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Water Quality Assessment of Yazır Pond (Tekirdağ, Turkey): An Application of Water Quality Index

Cem TOKATLI

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

*Corresponding Author
e-posta: tokatlicem@gmail.com

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Abstract
In this research, water quality of Yazır Pond was evaluated by using Weighted Arithmetic Water Quality Index (WAWQI). Samples were taken from three selected stations on the artificial pond in summer season of 2019. Sixteen parameters including total dissolved solids (TDS), oxygen saturation (OS), salinity, pH, dissolved oxygen (DO), turbidity, biological oxygen demand (BOD), nitrate (NO_3), electrical conductivity (EC), nitrate – nitrogenous (NO_3-N), nitrite (NO_2), nitrite – nitrogenous (NO_2-N), phosphate (PO_4), chemical oxygen demand (COD), phosphate – phosphorus (PO_4-P) and diphosphorus – penta oxide (P_2O_5) were measured in water samples. According to detected data, Yazır Pond has II – III. Class water quality in terms of oxygen saturation, EC, nitrate and nitrate parameters in general and any investigated water quality parameters have not exceeded the drinking water standards (except turbidity). According to the results of WAWQI, the values of overall WAWQI were recorded within the permissible limits (<100). But Yazır Pond was found as "C grade" water quality characteristic and quality rating scale values of turbidity were not within the permissible limits (>100) in all the investigated stations on the reservoir.

Keywords: Yazır Pond, Tekirdağ Province, Drinking water, Water Quality Index, Organic pollution

INTRODUCTION

Water management became a significant mandatory on all over the globe, because of increasing need of freshwater parallel to increase of agricultural use and rapid growth of world population and industrial development. One of the main points on a sustainable management of water resources is monitoring water quality in frequent intervals [1 – 5].

Water quality indices are effective tools to communicate information on the quality of water. Weighted Arithmetic Water Quality Index (WAWQI) is one of the most commonly used drinking water quality indices and it is calculated from the perspective of suitability of drinking water for human consumption [6 – 8].

Tekirdağ Province is known as an agriculture and industry city and it is located in the Thrace Part of Marmara Region. Yazır Pond is located in the Tekirdağ Province and away from the industrial part of the city. But as in many aquatic ecosystems, it is being adversely affected from agricultural and domestic discharges. The water of the pond is being used intensively for agricultural irrigation water supply and drinking water supply in the region [1]. The aim of the present investigation was to determine the water quality of Yazır Pond by determining some water quality parameters and evaluate the detected data according to Turkish Regulations Water Quality Classes and apply the WAWQI in order to assess the water quality in terms of drinking purposes.

MATERIAL AND METHOD

Sample Collection and Chemical Analysis

Yazır Pond has a volume of 5,450,000 cubic meters and 360 hectares of irrigation area [9, 10]. In this research, water samples were collected on the artificial pond from three selected stations (1. Station: Input side, 2. Station: Sylvan side and 3. Station: Output side) in summer season of 2019. Map of Yazır Pond and investigated stations are given in Figure 1.

Dissolved oxygen (DO), oxygen saturation (OS), pH, electrical conductivity (EC), total dissolved solids (TDS) and salinity were determined by using Hach Lange HQ40D Multiparameter during the field studies; turbidity was determined by using Hach Lange 2100Q Portable Turbidimeter during the field studies; nitrate (NO_3), nitrate – nitrogenous (NO_3-N), nitrite (NO_2), nitrite – nitrogenous (NO_2-N), phosphate (PO_4), phosphate – phosphorus (PO_4-P) and diphosphorus – penta oxide (P_2O_5) were determined by using Hach Lange DR890 Colorimeter during the laboratory studies; chemical oxygen demand (COD) was determined by using Hach Lange DR3900 Spectrophotometer during the laboratory studies; and biological oxygen demand (BOD) was determined by using Hach Lange BOD Trak II during the laboratory studies.

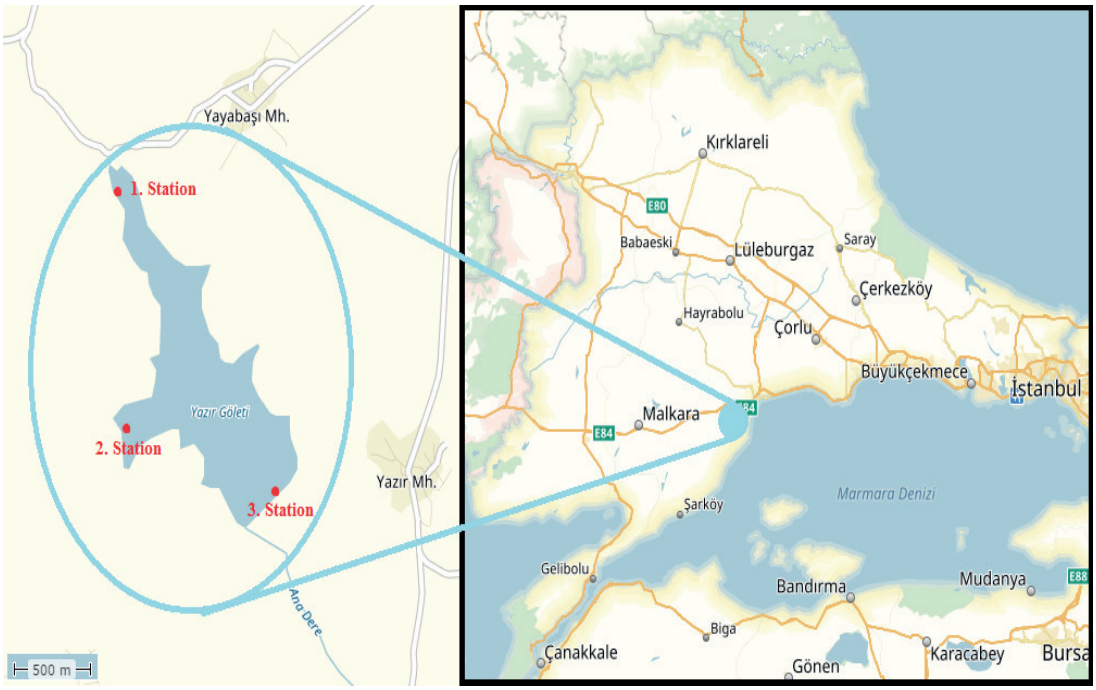

Figure 1. Map of Yazır Pond and selected stations

Calculation of Weighted Arithmetic Water Quality Index

WAWQI calculation was made by using the following formula:

Quality rating scale (Qi) calculation was made by using the following formula:

Vi is estimated concentration of i^{th} parameter,

Vo is the ideal value of this parameter (Vo= 0 in general),

Si is recommended standard value of i^{th} parameter.

Unit weight (Wi) calculation was made by using the following formula:

K (proportionality constant) calculation was made by using the following formula:

The rating of water quality according to WAWQI is given in Table 1 [11].

Table 1. Water quality rating for WAWQI

WAWQI Value	Rating of Water Quality	Usage Possibilities	Grading
0 – 25	Excellent	Drinking, irrigation, industrial	A
25 – 50	Good	Drinking, irrigation, industrial	B
50 – 75	Poor	Irrigation, industrial	C
75 – 100	Very Poor	Irrigation	D
> 100	Unsuitable	Proper treatment is required	E

RESULTS AND DISCUSSION

Results of detected physical, chemical and biological parameters in Yazır Pond are given in Figure 2.

According to the Turkish Regulations [12], input side (1. Station) and sylvan side (2. Station) of the pond have I. Class and II. Class and output side (3. Station) of the pond has II. Class and III. Class water quality in terms of dissolved oxygen and oxygen saturation parameters respectively in general.

As a result of this research, Yazır Pond was found as an alkaline water characteristic reservoir in general and the pond has III. Class water quality in terms of pH parameter according to the Turkish Regulations [12].

According to the Turkish Regulations [12, 13], the pond has I. Class water quality in terms of TDS values and II. Class water quality in terms of EC values. It was also determined that any investigated stations did not exceed the drinking water standards in terms of these parameters [14, 15].

According to the Turkish Regulations [12], Sylvan side (2. Station) of the pond has I. Class, output side (3. Station) of the pond has II. Class and input side (1. Station) of the pond has III. Class water quality in terms of nitrat and nitrite parameters. The input side (1. Station) of the pond has I. Class and Sylvan side (2. Station) and output side (3. Station) of the pond have II. Class water quality in terms of phosphate parameter [16]. It was also determined that nitrate and nitrite levels in water of the pond did not exceed the drinking water limits [14, 15, 17].

According to the results of this research, Yazır Pond was also found as in I. Class water quality characteristics in terms of COD and BOD parameters in general (except output side, it has II. Class water quality in terms of BOD parameter) [12].

Monomial and multinomial risks of electrical conductivity, turbidity, nitrate and nitrite parameters in water of Yazır Pond were determined by using Weighted Arithmetic Water Quality Index (WAWQI). The quality rating scale values

(Qi), which means the results of monomial WAWQI, calculated unit weights (Wi) of investigated parameters and the data of overall WAWQI, which means the results of multinomial WAWQI are given in Table 2.

According to the results of WAWQI, although the values of overall WAWQI were within the permissible limits (<100), Yazır Pond was found as "C grade" water quality characteristic and quality rating scale values of turbidity were not within the permissible limits (>100) in all the investigated locations on the reservoir. It was also determined that the risk sequence of the investigated parameters in water of Yazır Pond used in the Weighted Arithmetic Water Quality Index as follows; turbidity > nitrite > electrical conductivity > nitrate in general.

In a study conducted in Nagpur city (India), water quality index (WQI) was used for determining quality of different surface water resources. According to the results of this study, as similar of the results of the present study, the calculated WQI for various studied lakes showed poor water quality [18].

In another study conducted in the city of Pogradec, Albania, drinking water quality assessment was made by using the water quality index (WQI). According to the results of this study, the drinking water quality in the city of Pogradec was found as "good" level and as similar of the results of the present study, turbidity parameters was found as the main problem on quality [19].

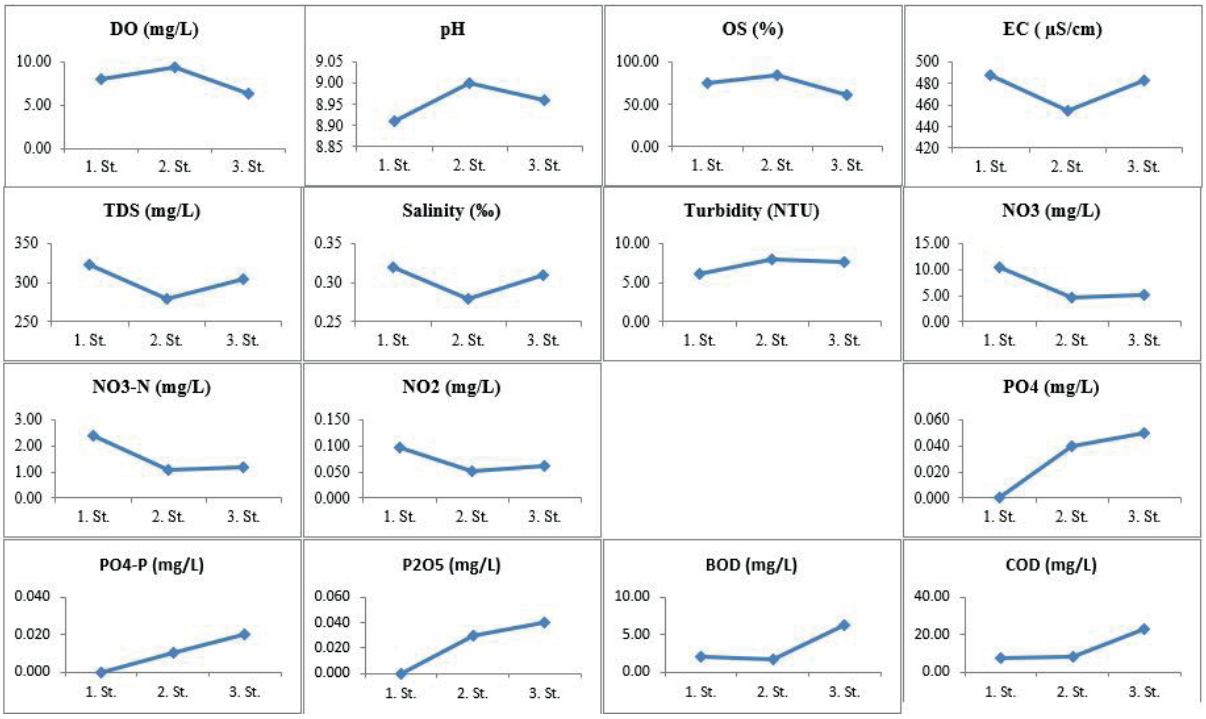

Figure 2. Results of detected parameters in Yazır Pond

Table 2. Quality rating scale values (Qi), unit weights (Wi) and overall WAWQI

Stations	Parameters used in WAWQI				Overall WAWQI
	EC	Turbidity	NO_3	NO_2	
	Wi				
	0.00007664	0.03832	0.0038	0.958	
	Qi				
1. Station	19.48	122.6	20.8	48.5	52.867654
2. Station	18.2	158	9.4	25.5	52.797624
3. Station	19.32	150.6	10.4	30.5	52.727594
min	18.2	122.6	9.4	25.5	52.727594
max	19.48	158	20.8	48.5	52.867654
mean	19	143.733	13.533	34.833	52.797624
SD	0.697	18.672	6.312	12.097	0.07003

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