, ppb	0,343	0,229	0,834	0,007	0,748	0,653	0,243	0,302	0,707	1,652	0,473	0,314	1,197	0,672	0,108
Pb, ppb	19,772	30,669	29,644	31,252	21,803	19,686	12,308	20,438	14,636	15,368	4,718	18,457	1,465	22,460	23,627
Çinko, ppb	4,258	64,864	16,373	90,656	23,449	33,457	16,245	31,086	24,483	5,400	14,545	4,710	6,645	3,591	6,862

# Results (Potable Water)

	Western Black Sea (ZONGULDAK)			Standarts		
Parameter	Ereğli	Devrek	Kozlu	Turkish Standardization Institute	WHO	EPA
<b>Turbidity (NTU birimi)</b>	0,360	0,230	0,360	25	5	5
<b>Total Coliform</b>	0,000	0,000	0,000	<1	0	<1
<b>F<sup>-</sup></b>	0,312	0,247	0,268	1.5	1.5	0,7-2,4
<b>NO<sub>3</sub><sup>-</sup></b>	0,216	0,560	0,148	50	50	
<b>Hg</b>	<0,001	<0,001	<0,001	0	0	
<b>Colour(Co-Pt )</b>	2,934	2,649	2,397	20	15	
<b>pH</b>	7,76	7,77/ 19,8°	7,64/ 21,0°	6.5-9.5	6.5-8.5	6.5-9.5
<b>SO<sub>4</sub><sup>-2</sup></b>	7,546	55,450	22,616	250	250	250
<b>Ca</b>	46,092	78,557	68,136	200		
<b>Hardness(CaCO<sub>3</sub>)</b>	142,500	157,000	102,500		500	
<b>Mg</b>	<b>96,408</b>	<b>78,443</b>	34,364	50		
<b>Cl<sup>-</sup></b>	9,997	7,498	7,498	250	250	250
<b>K</b>	1,54939	1,77307	0,88209	12		
<b>Ag</b>	0,000493	0,001214	0,000583	0.01	0.05	
<b>Al</b>	0,13439	0,193627	0,030718	0.20	0.20	1
<b>As</b>	0,005976	0,008426	0,009784	0.01	0.01	0.01
<b>Ba</b>	<b>0,173642</b>	<b>0,080228</b>	<b>0,07823</b>	0.03	1	
<b>Cd</b>	0,000199	0,000487	0,000391	0.005	0.003	0.003
<b>Cr(Total)</b>	0,003338	0,002046	0,000858	0.05	0.05	0.05
<b>Cu</b>	0,00084	0,003019	0,001516	3	1	0
<b>Fe</b>	0,040762	0,040909	0,01518	0.2	0.3	0.2
<b>Mn</b>	0,001099	0,00121	0,000548	0.05	0.1	0.05
<b>Pb</b>	0,000284	0,003247	0,004216	0.01	0.01	0.01
<b>Sb</b>	0,008171	0,002002	0,006673	0.005	0.005	0.005
<b>Se</b>	0,00181	0,009308	0,007816	0.010	0.01	0.01
<b>Zn</b>	0,12045	0,025204	0,020785	5	5	

# Results (Potable Water)

	Western Black Sea (BARTIN)			Standarts		
Parameter	Amasra	Merkez Orduyeri	Ulus	Turkish Standardization Institute	WHO	EPA
<b>Turbidity (NTU birimi)</b>	0,730	0,430	0,430	25	5	5
<b>Total Coliform</b>	0,000	0,000	0,000	<1	0	<1
<b>F<sup>-</sup></b>	0,256	0,325	0,294	1.5	1.5	0,7-2,4
<b>NO<sub>3</sub><sup>-</sup></b>	0,233	0,477	0,365	50	50	
<b>Hg</b>	<0,001	<0,001	<0,001	0	0	
<b>Colour(Co-Pt )</b>	3,179	2,541	3,199	20	15	
<b>pH</b>	7,97	7,53	7,91	6.5-9.5	6.5-8.5	6.5-9.5
<b>SO<sub>4</sub><sup>-2</sup></b>	10,193	12,967	1,955	250	250	250
<b>Ca</b>	70,540	86,172	74,148	200		
<b>Hardness(CaCO<sub>3</sub>)</b>	137,500	142,500	122,500		500	
<b>Mg</b>	<b>66,960</b>	<b>56,328</b>	48,352	50		
<b>Cl<sup>-</sup></b>	2,499	7,498	1,249	250	250	250
<b>K</b>	0,939582	1,61901	0,453968	12		
<b>Ag</b>	0,000775	0,001006	0,00019	0.01	0.05	
<b>Al</b>	0,014505	0,174603	0,096023	0.20	0.20	1
<b>As</b>	0,007218	0,008103	0,007066	0.01	0.01	0.01
<b>Ba</b>	0,054991	<b>0,148291</b>	<b>0,123721</b>	0.03	1	
<b>Cd</b>	0,000144	0,000175	0,000329	0.005	0.003	0.003
<b>Cr(Total)</b>	0,000931	0,000465	0,000229	0.05	0.05	0.05
<b>Cu</b>	0,000917	0,000081	0,013254	3	1	0
<b>Fe</b>	0,027326	0,031544	0,022861	0.2	0.3	0.2
<b>Mn</b>	0,002431	0,000373	0,000016	0.05	0.1	0.05
<b>Pb</b>	0,003734	0,001597	0,002415	0.01	0.01	0.01
<b>Sb</b>	0,002161	0,002085	0,002087	0.005	0.005	0.005
<b>Se</b>	0,002937	0,002052	0,001676	0.010	0.01	0.01
<b>Zn</b>	0,021346	0,018386	0,174294	5	5	

# Results (Potable Water)

Parameter	Western Black Sea (KARABUK)				Standarts		
	Merkez	Eskipazar	Eflani	Yenice	Turkish Standardization Institute	WHO	EPA
<b>Turbidity (NTU birimi)</b>	0.150	0.360	0.57	0.310	25	5	5
<b>Total Coliform</b>	0	0	0	0	<1	0	<1
<b>F<sup>-</sup></b>	0.226	0.348	0.267	0.284	1.5	1.5	0,7-2,4
<b>NO<sub>3</sub><sup>-</sup></b>	0.895	0.509	0.119	0.310	50	50	
<b>Hg</b>	<0.001	<0.001	<0.001	<0.001	0	0	
<b>Colour(Co-Pt )</b>	2.501	2.307	2.23	1.907	20	15	
<b>pH</b>	7.37	7.55	8.09	8.24	6.5-9.5	6.5-8.5	6.5-9.5
<b>SO<sub>4</sub><sup>-2</sup></b>	26.81	2.74	4.785	35.69	250	250	250
<b>Ca</b>	62.12	92.18	26.02	64.12	200		
<b>Hardness(CaCO<sub>3</sub>)</b>	190	170	117.5	142.5		500	
<b>Mg</b>	<b>187.27</b>	<b>77.81</b>	<b>91.44</b>	<b>78.37</b>	50		
<b>Cl<sup>-</sup></b>	4.99	2.49	2.49	2.49	250	250	250
<b>K</b>	2.07	0.72	1.72	1.19	12		
<b>Ag</b>	0.0016	0.001	0.001	0.0001	0.01	0.05	
<b>Al</b>	0.0015	0.0098	0.038	0.088	0.20	0.20	1
<b>As</b>	0.0081	0.0069	0.006	0.006	0.01	0.01	0.01
<b>Ba</b>	<b>0.0496</b>	<b>0.054</b>	<b>0.124</b>	<b>0.119</b>	0.03	1	
<b>Cd</b>	0.0004	0.0003	0.0002	0.0003	0.005	0.003	0.003
<b>Cr(Total)</b>	0.0023	0.011	0.001	0.0007	0.05	0.05	0.05
<b>Cu</b>	0.0024	0.001	0.0005	0.0026	3	1	0
<b>Fe</b>	0.027	0.026	0.109	0.24	0.2	0.3	0.2
<b>Mn</b>	0.0019	0	0.002	0.0005	0.05	0.1	0.05
<b>Pb</b>	0.0035	0.0003	0.003	0.0024	0.01	0.01	0.01
<b>Sb</b>	0.0002	0.0038	0.007	0.0002	0.005	0.005	0.005
<b>Se</b>	0.0051	0.0031	0.017	0.0007	0.010	0.01	0.01
<b>Zn</b>	0.1915	0.060	0.018	0.027	5	5	

# Conclusions

- Several drinking water samples had values of EC, essential and trace elements are suitable the National Turkish and WHO drinking water standards.
- Ba and Mg concentrations exceed the guidelines for safe water for three cities (Karabuk, Zonguldak, Bartın).
- Western black sea region has hardness water.
- The parameters monitored in drinking water during the study satisfy the standards (set by WHO, EPA, EU, and the relevant Turkish Regulations) except for Ba and Mg.