

Water quality for human consumption and agricultural use in Golbasi district of Ankara-Turkey

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Abstract: Water quality was assessed in Turkey-Gölbaşı Special Environmental Protection Area (SEPA) with respect to human consumption, irrigation and livestock drinking standards. A total of 41 groundwater samples (mostly existing wells and fountains) from 11 villages were collected and analyzed for relevant parameters. Among 41 samples collected, 56%, 59% and 68% of them were found acceptable for human consumption (H), irrigation (I) and livestock drinking (L). On the other hand, among 9 (H), 13 (I) and 27 (L) samples currently used, 7 (H), 6 (I) and 21 (L) were found suitable. Salinity class of 13 samples were determined as C3 (high salinity) and 6 samples were classified as C4 (very high salinity). Water requirement of plants ranged from 300 mm to 600 mm per season. Boron concentrations were generally not high. Results confirmed the severe quality and scarcity problems in Golbasi SEPA, which requires treatment and/or switching to alternative water resources such as rainwater harvesting.

Keywords: Groundwater; human consumption; irrigation; livestock; quality

Introduction

Turkey is under the risk of becoming a water-poor country by 2030, where the annual available water potential per capita is forecasted to decrease down to 1120 m³, as a result of population increase and climate change. Being a candidate country to the European Union (EU), Turkey has to adopt the environmental policy of EU and transpose the related legislation such as the Water Framework Directive (WFD) (2000/EC/60). The WFD promotes integrated management of water resources to reduce problems associated with excessive water abstraction, pollution, floods and droughts. Therefore, we need to use our water resources wisely to minimize water stress in the future.

In Turkey there are 15 regions designated as “special environmental protection area (SEPA)” to protect the natural beauty of the country. One of them is Golbasi SEPA, which is located at a distance of 20 m south of Ankara city, the capital of Turkey. Mogan and Eymir Lakes are two natural assets of Golbasi SEPA, however they are under the threat of pollution resulting from urbanization, recreational use and agricultural activities. Moreover, Golbasi region hosts more than 400 endemic plant species and 200 bird species, some of which need to be protected under Bern Agreement. Ankara has a semi-arid climate; Golbasi region gets an average of 400 mm precipitation per year, which is below the Turkey average of 600 mm. In recent

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years, the water scarcity in the region has lead to increased consumption of groundwater resources for agricultural use. However, groundwater is contaminated, especially with boron and salinity resulting from the soil quality. Therefore, not all water resources are suitable for human consumption and agricultural use. To this end, this study aims at assessing the groundwater quality in Golbasi SEPA for human consumption and agricultural use, in an attempt to suggest possible solutions for improving water quality and switching to alternative water resources.

Material and Methods

In Golbasi SEPA, 11 villages were visited in May 2012 (irrigation season) (Figure 1). Water resources used for human consumption, irrigation and livestock drinking were identified. A total of 41 samples were collected from several resources such as wells, lagoons and fountains. Samples were analyzed for relevant quality parameters, i.e., water intended for human consumption (Turkish standards, TS 266), irrigation (USA Salinity lab class) and livestock drinking (NAS, 1974). USA Salinity Lab class was determined for each sample by depicting sodium adsorption ratio (SAR) versus electrical conductivity (EC). The irrigation water requirement of plants grown in the study area was estimated via using long term average climate factors and Penman-Monteith method. Calculations were made using CROP-FAO computer programme.

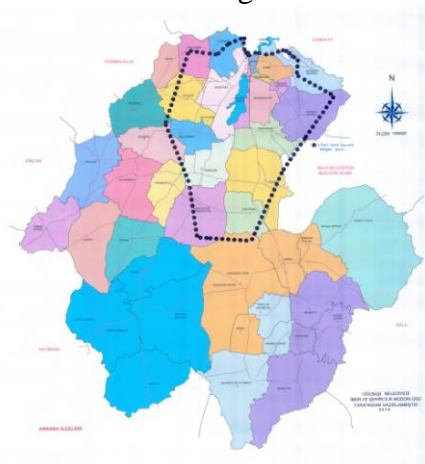


Figure 1 Golbasi SEPA (study area)

Results and Conclusions

Agricultural activities mainly depend on groundwater resources, which is a non-renewable resource. Among 41 samples mostly collected from wells, existing old networks and fountains, 9 samples were currently used for human consumption, 13 samples were used for irrigation and 27 samples were used for livestock drinking (Table 1). Some of the samples were used for single purpose, while others were used for multipurpose. The comparison of analysis results with relevant quality parameters revealed that; in total 23 samples were found acceptable for human consumption, which corresponds to 56% of all samples. However, only 9 of the samples were currently used for human consumption and 7 of them were acceptable, which corresponds to 78% of samples currently used for human consumption. Similarly, in total 24 samples was found acceptable for irrigation, 7 samples were found unacceptable and 10 samples needed to be used with special care. However, only 13 of collected samples were currently used for irrigation and 6 of them were suitable, corresponding to 46%. In parallel, 28 samples were found acceptable (68%) for

livestock drinking. The number of samples currently used for livestock drinking was 27, and 21 of them was suitable (78%).

Table 1. Evaluation of water quality in Golbasi SEPA

Village	Sample	Source	Purpose of use			Conformity			USA Salinity Lab Class
			(H)	(I)	(L)	(H)	(I)	(L)	
Ballikpinar	BP-1	Fountain			●	✓	✓	✓	C2-S1
	BP-2	Dug well			●	x	x	x	C4-S2
	BP-3	Drilling well		●		✓	✓	✓	C2-S1
Gaziosmanpasa	GP-1	Dug well				x	☑	✓	C3-S1
Gokcehoeyuk	GH-1	Fountain 1			●	✓	✓	✓	C3-S1
	GH-2	Fountain 2			●	✓	✓	✓	C2-S1
Hacilar	HA-1	Drilling well		●		x	x	x	C4-S4
Hacihasan	HH-1	Dug well			●	✓	✓	✓	C3-S1
	HH-2	Drilling well			●	✓	☑	✓	C3-S1
Karaoglan	KO-1	Drilling well		●		x	☑	✓	C3-S1
	KO-2	Fountain			●	✓	✓	✓	C2-S1
	KO-3	Drilling well	●		●	✓	✓	✓	C2-S1
	KO-4	Drilling well	●		●	✓	✓	✓	C2-S1
	KO-5	Fountain	●		●	✓	✓	✓	C2-S1
	KO-6	Drilling well	●		●	✓	✓	✓	C2-S1
	KO-7	Drilling well		●	●	✓	✓	✓	C2-S1
	KO-8	Drilling well		●	●	✓	✓	✓	C2-S1
	KO-9	Lagoon 2		●	●	✓	✓	✓	C2-S1
Ogulbey	OB-1	Drilling well			●	x	☑	x	C3-S1
	OB-2	Drilling well		●		x	x	x	C4-S1
	OB-3	Drilling well		●		x	✓	✓	C2-S1
	OB-4	Old network	●		●	✓	✓	✓	C2-S1
	OB-5	Drilling well		●		x	☑	x	C3-S1
	OB-6	Drilling well		●		x	x	x	C4-S1
	OB-7	Fountain			●	x	☑	x	C3-S1
	OB-8	Drilling well	●		●	x	☑	x	C3-S1
Orencik	ÖR-1	Old network 1	●			✓	✓	✓	C2-S1
	ÖR-2	Old network 2	●			✓	✓	✓	C2-S1
	ÖR-3	Dug well		●		x	☑	x	C3-S1
Yaglipinar	YP-1	Drilling well			●	x	✓	✓	C3-S1
	YP-2	Old network	●		●	x	☑	x	C3-S1
	YP-3	Creek			●	x	x	x	C4-S2
	YP-4	Fountain 1			●	✓	✓	✓	C2-S1
	YP-5	Fountain 2			●	x	☑	✓	C3-S1
Yavrucak	YC-1	Dug well		●		x	x	x	C3-S1
	YC-2	Old network		●		✓	✓	✓	C2-S1
	YC-3	Drilling well				x	x	x	C4-S4
Yurtbeyi	YB-1	Drilling well			●	✓	✓	✓	C2-S1
	YB-2	Fountain 1			●	✓	✓	✓	C2-S1
	YB-3	Old network			●	✓	✓	✓	C2-S1
	YB-4	Fountain 2			●	✓	✓	✓	C2-S1

(H): Human consumption, (I): Irrigation, (L): Livestock drinking

- : currently used for the specified purpose
- ✓ : suitable for the specified purpose
- x : not suitable for the specified purpose
- ☑ : to be used with special care

Figure 2 shows USA salinity and alkalinity lab class for all samples, which is generally in the region of C2-S1, C3-S1, C4-S1 and C4-S2. Only two samples were

C4-S4 (HA-1 and YC-3). The results revealed that 17 water resources given in Table 1 can only be used with special precautions or cannot be used at all for irrigation. This corresponds to 41% of all samples (17/41) collected in the region, which is a significant ratio indicating the severe quality problems in the water resources of Golbasi SEPA. Currently, 7 of these samples are being used for irrigation; which means 41% of samples (7/17) used for irrigation does not have the required quality.

The water requirement of plants grown in the study area ranged between 300-600 mm per season. Boron classes were evaluated (Table 2); 59% of samples are Class 1, 22% of samples are Class 2, 7% are Class 3, 2% are Class 4 and 10% are Class 5 regarding the irrigation of sensitive plants. On the other hand, 88% of samples are Class 1, 5% are Class 2, 2% are Class 3 and 5% are Class 5 for the irrigation of resistant plants. The boron concentration in the groundwaters of the region is of natural origin; Turkey lands are very rich in boron, which results in high boron concentrations in the water resources of some regions. Therefore, this situation cannot be regarded as environmental pollution; however the worse quality of water in addition to water scarcity adversely affects the agricultural activities in Golbasi SEPA. Results confirmed the severe quality and scarcity problems in Golbasi SEPA, which indicates the need of treatment and/or switching to alternative water resources such as rainwater harvesting.

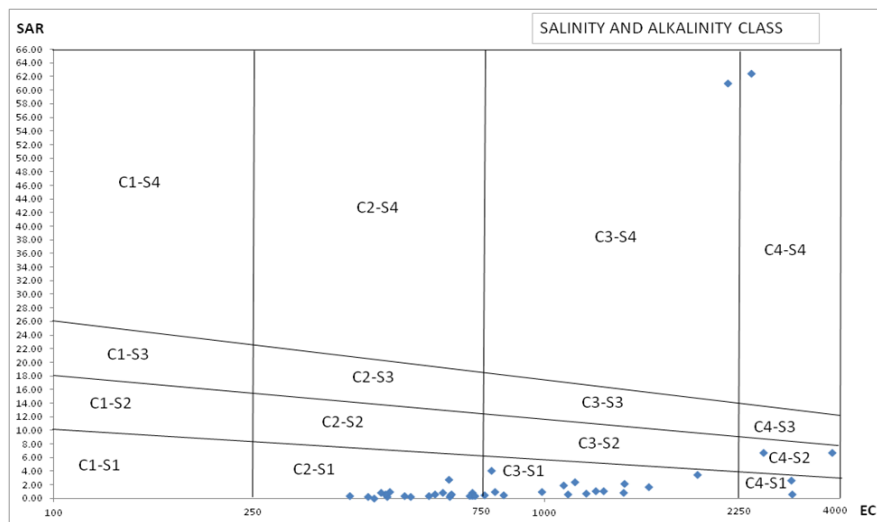


Figure 2 Salinity and alkalinity class for samples

Table 2. Ratio of samples with different boron classes

Boron Class	Sensitive Plants		Moderately sensitive plants		Resistant Plants	
	Number of samples	%	Number of samples	%	Number of samples	%
1	24	59	32	78	36	88
2	9	22	5	12	2	5
3	3	7	1	2	1	2
4	1	2	1	3	0	0
5	4	10	2	5	2	5
Total	41	100	41	100	41	100

References

- TS 266, Turkish Standards for Water Intended for Human Consumption, 2005.
 NAS, National Academy of Sciences, 1974.