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Evaluation of Soil Quality in Sapanca Lake Basin

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Abstract
The aim of the study is determination of the physical and chemical properties of the soil, which is taken around the Sapanca Lake. For this purpose, a total of 30 soil samples has been collected in order to represent the basin from 10 plots where 0-40 cm depth. Sapanca Lake is an important drinking water source for the Marmara region; it is supplied in both underground and side creeks. The content and the quality of water are affected by the soil structure in the basin. Therefore, soil structure has been evaluated with regard to color, organic matter, organic carbon, conductivity, pH, oxidation-reduction potential (ORP), salinity parameters. Munsell soil color chart is used for determining soil color. In terms of determination, half of the soil samples has been found to be dark brown in color. And the according to the results has been found just as pH 7-9, conductivity 150-500 µS/cm, salinity 81-300 mg/l, ORP 81-115 mg/l, organic matter 1% -10% in the range of, respectively. Determination of soil quality parameters of the study area is very important in terms of protection of ecology and living health, controlling environmental pollution and improvement of water quality.

Keywords: Soil pollution; soil quality; Sapanca; organic compounds

1. Introduction

Living life, protection and development of ecological balance has become increasingly important due to environmental pollution in recent years. The pollution which resulting of rapid population growth, unplanned urbanization, industrialization, not using agricultural lands efficiently and occurring negative changes in wetlands is adversely affect the life. Reducing negative effects on natural resources policy should be developed by making the planning for improvement of soil and water resources. Wetlands have to live several changes over time as a part of nature and natural phenomena. These changes, not only occur through natural events but also they can occur with human intervention. Besides, changes occurring in the soil become impractical using wetlands and especially drinking water supplies. It is also one of the most important stage that land planning and management according to the evaluation of soil quality criteria. Also soil form part of the environmental quality. Researches have showed that environmental quality criteria bases to determine the quality of soil such as water quality, soil erosion and air quality values. For this purpose various studies have been made;

Ozkan, K. et al., (2007), have been identified relationship among soil color and structure, and soil type, organic matter content, total lime content and soil acidity (pH) in Beysehir Lake Basin. According to the statistical analysis results, important relationships have been identified among especially soil color groups and structure types, and soil organic matter content and total lime content of the class. Dindaroglu, T. et al., (2013), forest soil health have been pursued according to the new soil quality index value in the Kuzgun Basin. On forests and grasslands, the northern slope views and the low height, it have been identified that, health of the soil in the area is very good, on the contrary especially on the high-altitude pastures, and the extreme views of the slopes and in the southern area, health of the soil is damaged.

Cimrin, K. et al., (2006), have been conducted a study to identify some macro and micro nutrient content of agricultural soil and to determine the relationship between some soil properties in Van. From the area where wheat cultivation made, has taken a total of 52 soil samples from 26 points for represent the region including two different depth, 0-20 and 20-40 cm. Ozbek, A. K. (2004), were evaluated in terms of soil quality index parameters in the soil located 6103 ha which is part of the Asagi Pasinler Plain would be irrigated. It have been identified that on Asagi Pasinler Plain, the region is degrade in terms of pH, organic matter; on the contrary in terms of the soil quality parameters such as soil texture, drainage and

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groundwater quality the region have the quality soil resources.

Cao, S. K. at al., (2011), combined actual field sampling data with geostatistical to study the characteristic and spatial variability of soil organic matter and organic carbon content around Qinghai Lake. The results showed that the mean content of soil organic carbon is 5.95 ± 3.40%, and organic matter is 3.45 ± 1.97%, both are low.

Purpose of this study is to evaluate in terms of soil quality on the Sapanca Lake Basin and to shed light on the choice of the most appropriate management practices for water and soil resources in the region.

2. Material and methods

2.1 Working area

Sapanca Lake is the freshwater lake where located in the eastern part of the Marmara Region. It has occurred result from tectonic formations in Sakarya. Sapanca Lake coordinates is 400 43 'north-300 15' East, and its altitude is 36 m. Sapanca Lake acreage is 42 km2, east-west direction length is 16 km and a width is 5, 5 km. The perimeter of the lake is 39 km and 26 km of this belongs to the province of Sakarya and 13 km the province of Kocaeli [1].

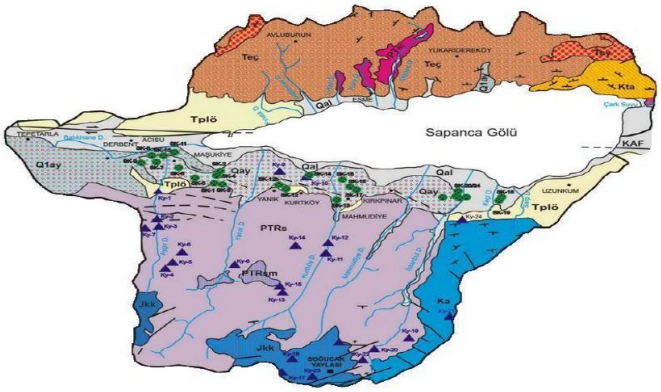

Figure 1. Sapanca Lake and Environment [2]

In lake basin Arifiye, Sapanca, Mahmudiye, Memnuniye, Esentepe, Aşagıdere, Serdivan, Adapazari, Kirkpinar Municipalities and Yanıkköy, Kurtköy, Uzunkum, Yukarıdere and other village settlements located in Sakarya province border; Maşukiye, Esme, Derbent, Acısu and other villages settlements located in Kocaeli province border. In these village settlements is made generally agricultural production.

2.2 Factors Affecting the Soil Structure in the Study Area

2.2.1 Agricultural Operations

It disrupts the nutrient during production, consumption and storage of foodstuffs and destroying harmful pathogens, chemicals used to destroy weeds and microorganisms are often the agrochemicals and "pesticides" we say. None of the drugs, which applied to soil and the field, is stay in application areas. They wafting elsewhere by natural factors such as wind, rain adhering to substance physical - chemical properties. In addition, they create environmental problems. In this way, the possibility of contamination is very high in Sapanca Lake.

2.2.2 Highway and Railroads

D-100 highway passes from north of the Sapanca Lake and TEM Anatolian Highway passes from the south very closely. This situation adversely affect nearby vegetation due to exhaust gases. This will affect the ecological balance of the lake in the long term negatively. Contamination occurs with reaching tires and oil residue from highway both the soil and the lake through rain. Wastewater reached in evacuation channel from TEM Anatolia highway, 300-400 m. intervals throughout Sapanca Lake. And the point in the shore which wastewater reached, pollution is observed on the soil. Releasing emissions into the atmosphere from motor vehicles also has a negative impact on the quality of water and soil.

2.3 Determination of Soil Quality

A total of 30 soil samples from 10 points have been taken from 0-40 cm depth for represent the Sapanca basin. Taken soil samples have been waited until they lost completely their wetness on 1050C. Then, soil sieved to 10 mm were prepared for physical and chemical analysis. Soil structure has been evaluated in terms of organic matter, organic carbon, conductivity, pH, oxidation-reduction potential (ORP), salinity and color parameters. When determining parameter values, the standard method have been used. Soil color is determined by matching the color of taken sample with color swatch in the Munsell Color Scale [8].

3. Results

Color groups of basins have grouped benefiting from in Munsell color scale and their codes have written (Table 1).

Table 1. According to the Munsell color scale color groups and codes of Beysehir lake basin soil

Soil Color Groups	Soil Color Group Codes
Dark Reddish Brown	2,5 YR 3/4, 5 YR 3/4 ve 5 YR 3/3
Reddish Brown	2,5 YR 4/4, 5 YR 4/3, 5 YR 4/4, 5YR 5/3 ve 5YR 5/4
Brownish Dark Brown	10 YR 4/3, 7,5 YR 4/8 ve 7.5 YR 4/2
Brown 1	10 YR 5/3, 7,5 YR 5/4 ve 7,5 YR 5/2

Brown 2	7.5 YR 5/4 ve 7,5 YR 5/2

Samples taken from 10 stations where we determined before in the basin have assayed in terms of organic matter, organic carbon, conductivity, pH, oxidation-reduction potential (ORP), salinity and color parameters, and the obtained results have given in Table 2.

Table 2. Some Quality Parameters of Sapanca Lake Basin Soil

	Conductivity (µS/cm)	SAL (mg/L)	pH	ORP (mV)	Organic Matter %	Organic Carbon %
1. St.	316,27	0,17	8,39	146,1	6,15	3,57
2. St.	177,03	0,09	8,39	144,33	2,88	1,67
3. St.	347,1	0,17	8,31	156,53	4,27	2,47
4. St.	316,03	0,16	8	148,86	5,68	3,29
5. St.	260,5	0,14	8,09	145,3	4,81	2,78
6. St.	346,5	0,18	8,22	141,63	7,08	4,1
7. St.	407	0,22	8,24	148,63	10,03	5,82
8. St.	358,43	0,19	8,31	143,4	6,59	3,82
9. St.	196,13	0,1	8,33	147,5	5,39	3,12
10. St.	297,93	0,16	8,31	154,17	8,32	4,82

4. Discussion

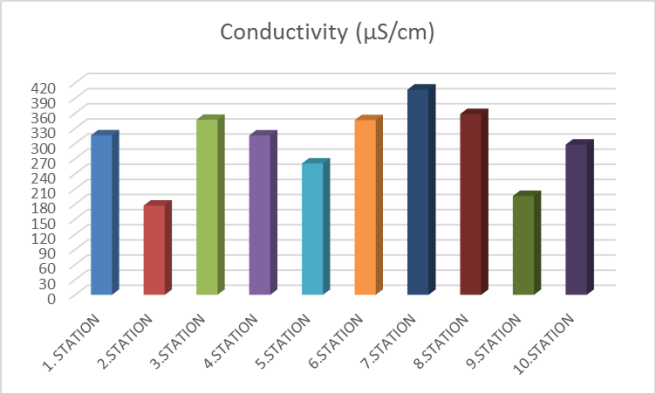

Figure 2. Distribution of Conductivity Parameters in Soil

According to the Figure 2, when we examined conductivity values of 10 stations, the lowest conductivity values in 2. station where located in Sapanca Uzunkum and the highest conductivity values in 7. station where is Balıkhane stream position. These values are 177.03 and 407 µS/cm, respectively.

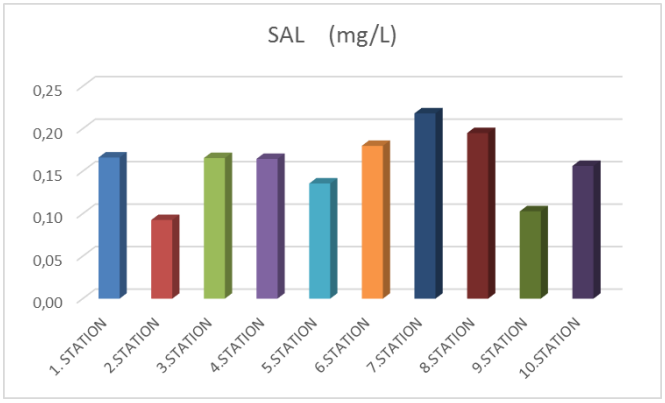

Figure 3. Distribution of Salinity Parameters in Soil

When Figure 3 examined some stations' salinity values indicate proximity according to the salinity of the samples. The lowest salinity values in 2. station where located in Sapanca Uzunkum and the highest salinity values in 7. station where is Balıkhane stream is position. The average salinity in each examples 0.09 to 0.22 mg / L.

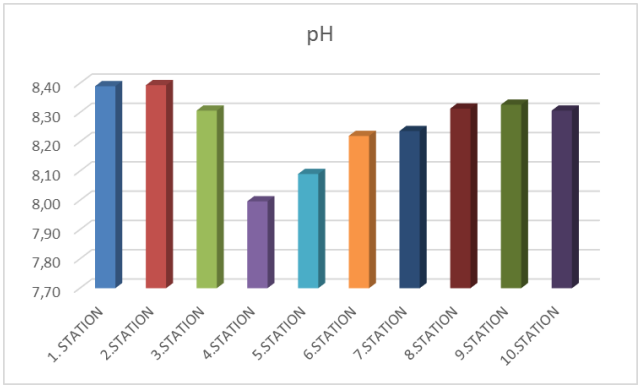

Figure 4. Distribution of pH Parameters in Soil

As it can be seen in Figure 4, according to the pH of soil samples the minimum value in 4. Station is located in Kurtköy. The highest pH values in 1. station is located in Golbasi and in 2. station is located in Uzunkum. Both values are equal. pH values are 8,00 and 8,39 respectively.

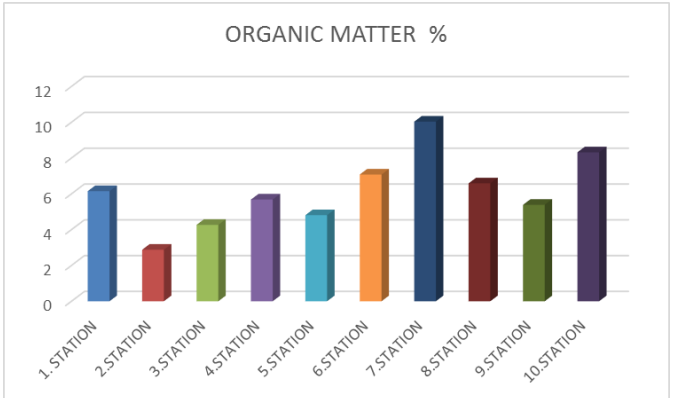

Figure 5. Distribution of Organic Matter Parameters in Soil

As it can be seen in Figure 5, organic matter contents in all soil samples are different. The lowest organic matter content of soil sample were taken from station 2. Moreover, the highest organic matter content of soil sample were taken from station 7.

5. Conclusions

Soil reaction has a special significance due to give information about soil properties easily. pH values are considered neutral between 6,6-7,3 in field work [9]. The average pH of each 30 samples is between 8,00 – 8,39 and it is classified as slightly alkaline. Salinity in the soil is divided into four levels according to the severity as it is seen in Table 3. The average salinity of each samples is between 0,09 – 0,22 mg/L and it is classified as slightly salty.

Organic matter is partially decomposed, partly disintegrated the accumulation of plant and animal residues. This matter are disintegrated continuously by soil microorganisms and continue to decay. Therefore, matter is not a permanent in soil [9]. Grouping of organic matter in the soil is as in Table 3. Organic matter range of taken 30 samples from 0-40 cm depth is between % 2,88 – 10,03 and they are rich especially in terms of organic matter. In the standard soil, %50 to %60 of the amount of organic matter is organic carbon. Organic carbon determination can be found with Walkley-Black method; also, it can be calculate with stoichiometric ratios. In this study, Organic carbon determination is made with stoichiometric ratios and it is between % 1,67 – 5,82. Analyzed soil samples are rich in terms of organic carbon, because of they are rich in terms of organic matter. The high agricultural activities in Sapanca are results from both the high amount of organic matter in the soil and the soil suitability for agricultural activities. The most important elements for agricultural activities are nitrogen, phosphorus and carbon. Results of examinations are shown that carbon content is sufficient for the growth of plants.

Electrical conductivity is the result of electrical resistance. Unit of measurement is decisiemens per meter or milliohms per centimeter. While increased ionic concentration, electrical conductivity is increased. The soil which 40000 µS/m and over conductivity in 25 ºC is considered as salty.

The presence of salt reduces water-holding capacity of the soil [10]. Conductivities of the study areas are lower than 40000 µS/m, thus they are sodic and their conductivity is well.

The color of the soil affects the temperature of the soil surface. Black and dark-colored soils absorbs more heat from the sun. Black and brown soil is indicate the presence of organic matter. Light-colored soils are not hot. Red soils include a good level of oxidized iron minerals [10]. Sapanca lake basin soils are usually in brown tones.

Table 3. Provisions in Standards for Soil Parameter Values

ANALYSIS TYPE	STANDARD SIZE	MEANING
Soil Reaction	<4,5 4,6-5,5 5,6-6,5 6,6-7,5 7,5-8,5 8,5+	Strong Acid Medium Degree Acid Mild Degree Acid Neutral Mild Alkaline Strong Alkaline
Soil Salinity	0,0-0,15 0,15-0,35 0,35-0,65 0,65+	Without salt Mild Salted Medium Salted Multi Salted
Organic Matter	0-1 1-2 2-3 3-4 4+	Too Few Less Medium Good High
Conductivity (µS/cm)	>80000 40000-80000 <40000	Bad Medium Good

Sapanca Lake is one of the most important drinking water source for the in particular Marmara Region. While it supplies drinking water requirement of Sakarya, it supplies requirement of a major industrial company, which is very important for both Kocaeli and Turkey. Sapanca Lake fed from streams as well as groundwater. Many factors affect the quality of water. One of them is the soil structure and content. Examination of drinking water sources at regular intervals shed light on improvement studies. However, for the protection of drinking water sources the water quality parameters will not be enough to examine alone. Besides, the soil structure and quality of the drinking water basins should determine and should be examined at regular intervals. Finally, this study contribute to creation of a comprehensive database by public authorities.

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