

## Assessment of Agricultural Pressure on Water Quality of a Significant Component in Meriç River Basin: Sazlıdere Stream

Cem TOKATLI

Laboratory Technology Program, İpsala Vocational High School, Trakya University, Edirne, Turkey

\*Corresponding Author

e-posta: tokatlicem@gmail.com

Received: April 11, 2019

Accepted: August 26, 2019

### Abstract

Meriç River Basin is one of most a significant watershed for the Balkans and the most significant aquatic habitat for Thrace Region of Turkey. Sazlıdere Stream, which is located on the Edirne Province, is one of most significant tributaries of Meriç River. In the present research, surface water quality of Sazlıdere Stream was investigated and the pressure of agricultural applications conducted around the system was assessed in terms of some physical and chemical water characteristics of the stream. Surface water samples were taken in the winter season of 2019 from 6 stations (from upstream to downstream) and some water quality parameters including pH, oxygen saturation, EC, dissolved oxygen, TDS, turbidity, nitrate, phosphate, nitrite, salinity, COD and BOD) were measured. Also Cluster Analysis (CA) was applied to the results in order to classify the investigated stations in terms of similar water quality characteristics. As a result of detected physicochemical data, it was determined that Sazlıdere Stream has an alkaline water character and has moderate salty water (C2 – C3) in term of total concentration of soluble salts and it has Class II. – III. water quality in general. According to the results of CA, 2 statistically significant clusters were formed, which were named as “Uncontaminated Regions (C1)” and “Contaminated Regions (C2)”.

**Keywords:** Sazlıdere Stream, Cluster Analysis, Organic pollution, Water quality, Meriç River Basin

### INTRODUCTION

Meriç – Ergene River Basin has a vital importance for the Thrace Region of Turkey. But unfortunately agricultural pressure by means of especially paddy and sunflower fields located almost all around the basin and industrial pressure by means of especially plants located around upstream of Ergene River are degreasing the water quality significantly. Sazlıdere Stream, which is located on the north side of the Meriç – Ergene River Basin in Edirne Province of Turkey, is one of the important tributaries of Meriç River and as in many aquatic habitats it is known to be exposed to an organic pollution by means of especially drainage channels mixing to the system [1 – 6]. The aim of this research was to determine the water quality of Sazlıdere Stream by determining some limnologic quality parameters and classify the stream zones in terms of water quality characteristics by using Cluster Analysis and present its pressure on the Meriç River.

### MATERIAL AND METHOD

#### Sample Collection

Surface water samples were taken during the winter season of 2019 from 6 stations from upstream to downstream select on the Sazlıdere Stream. Map of study area and selected sampling points are given in Figure 1.

#### Physicochemical Analysis

Dissolved oxygen (DO), oxygen saturation (OS), pH, electrical conductivity (EC), total dissolved solids (TDS) and salinity parameters were determined by using “Hach Lange HQ40D Multiparameter” device during the field studies; turbidity parameter was determined by using “Hach Lange 2100Q Portable Turbiditymeter” device during the field studies; nitrat (NO<sub>3</sub>), nitrite (NO<sub>2</sub>), phosphate (PO<sub>4</sub>) and chemical oxygen demand (COD) parameters were determined by using “Hach Lange DR3900 Spectrophotometer” device during the laboratory studies; biological oxygen demand (BOD) parameter was determined by using “Hach Lange BOD Trak II” device during the laboratory studies.

#### Statistical Analysis

Cluster Analysis (CA) was applied to detected

psychochemical data in order to classify the investigated zones of the Sazlıdere Stream according to similar ecological status and water quality characteristics by using the “Past” statistical package program

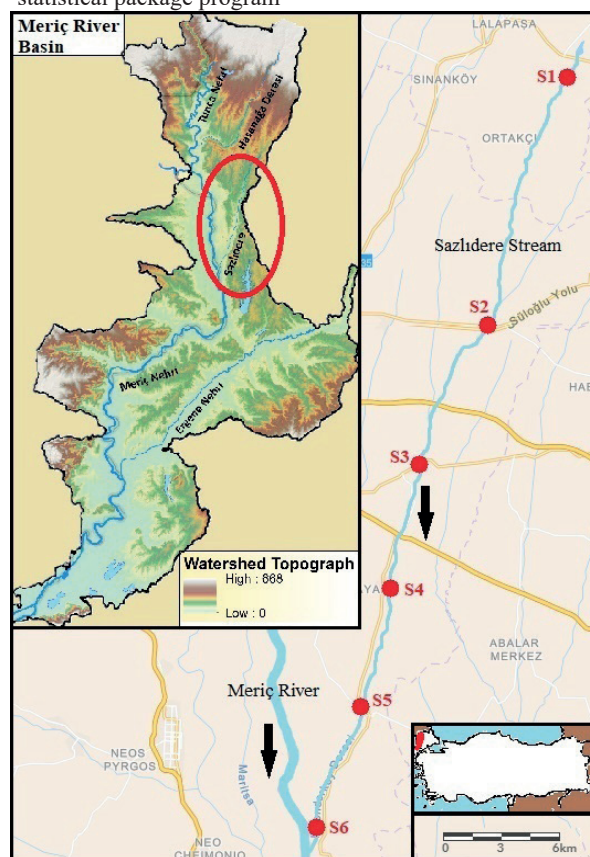


Figure 1. Map of the study area and sampling points on the stream

## RESULTS AND DISCUSSION

Results of detected physicochemical parameters on Sazlıdere Stream and surface water quality standards according to Turkish Regulations are given in Table 1 and the diagrams of investigated parameters are given in Figure 2.

As a result of this research, Sazlıdere Stream was found as alkaline water character and it was also determined that it has moderate salty water (C2 – C3) in term of total concentration of soluble salts. These results mean that the water of stream that is being used significantly for irrigation

is not suitable for the stenohaline plants.

According to the Turkish Regulations, Sazlıdere Stream has Class I water quality in terms of dissolved oxygen, oxygen saturation, nitrate, biological oxygen demand (S4 has Class IV for BOD), chemical oxygen demand (S4 has Class III for COD) and pH (S3 has Class III for pH) parameters; has Class II. water quality in terms of total dissolved solids, electrical conductivity (S2 has Class III for EC) and nitrite (S4 has Class III for NO<sub>2</sub>) parameters; and has Class III - IV water quality in terms of phosphate parameter in general [8 – 10].

**Table 2.** Physicochemical parameters recorded in the Sazlıdere Stream and some limits

Limit Values and the Results DO (mg/L)		Parameters											
		OS (%)	pH	EC (mS/cm)	*TDS (mg/L)	Salinity (‰)	Turbidity (NTU)	NO <sub>3</sub> (mg/L)	NO <sub>2</sub> (mg/L)	**PO <sub>4</sub> (mg/L)	BOD (mg/L)	COD (mg/L)	
Water Quality Classes	I. Class	8	90	6.5-8.5	400	500	-	-	5	0.01	0.02	4	25
	II. Class	6	70	6.5-8.5	1000	1500	-	-	10	0.06	0.16	8	50
	III. Class	3	40	6.0-9.0	3000	5000	-	-	20	0.12	0.65	20	70
	IV. Class	<3	<40	Out of 6.0-9.0	>3000	>5000	-	-	>20	>0.3	>0.65	>20	>70
Sazlıdere Stream	S1	10.65 Class I	102.7 Class I	8.46 Class I	164 Class I	100 Class I	0.10	18.30	0.0 Class I	0.000 Class I	0.190 Class III	0.9 Class I	13.6 Class I
	S2	10.79 Class I	102.8 Class I	8.41 Class I	1014 Class III	649 Class II	0.65	9.54	1.8 Class I	0.016 Class II	0.170 Class III	2.4 Class I	25.5 Class II
	S3	10.70 Class I	100.8 Class I	8.74 Class III	884 Class II	569 Class II	0.57	7.78	2.3 Class I	0.030 Class II	0.900 Class IV	0.3 Class I	11.4 Class I
	S4	9.42 Class I	88.8 Class II	8.24 Class I	908 Class II	584 Class II	0.59	10.70	2.5 Class I	0.073 Class III	0.040 Class II	24.0 Class IV	54.7 Class III
	S5	9.65 Class I	92.3 Class I	8.24 Class I	876 Class II	548 Class II	0.55	7.90	3.3 Class I	0.053 Class II	0.120 Class II	1.2 Class I	17.4 Class I
	S6	8.70 Class I	84.0 Class II	7.94 Class I	719 Class II	446 Class I	0.45	20.80	2.1 Class I	0.039 Class II	0.900 Class IV	1.7 Class I	20.2 Class I

\*: According to Turkish Regulations [8]; \*\*: According to Uslu and Türkman [7]

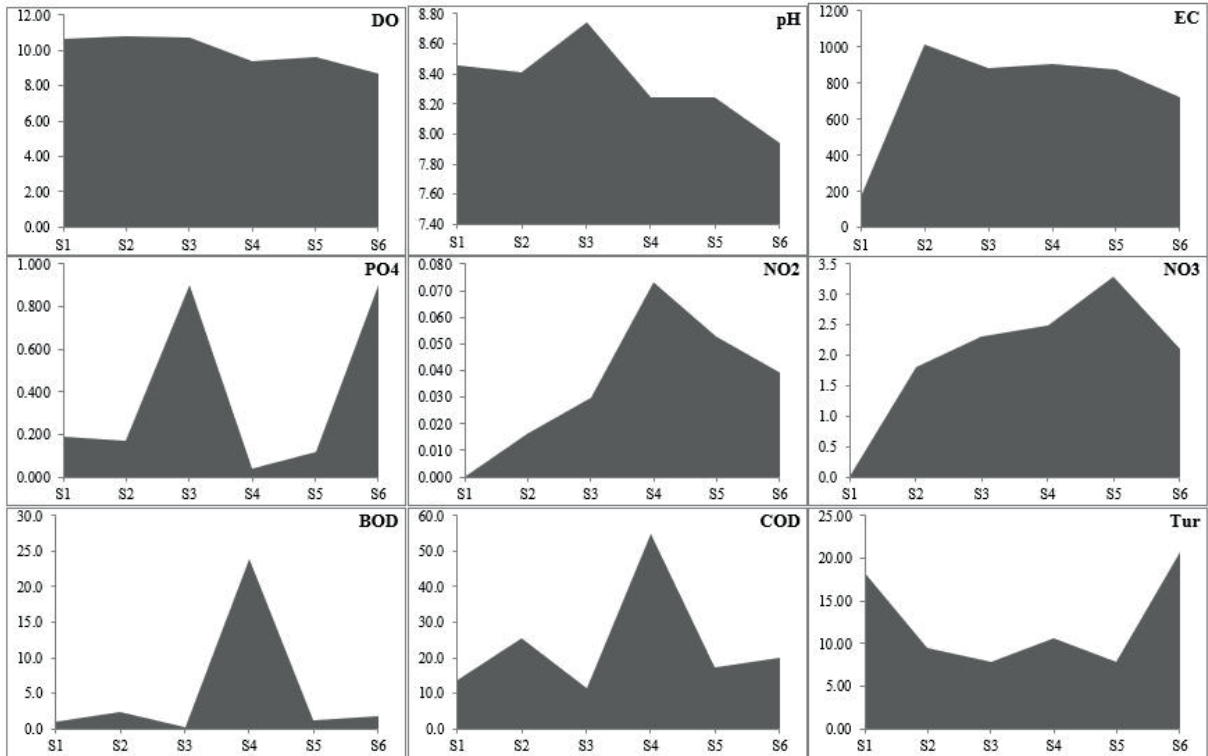


Figure 2. Diagrams of physicochemical parameters

Cluster Analysis (CA) is a significant group of multivariate statistical analysis. One of the most common approaches in CA is the hierarchical agglomerative clustering. It is typically illustrated by a graphic in order to provide a visual summary of the process of clustering [11 – 13].

CA was applied to detected psychochemical data to classify the investigated stream zones in terms of water quality statuses. The diagram of CA was given in Figure 3. According to results of CA, 2 statistically significant clusters were formed: Cluster 1 (C1) was named as “Uncontaminated Regions” and it was corresponded to station of S1; and Cluster 2 (C2) was named as “Contaminated Regions” and it was corresponded to stations of S2, S3, S4, S5 and S6.

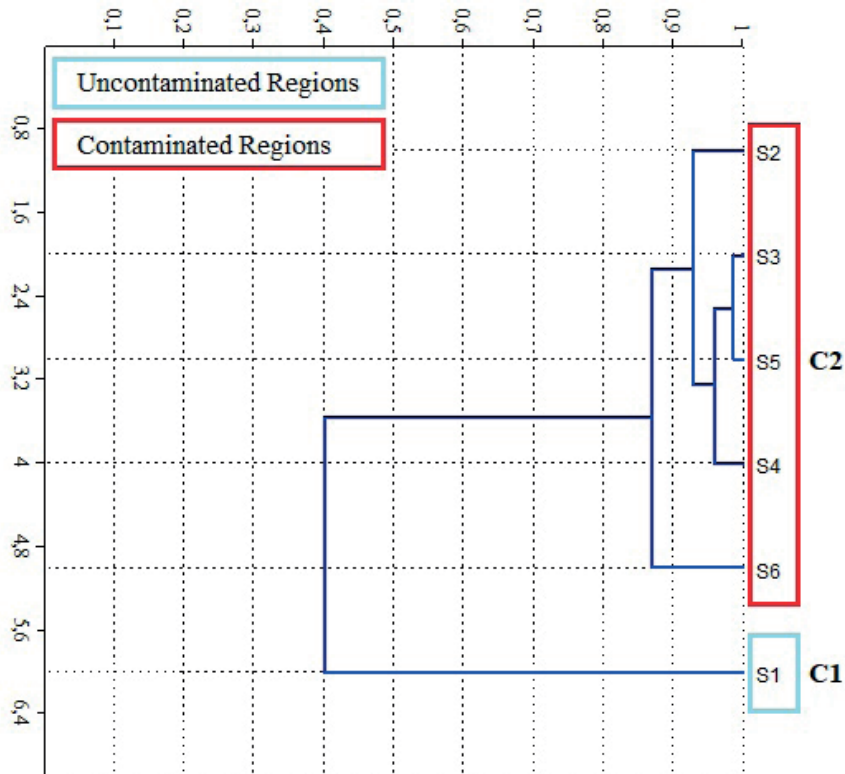


Figure 3. Diagram of CA

The electrical conductivity of water is a measure of the amount of salts or soluble matter present in water and depends on both geological and external factors [13]. It is known that unsuitable agricultural irrigation and over-used agricultural fertilizers increase salinity and electrical conductivity in soil and water [14, 15]. It was reported in the protocol on fishery standards and protection of surface water resources against contamination that the electrical conductivity has to be in the range of 150 - 500  $\mu\text{S}/\text{cm}$  [7]. It was determined that except the source region, this limit value was exceeded in all the investigated zones in Sazlıdere Stream.

Phosphorus in ground and surface waters depends on population density, agricultural fertilization methods and fertilization frequency. Vegetation and soil structure also have a significant effect on phosphorus accumulation in water. In addition, it is reported that the detergents used in cleaning works and reaching the receiving water environment with waste water are the significant factors that affect the phosphorus concentration in water [7].

Quite high electrical conductivity and phosphate values determined in the Sazlıdere Stream waters may indicate that agricultural fertilizers used in the watershed, drainage channels mixing to the system and municipal sewage water caused from settlement areas may be the main significant stress factors on this aquatic ecosystem.

## CONCLUSIONS

In this research, water quality of Sazlıdere Stream one of the significant tributary of Meriç River was evaluated by investigating some limnologic pollution parameters and by using Cluster Analysis. As a result of this study, electrical conductivity and phosphate were found as the most risky parameters for the Sazlıdere Stream and the detected values of these parameters in water of the system were detected in quite high levels and exceed the critical limit values. The detected data clearly reveals that agricultural runoff caused from intensive fertilizer applications and municipal sewage water caused from settlement areas are the main contamination factors for the Sazlıdere Stream.

## ACKNOWLEDGEMENT

This research has been supported by Trakya University (project number: 2018/154).

## REFERENCES

- [1] Tokatlı, C., 2015. Assessment Of The Water Quality In The Meriç River: As An Element Of The Ecosystem In The Thrace Region Of Turkey. *Polish Journal of Environmental Studies*, 24 (5): 2205-2211.
- [2] Tokatlı, C., 2017. Bio – Ecological and Statistical Risk Assessment of Toxic Metals in Sediments of a Worldwide Important Wetland: Gala Lake National Park (Turkey). *Archives of Environmental Protection*, 43 (1): 34-47.
- [3] Tokatlı, C., 2018. Essential and Toxic Element Bioaccumulations in Fishes of Gala and Sigirci Lakes (Meriç River Delta, Turkey). *Acta Alimentaria*, 47 (4): 470-478.
- [4] Tokatlı, C., 2019. Water and Sediment Quality Assessment of the Lifeblood of Thrace Region (Turkey): Meriç River Basin. *Fresenius Environmental Bulletin*, 28 (5): 4131-4140.
- [5] Tokatlı, C., Başatlı, Y., 2016. Trace and Toxic Element Levels In River Sediments. *Polish Journal of Environmental Studies*, 25 (4): 1715-1720.
- [6] Tokatlı, C., Başatlı, Y., Elipek, B., 2017. Water

Quality Assessment of Dam Lakes Located in Edirne Province (Turkey). *Sigma Journal of Engineering and Natural Sciences*, 35 (4): 743-750.

[7] Uslu, O., Türkman, A., 1987. Su Kirliliği ve Kontrolü. T.C. Başbakanlık Çevre Genel Müdürlüğü Yayınları, Eğitim Dizisi I, Ankara.

[8] Turkish Regulations, 2004. Yüzeysel Su Kalitesi Yönetimi Yönetmeliği, 31 Aralık 2004 tarihli Resmi Gazete, Sayı: 25687, <http://suyonetimiormansu.gov.tr>.

[9] Turkish Regulations, 2015. Yüzeysel Su Kalitesi Yönetimi Yönetmeliği, 15 Nisan 2015 tarihli Resmi Gazete, Sayı: 29327, <http://suyonetimiormansu.gov.tr>.

[10] Tabachnick, B. G., Fidell L. S., 1996. Using multivariate statistics (3rd ed.). New York: Harper Collins College Publishers.

[11] Shrestha S., Kazama F., 2007. Assessment of surface water quality using multivariate statistical techniques: A case study of the Fuji river basin; Japan. *Environmental Modelling & Software*, 22, 464-475.

[12] Tokatlı, C., Çiçek, A., Emiroğlu, Ö., Arslan, N., Köse, E., Dayıoğlu, H., 2014. Statistical Approaches to Evaluate the Aquatic Ecosystem Qualities of a Significant Mining Area: Emet Stream Basin (Turkey). *Environmental Earth Sciences*, 71 (5): 2185-2197.

[13] Höll, K., 1979. Wasser (Untersuchung, Beurteilung, Aufbereitung, Chemie, Bakteriologie, Virologie, Biologie). 6. Auflage, de Gruyter, Berlin. 586 pp.

[14] Wetzel, R. G., 2001. Limnology: Lake and River Ecosystems. Elsevier Academic Press, 1006 pages.

[15] Manahan, S. E., 2011. Water Chemistry: Green Science and Technology of Nature's Most Renewable Resource. Taylor & Francis Group, CRC Press, 398 pages.