



Ecologia

ISSN 1996-4021



Academic
Journals Inc.

www.academicjournals.com

Assessment of Water Quality Using Physico-chemical Parameters of Çamlığöze Dam Lake in Sivas, Turkey

Seher Dirican

Department of Fisheries, Suşehri Vocational Training School, Cumhuriyet University, Suşehri, 58600, Sivas, Turkey

ABSTRACT

The present study was carried out with the aim to assess of water quality using physico-chemical parameters of Çamlığöze Dam Lake located at Central Anatolian region of Turkey. For this purpose, water samples were collected from surface and 10 m depth from two stations selected in Çamlığöze Dam Lake. The physico-chemical parameters such as water temperature, pH, dissolved oxygen, oxygen saturation, conductivity, salinity, secchi disc depth, nitrate, nitrite, orto-phosphate, sulfate, chloride, total hardness, calcium and magnesium were analyzed in the water samples. By assessing the physico-chemical data according to the Turkish water pollution control regulation, the water quality classes of the chosen stations in Çamlığöze Dam Lake were determined as class-I in respect to the pH, dissolved oxygen, oxygen saturation, nitrate, nitrite, sulfate and chloride. Water temperature, conductivity, salinity and orto-phosphate of Çamlığöze Dam Lake were within desirable limits. Çamlığöze Dam Lake could be classified as moderately hard in terms of total hardness. It was categorized as mesotrophic by secchi disc depth. Based on the values of the obtained physico-chemical parameters, it can be concluded that the Çamlığöze Dam Lake water quality was good and did not show any significant pollution problem. The results obtained from the present study shall be useful in future management of the Çamlığöze Dam Lake.

Key words: Water quality, physico-chemical parameters, Çamlığöze dam lake, Turkey

INTRODUCTION

Water is an essential component for survival of life on earth, which contains minerals, important for humans as well as for world and aquatic life. Lakes and surface water reservoirs are the planet's most important freshwater resources and provide innumerable benefits. They are used for domestic and irrigation purposes and provide ecosystems for aquatic life especially fish, thereby functioning as a source of essential protein and for significant elements of the world's biological diversity. They have important social and economic benefits as a result of tourism and recreation, are culturally and aesthetically important for people throughout the world (Arain *et al.*, 2008). The physico-chemical parameters are very essential and important to test the water, before it is used for drinking, domestic, agricultural or industrial purpose. Water must be tested with different physico-chemical parameters. Selection of the tested parameters is only depended on the purpose of using that water and what extent we need its quality and purity. The physico-chemical parameter is very important to get exact idea about the quality of water and then we compare the obtained results with standard values. Water quality analysis is important to protect the natural ecosystem (Patil *et al.*, 2012). Few literatures exist on the physico-chemical parameters of Çamlığöze Dam Lake. Dirican *et al.* (2009) investigated some physico-chemical characteristics

(water temperature, electrical conductivity, pH, dissolved oxygen and secchi disk depth) and rotifers of only the surface water in Çamlığöze Dam Lake. The present study was carried out with the aim to assess of water quality using physico-chemical parameters of Çamlığöze Dam Lake.

MATERIALS AND METHODS

The study area was Çamlığöze Dam Lake located at Central Anatolian region of Turkey. Çamlığöze is a small inland dam lake in Sivas. Geographical coordinates of Çamlığöze Dam Lake are 40°13' 45" N, 38°04' 36" E. Çamlığöze Dam Lake is situated approximately 140 km North-East of Sivas province centre. The Çamlığöze Dam was constructed between 1987 and 1998 on the Kelkit Stream, a tributary of Yeşilirmak River. Çamlığöze Dam is a 37 m high rockfill a power plant. The water of Çamlığöze Dam Lake is mainly used for produce electrical energy, commercial fishing, aquaculture, irrigation and recreation. The surface area and maximum depth of the Çamlığöze Dam Lake are 5 km² and 30 m respectively (Dirican *et al.*, 2009).

The present study was performed by using the information about assessment of water quality of Çamlığöze Dam Lake from Sivas Provincial Regional Directorate of State Hydraulic Works (DSI) in January 2007. Regional Directorate of State Hydraulic Works was developed in the province of Sivas Çamlığöze Dam Lake is within the scope of the work of the limnological study of existing the first data, physico-chemical characteristics of this work in 21 October 2001. For this purpose, water samples were collected from surface and 10 m depth from two stations selected in Çamlığöze Dam Lake. The location of Çamlığöze Dam Lake and the sampling stations are shown in Fig. 1. The water samples were collected between 12:15 and 13:45 pm from the two stations. In the collected water samples, totally 15 physico-chemical parameters were analyzed. Water temperature, pH, dissolved oxygen, oxygen saturation, conductivity, salinity and secchi disc depth were measured during sampling in the field. The water temperature and pH were measured with a pH meter (HANNA, HI 8314) while, the conductivity was measured using a WTW LF330 conductivity meter. Dissolved oxygen, oxygen saturation and salinity were measured with a water quality meter (YSI 85) while, the secchi disc depth was measured using a secchi disc in the field. Water samples for chemical analyses were collected from each station by using prewashed polyethylene bottles from each station. All samples were analyzed within 24 h after collection. Nitrate, nitrite, orto-phosphate, sulfate, chloride, total hardness, calcium and magnesium were analyzed in the laboratory according to the APHA (1998) standard methods for the examination of water and wastewater.



Fig. 1: Çamlığöze Dam Lake and stations

RESULTS AND DISCUSSION

The physico-chemical parameters obtained from analysis of water samples were presented in Table 1. The value of water temperature was ranged from 17.60-17.84°C at the surface whereas, they were 16.24-16.47°C at the 10 m water of Çamlığöze Dam Lake. The highest value of water temperature with 17.84°C was obtained in station-I surface, while the lowest value of 17.60°C was obtained at station-II surface (Table 1). In the other study, a bit low water temperature mean values (15.80±3.95 and 14.10±2.40°C) was determined in surface water of Çamlığöze Dam Lake (Dirican *et al.*, 2009). Temperature can vary throughout the lake, with surface water affected more by air temperature than deeper water. Water temperature is one of the most important physical characteristics of aquatic ecosystems and affects a number of water quality parameters. The pH of Çamlığöze Dam Lake was found to be slightly alkaline ranged between 7.56 and 7.83. The pH values did not vary much among the stations. The highest value of pH (7.83) was obtained at station-I surface, while the lowest value of 7.56 was obtained at station-II surface (Table 1). According to the USEPA (1980), accepted water quality criteria indicate a pH of less than 6.5 units may be harmful to many species of fish. Therefore, the pH range of 6.5-9.0 units would be suitable for the protection of aquatic habitats. According to the USEPA (1980), the values of pH were normal in Çamlığöze Dam Lake. The pH values obtained in the present study are adequate for aquatic life including fish within recommended range of 6.5-8.5 (Egemen, 2011). The acidic pH is a characteristic of oligotrophic water bodies whereas, the neutral and alkaline pH are shown by eutrophic and mesotrophic nature of water bodies, respectively (Jitendra *et al.*, 2008; Soni *et al.*, 2013). According to Turkish water pollution control regulation, a pH value between 6.5 and 8.5 should be obtained if lake, pond and dam lake reservoirs are natural protection area or for recreational usage (Anonymous, 2008). In the other study, a bit high pH mean values (8.03±0.04 and 8.30±0.00) was determined in surface water of Çamlığöze Dam Lake (Dirican *et al.*, 2009).

The value of conductivity was ranged from 335 to 342 µmhos cm⁻¹ at the surface whereas, they were 339 to 341 µmhos cm⁻¹ at the 10 m water of Çamlığöze Dam Lake. The highest value of conductivity with 342 µmhos cm⁻¹ was obtained at station-II surface, while the lowest value of 335 µmhos cm⁻¹ was obtained at station-I surface (Table 1). The recommended value of conductivity for a potable water is 2500 µmhos cm⁻¹ (WHO., 1988). According to Polat (1997), when conductivity is over that 1000 µmhos cm⁻¹, it means that pollution occurs in lake. According to those limits, the conductivity values determined in Çamlığöze Dam Lake were at normal and low levels.

Table 1: Physico-chemical parameters obtained from analysis of water samples in Çamlığöze Dam Lake

Physico-chemical parameters	Station-I		Station-II	
	Surface	10 m	Surface	10 m
Water temperature (°C)	17.84	16.24	17.60	16.47
pH	7.83	7.79	7.56	7.64
Conductivity (µmhos cm ⁻¹)	335.00	339.00	342.00	341.00
Salinity (ppt)	0.16	0.16	0.16	0.16
Dissolved oxygen (O ₂ mg L ⁻¹)	9.75	9.32	9.06	8.66
Oxygen saturation (%)	102.80	95.10	95.00	88.70
Nitrate (NO ₃ -N mg L ⁻¹)	0.80	0.50	0.40	0.30
Nitrite (NO ₂ -N mg L ⁻¹)	0.002	0.002	0.002	0.002
Orto-Phosphate (PO ₄ -P mg L ⁻¹)	0.009	0.008	0.016	0.007
Sulfate (SO ₄ mg L ⁻¹)	43.00	43.00	43.00	43.00
Chloride (Cl ⁻ mg L ⁻¹)	6.25	6.25	6.25	6.25
Total hardness (CaCO ₃ mg L ⁻¹)	156.00	156.00	156.00	156.00
Calcium (Ca ⁺² mg L ⁻¹)	37.70	38.70	34.50	36.50
Magnesium (Mg ⁺² mg L ⁻¹)	15.20	14.60	17.10	15.90
Secchi disc depth (m)	1.90		2.05	

Salinity refers to the total concentration of dissolved inorganic ions in water or soil and is therefore, a component of all natural waters (Williams and Sherwood, 1994; Canedo-Arguelles *et al.*, 2013). Salinity is the concentration of salt in water, usually measured in parts per thousand (ppt). The salinity value did not vary among the stations in the present study. The water during the study showed freshwater features, with a value of 0.16 ppt in all station selected in Çamlığöze Dam Lake.

The value of dissolved oxygen was ranged from 9.06-9.75 mg L⁻¹ at the surface whereas, they were 8.66-9.32 mg L⁻¹ at the 10 m water of Çamlığöze Dam Lake. In the present study, dissolved oxygen concentration among the stations showed little variation. The highest value of dissolved oxygen concentration with 9.75 mg L⁻¹ was obtained in station-I surface, while the lowest value of 8.66 mg L⁻¹ was obtained at station-II 10 m (Table 1). Dissolved oxygen is one of the important parameter in water quality assessment and reflects the biological and physical processes prevailing in the water. The dissolved oxygen is an important factor for aquatic life and the chemical characteristics of the environment. In inland ecosystems, the minimum dissolved oxygen may not be less than 5.0 mg L⁻¹ for aquatic life (Egemen, 2011). The value of dissolved oxygen was good in Çamlığöze Dam Lake for aquatic life. According to classifical continental inland, water sources of the Turkish water pollution control regulation Anonymous (2008), if dissolved oxygen is 8 m L⁻¹, the water is class-I; if it is 6 mg L⁻¹, the water is class-II; if it is 3 mg L⁻¹, the water is class-III and if dissolved oxygen is <3 mg L⁻¹, the water is class-IV. According to those limits, in Çamlığöze Dam Lake could be categorized as class-I. It is obvious that Çamlığöze Dam Lake has a high water quality standard or class-I. Thus, it can be said that Çamlığöze Dam Lake water can be used not only for drinking purpose by disinfecting it, but also for recreational aims, rainbow trout culture, animal production and other aims.

The value of oxygen saturation was ranged from 95.0-102.8% at the surface whereas, they were 88.7-95.1% at the 10 m water of Çamlığöze Dam Lake. The highest value of oxygen saturation with 102.8% was obtained at station-I surface, while the lowest value of 88.7% was obtained at station-II 10 m (Table 1). According to classifical continental inland water sources of the Turkish water pollution control regulation Anonymous (2008), if oxygen saturation is 90%, the water is class-I; if it is 70%, the water is class-II; if it is 40%, the water is class-III and if oxygen saturation is <40%, the water is class-IV. According to those limits, in Çamlığöze Dam Lake could be categorized as class-I. It is obvious that Çamlığöze Dam Lake has a high water quality standard or class-I. Thus, it can be said that Çamlığöze Dam Lake water can be used not only for drinking purpose by disinfecting it, but also for recreational aims, rainbow trout culture, animal production and other aims.

The value of nitrate was ranged from 0.40-0.80 mg L⁻¹ at the surface whereas, they were 0.30-0.50 mg L⁻¹ at the 10 m water of Çamlığöze Dam Lake. In the present study, nitrate content among the stations showed little variation. The highest value of nitrate with 0.80 mg L⁻¹ was recorded at station-I surface, while the lowest value of 0.30 mg L⁻¹ was recorded at station-II 10 m (Table 1). According to classifical continental inland water sources of the Turkish water pollution control regulation Anonymous (2008), if nitrate is 5 mg L⁻¹, the water is class-I; if it is 10 mg L⁻¹, the water is class-II; if it is 20 mg L⁻¹, the water is class-III and if nitrate is >20 mg L⁻¹, the water is class-IV. According to those limits, Çamlığöze Dam Lake could be categorized as class-I. It is obvious that Çamlığöze Dam Lake has a high water quality standard or class-I. Thus, it can be said that Çamlığöze Dam Lake water can be used not only for drinking purpose by disinfecting it, but also for recreational aims, rainbow trout culture, animal production and other aims.

The nitrite was 0.002 mg L^{-1} in Çamlığöze Dam Lake. Nitrite content did not show any significant variations among the stations. According to classificical continental inland water sources of the Turkish water pollution control regulation Anonymous (2008), if nitrite is 0.002 mg L^{-1} , the water is class-I; if it is 0.01 mg L^{-1} , the water is class-II; if it is 0.05 mg L^{-1} , the water is class-III and if nitrite is $>0.05 \text{ mg L}^{-1}$, the water is class-IV. According to those limits, Çamlığöze Dam Lake could be categorized as class-I. It is obvious that Çamlığöze Dam Lake has a high water quality standard or class-I. Thus, it can be said that Çamlığöze Dam Lake water can be used not only for drinking purpose by disinfecting it, but also for recreational aims, rainbow trout culture, animal production and other aims.

The value of orto-phosphate was ranged from $0.009\text{-}0.016 \text{ mg L}^{-1}$ at the surface whereas, they were $0.007\text{-}0.008 \text{ mg L}^{-1}$ at the 10 m water of the study area. The highest value of orto-phosphate with 0.016 mg L^{-1} was recorded at station-II surface, while the lowest value of 0.007 mg L^{-1} was recorded at station-II 10 m (Table 1). The orto-phosphate values obtained in the present study is normal for aquatic ecosystems within recommended range of $0.05\text{-}0.3$ (Cirik and Cirik, 2008). According to Bulut *et al.* (2011), when phosphate concentration is over that 0.30 mg L^{-1} , it means that eutrophication occurs in lake. According to those limits, the phosphate amounts detected in Çamlığöze Dam Lake were at normal and low levels.

The sulfate was 43 mg L^{-1} in Çamlığöze Dam Lake. Sulfate content did not show any significant variations among the stations. According to classificical continental inland water sources of the Turkish water pollution control regulation Anonymous (2008), if sulfate is below 200 mg L^{-1} , the water is class-I; if it is 200 mg L^{-1} , the water is class-II; if it is 400 mg L^{-1} , the water is class-III and if nitrite is $>400 \text{ mg L}^{-1}$, the water is class-IV. According to those limits, Çamlığöze Dam Lake could be categorized as class-I. It is obvious that Çamlığöze Dam Lake has a high water quality standard or class-I. Thus, it can be said that Çamlığöze Dam Lake water can be used not only for drinking purpose by disinfecting it, but also for recreational aims, rainbow trout culture, animal production and other aims.

The chloride was 6.25 mg L^{-1} in Çamlığöze Dam Lake. According to classificical continental inland water sources of the Turkish water pollution control regulation Anonymous (2008), if chloride is 25 mg L^{-1} , the water is class-I; if it is 200 mg L^{-1} , the water is class-II; if it is 400 mg L^{-1} , the water is class-III and if chloride is $>400 \text{ mg L}^{-1}$, the water is class-IV. According to those limits, Çamlığöze Dam Lake could be categorized as class-I. It is obvious that Çamlığöze Dam Lake has a high water quality standard or class-I. Thus, it can be said that Çamlığöze Dam Lake water can be used not only for drinking purpose by disinfecting it, but also for recreational aims, rainbow trout culture, animal production and other aims.

The total hardness of water is defined as the sum of calcium and magnesium concentrations, both expressed as milligrams of calcium carbonate equivalent per litre (Karim and Panda, 2014). In present study the total hardness of Çamlığöze Dam Lake water was found 156 mg L^{-1} (Table 1). Egemen (2011) classified water bodies on the basis of total hardness into six categories; soft (hardness less than $50 \text{ CaCO}_3 \text{ mg L}^{-1}$), moderately soft (from $50\text{-}100 \text{ CaCO}_3 \text{ mg L}^{-1}$), slightly hard (from $100\text{-}150 \text{ CaCO}_3 \text{ mg L}^{-1}$), moderately hard (from $150\text{-}250 \text{ CaCO}_3 \text{ mg L}^{-1}$), hard (from $250\text{-}350 \text{ CaCO}_3 \text{ mg L}^{-1}$) and very hard (from $>350 \text{ CaCO}_3 \text{ mg L}^{-1}$). According to those limits, Çamlığöze Dam Lake could be classified as moderately hard.

The value of secchi disc depth was ranged from $1.90\text{-}2.05 \text{ m}$ for stations in Çamlığöze Dam Lake. The highest value of secchi disc depth with 2.05 m was obtained at station-I, while the lowest value of 1.90 m was obtained at station-II from Çamlığöze Dam Lake (Table 1). Similar secchi disc depth mean values range of between 1.70 ± 0.07 and $2.30\pm 0.14 \text{ m}$ was determined by Dirican *et al.*

(2009), who worked on some physico-chemical characteristics and rotifers of Çamlığöze Dam Lake. The secchi disc depth is considered as an important parameter of trophic status of water bodies. According to the level system of OECD for trophic status of lakes, if secchi disc depth is between 0.8 and 1.5 m, the lake is eutrophic; if it is between 1.4 and 2.4 m, the lake is mesotrophic and if it is between 3.6 and 5.9 m, the lake is oligotrophic (Ryding and Rast, 1989; Altındag and Yigit, 2004). According to those limits, Çamlığöze Dam Lake could be categorized as mesotrophic in terms of secchi disc depth parameters.

CONCLUSION

The results obtained from the present study shall be useful in future management of the Çamlığöze Dam Lake. By assessing the physico-chemical datas according to the Turkish water pollution control regulation, the water quality classes of the chosen stations in Çamlığöze Dam Lake were determined as class-I in respect to the pH, dissolved oxygen, oxygen saturation, nitrate, nitrite, sulfate and chloride. The other physico-chemical parameters such as water temperature, conductivity, salinity and orto-phosphate of Çamlığöze Dam Lake water were within desirable limits. Çamlığöze Dam Lake could be classified as moderately hard in terms of total hardness. It was categorized as mesotrophic by secchi disc depth. Based on the values of the obtained physico-chemical parameters, it can be concluded that the Çamlığöze Dam Lake water quality was good and did not show any significant pollution problem in the present study.

REFERENCES

- Altındag, A. and S. Yigit, 2004. The Zooplankton fauna and seasonal distribution Beysehir Lake. Gazi Univ. J. Gazi Educ. Fac., 24: 217-225.
- Anonymous, 2008. Turkish water pollution control regulation. Ministry of Environment and Forest, The Republic of Turkey Official Journal No: 26786, pp: 18-76.
- APHA., 1998. Standard Methods for the Examination of Water and Wastewater. 20th Edition., American Public Health Association, Washington, DC., USA., pp: 1-541.
- Araın, M.B., T.G. Kazi, M.K. Jamali, H.I. Afridi, J.A. Baig, N. Jalbani and A.Q. Shah, 2008. Evaluation of physico-chemical parameters of manchar lake water and their comparison with other global published values. Pak. J. Anal. Environ. Chem., 9: 101-109.
- Bulut, S., R. Mert, K. Solak and M. Konuk, 2011. Some limonological properties of Selevir Dam Lake. Ekoloji, 20: 13-22.
- Canedo-Arguelles, M., B.J. Kefford, C. Piscart, N. Prat, R.B. Schafer and C.J. Schulz, 2013. Salinisation of rivers: An urgent ecological issue. Environ. Pollut., 173: 157-167.
- Cirik, S. and S. Cirik, 2008. Limnology. Ege University Fisheries Faculty Publication No. 21, Izmir, Turkey, pp: 1-166.
- Dirican, S., H. Musul and S. Cilek, 2009. Some physico-chemical characteristics and rotifers of camligoze Dam Lake Susehri, Sivas, Turkey. J. Anim. Vet. Adv., 8: 715-719.
- Egemen, O., 2011. Water quality. Ege University Fisheries Faculty Publication No. 14, Izmir, Turkey, pp: 1-150.
- Jitendra, K., S. Siddharth and P. Amit, 2008. Water quality of Turamdih and Jaduguda uranium mines and adjacent areas, East Singhbhum, Jharkhand. J. Ecophysiol. Occup. Health, 8: 7-14.
- Karim, A.A. and R.B. Panda, 2014. Assessment of water quality of Subarnarekha River in Balasore Region, Odisha, India. Curr. World Environ., 9: 437-446.
- Patil, P.N., D.V. Sawant and R.N. Deshmukh, 2012. Physico-chemical parameters for testing of water: A review. Int. J. Environ. Sci., 3: 1194-1207.

- Polat, M., 1997. Physical and chemical parameters monitored rivers and lakes. Proceedings of the Water Quality Management Seminar, May 15, 1997, Ankara, Turkey, pp 45-57.
- Ryding, S.O. and W. Rast, 1989. The Control of Eutrophication of Lakes and Reservoirs. Parthenon Publishing Group, Lancaster, New Jersey, Pages: 314.
- Soni, V.K., M. Visavadia, C. Gosai, M.D. Hussain, M.S. Mewada, S. Gor and K. Salahuddin, 2013. Evaluation of physico-chemical and microbial parameters on water quality of Narmada River, India. Afr. J. Environ. Sci. Technol., 7: 496-503.
- USEPA., 1980. Clean lakes program guidance manual. Report No.: EPA-440/5-81-003, United States Environmental Protection Agency (USEPA), Washington, DC., USA.
- WHO., 1988. Assessment of freshwater quality. Global Environmental Monitoring Systems (GEMS) Report on the Related Environmental Monitoring, World Health Organization (WHO), Geneva, Switzerland, pp: 1-121.
- Williams, W.D. and J.E. Sherwood, 1994. Definition and measurement of salinity in salt lakes. Int. J. Salt Lake Res., 3: 53-63.