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A CASE STUDY OF THE JAMWA RAMGARH WETLAND WITH SPECIAL REFERENCE TO PHYSICO-CHEMICAL PROPERTIES OF WATER AND ITS ENVIRONS

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The wetland of Jamwa Ramgarh Lake, located at Jaipur, Rajasthan, India, covers an area of 297 square miles. This paper advocates habitat conservation and ecological studies with special reference to the physico-chemical characteristics of water. The constituents monitored included temperature, pH, EC, TDS, DO, alkalinity, hardness and chloride ion. A significant variation in these parameters was observed throughout the study period. The pH of the Ramgarh lake water ranged from 6.8 to 8.5, which may be due to the high buffering capacity of the system. The electrical conductivity values ranged from 500 to 700 micromhos/cm, with a maximum in summer and a minimum in the monsoon season. Alkalinity was high during the summer season followed by a steep fall in the monsoon. Total alkalinity values fluctuated from 102.6 to 215 mg/l, indicating that the water is hard. If the present conditions continue for a long period, Ramgarh Lake may soon become ecologically inactive.

INTRODUCTION

Wetlands are very productive ecosystems, which help in the regulation of biological cycles, maintenance of water quality, nutrient movement and support for food chains. In addition, they provide refuge for endangered species of plants and animals and economic benefits such as fish breeding. Wetlands reduce the impact of floods by acting as storage areas. Stored water percolates downward, getting purified in the process, and replenishes the groundwater. But our wetlands are shrinking rapidly because of man's need for space. They are reclaimed for construction purposes to erect industrial colonies and to dump urban wastes, therefore the present concern. The quality of water is of vital concern for mankind since it is clearly linked with human welfare.

The main sources of water for the inhabitants of Jaipur city are groundwater and a few water reservoirs. Reservoirs are important to impound surface water runoff for the requirements of drinking, domestic, agricultural and industrial use. The Jamwa Ramgarh reservoir receives water from the Bhanganga River and attracts a large number of migratory and domestic birds. In Jaipur city 60 million gallons of water is supplied from Jamwa Ramgarh Lake. The water from this wetland, besides being a source of potable water for inhabitants of Jaipur, has economic value such as for fish breeding. Man's activities, including agricultural practices, that are carried out within the catchment area affect biodiversity. The physical and chemical characters of the reservoir water can be used to assess the ecological nature of the reservoir.

Several studies have been conducted to understand the physical and chemical properties of lakes, ponds and reservoirs such as the Halai Reservoir, Kolovoi Lake, Kalyani reservoirs, Salim Ali Lake, Dahikhura reservoir, and wetlands in urban Coimbatore in India (Jain et al., (1996); Sreenivasan et al., (1997); Srinivasa Gowd and Kotaiah (2000); Thorat and Masarrat Sultana (2000); Yogesh Shastri and Pendse (2001); Mohanraj et al., (2000)).

The main focus of the study of Rai and Munshi (1979); Rai and Sharma (1991); Munshi et al., (1993); Dehdrai (1994); Salodia, (1995); Kumar and Singh (1996) and Verma et al., (2001) were related to water bodies/wetlands, which support the culture of carps (food fishes) and are economically important. In such studies the characteristics of water bodies were taken into consideration with reference to physical, chemical and biological properties. Gupta et al., (2001) have used only chemical characteristics of water bodies of Udaipur in their observations. Srivastava et al., (2003) studied the physicochemical properties of various water bodies in and around Jaipur. His results revealed that the water of Jalmahal Lake is most polluted due to high pH, hardness, alkalinity, free carbon dioxide, zinc content, and a low level of dissolved oxygen. It is a well-established fact that domestic sewage and industrial effluent discharges result in changes of water quality and eutrophication. The other important sources of water pollution include mass bathing, disposal of dead bodies, rural waste matter, agricultural runoff and solid waste disposal. The present study was undertaken to analyze the physical and chemical nature of the important water reservoir for the inhabitants of Jaipur city .

MATERIALS AND METHODS

Area of study

The study area is located 3 km from the Jamwa Ramgarh village and 30 km from Jaipur city in a northeast direction. It is situated in eastern part of Rajasthan, and is bounded by Sikar on the northwest, Alwar in the northeast, Swai Madhopur and Dausa on the east, Nagaur on the west and Ajmer on southwest.

The Ramgarh Lake (lat. 27°32' and long. 75°32') is deep and apparently oligotrophic. It has a catchment area of 297 square miles and a gross storage capacity of 2650 million cubic feet

Water samples were collected for physico-chemical analysis from four sampling stations at the wetland. Samples were taken once every month from January 2003 to December 2003. Water samples were collected in one liter plastic bottles and collection was usually completed during morning hours between 8:00 A.M. to 10:00 A.M. For each sampling event, pH, temperature, and dissolved oxygen were monitored at the sampling sites while total dissolved solids, total alkalinity, total hardness, chloride and BOD were analyzed in the laboratory in accordance with APHA (1989); Trivedy & Goel (1986) and Maiti (2001).

RESULTS AND DISCUSSION

It is an established fact that maintenance of healthy aquatic ecosystem is dependent on the physico-chemical properties of water and biological diversity. Temperature is one of the most important ecological factors, which controls the physiological behavior and distribution of organisms. Minimum and maximum temperatures recorded in our study range from 18 to 31°C respectively (Figure 1). The temperature of lake water varied with seasons. Water temperature was found to be lower than atmospheric temperature. During the winter season water temperature was low due to frequent clouds, high humidity, high current velocity and high water level. Shakar et al., (1993) observed diurnal variation in some abiotic parameters of water at the Gupt-Ganga station of the torrential Neeru Nallah of Bhabarwah (Jammu) and Jain et al., (1996) also observed diurnal variations in temperature in the Halai Reservoir of Vidisha which influence the aquatic life and concentration of dissolved gases like CO₂, O₂ and chemical solutes. Higher temperatures were observed during summer due to clear atmosphere, greater solar radiation, and low water level. Swaranlatha and Narsing Rai (1998) made a similar observation in their study of Banjara Lake. Yogesh Shastri and Pendse (2001) also made similar observation of the Dahikhura Reservoirs.

One of the most important factors that serve as an index for pollution is pH. In our study, the pH of the Ramgarh Lake water ranged from 6.8 to 8.5 (Figure 1), this may be due to the high buffering capacity of the system. The pH of water was relatively high in the winter months and low in the monsoon and summers. Maximum values reached 8.5 in February and the lowest value of 6.8 occurred in the month of August. The higher values of pH recorded during winter months could be attributed to increased primary productivity wherein carbonates, sulfate, nitrates and phosphates are converted to hydroxyl ions. The lake water was always alkaline as pH constantly remained above 7. The earlier studies show that the range of pH of a majority of lakes and reservoirs lies between 6 and 9. This is in accordance with earlier reports by Wetzel (1975) who reported that the value of pH ranges from 8 to 9 units in Indian waters. The lower pH during monsoon is due to high turbidity, and in summers, the high temperature enhances microbial activity, causing excessive production of CO₂ and reduced pH. Khan & Khan (1985) and Narayani (1990) also reported similar results at Seikha Jheel in Aligarh and eutrophic wetlands (lower lake, Bhopal) respectively. Ghose and Sharma (1988) also recorded relatively high pH of water in winter months in their study of the Ganga River attributing high pH to increased primary-productivity.

The electrical conductivity values of water samples ranged between 500-700 micromhos/cm (Figure 1), with a maximum in summer and a minimum in the monsoon. Conductivity of water depends upon the concentration of ions and its nutrient status and the variation in dissolved solid content. Dilution of water during the rains causes a decrease in electrical conductance.

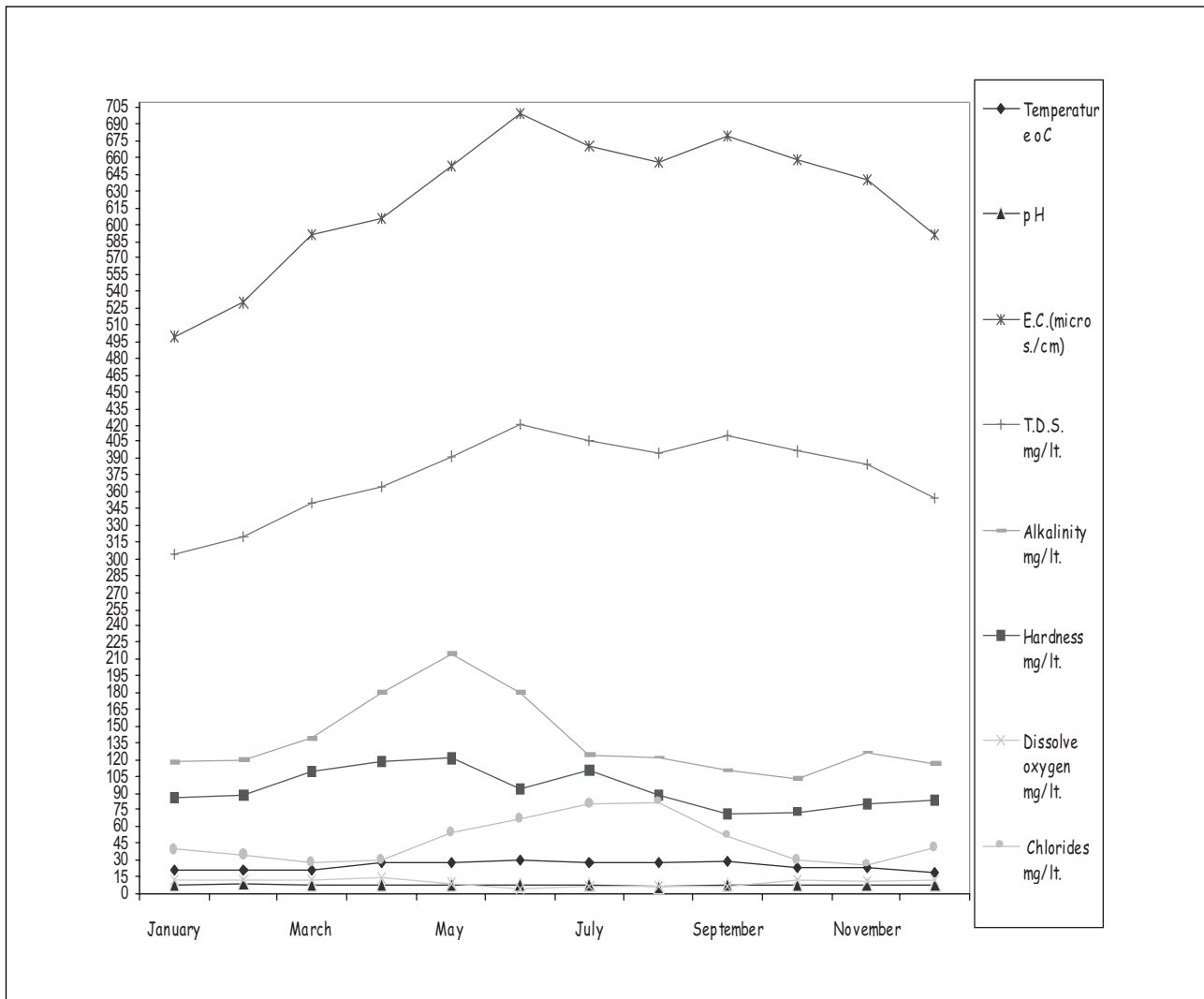


Figure 1. Graph of Physico-Chemical characteristics of water of Jamwa Ramgarh lake (Jaipur) Rajasthan, India. (year 2003)

The total dissolved solids values of water samples ranged between 305-421 mg/l (Figure 1). The concentration is high during the monsoon, which may be due to addition of solids from the runoff water. Marker (1977) has made the same observation. The amounts of total solids are influenced by the activity of plankton and organic materials.

Oxygen is an important parameter of the wetland /reservoir which is essential to the metabolism of all aquatic organisms that possess aerobic respiration. Concentration of dissolved oxygen indicates water quality and its relation to the distribution and abundance of various algal species. In the present study, the dissolved oxygen of water samples ranged from 4.88 to 13.4 mg/l (Figure 1). Presence of dissolved oxygen in water may be due to direct diffusion from air and photosynthetic activity of autotrophs. In the present study a strong correlation was also observed between pH and dissolved oxygen; with the lowering of pH, dissolved oxygen was also lowered. The addition of a variety of biodegradable pollutants from domestic and industrial sources stimulates the growth of microorganisms, which consume the dissolved oxygen. The values further deplete during summers because at high temperature, the oxygen holding capacity of water decreases. Present observations are in agreement with similar ones made by Verghese et al., (1992) at a domestically polluted tropical pond and Yogesh Shastri and Pendse (2001); Shanthi et al., (2002) who studied the Dahikhura

Reservoir and Singanallur Lake respectively. Pandey and Soni (1993) had observed high values of free carbon dioxide, alkalinity and pH along with low dissolved oxygen in highly polluted lake water at Naukuchiyatal Lake situated in Kumaon, Himalayas.

Alkalinity and pH are the factors responsible for determining the amenability of water to biological treatment (Manivasakam, 1980). Total alkalinity values in our observations fluctuated from 102.6 to 215 mg/l (Figure 1), indicating that the water is hard. Alkalinity was high during the summer season (215 mg/l) followed by steep fall in the monsoon periods (102.6 mg/l). The low alkalinity during the monsoon may be due to dilution. Bishop (1973) and Jain et al., (1996) also reported similar findings in their study on Malayan rivers and the Halali Reservoir.

The total hardness of this wetland water was observed to be high (120.8 mg/l) (Figure 1) during the summer season which may be due to evaporation of water and addition of calcium and magnesium salts. Bagde and Verma (1985) suggested a similar finding about J.N.U. Lake. Khan et al., (1986) studied the hardness in different reservoirs of Bhopal during the winter season and showed that the hardness varied from reservoir to reservoir due to their geological setting. Kannan (1991) has classified water on the basis of hardness values in the following manner: 0-60 mg/l, soft, 61-120 mg/l, moderately hard, 121-160 mg/l, hard and greater than as 180 mg/l very hard. Using these criteria, the water of the Jamwa Ramgarh wetland can be included in the moderately hard category. The observed higher values of alkalinity with respect to hardness indicates the presence of basic salts – sodium and potassium in addition to those of calcium and magnesium.

Chloride levels of the wetland water were found to be high (82.07mg/l) during the summer period. The higher concentration of Cl⁻ is considered to be an indicator of higher pollution due to higher organic waste of animal origin. Munawar (1970) observed a direct correlation between Cl⁻ concentration and pollution level in fresh water ponds of Hyderabad. Govindan and Sundaresan (1979); Jana (1973) observed that concentration of higher Cl⁻ in the summer period could be also due to sewage mixing and increased temperature and evaporation by water.

In Jamwa Ramgarh Lake, reeds and other aquatic vegetation are plentiful in the shallow region and they are an ideal feeding ground for birds. Human interference, which was restricted to bathing and washing of clothes in the lake previously, now includes recreation for visitors, especially tourists. Man's activities and agricultural practices in the drier areas of the wetland have resulted in constant disturbances all around the lake.

The age-old Indian philosophy appears to be undergoing changes. Population growth and fast methods of production have given rise to developmental programs. They generally undermine the importance of lakes, wetlands and areas that maintain vegetation and support a vast variety of life forms. Wetlands are shrinking fast because of man's greed for space and profit. They are reclaimed for construction purposes to erect industrial colonies and to dump urban wastes. However, this process is fortunately not prevalent in Rajasthan. But the damage done by geological exploration and development such as stone mining, creates silting etc. to the wetland, which is irreversible. The result of this study necessitates that some drastic regulations be made and warrants remedial measures to save this wetland.

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