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A Study on the Trophic Status and Phytoplanktonic Algae of Mamasin Dam Lake (Aksaray-Turkey)

Tahir Atıcı[1,]*, Ali Alaş[2]

[1] Gazi University, Faculty of Education, Department of Biology, 06500, Ankara, Turkey.
[2] Necmettin Erbakan University, A.K. Education Faculty, Department of Biology, 42090, Meram, Konya, Turkey.

* Corresponding Author: Tel.: +90.535 9776901; Fax: ;
E-mail: tahir@gazi.edu.tr

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Abstract

This study was carried out between April, 2002 and April, 2003 at four stations in Mamasın Dam Lake in the Central Part of Anatolian Region of Turkey. Sixty phytoplanktonic algal taxa were recorded at these stations. These were consisting of species belonging to divisions of *Ochrophyta (=Bacillariophta), Chlorophyta, Charophyta, Cyanobacteria and Euglenozoa.* Generally, members of *Ochrophyta* group were dominant in the lake. Some physical and chemical water quality parameters were determined and these were related with chlorophyll-*a* values.

Keywords: Phytoplankton, Chlorophyll-*a*, Mamasın Dam Lake, trophic status.

Mamasın Barajı (Aksaray-Türkiye) Trofik Statüsü ve Fitoplanktonik Algleri Üzerine Bir Çalışma

Özet

Bu çalışma Nisan 2002-Nisan 2003 tarihleri arasında Türkiye'nin İç Anadolu Bölgesinde yer alan Mamamasın Baraj Gölü'nde belirlenen dört istasyonda yapılmıştır. Bu istasyonlarda toplam 60 fitoplanktonik alg taksonu belirlenmiştir. Bunlar *Ochrophyta* (=*Bacillariophyta*), *Chlorophyta, Charophyta, Cyanobacteria ve Euglenozoa* divizyolarına ait türlerden oluşmuştur. Mamasın Barajın'da *Ochrophyta*, üyeleri genel olarak hâkim organizma grubu olmuştur. Baraj suyunun bazı Fiziksel, kimyasal ve ekolojik parametreleri belirlenerek klorofil-*a* değerleriyle ilişkilendirilmiştir

Anahtar Kelimeler: Fitoplankton, klorofil–*a*, Mamasın Barajı, trofik durum.

Introduction

River, ponds, lakes and dam lakes have enormous contribution on primary productivity of the aquatic ecosystems. Recent years, there have been a lot of studies on this subject in Turkey (Aykulu *et al*., 1983; Altuner and Pabuçcu, 1996; Atıcı, 1997, Elmacı and Obalı, 1998). On the other hand, one of them was made by Alaş and Çil (2002) in which is an investigation of water quality parameters at some springs supplying drinking water for Aksaray.

One of the biggest problems in the future, agreed to find enough nutrients and nutrient sources that are new to ensure continuity requires. Therefore most of research resources more effectively in the new foods are intended to be used.

This work in the area of water products and pollution by creating the foundation to work on, it will contribute to the algal flora of Turkey. The water quality of streams and rivers fed by dams and water dish in the geological structure of the primary productivity of algae is significantly affected (Obalı and Atıcı, 2000). Environmental pollution has been occurring for many years in Turkey, due to rapid increases in population and unplanned industrialization. Streams are also affected by the pollution.

In this study within the boundaries of Aksaray province of algae in the lake dam Mamasin examined, as well as planktonic algae in the surface and deep chlorophyll-a (Chl-a) were made for comparison. A total of 60 taxa in lakes were determined.

Study Area

In the middle of Central Anatolia between 30°-35° eastern meridians and 38°-39° north parallel is located to the north of the Aksaray and Kırşehir Ankara; to the east of Nevsehir, Nigde in the south east, south west of Konya, and is located north west of Salt Lake Anonymous (1989).

The annual average temperature of Aksaray is 11.5°C. Average temperature in January is 2°C. The highest temperature measured in the month of July as 37.5°C. The minimum temperature in January is -26.4°C and at least rainfall measured in July. Annual rainfall is 351,6 ml/m^2. In November, according to the extent of configuration starts snowing, in April it ends. Annual average humidity is 62% and the lowest value is 5%. According to these data, Aksaray is in the middle belt and the type of climate is semi-terrestrial (Anonymous, 2001).

The working space is selected as the dams are Mamasin, in 1961 completed construction as 38 m. height and which is filled with soil. It is still used as irrigation purposes and it is one of the important services still in Aksaray as storage facility. Dam is 17 km east of Aksaray province and on the Melendiz river (Figure 1) (Anonymous, 1979).

Materials and Methods

Samples are collected from the 4 different stations, between April 2002 to April 2003 from the surface, 5 m, 10 m with the help of plankton net. Received materials are placed on 250-500 cc plastic jars and to diagnose species Formaldehyde + Alcohol + Glycerin buffer were added and it was brought to laboratory with them. Ready to review preparations for the temporary return of the samples, optical research microscope and the determination of the genre photos were taken. At the same time to do a rough count by the degree of abundance and occurrence are given.

Classification has been done based on Round (1973). To classify relevant sources (Prescott, 1975; Germain, 1981; Husted, 1985; Korshikov, 1987; Dillard, 1989) have been benefited. All detected species were examined systematically. Count for roughly the following ratings scale is used in abundance. 100 organisms were counted on the scale according to the census; between 0-20 very little (+), between 20-40 little (++), 40-60 normal (+++), 60-80 abundant (++++) and 80-100 continuous current (+++++).

Pigment Analysis and Measurement of Phytoplankton Biomass

In order to determine the amount phytoplankton chl-*a* in Mamasin Dam, 0.5 L volume samples were filtered with the help water tromp from acetate filter paper (Whatmann GF/C 0.8 µ) with vacuum. The residue stayed on filter paper were put into a coverage bottle with14 mL methanol which has a volume of 100-125 ml. Bottles are then placed in bath water with 70^0C temperature and after letting it boiled 10 minutes in methanol, it is held 5 minutes in a dark room. Then the filter paper was washed thoroughly with methanol by a glass stick bottles. Following this process, methanol is taken into centrifuge tubes and centrifuged with 5000 rpm. Spectrophotometer's zero set is made my using pure methanol at 665 nm. Then, the absorbance of centrifuged filter is measured. Read once again after the reading at 750 nm. This value also must be below the value of 0.02. As a last step the volume of the filtered example was measured (Youngman 1978).

Results

Physical and chemical parameters

In all the sampling dates the temperature, dissolved oxygen, depth, turbidity, light permeability, and pH of Physical and chemical measurements were made. Mamasın Dam Reservoir designated stations in the lake, some physical and chemical parameters measured are given Table 1-5.

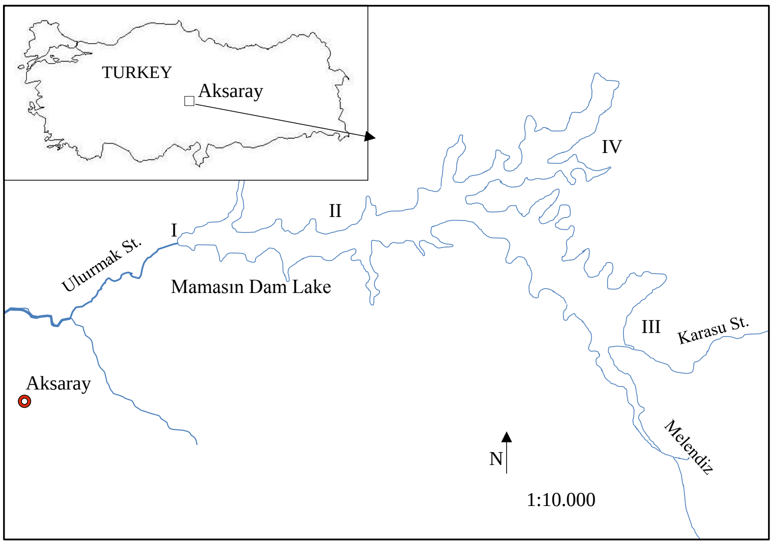

Figure 1. Sampling station in Mamasın Dam Lake

Table 1. Water quality parameters at station I of Mamasın Dam Lake

	Months											
Parameters	A	M	J	J	A	S	O	N	D	J	F	M
Temp (°C)	16.20	19.30	22.00	23.50	21.20	19.8	16.30	**	4.30	4.50	**	5.50
DO (mg/L)	13.90	8.47	6.22	4.30	4.69	7.26	6.86	**	8.95	9.50	**	10.71
pH	9.78	9.60	9.50	8.71	8.53	8.64	8.80	**	8.79	8.67	**	8.60
Elc.Cond. (µmhos/cm)	480	476	433	532	546	584	624	**	579	581	**	581
Sechi (cm)	60	60	105	155	55	70	60	**	105		**	95
Turbidity (NTU)	8.51	7.55	4.10	4.30	10.60	25.10	13.10	**	7.45	10.50	**	10.50
$KMnO_4$ (mg/L)	2.20	8.40	3.40	2.40	2.10	5.00	1.60	**	2.80	2.40	**	2.40
Total hardness (FrS)	17	16	14	15	20	20	20	**	21	20	**	20

Table 2. Water quality parameters at station II of Mamasın Dam Lake

	Months										
Parameters	A	M	J	J	A	S	O	N	D	J	M
Temp (°C)	16.5	19.2	19.6	26.6	20.9	19.8	15.5	9.6	4.3	5	6.4
DO (mg/L)	12.80	9.50	8.66	4.86	4.93	5.80	8.54	8.30	8.77	15.90	10.35
pH	9.70	9.79	9.30	8.61	8.19	8.63	8.90	8.50	8.60	8.27	8.50
Elc.Cond. (µmhos/cm)	482	453	441	487	566	593	610	577	568	580	565
Sechi (cm)	55	50	175	200	50	70	55	55	100	75	75
Turbidity (NTU)	8.25	11.50	2.80	5.45	11.20	14.50	21.40	14.20	7.20	11.7	9.95
$KMnO_4$ (mg/L)	2.2	3.8	3.0	2.4	1.9	4.0	2.0	2.4	3.0	2.6	2.4
Total hardness (FrS)	17	15	13	15	18	18.4	22	21	20	20	20

Table 3. Water quality parameters at Station III of Mamasın Dam Lake

	Months									
Parameters	A	M	J	J	A	S	O	N	D	J
Temp (°C)	15.75	20.2	20.5	27	19.6	20.7	15.6	9.1	5.7	4.7
DO (mg/L)	15.04	11.12	4.30	4.60	7.22	8.10	12.65	9.40	9.31	9.70
pH	9.45	9.80	9.25	8.50	8.69	8.73	9.09	8.96	8.90	8.59
Elc.Cond. (µmhos/cm)	492	427	450	495	630	607	579	572	568	572
Sechi (cm)	25	50	150	125	45	45	25	60	60	125
Turbidity (NTU)	8.39	10.9	3.1	11.5	22.2	19.5	50.5	30.5	7.33	11.3
$KMnO_4$ (mg/L)	2	2.8	2.8	2.0	1.96	4.8	6	3.2	2.6	2.2
Total hardness (FrS)	18	14	14	15.6	19	19.4	20	20	20	20

Table 4. Water quality parameters of Station IV of Mamasın Dam Lake

II. Station	Months										
Parameters	A	M	J	J	A	S	O	N	D	J	F
Temp (°C)	17.2	19.8	20.4	26.9	19.1	20.4	15.6	9.1	6.1	4.5	6
DO (mg/L)	12.00	10.21	12.01	5.90	5.63	6.75	9.62	9.35	9.10	9.50	9.75
pH	9.60	9.80	9.35	8.66	8.43	8.55	9.04	8.80	8.64	8.69	8.40
Elc.Cond. (µmhos/cm)	471	439	440	488	589	591	608	586	552	573	567
Sechi (cm)	75	50	170	150	50	55	45	65	95	125	75
Turbidity (NTU)	8.45	8.12	3.6	9.5	15.5	17.3	34.7	15.9	8.3	11.2	10.5
$KMnO_4$ (mg/L)	2.4	2.80	3.20	2.40	2.80	4.20	4.00	1.00	2.4	2.6	2.2
Total hardness (FrS)	17.0	14.4	13.0	15.4	18	19.0	21.0	21.0	20.0	20.0	20.0

Tablo 5. Chlorophyll- *a* (mg/L) value at saling stations of Mamasın Dam Lake

	Months										
Stations	A	M	J	J	A	S	O	N	D	J	M
I	11.80	6.94	4.85	17.00	18.36	69.36	12.94	47.6	13.9	13.23	13.42
II	7.80	6.94	26.9	20.40	25.38	30.02	13.65	62.0	19.3	13.99	8.282
III	7.23	10.47	31.0	63.65	20.89	8.92	25.13	**	24.8	15.8	* *
IV	13.99	8.80	18.2	43.09	41.34	16.32	9.46	**	29.1	16.95	17.99
Average	10.21	8.29	20.2	36.03	26.49	31.15	15.30	54.8	21.8	14.99	13.23

** Do not take sampling

Biological Parameters

The phytoplankton list detected on Mamasın Dam Lake is given in Table 6.

Discussion and Conclusion

At the study conducted in April 2002-April 2003 in the dam lake Mamasin the *Ochrophyta*

Tablo 6. Phytoplanktonic algae of Mamasın Dam Lake

CYANOBACTERIA (= CYANOPHYTA)	% individual
Chroococcus varius A.Braun	+ +
Dolicospermum circinale (Rabenhorst ex Bornet and Flhault) Waklin, Hoffmann and Komárek	+ ++
Gleocapsa sp.	++++
Merismopedia elegans A. Braun ex Kützing	+ ++
Microcystis robusta (Clark) Nygaard	+ ++
Oscillatoria curviceps C.A.Agardh ex Gomont	+++
Oscillatoria tenuis C.A. Agardh ex Gomont	+ +
Pseudanabaena limnetica (Lemmermann) Komárek	+ + + +
Spirulina major Kützing ex Gomont	+ +++
CHLOROPHYTA	
Actinastrum hantzschii Lagerheim	+++
Acutodesmus acuminatus (Lagerheim) Tsarenko.	+++
Ankyra judayi (G.M.Smith) Fott	+ + +
Chlamydomonas globosa Snow.	+ + +
Chlamydomonas pseudopertyi Pascher	+++
Chlorella vulgaris Bayernick.	+++
Coelastrum microporum Naeg.	+ + +
Coelastrum pseudomicroporum Kors.	+ +
Desmodesmus armatus (Chodat) Hegewald.	+++
Oocystis borgei Snow.	+ + + ++
Oocystis parva W.and G.S.West	+ +
Pediastrum boryanum (Turpin) Hegewald	+ ++
Stauridium tetras (Ehrenbeg) Hegewald	+ + ++
CHAROPHYTA	
Closterium aciculare T. West	+ + +
Cosmarium botrytis Menegh.	+ ++
Spirogyra princeps (Vaucher) Meyen	++
Spirogyra subsalsa Kütz.	+ ++
EUGLENOZOA (= EUGLENOPHYTA)	
Euglena elongata Schewiakoff	+ +
Euglena proxima Dangeard	+++
Trachelomonas hispida (Petry) Stein	+ +++
OCHROPHYTA (=BACILLARIOPHYTA)	
Amphora ovalis (Kütz.) Kütz.	+ ++
Cocconeis placentula Ehr.	+ +
Craticula cuspidata (Kützing) D.G.Mann	+ ++
Cyclotella meneghiniana Kütz.	+ + +++
Cyclotella ocellata Pantock.	+ + +
Cymbella cymbiformis C.Agardh	+ +
Cymbella helvetica Kütz	+ ++
Cymbella lanceolata Kirchner	+ + +
Cymbopleura amphicephala (Nägeli) Krammer	+ + +
Diatoma tenuis C.Agardh	+ ++
Eucocconeis lapponica (Östrup) Lange-Bertalot	+++
Fragilaria capucina Dezmaizieres var. vaucheriae (Kützing) Lange-Bertalot	+ +
Fragilaria constricta Ehrenberg	+ +
Fragilariforma virescens (Ralfs) Williams and Round	+ +
Gomphonema acuminatum Ehrbg.	+ +
Gomphonema olivacecum (Hornemann) Brébisson	+ + +
Gomphonema truncatum Ehrenberg	+ ++
Gyrosigma attentuatum C.Agardh	++
Melosira varians Ag.	+ +
Navicula lanceolata Ehrenberg	+ + ++
Navicula menisculus Schumann.	+ ++
Navicula minuta Skvortzov	+ +
Navicula radiosa Kütz.	+ + +
Nitschia linearis (C.Agardh) W.Smith	+ +++
Nitzschia amphibia Grun.	+
Pinnularia biceps Greg.	+ +
Stephanodiscus astraea (Ehr.) Grun.	+ + +
Surirella minuta Brébisson	+ +
Surirella angustata Kütz.	+ +
Synedra ulna (Nitzsch.) Ehr.	+ +
Ulnaria capitata (Ehrenberg) Compére	+ ++++

(=*Bacillariophyta*), *Chlorophyta, Charophyta, Euglenozoa* and *Cyanobacteria*, a total of 60 taxa were found. The 31 belong of *Ochrophyta*, 9 belong of *Cyanobacteria*, 13 belong of *Chlorophyta*, 4 belong of *Charophyta* 3 belong of them *Euglenozoa*. 51% of the total number of species belonging *Ochrophyta* are dominated.

The density and speed of phytoplankton are depends upon, light, temperature, nutrient salts, and chlorophyll-a values influenced Physico-chemical properties. However, lakes and dams and their arms move from feeding the contribution of organic and Inorganic substances is also important.

Physical factors were more influential phytoplankton is cyclical. Light intensity and temperature in the months with low phytoplankton density generally is low (in December, the temperature 4.3°C, light permeability 105 cm). Spring in the correct light intensity and temperature increases, can be used in winter to accumulate more nutrients to be agreed with the intensity of salt biomass of phytoplankton was rich reasons (July, temperature 26.6 ^{0}C, light permeability 200 cm). But spring rains have caused the blurry fully to influence the light penetration, water entered the lake to form the great extent of thin high-density planktonic algal community has blocked access to lake (September, temperature 20.7°C, the light permeability of 45 cm).

The total biomass of phytoplankton measurements the number of cells in unit volume, in addition to a calculated density phytoplankton Chl-*a* 5-70 µg/L has changed between. Four different stations in the study area with density of Chl- *a*, 1 stations in the 5-70 µg/L, 2 stations in the 8-31 µg/L, 3 stations in the 8-62 µg/L, 4 stations in the 10-42 µg/L was calculated.

Tablo 7. Trophic status of lakes according to the Chl-*a*

Trophic status	Consantration (µg/L)
Ultraoligotrophic	1 µg/L
Oligotrophic	3 µg/L
Mesotropfic	10 µg/L
Eutrophic	30 µg/L
Hipertrophic	100 µg/L

According to the Nygaard (1949) between the 5–140 µg/L values was found usually eutrophic characters. Used to determine the status of Lakes tropic levels of Chl-*a* value are given in Table 7.

Chl-*a* concentration at that moment as an index of algal biomass can be given. Chl-*a* of the old lake oligotrophic major concentration in the epilimnion layer 0.3-2.5 mg/L respectively. These values in eutrofic lakes can vary between 5-140 mg/L (Erbil, 1999).

Chl-a value, the light permeability has an interest in the search. Chl-*a* value decreases when the light transmission increases (Figure 2).

According to the seasonal variations of chl-*a* value in the distribution of stations the highest value of chl-*a* 69.36 mg/L was September 2002 at station 1. The increase in density and decrease the amount of chl-*a* and the total number of organisms is not always comply (Table 5).

In the first station chl-*a* value the highest value (69.36 mg/L) in September 2002, while there is an increase in density of chl-*a*, the density of organisms decreased this time. This is because the temperature and light transmission levels may be sufficient for the algae to increase production of phytoplankton as well as to increase the value of dissolved oxygen is required. Also in the spring rain caused muddy to fully affect light penetration, water entered the lake to form the great extent of thin high density of algae communities were preventing access. This period is dominated *Cymbella* and *Synedra* genus. June 2002, the lowest value of chl-*a* (4.85 mg/L) is deemed to be. Temperature, light permeability increase in phytoplankton production may be sufficient enough to ensure that the amount of dissolved oxygen (6.22 mg/L) is less than a quantity of the chl-*a* has reason to fall. *Coelastrum Oscillatoria* and *Trachelomonas* genus is dominated this period.

The second station of chl-*a* is the maximum value (62.070 mg/L) in November 2002. Value if the temperature is low (9.6°C) over the amount of

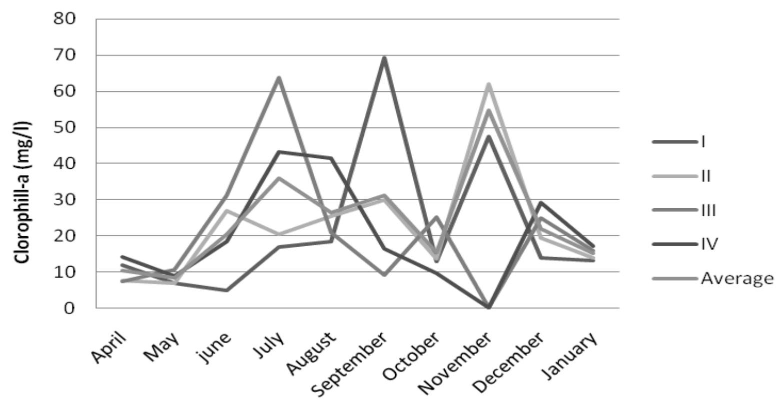

Figure 2. Seasonal variation of Chlorophyll-*a* value at sampling stations of Mamasın Dam Lake.

dissolved oxygen is the result of increased phytoplankton production. Diatoms dominated at this station so that the chl-*a* and phytoplankton density and an increase has occurred in the compliant. chl-*a*, is the lowest value (6.949 mg/L) in May 2002. Required for phytoplankton production values of the temperature and dissolved oxygen values are low due to the chl-*a* value even though the intensity is enough gender. *Synedra*, *Surirella*, *Cyclotella*, *Diatoma*, and *Anabaena* species determined abundantly during this period.

In the third station of chl-*a* is the maximum value (63.65 mg/L) in July 2002, the optimal temperature for phytoplankton biomass chl-*a* high value but the amount of dissolved oxygen 5 mg/L' are in so much below that there is no gender diversity. In this period, *Spirogyra Synedra*, and *Trachemonolas* is dominated. Chl-*a* the lowest value of (7.235 mg/L) in April 2002. Quantity of dissolved oxygen and temperature in high levels cause to the phytoplankton production increased. *Chlorella*, *Scenedesmus*, *Actinastrum*, *Cymbella*, *Synedra*, *Diatoma*, and *Nitzchia* genus adequate levels are available.

In the fourth station of chl-*a* is the maximum value (43.09 mg/L) in July 2002. The amount of dissolved oxygen for the phytoplankton biomass, the optimum temperature and high level chl-*a* value compatible increase in phytoplankton density has occurred. *Spirogyra*, *Cyclotella*, *Anabaena* and *Trachelomonas* genus is dominated this period. The lowest value of chl-*a* (8.806 mg/L) in May 2002. Despite a very low value of chl-*a* phytoplankton at the intensity level of the other values are still here, just *Anabaena*, *Synedra*, *Cyclotella* and *Oscillatoria* genus can be seen.

Genus recorded around the Mamasın Dam Lake were also found in lakes which are the Cubuk-I Dam Lake (Gönülol and Aykulu, 1984) in Lake Manyas (Balıkesir) (Şipal *et al*., 1994; Çelik and Ongun, 2008), Lake Uluabat (Bursa) (Karacaoğlu *et al*., 2004), Lake Marmara (Manisa) (Cirik, 1982, 1983, 1984), Lake İkizgöl (Şipal *et al*., 1996), Lake Kazangöl, (İzmir) (Aysel *et al*., 1998), Ömerli Reservoir (İstanbul) (Albay and Akçaalan, 2003), Yedigöller Lakes, Lake Abant and Lake Gölköy (Bolu) (Atıcı and Obalı, 2002; Çelekli *et al*., 2007) located in the different regions.

Chl-*a*, for all the algae division in the lake environment is one of the method used to detect biomass (Atıcı, 2002). Despite this, a quantity of the chl-*a* density between phytoplankton, there is no parallel in the amount of increase and decrease.

Eutrophic lakes according to the physical and chemical properties of productivity are rich. Especially in the summer phytoplankton population is higher. The temperature of Mamasın Dam like as shallow lakes. This case makes aquatic lives choose appropriate temperature ranges. Moreover, biological and chemical reactions depending on the speed of temperature increase is shown.

Organic pollution in Lake Dam Mamasin is not in question. However, feeding dams to protect water resources must be taken too immediately. Longer and more efficient use of the lake dam to dam water quality must be kept under continuous control.

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