Hindawi Publishing Corporation
Journal of Chemistry
Volume 2015, Article ID 725082, 8 pages
http://dx.doi.org/10.1155/2015/725082

Research Article

Chemical and Physical Quality Criteria of Bulakbaşı Stream in Turkey and Usage of Drinking, Fisheries, and Irrigation

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Received 3 March 2015; Accepted 4 June 2015

Academic Editor: Ana Moldes

Water quality parameters were analyzed in Bulakbaşı stream. The in situ measurements and laboratory analyses were made on water samples taken from 4 sampling points on the Bulakbaşı stream monthly. During the study, the average water temperature as 16.3°C, dissolved oxygen (DO) 12.91 mg/L, oxygen saturation (OS) 152.8%, pH 8.25, electrical conductivity (EC) 779.6 μS/cm, salinity 0.435‰, chloride 83.97 mg/L, calcium 56.5 mg/L, magnesium 57.1 mg/L, total hardness 391.1 mg/L $CaCO_3$, carbonate 0 mg/L, bicarbonate 365.95 mg/L, total alkalinity 299.85 mg/L, nitrate 4.74 mg/L, nitrite 20.83 μg/L, ammonium 50.8 μg/L, ammonia 48.3 μg/L, phosphorus 77.5 μg/L, sulfate 57.6 mg/L, potassium 4.52 mg/L, copper and aluminum 0.0 μg/L, total iron 10.1 μg/L, zinc 168.2 μg/L, chromium 24 μg/L, manganese 401.7 μg/L, and cyanide 6.79 μg/L were found. According to EU, WHO, and Turkish standards, Bulakbaşı stream is not polluted and it has suitable quality with respect to drinking, aquaculture, and irrigation.

1. Introduction

Water is an indispensible substance to be utilized for the survival of all biological organisms. Moreover, water is an essential requirement of human life and activities associated with industry, agriculture, fisheries, and others, and it is considered one of the most delicate parts of the environment [1]. For centuries, people have chosen to settle in areas which have been rich in water and eked out their living nearby water resources where they can use from plenty of water, or in which aquatic resources can easily and abundantly be obtained. However, the perturbations in the hydrodynamics in the earth's ecosystems and the population increases have imposed strains and stresses on water resources over time in these areas and necessitated water bodies to be constructed in order to have an adequate utilization and management of water resources. Furthermore, the amount of water in the world is limited, and it is a known fact that water can never be replaced with any other element in nature. The required quantity and quality of water resources in any given region are limited. Various factors are believed to contribute to a degradation and slump in water resources. For aquatic ecosystems, pollution is on of the most important problems nowadays; therefore, aquatic resources must be protected very well [2].

In meeting the energy needs, and of all natural resources, streams are considered to provide cheap, clean, and continuous supplies for biological species. It is therefore imperative to establish an appropriate regulatory system for the management and utilization of water resources. The potential of herbal production, flora, and fauna in any given area is proportionate to the potential of water resources to be utilized there. Facilities established for transportation, tourism, and recreation activities in any region also depend upon a healthy and effective management of water resources. It would therefore be of paramount significance for human beings eking out their livings in the local and natural environment to have an effective management of the water resources and protect the ecosystems of biological species in any given region on earth. In the biological richness of valuable fish stocks, there can be found numerous favors and utilities for humanity. In order to take due advantages and benefits from the rivers in the most effective way, their natural potential, physical wealth should be protected to ensure continuity and sustainability of their ecosystems; due examinations and analyses to be conducted about their chemical and biological properties are

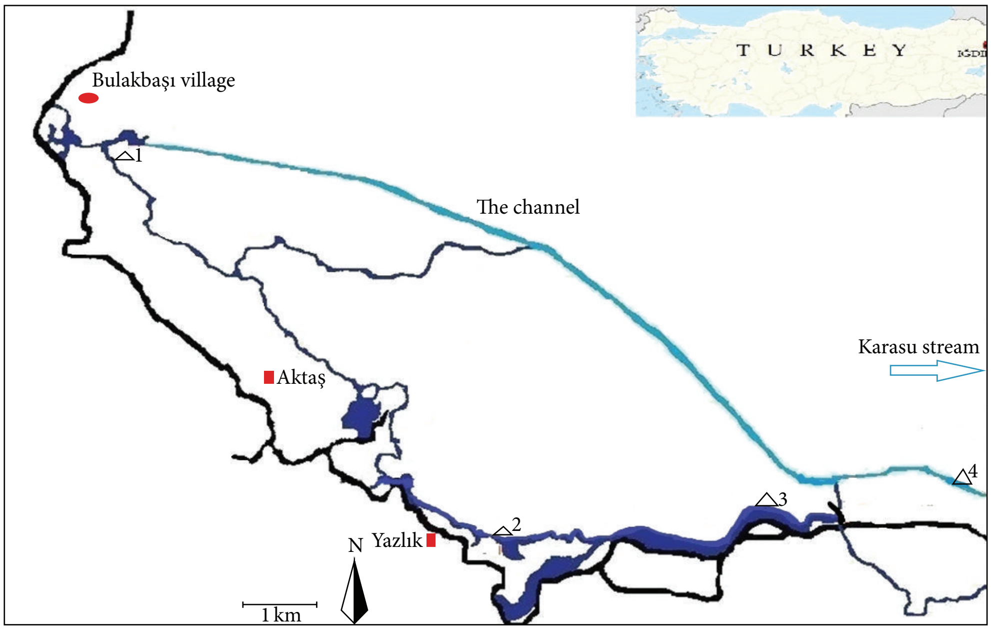

Figure 1: Bulakbaşı stream and four sampling points.

also of great value in order to have adequate utilization and management of these resources [3]. However, in recent years, decreases in the amount of potable water have prompted authorities to have much more effective management and control; it has become indispensable for them to take due measures [4].

No study has been conducted on the limnological features, water quality, and pollution of Bulakbaşı water so far. In this study, the current situation of Bulakbaşı, water quality criteria, and basic pollution parameters were discussed within the context of the aforementioned points and premises. Bulakbaşı stream was also investigated and analyzed for its properties of drinking, fisheries, and irrigation and recommendations were made for prospective researchers and authorities to conduct further studies on this stream.

2. Materials and Methods

Bulakbaşı stream is in eastern Turkey, within the domains of Iğdır province, intersecting with the borders of Armenia and Iran, in the foothills of Mount Ararat and within 39° 56′ N and 44° 15′ E coordinates. The altitude is between 820 and 850 m, average annual temperature is 12°C, and rainfall is about 255.2 mm around the area where the stream is scattered into mountainous terrain. The resources of this stream are within boundaries of Bulakbaşı, Aktaş, and Yazlık villages which are foothills of Mount Ararat. A regulator and irrigation channels have been constructed alongside the stream. Remaining water is poured into the Aras River using in this channel which is about 65 km far away (Figure 1). Around the terrain are large pastures [5].

Four sampling points, which were considered to be likely changed in water quality, have been determined to collect water samples and to make in situ measurements from Bulakbaşı stream (Figure 1). Research was carried out between October 2011 and September 2012. Examples were taken 15–20th days of each month at 12:00–15:00 hours. Water temperature, pH, EC, DO, OS (%), and salinity (‰) were determined through the measurements conducted in the field of investigation with HACH-LANGE HQ40D multimeter. After the in situ measurements, the samples were taken in a volume of 1.5 L bottle, and we brought them to our laboratory, and then analyses were performed in replicates of two or three.

Calcium, magnesium, and total hardness were analyzed with EDTA method, chloride with Argentinometry (Mohr-Knudsen) method, and alkalinity and carbonate-bicarbonate HCl titration methods [6]. Aluminum with aluminon method (Hach method 8012), ammonia with Nessler method (Hach method 8038), copper with porphyrin method (Hach method 8143), zinc with zincon method (Hach method 8009), phosphorus with PhosVer 3-ascorbic acid method (Hach method 8048), chromium-hexavalent with 1.5-diphenylcarbohydrazide method (Hach method 8023), manganese with periodate oxidation method (Hach method 8034), nitrate with cadmium reduction method (Hach method 8039), nitrite with diazotization method (Hach method 8507), potassium with tetraphenylborate method (Hach method 8049), cyanide with pyridine-pyrazolone method (Hach method 8027), sulfate with SulfaVer 4 method (Hach method 8051), and total iron with TPTZ method (Hach method 8112) were analyzed with Hach-Lange DR 5000 spectrophotometer [6, 7]. Evaluation of the results and analysis was made with Turkish Standards (TS 266) [8]; Water Intended for Human Consumption Regulation (WHCR) [9], Water Pollution Control Regulation (WPCR) [10], World Health Organization (WHO), the European Union (EU) drinking (76/464/EEC)

Table 1: Bulakbaşı water results obtained based on in situ measurements.

Sampling months	Temperature (°C)	DO (mg/L)	OS (%)	pH	EC (μS/cm)	Salinity (‰)
October 2011	16.8	16.19	186.1	7.97	599.0	0.40
November 2011	16.6	15.71	180.4	7.99	576.0	0.40
December 2011	15.2	13.72	164.3	8.31	653.3	0.37
January 2012	14.5	12.12	142.3	8.27	661.3	0.38
February 2012	13.7	9.65	105.0	8.47	687.0	0.44
March 2012	12.7	11.46	118.1	8.83	664.8	0.43
April 2012	16.1	10.52	117.8	8.47	714.5	0.43
May 2012	17.5	13.93	162.2	8.35	1044.3	0.53
June 2012	19.7	11.21	163.5	8.23	941.5	0.48
July 2012	17.6	9.32	119.0	8.11	946.0	0.48
August 2012	17.8	14.42	181.3	7.85	930.0	0.43
September 2012	17.3	16.67	193.9	8.11	937.3	0.45
Mean	16.3 ± 1.97	12.91 ± 2.55	152.8 ± 31.15	8.25 ± 0.27	779.6 ± 165.55	0.435 ± 0.045

and fisheries (78/659/EEC) water directives [11], and other relevant legal and technical regulations have been made within a scientific framework [12]. Evaluation of the resulting data was made according to general statistical basis.

3. Results and Discussion

Due to the channel and regulator on the Bulakbaşı stream source, the original bottom and coastal structures degraded. Throughout the study, in the stream, freezing has not been observed. Slope along the river is low; the bottom is sandy and muddy. In the downside, a slight turbidity of the water can be observed.

Water temperature, DO, OS, pH, EC, and salinity values have been recorded through in situ measurements in the field, which are given in Table 1 according to the average of the months.

Temperature is important in the nutrition, reproduction, growth, and migration of fish and other aquatic organisms. Temperature changes will affect parameters such as pH, EC, and DO [12]. Water temperature also directly affects the metabolism and physiology of aquatic organisms. Also temperature has an impact on the speed of the chemical reaction, the solubility of the gases, the taste, smell, and other properties of the water [11]. Temperature of drinking water has a direct association with the taste. Optimum drinking temperature is considered to be 10–12°C [13]. In this study, the average annual water temperature was defined as 16.3°C, and the samples may be included in the first class according to [8–10] and WHO and EU drinking and fisheries directive [11]. The average values throughout the year never exceed 20°C. Upper regions are suitable for trout aquaculture, and subregions for carp aquaculture [14]. Temperature values have been reported to be in Nazik Lake 2–24.5°C [15], in Akköprü stream −1.0–24.5°C [16], and in Karasu Stream 0.8–24.5°C [17]. These values are similar to those found in our study.

The DO is one of the most important criteria for water quality control. Oxygen-saturated water has a good taste and the absence of water gives an insipid taste. Therefore, if there is a DO problem in drinking water, it should be ventilated [11]. The amount of DO in water is an indicator of the level of the water supply which is generally healthy [12]. DO value of this study was 12.91 mg/L and OS was 152.80%. DO and OS values, in Akköprü stream 8.2 mg/L and 98.8% [16], in Karasu stream 10.03 mg/L and 119.4% [17], in Nazik Lake from 1.0 to 13.2 mg/L [15], in Sakegaon River 6.5–8.2 mg/L [18], in Yuvarlakçay stream 5.5–14.4 mg/L [19], in Kelkit stream 7.68–9.90 mg/L [20], in Bhavani River 6.56–12.0 mg/L [21], in Sarada River 7.0–7.8 mg/L [22], in El-Kabir River 7.1 mg/L [23], in Cauvery River 1.34–5.5 mg/L [24], in Kosi River 6.2–6.8 mg/L [25], in Semenyih River 4.18–7.44 [1], and in Nainital Lake 5.77–8.2 mg/L [26], were reported. Bulakbaşı stream is in the first-class water with regard to WPRC [10]. In trout farming, the DO should also be higher than 7 mg/L [14]. In first-class drinking water, OS in the EU directives must be 70% and above [11].

The pH of water plays an important role in the reproduction, growth, and nutrition. The higher the pH increases, the toxic the effect of ammonia is [12]. In waters, various chemical reactions are controlled by pH. A vast majority of biological activities are restricted within a narrow range between pHs 5 and 8. Highly acidic or alkaline water is undesirable because of corrosion problems [11]. Optimum limit of pH for aquatic life is between 6.5 and 9.0 [4]. In [8, 9], the optimum pH range for first-class drinking water is between 6.5 and 9.5, and in [10] and EU directive it is between 6.5 and 8.5 [11]. For aquaculture, the pH values between 6.5 and 8.5 [14] and, in EU fisheries directive, between 6 and 9 [11] were adopted. The average pH was determined as 8.25 in Bulakbaşı. The pH obtained from the study is suitable for general aquaculture. pH values are between 8.06 and 8.87 in [15], 7.19 and 7.32 in [18], 5.34 and 8.96 in [19], 7.76 and 8.45 in [20], 7.66 and 8.58 in [21], 7.85 and 8.0 in [22], 7.2 and 8.14 in [27], 7.3 and 7.9 in [25], 5.23 and 8.41 in [1], and 7.55 and 7.75 in [26], and an average of 7.98 in [23], 8.3 in [16], and 8.2 in [17] have been reported.

The EC of water source is connected with chemical structure of the stream bed and joins the speed and level of hydrocycle [12]. EC increase in drinking water is an indicator

Table 2: Data obtained from titrimetric analysis conducted on Bulakbaşı water.

Sampling months	Cl (mg/L)	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	HCO_3 (mg/L)	Alkalinity (mg/L)
October 2011	80.9	59.2	67.2	497	359.0	294.25
November 2011	84.9	54.2	77.0	452	373.6	305.00
December 2011	95.7	65.2	83.8	533	358.9	294.13
January 2012	85.9	67.5	62.3	479	349.8	286.75
February 2012	74.4	47.5	55.5	377	369.7	303.00
March 2012	79.9	47.5	46.0	308	404.1	331.25
April 2012	77.8	50.5	56.0	357	403.7	330.88
May 2012	91.7	48. 6	48.4	320	358.1	293.50
June 2012	80.5	45.6	54.8	339	347.9	285.13
July 2012	80.5	47.8	44.4	302	354.9	290.88
August 2012	88.2	73.3	47.9	380	356.4	292.13
September 2012	87.7	70.6	41.9	349	355.3	291.25
Mean	83.97 ± 6.12	56.5 ± 10.2	57.1 ± 13.2	391.1 ± 79.0	365.95 ± 19.13	299.85 ± 15.64

of pollution or mixing of the sea water [13]. The mean EC in Bulakbaşı was defined as 779.6 μS/cm. EC values were between 470 and 790 μmhos/cm in [18], 200 and 570 μS/cm in [19], 480 and 590 μS/cm in [20], 450 and 1064 μmhos/cm in [16], 414 and 808 μS/cm in [17], 421 and 514 μS/cm in [25], and 525 and 536 μS/cm in [26]. According to Turkish and EU drinking water standards [8, 9, 11], it is first class. According to Turkish irrigation water standards [10], Bulakbaşı stream water is second class. Bulakbaşı stream is in the middle class salty water for irrigation, and any measures taken to prevent the accumulation of salts in the soil can be in quality that can be given to any kind of soil and plant [28].

The values of analysis with titrimetric method were given in Table 2.

There is no gaseous chlorine in natural waters, in the form of chloride or salt. Chlorine will damage the gills of aquatic animals and lead to death. A healthy drinking water is one of the important indicators [12]. It may be an indicator of sewage mixture and taste threshold value is between 250 and 500 mg/L. However, up to 1500 mg/L of concentration has been found to be harmless to health. 250 mg/L of high concentrations of salts generates a bitter taste [11]. It is the highest toxic effect wherein the anion and its content are above a certain value of irrigation water, which causes leaf blight in plants. The 100–200 mg/L of sodium chloride can damage some vegetables [28]. The average chloride in the Bulakbaşı stream was determined as 84.0 mg/L. Chloride values in [18] as 42–52 mg/L, in [20] as 74.3–205.8 mg/L, in [22] as 192.1 mg/L, in [2] as 15–45 mg/L, in [16] as 27.29–70.29 mg/L, in [24] as 176–254 mg/L, in [17] as 23.66–94.66 mg/L, in [25] as 18.1–25.3 mg/L, and in [26] as 14.5–16.75 mg/L have been reported. In terms of chloride values, Bulakbaşı is first-class water according to [8, 9, 11].

In total hardness Ca and Mg are the most important two elements. They are important for skeleton structure of both aquatic and terrestrial organisms. Also, Mg has an important function in the blood of the human and animals. Water hardness is very important quality criteria for fisheries and drinking [12]. Generally, the total hardness is a function of the geology of the area with which the surface water is associated. Hardness has no known adverse influences on health; nevertheless, some evidence has been given to point out its impact on heart diseases [1]. A high amount of Ca poses no hazards to human health, but in some cases Mg may cause damage to the eyes. Diarrhea is another complication which might occur in these cases when they are exposed to improper amounts of Mg. Similarly, higher amounts of Ca and hardness may cause a problem in terms of flavor inside the water. Also, due to the nature of the stone hot water facility will not be prompted. If the hardness is low, it leads to abrasive action [13]. Although there may be health benefits in terms of hardness, this may cause disadvantages such as more energy to be spent on increasing the soap consumption, and heating systems are also available [11]. Further, Ca in the irrigation water, enough to settle the matter in extreme cases, soil, and plants, leads to chlorosis and restricts the acquisition of certain nutrients. Small amount of Mg is sufficient for plant. Irrigation water at 24 mg/L concentration is allowed [28]. High temperature, evaporation of water, weathering of rocks, and addition of calcium and magnesium salts by means of plants and living organism are contributing factors for the hardness of the water [26]. The values of Ca, Mg, and total hardness were determined as 57.29 mg/L, 59.57 mg/L, and 391 mg/L as $CaCO_3$, respectively, in this study. In fisheries, 400 mg/L calcium and hardness values are accepted as suitable [14]. Bulakbaşı stream may be included in the class of very hard waters. Total hardness was reported between 155 and 220 mg/L in [18], 188 and 310 mg/L in [15], 154 and 240 mg/L in [20], 184 and 211 mg/L in [25], and 241.5 and 250.0 mg/L in [26] and averages as 474.9 mg/L in [16] and as 536 mg/L in [17].

Bicarbonate was determined as 365.94 mg/L, but carbonate has not been observed in this study. Total alkalinity was determined as 299.84 mg/L. Alkalinity is important in terms of impact on the buffering capacity of the water. Bulakbaşı may be included in the highly alkaline class water. In terms of value for rainbow trout farming are in the upper limit [11, 12, 14]. Very small amount of carbonate is sufficient for plants. High concentrations of carbonate have toxic effects. It also negatively affects the physical properties of the soil. It reduces soil permeability. If the soil dries, it hardens and binds the duff layer. Soil large cracks are formed [28]. The total alkalinity value in [18] as 201–230 mg/L, in [21] as 47.5–250.0 mg/L, in [16] as 200–440.0 mg/L, in [17] as 262.5–75.0 mg/L, in [25] as 91–197 mg/L, and in [26] as 142.0–253.5 mg/L $CaCO_3$ was reported.

The values of analysis with spectrophotometric method were given in Table 3.

As is known, high levels of sulfates in water can be stem from volcanic contaminations [12]. Bulakbaşı is within the geographical domains of Mount Ararat. Sulfates are major pollutants due to taste, smell, toxicity, and corrosions that they form as a result of various reactions. Sodium sulfate and magnesium sulfate, which show laxative effects in humans at 250 mg/L, are limited to the upper limit. For animals the limit is of 1000 mg/L. Sulfate converts into H_2S which is toxic and malodorous and formation of anaerobic conditions and bacteria activities. The value of corrosive effect of sulfate begins from 100–250 mg/L [13]. According to Turkish and EU standards [8–11], it is first class. The value of sulfate in Bulakbaşı was determined as 57.12 mg/L. It was reported in [18] as 29.2–40.32 mg/L, in [20] as 63.3–94.3 mg/L, in [21] as 609.6–740.9 mg/L, in [22] as 61.5 mg/L, and in [1] as 1.67–61.0 mg/L.

Potassium creates much bitter taste problems in drinking water. Sources of potassium create industrial pollution, agricultural fertilizers, and soil structure. It is one of the basic nutrients desirably present in irrigation water [28]. The value of Bulakbaşı was found as 4.52 mg/L. It was declared in [24] as 6.2–16.2 mg/L and in [26] as 10.27–14.57 mg/L. According to Turkish, WHO, and EU standards [8–11], it is first class.

Nitrate is the final product resulting from oxidation process by nitrogenous compounds. Through nitrification process higher nitrate levels affect water quality in a negative way. Nitrate may cause blood poisoning called the blue baby disease in the stomach of the infants younger than six months and may lead to death. Nitrate, in natural waters, soil, surface, and groundwater or discharged into water by means of domestic, agricultural and industrial waste, passes through the water; an excessive amount of nitrate in water allows the proliferation of algae and aquatic plants. The amount of nitrate nitrogen in water less than 40 mg/L is desirable [12]. In Bulakbaşı stream value was found as 4.7 mg/L. In other studies, it was declared to be 9.15–15.8 mg/L in [20], 54.1 mg/L in [22], maximum 3.39 mg/L in [29], maximum 0.05 mg/L in [24], and 4.23–8.53 mg/L in [1]. In Turkish, EU, WHO, Germany, and USA drinking and fisheries standards, the water is first class [8–11, 14]. It is necessarily due to take place between irrigation waters among the essential ingredients of plant nutrients [28].

Nitrite is converted to nitrate oxidized intermediates in suitable conditions. Therefore, they are not long lasting in the natural waters. Presence in drinking water is definitely not required. They are toxic to aquatic organisms. There are toxic effects more than 100 μg/L in soft water and 200 μg/L in hard water for rainbow trout. Nitrite arises in water which has low oxygen and more organic matter problems [12, 14]. The nitrite value in our sample was determined as 25 μg/L. The maximum values were reported by Duran et al. [20] as 680 μg/L and Begum and Harikrishnarai [24] as 10 μg/L. Since there is no oxygen deficit in Bulakbaşı stream, nitrite-based pollution is not considered to be a hazard. According to [8, 9], WHO, and EU drinking water standards Bulakbaşı stream is first-class water [11].

Ammonia in water is a result of physical and chemical events or microorganism activities and because of organic-based, it is dangerous. Ammonia in water appears in two forms, ammonia (NH_3) and ammonium (NH_4). NH_3 is toxic to all living organisms. It leads to impairments in taste and causes smelling problems. The presence of ammonia in water indicates that there is an infiltration of domestic waste water. If the ammonia is more than 50 μg/L in water, it has been shown to be a sign of pollution [12, 13]. In Bulakbaşı stream, an average of 40 μg/L ammonia and 50 μg/L ammonium was determined. In the salmonids farming, ammonia 12.5 μg/L and ammonium 1000 μg/L cannot be required to be more [14]. Above 31 μg/L of ammonia is not recommended for salmonids by EU fisheries directive. According to [8, 9, 11], Bulakbaşı stream is first-class water.

Phosphorus has a role in the energy transfer and the presence of nucleic acid is required for biological activity. Food is one of the elements that are needed for aquatic algae as well as for macrophytes growth and proliferation. Water should be available in certain concentrations of phosphorus. If there is an excessive amount, it is based on pollution. In fertilizers, foods and detergents present in excess. It is carried to water sources via runoff, irrigation, drainage, and domestic waste water leaked into the groundwater [12]. In Bulakbaşı stream the values were determined to be 80 μg/L as total P, 230 μg/L as PO_4, and 170 μg/L as P_2O_5. It was declared in [20] as 190–3860 μg/L PO_4, in [29] as 20–340 μg/L TP, in [1] as 80–1900 μg/L PO_4, and in [26] as 123–143 μg/L PO_4. Total phosphorus level in drinking water is recommended as maximum 400 μg/L [4] and according to [9] this may be into the first quality class. EU directive designates first-class water at 400 μg/L of P_2O_5; in salmonids farming it is permitted in 65 μg/L [11].

The presence of excessive iron in water gives a metallic taste to the water. Water makes variegation. Iron do not pose any problem in terms of health but may pose some risks to laundry, textile industry, soap and toothpaste, and paper industry used in the manufacture of products; such water is not desirable due to the presence of iron stain [13]. Total iron in Bulakbaşı stream was determined as 10 μg/L. Iron value was declared in [20] as 37.6–99.16 μg/L, in [21] as 221–1326 μg/L, in [24] as 560–5200 μg/L, and in [26] as 680–700 μg/L. For drinking water, according to [4, 8–10], EU, US, and WHO, it can be incorporated into the first quality class [11]. In salmonids, it is permitted up to 500 μg/L [14].

The presence of zinc is required in waters, because it is of vital importance for skin and hair cells [13]. The average value of zinc in Bulakbaşı was found to be 169 μg/L. The value was reported in [20] as 0.36–0.72 μg/L, in [29] as 70–440 μg/L, and in [26] as 40–60 μg/L. First-class value for zinc in drinking water is 100 μg/L; the allowable upper limit is of 5000 μg/L [4]. EU drinking water directive in first-class water 500 μg/L, the WHO directive 3000 μg/L, and the EU directive for salmonids 10–125 μg/L have been reported [11].

Table 3: Data obtained through analysis with spectrophotometer on Bulakbaşı water.

Sampling months	SO_4 (mg/L)	K^+ (mg/L)	NO_3 (mg/L)	NO_2 (μg/L)	NH_4 (μg/L)	NH_3 (μg/L)	Total P (μg/L)	PO_4^{-3} (μg/L)	P_2O_5 (μg/L)	Fe^{++} (μg/L)	Zn (μg/L)	Cr^{+6} (μg/L)	Mn^{++} (μg/L)	CN^- (μg/L)
Oct. 2011	57.00	**4.05**	4.3	42	80	80	80	260	190	10	168	30	330	6.5
Nov. 2011	55.50	4.33	6.4	22	130	130	60	190	140	8	160	29	380	6.8
Dec. 2011	55.00	4.50	7.5	25	130	120	40	120	90	13	160	29	480	7.3
Jan. 2012	57.50	4.73	9.4	16	110	100	90	260	200	0	137	26	430	7.0
Feb. 2012	61.25	4.65	9.6	14	100	140	110	310	210	10	167	20	650	6.5
Mar. 2012	57.25	4.50	3.6	10	10	0	80	250	190	10	148	19	380	6.8
Apr. 2012	58.25	4.58	3.4	8	0	0	100	290	220	13	165	19	380	7.5
May 2012	61.75	4.88	4.7	10	10	10	90	270	170	10	185	22	350	6.0
June 2012	56.75	4.47	2.0	20	10	0	90	280	210	13	183	19	450	7.3
July 2012	57.75	4.58	3.0	16	10	0	60	180	130	13	185	26	280	7.0
Aug. 2012	55.50	4.60	1.6	34	10	0	60	190	140	13	180	23	360	6.5
Sept. 2012	57.25	4.40	1.4	33	10	0	70	220	160	8	180	26	350	6.3
Mean	57.6 ± 2.09	4.52 ± 0.21	4.74 ± 2.87	20.83 ± 10.79	50.8 ± 53.84	48.3 ± 59.8	77.5 ± 20.06	235 ± 55.5	170.8 ± 39.6	10.1 ± 3.7	168.2 ± 15.3	24 ± 4.2	401.7 ± 95.04	6.79 ± 0.45

In waters, chromium is available as +3 and +6 valence chromium. Cr^{+6} salts are carcinogenic properties. Therefore, drinking water should be protected from chromium contamination [30]. Chromium is allergic to the skin of human [13]. Cr^{+6} in Bulakbaşı stream was determined as 24 μg/L and reported in [21] as 120 μg/L and in [24] as 100–120 μg/L. According to TS 266 [8], WHCR [9] and WHO [11] chromium can be maximum 50 μg/L In drinking waters and, in salmonids fisheries, it can be maximum 5–50 μg/L [11]. Considering the values obtained in the study results, average value is within the limit for chromium and it is the first quality class.

More than 500 μg/L of manganese gives a metallic taste to the water. It is a basic element in the lives of humans and animals. A certain amount of it is recommended for human beings in the drinking water to improve cardiac health and reduce cardiovascular disease mortality [30]. In this study the average value was determined as 400 μg/L. According to [8, 9], WHO, and the EU drinking water standards [11], Bulakbaşı stream is second class.

In the nervous system and thyroid gland, cyanide causes significant problems. It is one of the most well-known poisons which is extremely dangerous to all organisms. Some fruits kernels (such as apricot and peach kernel) contain cyanide [13, 31]. Cyanide value in the study was determined as 6.8 μg/L. According to [8–10], EU, and WHO, it is first-class [11].

Aluminum in water is present dissolved salt, colloidal, or insoluble compounds. It constitutes strong complex ions with organic materials sulfate and fluoride [30]. When there is an excess of it, water has a discoloring property and gives turbid bluish image [13]. Aluminum could not be found in Bulakbaşı stream.

Copper causes the water taste problems and can lead to liver and kidney damage and accelerates the corrosion of other metals. Copper is originated from plating industry waste; copper sulfate is scattered the reservoirs in case of fight program with algae and pesticides. However, 1% remains in biologically available ions and passes to the remainder precipitates and sediments [13, 30]. Copper was not detected throughout the study in our sample.

4. Conclusion

When Bulakbaşı stream is classified in terms of drinking, in respect to water, temperature, DO, OS, EC, pH, chloride, calcium, hardness, nitrate, nitrite, ammonia, sulfate, phosphorus, potassium, copper, aluminum, total iron, zinc, chromium, and cyanide, it can be first-class, and with regard to magnesium, it may be first and second class, and the manganese can be second quality class. In terms of fisheries, P_2O_5 and alkalinity are only slightly above the first quality class. Bulakbaşı stream has the first quality in terms of other parameters. With respect to analysis and measurement of all parameters, it is suitable quality of water for both salmonids and other species. In point of irrigation, it is considered as second quality class with respect to EC, magnesium, and alkalinity and first-class in terms of other parameters. Irrigation water is a quality that can be used easily.

In terms of quality and clean drinking water in our world in an age in which there is an increasing impoverishment, it is of paramount importance to protect natural resources, which must be well managed and kept clean. We should also implement due measures for the protection and rehabilitation of the available resources.

When taking into consideration research findings related with water quality classes described above, it would be much more tempting to say that Bulakbaşı in Iğdır as a drinking water supply for the surrounding settlements can be considered to possess features that are suitable for potable water and favorable for trout and carp farming. However, in order to determine the carrying capacity of water to be used, and taking into account the results obtained from this study, we should provide a good resource for management planning.

Disclosure

This study was produced from the data of Master Thesis conducted by Abdullah AKSOY in the management of Associate Professor Dr. Fazıl ŞEN.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

References

[1] F. Al-Badaii, M. Shuhaimi-Othman, and M. B. Gasim, "Water quality assessment of the Semenyih river, Selangor, Malaysia," *Journal of Chemistry*, vol. 2013, Article ID 871056, 10 pages, 2013.

[2] S. Dirican and M. Barlas, "Physico-chemical characteristics and fish of Dipsiz and Çine (Muğla-Aydın) stream," *Ekoloji*, vol. 14, no. 54, pp. 25–30, 2005.

[3] O. Çetinkaya, M. Sarı, F. Şen, M. Arabacı, and H. A. Duyar, "Limnological characteristics of Karasu river inflowing lake van," *Yuzuncu Yil University Agricultural Sciences*, vol. 4, pp. 151–168, 1994.

[4] A. Türkman, S. Tokgöz, and H. Sarptaş, "Drinking water standards and reliable drinking water," in *Proceedings of the 3rd National Congress on Environmental Engineering*, pp. 1–9, İzmir, Turkey, November 1999.

[5] Anonymous, "General Geography of Igdir," 2014, http://www.igdir.gov.tr/default_B0.aspx?content=219.

[6] A. E. Greenberg, L. S. Clesceri, and A. D. Eaton, *Standard Methods for the Examination of Water and Wastewater*, APHA, AWWA, WEF, Washington, DC, USA, 1992.

[7] Hach, *DR 5000 Spectrophotometer Working Procedures*, Hach-Lange-DOC022.52.00667, Hach Lange, Düsseldorf, Germany, 2005.

[8] TS 266, "Water intended for human consumption," ICS 13.060.20, Turkish Standards Institute, Ankara, Turkey, 2005.

[9] WHCR, *Water Intended for Human Consumption Regulation*, Turkish Official Gazette, 2005.

[10] WPCR, "Turkish water pollution control regulation," Official Gazette No. 25687, Turkish Official Gazette, 2004.

[11] T. H. Y. Tebbutt, *Principles of Water Quality Control*, chapter 2, Butterworth-Heinemann Elsevier, Oxford, UK, 5th edition, 1998.

[12] O. Çetinkaya, *Water Quality*, Yüzüncü Yıl University, Agricultural Faculty, Van, Turkey, 2003.

[13] "The Measurements of The Parameters in Drinking Water," 2014, http://www.aqualine.gen.tr/icme-suyunda-olcumu-yapilan-parametreler.html.

[14] Y. Emre and V. Kürüm, *Trout Breeding in Ponds and Cages*, Posta Publishing, Istanbul, Turkey, 2nd edition, 2007.

[15] F. Şen, *A study on population of carp (Cyprinus carpio, L. 1758) in Nazik Lake [Ph.D. thesis]*, Ataturk University, Erzurum, Turkey, 2001.

[16] N. Cantürk, *The investigation of the water quality of the Akköprü stream inflowing to Lake Van, Turkey [M.S. thesis]*, Yüzüncü Yıl University, Van, Turkey, 2007.

[17] İ. Şekerci, *The investigation of the water quality of Karasu (Mermit) stream inflowing to Lake Van, Turkey [M.S. thesis]*, Yüzüncü Yıl University, Van, Turkey, 2011.

[18] S. V. Agarkar, "Assessment of water quality of Sakegaon reservoir, Maharashtra," *Asian Journal of Chemistry*, vol. 10, no. 4, pp. 997–998, 1998.

[19] N. Kazanci and M. Dügel, "An evaluation of the water quality of Yuvarlakçay stream, in the Köycegiz-Dalyan protected area, SW Turkey," *Turkish Journal of Zoology*, vol. 24, no. 1, pp. 69–80, 2000.

[20] M. Duran, M. Tüzen, and M. Kayim, "Exploration of biological richness and water quality of stream Kelkit, Tokat-Turkey," *Fresenius Environmental Bulletin*, vol. 12, no. 4, pp. 368–375, 2003.

[21] P. M. Gopalswami, P. E. Kumar, and A. R. Kulandaivelu, "Study on the quality of water in the Bhavani river," *Asian Journal of Chemistry*, vol. 15, no. 1, pp. 306–310, 2003.

[22] Y. A. Maruthi and S. R. Rao, "Physico-chemical, biological and bacteriological study of Sarada river," *Asian Journal of Chemistry*, vol. 16, no. 1, pp. 122–130, 2004.

[23] R. L. Thomas, J. C. Cadham, S. Hassan et al., "A physicochemical characterization of the waters of the El-Kabir River and major tributaries in Syria and Lebanon," *Lakes & Reservoirs: Research and Management*, vol. 10, no. 2, pp. 103–108, 2005.

[24] A. Begum and Harikrishnarai, "Study on the quality of water in some streams of cauvery river," *E-Journal of Chemistry*, vol. 5, no. 2, pp. 377–384, 2008.

[25] A. Kumar and Y. Bahadur, "Water quality of river kosi and rajera system at Rampur (India): impact assessment," *Journal of Chemistry*, vol. 2013, Article ID 618612, 4 pages, 2013.

[26] M. Sharma, "Water quality assessment of the Central Himalayan Lake, Nainital," *Advances in Environmental Chemistry*, vol. 2014, Article ID 473074, 5 pages, 2014.

[27] B. Ödemiş, M. K. Sangün, and D. Büyüktaş, "Temporal variations in water quantity and quality of Orontes River, Turkey," *Asian Journal of Chemistry*, vol. 19, no. 1, pp. 711–723, 2007.

[28] A. Günay, *General and Special Vegetables: Irrigation Water Quality*, 2014, http://www.bahcesel.net/forumsel/genel-ve-ozel-sebzecilik-profdratila-gunay/16995-sulama-suyunun-ozellikleri-sulama-sebzecilik/.

[29] F. Tanir, Z. Sütoluk, M. Z. L. Göksu, and M. Akbaba, "An investigation on chemical and bacteriological quality of Seyhan river water in the Province of Adana, Turkey," *Asian Journal of Chemistry*, vol. 17, no. 4, pp. 2720–2726, 2005.

[30] C. Güler and Z. Çobanoğlu, *Water Quality*, Ministry of Health of Turkey, General Directorate of Primary Health Care Publications, Ankara, Turkey, 1997.

[31] M. Özdemir and B. Sırıken, "Determination of cyanide levels in well water in the Afyonkarahisar region," *Veterinary Journal of Ankara University*, vol. 53, no. 1, pp. 37–40, 2006.