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Seasonal Variation and Water Quality Analysis of Tisgaon Dam, District Aurangabad, India

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Abstract: The present study deals with assessment of the physico-chemical parameters and correlation coefficient of Tisgaon dam, Aurangabad [M.S] India. The physico-chemical characteristics and correlation coefficient were studied and analyzed during January - December 2010. Seasonal variations at four different sampling sites of the Tisgaon dam, Aurangabad [M.S] India were observed. The results revealed that the condition of this dam in different seasons showed fluctuations in term of its physico-chemical parameters.

Key words: Physico-chemical parameters · Seasonal variations · Tisgaon dam

INTRODUCTION

Freshwater is abundant worldwide. Though, every year on average of more than 7,000 cubic meters per capita enters rivers and aquifers. There are 22 countries with less than 1,000 m^3 per capita - a level commonly taken to indicate that water scarcity is a severe constraint. Eighteen countries have less than 2000 m^3 per capita on average. The limited renewable water resources are in the Middle East, North Africa and Sub-Saharan Africa.

Water scarcity is often a regional problem. More than 200, river systems, draining over half of the earth's land are shared by two or more countries. Over pumping of groundwater aquifers that stretch under political boarders also injects international politics into the management of water scarcity. Water is one of the most amazing compounds in nature consists of two common elements hydrogen and oxygen. Water plays an important role in environmental ecosystems. It acts as a universal solvent for many more compounds than any other liquid providing ionic balance and nutrient, which support life.

The population explosion is increasing pressure on natural resources. Demand for water is growing rapidly as population and industrial activities are expanding and irrigated agriculture continues to increase. From the last five decades withdrawal of fresh water from rivers, lakes and underground aquifers has increased. Future availability of water for human use depends on how water resources are managed.

Countries may some times have to make choices between quantity and quality; Effluents are less diluted when river flows decline. In countries with inadequate effluent treatment, water quality can often been improved only if supplies from dams are used to maintain flows for dilution rather than for other economic uses. Often the disparate agencies involved in management can not agree on trade-offs between quantity and quality. Water scarcity in many countries is becoming an increasing constraint not just on household provision but on economic activity in general. Water drawn of upstream makes down stream so short of water that there industries are seasonally forced to curtain operations. This has become routine in Indonesian regional capital of Surabaya. As industry, irrigation and population expand, so do the economic and environmental cost of investing in additional water supply.

Access to safe water remains an urgent human need in many countries. Part of the problem is contamination, diseases that are largely conquered when adequate water supply and sewerage systems are installed cause

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tremendous human suffering. The problem is compounded in some places by growing water scarcity, which makes it difficult to meet increasing demand.

Human wastes pose great health risks for the many people who are compelled to drink and wash in untreated water from rivers and ponds. Data from UNEP's Global Environmental Monitoring System (GEMS) demonstrate the enormous problem of such contamination, with poor and deteriorating surface water quality in many countries. Water pollution from human wastes matters less in countries that can afford to treat all water supplies, still in some high income countries water quality has continued to deteriorate.

Decomposition of pollutants lowers the amount of O_2 dissolved in water decreasing the capacity of river to support aquatic life. Oxygen loss does not threaten health directly, but it affects on fisheries may be economically important. Human sewage and agro-industrial effluent are the main causes of this problem; nutrient runoff in agricultural areas with intensive fertilizer use is another contributor. Although inadequate levels of dissolved oxygen tend to affect shorter lengths or rivers than does faecal contamination a sample of GEMS monitoring sites in the mid 1980's found that 12% had dissolved oxygen levels low enough to endanger fish populations. The problem was worst where rivers pass through larger cities or industrial centers. In China only five of 15 rivers stretches sampled near large cities were capable of supporting fish. High-income countries have seen some improvement over the past decade. Middle-income countries have, on average shown no change and low-income ones show continued deterioration.

As surface waters near towns and cities becomes increasingly polluted and costly to purify, public water utilities and other urban water users have turned to groundwater as a potential source of a cheaper and a safer supply. It is often more important to prevent contamination of groundwater than of surface water. Aquifers do not have the self-cleaning capacity of rivers and once polluted, are difficult and costly to clean.

One of the principal origins of groundwater pollution is seepage from the improper use and disposal of heavy metals, synthetic chemicals and other hazardous wastes. In Latin America, for instance, the quantity of such compounds reaching groundwater from waste dumps appears to be doubling every fifteen years. Sometimes industrial effluents are discharged directly into groundwater. In coastal areas over pumping causes self water to infiltrate freshwater aquifers. In some towns contamination occurs because of lack of sewerage systems or poor maintenance of septic tanks. High chemical inputs combined with irrigation in intensive agriculture contaminate groundwater as chemicals often leach into groundwater. Good quality of water is essential for living organisms. Hence, it is referred as most vital resource for all kinds of life on this planet. Water is required for various purposes such as drinking, cooking, washing, bathing, fire fighting, cleaning, maintenance of public gardens, swimming pools, development of industries etc. Water is a vital medicine. It can eliminate water born diseases, promote rural development and improve the quality of life. Therefore, water is an essential factor in economic, social and cultural development of community.

Among all these requirements according to National Water Policy, drinking water gets first priority and importance. Water is main source for human consumption must be free from organisms and from concentration of chemicals substances, soluble or non soluble in nature, which may be hazardous to health. If water is fit for drinking, it will be suitable for all purposes. Water is in constant demand for domestic use, animal culture, industries and agriculture. However the limited sources, less than 1 percentage, water is available for the above purposes, hence it is treated as precious. Its judicious use is strongly recommended in all sectors including crop irrigation. Agricultural is dependent on water. It may be dependant on direct rainfall or surface ground water irrigation. It eventually is a more important commodity in a country like India, because here largely economy depends on the agriculture i.e. critically on water [1].

The study of different water parameters is very important for understanding of the metabolic events in aquatic ecosystem. The parameters influence each other and also the sediment parameters, as well as they govern the abundance and distribution of the flora and the fauna. Therefore, it has become obligatory to analyze at least the important water parameters when ecological studies on aquatic ecosystems are carried out. Such studies when done from time to time can indicate the favorable or unfavorable changes occurring in the ecosystem.

In India some hydrobiological work on historic shallow water bodies like temple reservoir and village ponds have been done [2-6].

MATERIALS AND METHODS

The water samples for physico-chemical analysis were collected from Tisgaon dam, geographical coordination Longitude 75° - 15' - 45 " and Latitude. 19° - 52 ' - 30 " Aurangabad, (M.S) India, at 3 different sites in the early morning between 8 am to 11 am in the first

week of every month from January - December 2010. The samples were collected in acid washed five liter plastic container from a depth of 5-10 cm below the surface of water. Separate samples were collected for dissolve oxygen in 250 ml bottles and dissolved oxygen was fixed in the field by adding alkaline iodide-azide solution immediately after collection. The samples were analyzed immediately in the laboratory.

The physico-chemical characteristics of the dam water like Atmospheric temperature, DO, BOD, COD, suphate, chloride, nitrate and phosphate were determined in summer, monsoon and winter according to standard methods [7, 1].

RESULTS AND DISCUSSION

The seasonwise physico-chemical parameters data of Tisgaon dam, Aurangabad [M.S] India have been presented in Table 1.

Atmosphere Temperature: Temperature is very important parameter, because it influences the biota in a water body by affecting activities such as behavior, respiration and metabolism. It is necessary to study temperature variations in water body, in animals ecophysiological and toxicological aspects because, water density and oxygen content are temperature related and hence temperature indirectly affects osmoregulation and respiration of the animal.

The maximum value was recorded (38.45±0.29 °C) during summer; minimum value was recorded (23.50±0.69°C) during winter. The overall mean was 30.12±7.61°C (Table 1).

In the present investigation, the temperature values were maximum during summer and minimum during winter. Low temperature recorded in winter may be due to high water level, lesser solar radiation, low atmospheric temperature and high temperature in summer because of low water level, high solar radiation and clear atmosphere.

Similar results were also reported by Jawale and Patil [8]; Narayana *et al*. [9] and Sharma *et al*. [10]. They recorded minimum temperature, in winter season and maximum in summer.

Dissolved Oxygen (DO): DO is one of the most important parameter indicating the health of the water body. DO is most important parameter in the quality assessment. All living organisms are dependent upon oxygen in one form or the other to maintain the metabolic processes that produces energy for growth and reproduction. DO is inversely proportional to temperature. DO is also important in precipitation and dissolution of inorganic substances in water.

The maximum value was recorded (6.42±0.70 mg/l) during winter; minimum value was recorded (4.16±0.62 mg/l) during monsoon. The overall mean was 5.27±1.13 mg/l (Table 1).

High values of DO during winter could be due to increased photosynthesis by Phytoplankton and during post-monsoon may be due to circulation of oxygen. A lower value during pre-monsoon was experienced probably due to decomposition of organic matter. Similar results were also reported by Chauhan and Sharma, [11].

Biochemical Oxygen Demand (BOD): Biochemical oxygen demand (BOD) is defined as the amount of oxygen required by Microorganisms while stabilizing biological decomposable organic matter in a waste under aerobic conditions. The term decomposable may be interpreted as the organic matter which can serve as food for the bacteria and energy is derived from its oxidation. BOD is an index of degree of organic pollution in water body. BOD test is widely used to determine the polluting strength of domestic and industrial waste in terms of oxygen that will require its discharge into natural water bodies in which aerobic condition exist. Biological degradation of organic matter under natural condition is brought about by a diverse group of organisms that carry on oxidation essentially to completion.

The maximum value was recorded (7.98±0.54 mg/l) during monsoon; minimum value was recorded (5.10±0.22 mg/l) during summer. The overall mean was 6.65±1.45 mg/l (Table 1).

In the present investigation, the BOD values were maximum during monsoon and minimum during summer. Higher values of BOD in monsoon, as compared to those in winter and summer might be because of the presence of pollutants mixed with rain water. Similar results were reported by Reddy *et al*. [12] and Jayabhaye *et al*. [13].

Chemical Oxygen Demand (COD): The COD is the test which is used to measure the pollution of domestic and industrial waste. The waste is measured in. terms of quantity of oxygen required for oxidation of organic matter to produce carbon dioxide and water. It is fact that all organic compounds with few exceptions can be oxidized by the action of strong oxidizing agents under acidic condition. COD test is useful in pointing toxic

Table 1: Seasonal variations in physico-chemical parameters of Tisgaon dam, (M.S) India (During January - December 2010).

Parameters	Summer	Monsoon	Winter	Average
Atmospheric temperature (0°C)	38.45±0.29	28.42±0.25	23.50±0.69	30.12±7.61
DO (mg/l)	5.23±0.34	4.16±0.62	6.42±0.70	5.27±1.13
BOD (mg/l)	5.10±0.22	7.98±0.54	6.89±0.34	6.65±1.45
COD (mg/l)	12.23±0.82	19.23±1.36	17.12±1.15	16.19±3.59
Sulphate (mg/l)	20.80±1.37	18.70±3.00	15.12±1.14	18.20±2.87
Chloride (mg/l)	33.05±1.73	30.12±1.12	24.16±1.10	29.11±4.53
Nitrate (mg/l)	0.82±0.02	1.90±0.03	1.0±0.01	1.24±0.57
Phosphate (mg/l)	0.40±0.01	0.97±0.01	0.78±0.02	0.71±0.29

condition and presence of biological resistant substances. The COD test determines the oxygen required for chemical oxidation of organic matter with the help of strong chemical oxidant. Chemical oxygen demand determination has an advantage over biological oxygen demand determination in that the result can be obtained in about 5 hours as compared to 5 days, required for BOD test, further the test is relatively easy, gives reproducible results and is not by interference of the BOD test.

The maximum value was recorded (19.23±1.36 mg/l) during monsoon; minimum value was recorded (12.23±0.82 mg/l) during summer. The overall mean was 16.19±3.59 mg/l (Table 1).

In the present investigation, the COD values were maximum during monsoon and minimum during summer. Maximum values of COD in monsoon may due to mixing of runoff water due to which carry mud, dead and decaying biomass on the other hand minimum COD in summer was probably due to settlement of organic matter. Similar, results were reported by Ingole *et al*. [14].

Sulphate: The most stable forms of sulphur in water at 25°C and 1 atomospheric pressure are free sulphur, SO^{-2}_4, $H_2SO_4^-$, HS-H_2S and S_2. Involvement of sulphate species in geological and biological processes and use of sulphate fertilizers contribute to water pollution. In urban areas, industrial emission of SO_2 gas and its contact with atmospheric moisture forming sulphuric acid, constitutes an important source of sulphate pollution in surface waters. Discharge of industrial wastes and effluents into waters also increases its concentration. Chemically, sulphate plays an important role in forming salts of Ca and Mg to give permanent hardness to water and biological pollution of sulphates in the form of sodium salt upsets normal functioning of the intestine [1].

The maximum value was recorded (20.80±1.37 mg/l) during summer; minimum value was recorded (15.12±1.14 mg/l) during winter. The overall mean was 18.20±2.87 mg/l (Table 1).

In the present investigation, the sulphate values were maximum during monsoon and minimum during winter. Maximum sulphate concentration during monsoon may be due to the dilution and utilization of sulphate by aquatic plants. However, the low sulphate concentration was noted during winter may be due to biodegradation and low water level.

Similarly, results have been reported by Telkhade *et al*. [15] and Shanthi *et al*. [16]. They also observed high value in monsoon.

Chlorides: Chlorides are generally present in natural waters. The salty taste produced by chloride depends upon the chemical composition of the water. A concentration of 250 mg/L may be detectable in some waters containing sodium ions. On the other hand typical salty taste may be absent in water containing 1000 mg/1. Chlorides when calcium and magnesium ions are predominant. Chlorides are an anion found in variable amounts in natural waters and waste waters. The chloride content normally increases as the mineral content increases. Sea and Ocean water represents the residue resulting from partial evaporation of natural waters at flow into them and chloride levels are very high. The origin of chlorides in surface and ground water may be from diverse source such as weathering and leaching of sedimentary rocks and soils, infiltration of seawater, wind blow sea salt in precipitation, domestic and infiltration waste discharges etc.

The maximum value was recorded (33.05±1.73 mg/l) during summer; minimum value was recorded (24.16±1.10 mg/l) during winter. The overall mean was 29.11±4.53 mg/l (Table 1).

In the present investigation, the Chloride values were maximum during summer and minimum during winter. Maximum value recorded during summer and minimum during winter. It can be concluded that there was no definite pattern of chloride fluctuation, lower value during winter could be attributed to dilution effect and renewal of water mass alter summer stagnation and also may be due

to high sedimentation rate on relatively stable environmental condition. Maximum value during summer could be due to higher concentration of chloride resulted from evaporation.

Similarly, results have been reported by Nirmal *et al*. [17] reported that the chloride maximum value recorded in May while minimum recorded in August.

Nitrate: Nitrates are contributed to surface waters to a large extent, by sewage and industrial effluents as also due to biological fixation and oxidation of organic matter. The run off waters coming from intensive agricultural activity (involving the use of fertilizers) also significantly contribute to the higher nitrate content in surface waters.

The maximum value was recorded (1.90±0.03 mg/l) during monsoon; minimum value was recorded (0.82±0.02 mg/l) during summer. The overall mean was 1.24±0.57 mg/l (Table 1).

In the present investigation, values of nitrate were maximum during monsoon and minimum during summer season. Nitrate levels in surface water often show marked seasonal fluctuations with higher concentrations being found during monsoon months compared to summer and winter months. During summer months the reduction in nitrates could be due to algal assimilation and other biochemical mechanism and nitrate value higher during monsoon may be due to surface run off and domestic sewage and specially washing activities.

Similarly, results have been reported by Gohram [18]) and Rajashekar *et al*. [19].

Phosphate: Presence of phosphates in water and waste water analysis has a great significance. Phosphates in small concentrations are used in water to remove iron and manganese in micro qualities and in coagulation especially in acid conditions. The presence of phosphate in large quantities in freshwater indicates pollution through sewage and industrial wastes. It promotes growth of nuisance causing microorganisms; though phosphate poses problems in surface waters its presence is necessary for biological degradation of waste water.

The maximum value was recorded (0.97±0.01 mg/l) during monsoon; minimum value was recorded (0.40±0.01 mg/l) during summer. The overall mean was 0.71±0.29 mg/l (Table 1).

In the present investigation, the chloride values were maximum during monsoon and minimum during summer. Maximum during monsoon might be due to the washing activities, there is an entry of detergents in the water body and less water quantity and during summer season the relatively low level of phosphate have been reported which may be attributed to abundance of Phytoplanktons. Same results have also been reported by Chary [20] and Rao [21].

CONCLUSIONS

The present study exhibited detailed physico-chemical characteristics and quality of water in Tisgaon dam, Aurangabad (M.S) India.

The summer, monsoon and winter seasons shows different seasonal fluctuations in various physico-chemical attributes. The water quality parameters are within the range recommended by WHO and ISI. The water of present dam is useful for irrigation as well as fish culture and before some treatment it is a source of drinking water in Aurangabad. The water parameters indicate that the reservoir is rich in nutrients. To improve quality of water there should be continuous monitoring of pollution level and maintain the favorable conditions essential for fish survival, growth and reproduction in Tisgaon dam Aurangabad (M.S) India.

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