

# THE DETERMINATION OF ELEMENT SURFACE WATER POLLUTION IN THE BUYUK MENDERES BASIN (TURKIYE)

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In this study, water samples were taken from 19 different points in the Büyük Menderes Basin under the effect of drought and the physicochemical parameters, total concentrations of elements P, K, B, Ca, Mg, Fe, Cu, Mn, Zn, Cd, Pb, As and Hg were measured. The analyses revealed that the region is at potential environmental risk due to metal pollution. The results of the metal analysis show that the Büyük Menderes River is under pressure from various pollutants, especially agricultural and industrial pollutants. Especially Hg and As pollution of industrial and agricultural origin pose a risk of increasing environmental toxicity in the basin.

**Keywords:** water pollution; Büyük Menderes basin; elements; pollutants.

## ОПРЕДЕЛЕНИЕ ЭЛЕМЕНТНОГО СОСТАВА ЗАГРЯЗНЕНИЯ ПОВЕРХНОСТНЫХ ВОД В БАСЕЙНЕ БУЮК-МЕНДЕРЕС (ТУРЦИЯ)

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В этом исследовании были взяты пробы воды из 19 различных точек в бассейне реки Буюк-Мендерес под воздействием засухи и измерены физико-химические параметры, общие концентрации элементов P, K, B, Ca, Mg, Fe, Cu, Mn, Zn, Cd, Pb, As и Hg. В результате анализов было установлено, что регион находится под потенциальным экологическим риском с точки зрения загрязнения металлами. Результаты анализа металлов показывают, что река Буюк-Мендерес находится под давлением многих загрязняющих веществ, особенно сельскохозяйственных и промышленных загрязняющих веществ. Особенно загрязнение ртутью и мышьяком промышленного и сельскохозяйственного происхождения представляет риск увеличения токсичности окружающей среды для бассейна.

**Ключевые слова:** загрязнение воды; бассейн Буюк-Мендерес; элементы; загрязняющие вещества.

<https://doi.org/10.46646/SAKH-2025-2-74-77>

## INTRODUCTION

Water is an indispensable resource for the continuity of vital activities [1]. However, due to population growth, anthropogenic activities and climate change, all resources, especially basins that provide water supply, have been in great danger in recent years [2,3]. In this direction, the main objectives of observing environmental parameters in natural resources are to evaluate the availability and quality of natural resources, control the frequency of pollution-oriented problems, identify environmental and public health risks and use them beneficially [4]

The aim of this study is to conduct a pollution assessment of the Büyük Menderes River Basin, one of the most important rivers of Turkey (584 km<sup>2</sup>), which is under the influence of point and non-point pollution sources such as agricultural activities, geothermal power plants, leather and textile industry, olive oil factories, mining, domestic and other industrial wastes, thermal power plants, boat use and fishing, by measuring the concentrations of P, K, B, Ca, Mg, Fe, Cu, Mn, Zn, Cd, Pb, As and Hg in water.

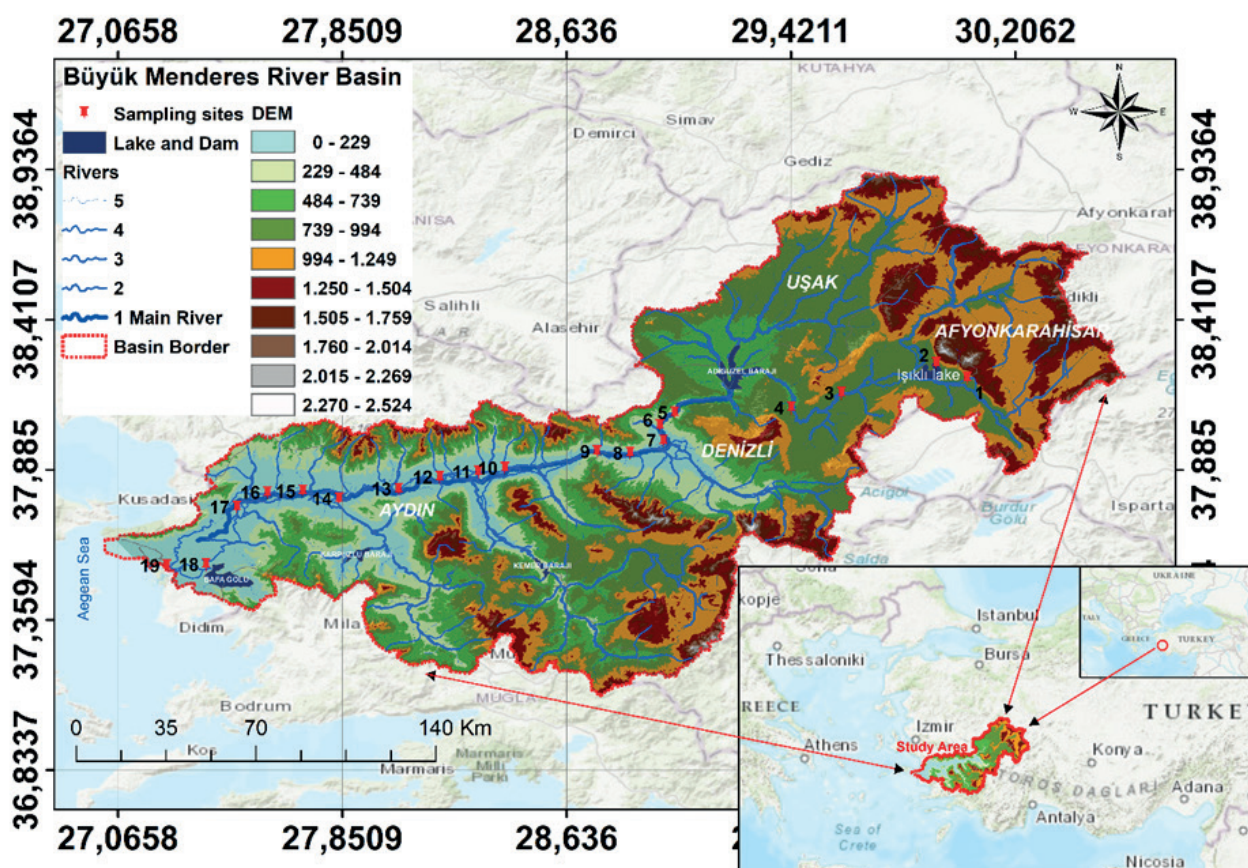
## MATERIALS AND METHODS

The Büyük Menderes basin is located in the west of our country with a length of 584 km (figure). P, K, Ca, Mg, B, Fe, Cu, Mn, Zn, Cd, Pb, As and Hg analyses of water samples were performed with ICP-OES (inductively coupled plasma/optical emission spectroscopy) device at Muğla Sıtkı Koçman University Agricultural Application and Research Center. The analysis methods used in the study were selected in accordance with APHA Standard Methods, EPA Methods and matrices from current literature for water and wastewater analyses. Each sample was repeated 3 times and the average was taken and noted. The water analysis parameters and analysis methods used in the study are given in Table 1.

Table 1

Methods and parameters used in water analysis

| Parameters        | Methods                     | Reference Methods        | Measurement range      |
|-------------------|-----------------------------|--------------------------|------------------------|
| Water temperature | Laboratory and field method | SM 2550 B                | 0-100 °C               |
| pH                | Electrometric method        | SM 4500 H <sup>+</sup> B | 1-14                   |
| Dissolved oxygen  | Optical probe               | SM 4500-O H              | 0-50 mgL <sup>-1</sup> |
| Conductivity      | Laboratory and field method | SM 2510 B                | 0-200 mS/cm            |
| Salinity          | Laboratory and field method | SM 2520 B                | 0-70 ‰                 |



Study area map, sampling points and digital elevation model  
(Taken from the PhD thesis Nigar 2023: Investigation of the Effects of Climate Change on Metal Mobilization in the Büyük Menderes Basin)

## RESULTS

The water temperature values of the basin vary between 16.6-25.9 oC, and the average value in the study area is 21.5 oC, pH values vary between 7.5-9.3, and the average value was measured as 8.3. Dissolved Oxygen values in the Büyük Menderes River vary between nd (not determined) -12.2 mgL<sup>-1</sup>, and the average value was determined as 6.84 mgL<sup>-1</sup>. Electrical conductivity values in the Büyük Menderes River are between 314-30208 µScm<sup>-1</sup>, and the average value is 3101 µScm<sup>-1</sup>. Salinity values are between 0.18-19.6 ‰, and the average value is determined as 1.86 ‰. The analysis results of the elements obtained in the study are given in Table 2.

Table 2

**Results of element determination in water samples**

| Descriptive Statistics |      |       |        |         |                 |
|------------------------|------|-------|--------|---------|-----------------|
| Elements               | Unit | Min.  | Max.   | Average | Std. deflection |
| K                      | ppm  | 3,13  | 248,38 | 30,91   | 52,50           |
| Ca                     | ppm  | 48,63 | 318,20 | 108,35  | 66,46           |
| Mg                     | ppm  | 12,49 | 152,19 | 65,49   | 33,97           |
| B                      | ppm  | ND    | 2,42   | 1,84    | 0,67            |
| Fe                     | ppm  | ND    | 2,15   | 1,72    | 0,53            |
| Cu                     | ppb  | ND    | 38,32  | 12,5    | 10,61           |
| Mn                     | ppb  | 1,56  | 769,08 | 194,97  | 186,24          |
| Zn                     | ppb  | ND    | 12,44  | 9,71    | 3,02            |
| Cd                     | ppb  | ND    | ND     | ND      | ND              |
| Pb                     | ppb  | ND    | ND     | ND      | ND              |
| As                     | ppb  | 1,65  | 55,64  | 23,61   | 14,95           |
| Hg                     | ppb  | ND    | 47,54  | 27,7    | 10,30           |

ND: Not Determined, Min: Minimum, Mak: Maximum,

## DISCUSSION AND CONCLUSION

In the studies conducted in the geothermal areas of the basin, Mn, Ca, Mg, B, Fe and As elements were found in high concentrations. In particular, As values were determined between ND-55.4 µgL<sup>-1</sup>, while the average value was determined as 23.61 µgL<sup>-1</sup>. Cu element was found to be more concentrated in areas close to agricultural areas, this is thought to be due to studies such as fertilization, chemical use and pesticide use. The fact that Zn increased more in rural and agricultural areas indicates that this element may have both agricultural and lithogenic properties. It is thought that Mn, Zn, Cu increased due to their use as pesticides in agricultural areas. Cd and Pb values of the Büyük Menderes River were determined as ND in all sampling stations. However, Hg values were determined between ND-46.8 µgL<sup>-1</sup>, while the average value was determined as 27.7 µgL<sup>-1</sup>.

In this study, the correlation results obtained for metals in water are given in Table 3. Significantly high positive and negative correlations between metals in water are marked in bold in the table. In this study, the Kruskal Wallis Test was used to examine whether there was a difference between the metals in water and the measurement stations. In the results obtained as a result of the examination, except for Cd and Pb (p>0.05), the distributions of other metals in the stations showed significant differences (p=0.000).

Table 3

## Correlation results of elements in water

|    | K             | Ca             | Mg             | B              | Fe            | Cu     | Mn            | Zn    | As            | Hg |
|----|---------------|----------------|----------------|----------------|---------------|--------|---------------|-------|---------------|----|
| K  | 1             |                |                |                |               |        |               |       |               |    |
| Ca | <b>0,51**</b> | 1              |                |                |               |        |               |       |               |    |
| Mg | <b>0,69**</b> | <b>0,68**</b>  | 1              |                |               |        |               |       |               |    |
| B  | <b>0,72**</b> | <b>0,59**</b>  | <b>0,91**</b>  | 1              |               |        |               |       |               |    |
| Fe | 0,08          | -0,32*         | 0,15           | 0,19           | 1             |        |               |       |               |    |
| Cu | -0,01         | -0,32*         | -0,27*         | -0,18          | 0,01          | 1      |               |       |               |    |
| Mn | 0,30*         | 0,07           | <b>0,53**</b>  | <b>0,52**</b>  | <b>0,69**</b> | -0,12  | 1             |       |               |    |
| Zn | -0,19         | <b>-0,55**</b> | <b>-0,50**</b> | <b>-0,53**</b> | 0,06          | 0,26   | -0,23         | 1     |               |    |
| As | 0,11          | 0,13           | <b>0,46**</b>  | <b>0,45**</b>  | <b>0,65**</b> | -0,32* | <b>0,81**</b> | -0,17 | 1             |    |
| Hg | 0,17          | 0,29*          | 0,28*          | 0,12           | -0,13         | 0,03   | 0,17          | 0,19  | <b>0,35**</b> | 1  |

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

As a result, it is seen that the basin is under intense pollution pressure. Therefore, since some ions, organic matter and particulate matter coming from pollutants can cause changes in the chemistry, especially in the physicochemical properties of sediments and soils, it can be said that water quality is quite effective in both the mobility and concentration of metals.

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