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RESEARCH ARTICLE

IMPACT OF URBANIZATION ON THE HYSICOCHEMICAL CHARACTERISTICS AND ITS SEQUENTIAL CHANGES IN THE ETHANO-BOTANICAL COMPOSITION OF THE ODATHURAI LAKE OF ERODE DISTRICT, SOUTH INDIA

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ABSTRACT

Water is the elixir of life. Modern human society not interested with the environmental quality, especially with water bodies. Careless attitude towards inland water bodies lead to not only the extinction of precious water ecosystems but also the unimaginable loss of biodiversity. In this aspect most affected groups are aquatic organisms and floral species which highly depended on the inland ecosystem. Most studies have clearly explains the impact of water quality on the aquatic organisms. However, this study intended to high light the impact of water quality on highly useful ethano-botanical species. Odathurai lake of Erode district, South India is a selected study area. Odathurai lake latitude is 11°45' 28" N and Longitude is 77° 51' 75" E. By the analysis of water and sediment quality and recording of medicinal plant species, the present investigation addressed that the lake ecosystem is very much affected by urbanization and anthropological activities.

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INTRODUCTION

Without water no life is possible to sustain on this planet earth. Hence water is termed as "Natural Liquid Gold". It is also called "Universal Solvent" almost of the inorganic chemicals are dissolved in water (Venkatesharaju *et al.,* 2010). Today however expansion of agriculture, damming, diversion, over use and pollution threaten these irreplaceable sources in many parts of the globe (US GS, 2013). Aquatic organisms need a healthy environment to live and have adequate nutrients for their growth. The productivity depends on the physicochemical characteristics of the water body. The maximum productivity obtained when the physical and chemical parameters are at optimum level (Kamal *et al.,* 2007). The concentration of several inorganic and organic substances beyond the acceptable range causes an adverse impact on human health. Systematic evaluations of ground water quality is therefore necessary for meeting the increasing drinking water demand and essential for optimal utilization of available ground water on a sustained basis(Andre *et al.,* 2005). Other ingredients which enter the various water bodies are the plant nutrients, i.e.., nitrates and phosphates. They support growth of large, commonly called algal bloom. This process is called eutrophication (Purcell and Adam, 2012). Natural lakes provide a microcosm of living and non-living elements that are relatively independent of their surrounding environments. Therefore, lake organisms can often be studied in isolation from the lake's surroundings (Frobes and Stephen, 1887). Ahmed *et al.,* (2013) and Natarajan and Udhayakumar (2013) expressed that documentation of medicinal plant species can be a useful tool to study the relationship between the human beings and nature. By their ethano-botanical survey in south Indian district, Murugeswaran *et al.,* (2014) found that more than 1000 herbal species are under threat. In South India, many ethano-botanical studies have been conducted on the role of local communities and curative values of the plants among hill stations. However, According many survey, in South India many inland water bodies supports wide range of plant diversity. Hence, the present investigation intended to find the ethano-botanical diversity of the Odathurai Lake of Erode District and its relationship with physicochemical changes the lake.

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MATERIALS AND METHODS

Odathurai Lake situated in Odathurai village in Bhavanitaluk in Erode district of Tamilnadu state, India. It is located 31 km towards west from District head-quarters Erode. 22 km from Bhavani and 405 km from Sate capital Chennai (Photo 1).

Odathurai is surrounded by Thoockanaickenpalayam taluk towards west, Andiyur taluk towards North, Bhavani taluk towards east, Perundurai taluk towards south. The total geographical area of village is 1346.77 hectares. Odathurai has a total population of 9,196 peoples. These are about 2,875 house in Odathurai village. Odathurai lake latitude is $11^{o}45'$ 28" N and Longitude is 77^{o} 51' 75" E. Odathurai current weather current temperature is 29^{o} c and Humidity is 66% wind: from swat 15 kph. Odathurai is one of the biggest revenue village in erode district. The Odathurai lake receives water from seepage of nearby LBP canals and from rain water and once it is filled the area of Odathurai lands will get good support of water recharged for agriculture. The farmers are very intensive agriculturists.

A. Water analysis

During the study water samples were collected at the surface and depth of about eight foot from four sampling points of the lake. Water samples were collected in properly cleaned, nonreactive plastic containers. After the collection containers were properly labeled by permanent marker with information including name of the site, time, date, month and year of the sample. For the analysis of bacteriological populations (total and fecal) water samples were collected separately without air bubbles in well sterilized bottles. Physical parameters like colour, appearance and odour of the water samples were recorded by the help of physical test methods. Chemical parameters like pH, Electrical Conductivity, Turbidity, Total Dissolved Solids, Total Suspended Solids, Total Alkalinity, Phenolphthalein Alkalinity, Carbon dioxide, Nitrates, Nitrites, Phosphates, Potassium, Sulphates, Calcium, Magnesium, Sodium and Chloride were analyzed. All the parameters were analyzed as per the procedure of American Public Health Association (APHA, 1998 and 2005).

B. Sediment analysis

Sediment samples of the lake were collected from surface and bottom. The bottom sediment samples were collected by the help of a sampler at four corners, where the water samples were collected. Collected sediment samples were packed in polyethylene paper and labeled properly and transported to the laboratory for further analysis. The parameters including pH, electrical conductivity, total organic carbon, phosphates, potassium, total nitrogen, chlorides, sulphates, calcium, magnesium and sodium were analyzed

C. Recording of diversity of medicinal plant

In the present study medicinal plants of the shore area of the lakes were collected by the assistance of the local peoples and other standard reference papers. All collected plant portions were properly preserved by pressing and drying method. Properly preserved plants were identified by the assistance of Botanical Survey of India, Coimbatore.

D. Other observations

Other than water quality, sediment quality and bio-monitoring some of the other physical and biological observations were recorded to know the interactions and variations among the components of the lake ecosystem.

RESULTS

A. Physicochemical analysis of water samples

pH: pH is the scale of intensity of acidity and alkalinity of water and measures the concentration of hydrogen ions. The pH of water samples ranged between is 8.5 and Deep water is 8.56. The pH of water samples is slightly found in both water samples (Fig. 7). Turbidity: The turbidity in water is mainly caused by sand, silt, clay, phytoplankton, microorganism or organic material suspended or dissolver in it. The turbidity values varied between 5 NTU and deep water 3 NTU (Fig. 7). Electrical Conductivity: Conductivity is the measure of capacity of a substance or solution to conduct substance or solution to conduct electrical current through the water. EC values were in the range of Odathurai Lake surface water 742 mic S/ cm deep water 741 mic S/cm (Fig. 8). Total Dissolved solids: TDS indicates the general nature of salinity of water. Water with high TDS produces scales on cooking vessels and boilers. The TDS values varied from Odathurai Lake surface water 519 mg/l and deep water 519 mg/l (Fig. 8). Total Alkalinity: Total Alkalinity is the measure of capacity of water to neutralize the acids. Alkalinity Level varied from Odathurai Lake surface water 192 mg/l and deep water 184 mg/l (Fig. 8). Total Alkalinity value for all the investigated samples were found to be limit in both water samples. Total Hardness: Water become hard primarily due to excessive presence of bicarbonate, chloride and dissolved Sulphate in water primarily. Total Hardness values ranged from the Surface water 192 mg/l and deep water 168 mg/l (Fig. 8). Chlorides: Chloride concentration in water indicates presence of organic water particularly of animal origin. Chloride concentration varied from surface water 76mg/l. deep water 74 mg/l. All the samples were found within the Permissible Limit in both water samples. Calcium and Magnesium: The sources of Ca and Mg in natural water are various types of rocks, Industrial waste and sewage. The calcium ranged from surface water 54 mg/l, deep water 48 mg/l (Fig. 9) and Magnesium concentration was ranged between surface 13 mg/l and deep 12 mg/l (Fig. 9). Sodium and Potassium: In the present investigation, the sodium and potassium concentration in Odathurai lake water were well below permissible limit (Fig. 9). Nitrate: Nitrate is Produced due to the presence of dissolved ions of sodium and potassium Salts. It varied in the lake water from surface water 1 mg/l, Deep water 1 mg/l.

Phosphate: Phosphate content enters into the ground water from biological decomposition or as run-off from human activity in agricultural areas. In water the phosphate concentration accumulates because of soluble in organic salts. The study has shown that the phosphate concentration is in Lake surface water 0.29 and deep water 0.32 mg/l (Fig. 11).

Fluoride and Sulphate: Fluoride occurs as Fluorspar (Fluorite), rock phosphate, triphite and phosphorite crystals in nature. Among factors which control the concentration of fluoride in lake water are the climate of the area and the presence of accessory minerals in the rock. BIS prescribed desirable limit for fluoride is 1 and 1.5 mg/l as permissible limit. Human being needs less than 1mg/l Fluoride ion to maintain teeth and bone Formation in good Quality condition. The study indicates in Lake surface water 0.4 mg/ldeep water 0.4 mg/l. The study indicates in this both water samples the

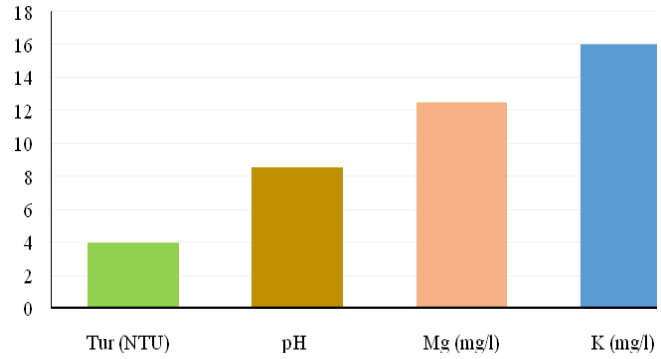

Fig. 1. Level of turbidity, pH, Magnesium and Potassium

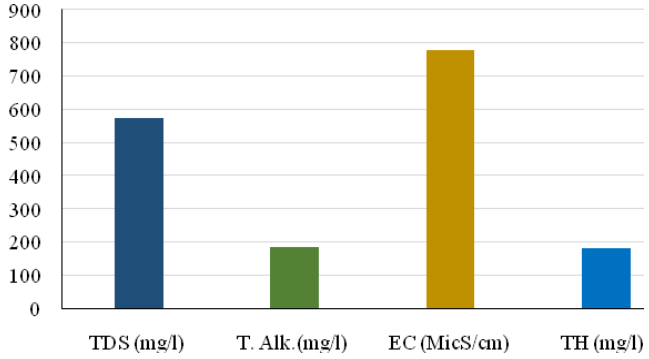

Fig. 2. Level of TDS, total alkalinity, EC and total Hardness

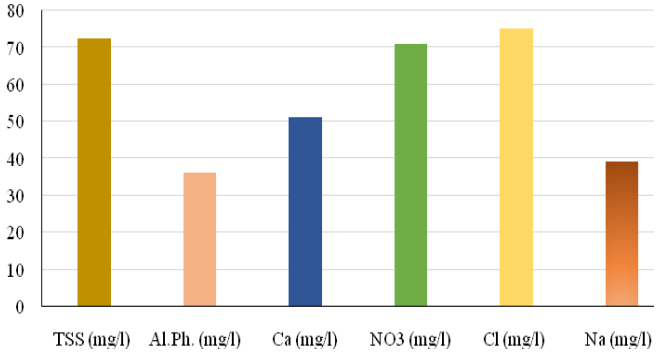

Fig. 3. Level of TSS, Phenol. Alk., Calcium, Nitrates, Chlorides and Sodium

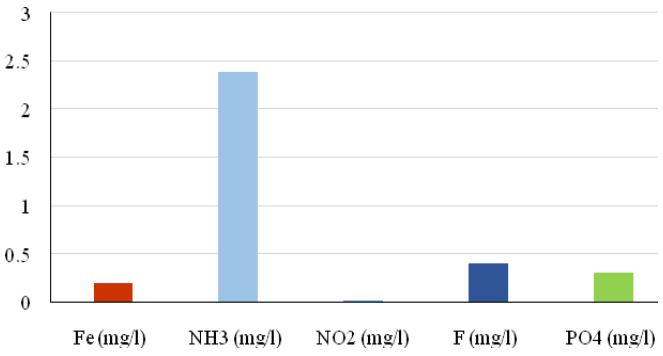

Fig. 4. Level of iron, ammonia, Nitrites, Fluride and Phosphates

Table 1. Recorded Medicinal Plants of Odathurai Lake

S.N	Species Name	Common Name	Vernacular Name	Family	Order	Class	Phylum
1	*Acalypha indica*	Indian nettle	Kuppaimeni	Euphorbiaceae	Malpighiales	Eudicots	Angiosperms
2	*Achyranthus aspera*	Devil's horse whip	Nauruvi	Amaranthaceae	Caryophyllales	Eudicots	Angiosperms
3	*Alternanthera sessilis*	Sessile joy weed	Ponnakanni	Amaranthaceae	Caryophyllales	Magnoliopsida	Magnoliphyta
4	*Amaranthus viridis*	Green amaranth	Kuppakerai	Amaranthaceae	Caryophyllales	Eudicots	Angiosperms
5	*Andrographis paniculata*	King of bitters	Nilavembu	Acanthaceae	Lamiales	Eudicots	Angiosperms
6	*Annona squamosa*	Custard apple	Sithapalzam	Annonaceae	Magnoliales	Magnolids	Angiosperms
7	*Argemone Mexicana*	Maxican poppy	Birammathandu	Papaveraceae	Ranuncuales	Eudicots	Angiosperms
8	*Calotropis gigantean*	Crown flower	Erugam	Asclepiadaceae	Apocynoles	Eudicots	Angiosperms
9	*Cynodon dactylon*	Dog's tooth grass	Arugampul	Poaceae	Poales	Monocots	Angiosperms
10	*Datura metal*	Devill's trumpet	Oomatham	Solanaceae	Solanales	Eudicots	Angiosperms
11	*Elipta prostrata*	False daisy	Karisilangani	Asteraceae	Asterales	Eudicots	Angiosperms
12	*Phyllanthus niruri*	Seed under leaf	Keezhanelli	Euphorbiaceae	Malpighiales	Eudicots	Angiosperms
13	*Phyllanthus reticulates*	Black honey shrub	Pollapoo	Phyllantahceae	Eubhorbiales	Eudicots	Angiosperms
14	*Possiflora foetida*	Wild water lemon	Poonaipalzham	Passifloraceae	Malpighiales	Eudicots	Angiosperms
15	*Tinospora cardifolia*	Guduchi	Onnagkodi	Menispermaceae	Ranunculales	Magnoliopsida	Magnoliophyta
16	*Tridax procumbans*	Coat buttons	Thathapoo	Asteraceae	Asterales	Eudicots	Angiosperms

Fluoride level is very Low (Fig. 11). Natural water contains sulphate ions and most of these ions are also soluble in water. Lake surface water 80 and deep water 85 mg/l (Fig. 11).

Iron and Ammonia: Iron content is present in the lake water as soluble in organic salts. The lake surface water 0.23 and deep water 0.18 mg/l. In this sample the iron concentration is middle the permissible limit (Fig. 10).

B. Physicochemical analysis of Sediment samples

Odathurailake sediment contains pH of surface sediment and bottom sediment were 7.7 and 8.02 respectively. Electrical conductivity of the lake sediment were 0.06 dsm^{1} and 0.07 dsm^{-1}. Organic nitrogen were respectively 2.36 % and 6.9 %. Total nitrogen were 621kg/ha and 565kg/ha. 96 kg/ha and 29.8 kg/ha of phosphates were estimated among the lake sediment. Estimated potassium of the surface sediment and bottom sediment were 181 mg/kg and 77.3 mg/kg. Sulphur content of the sediment were 13.8 mg/kg and 7.2 mg/kg. Estimated zinc was 1.2 and 1 mg/kg, boron was 0.6 mg/kg and 0.5 and iron was 7.3 mg/kg and 6.2mg/kg in surface and bottom sediment of the Odathruai lake (Table10 and Fig. 19 - 24).

C. Bacteriological analysis of water samples

In the present bacteriological analysis 438 MPN/ 100 ml of fecal coliforms and 840 MPN/100 ml of total coliforms were counted in Odathurai Lake water samples.

D. Recoding of medicinal plants of Sanjeevirayan Lake and Odathurai Lake

Present ethano-botanical study recorded only 16 species were recorded in Odathurai Lake. The taxonomy of the medicinal plants were tabulated with their common name, vernacular name (local name), family, order, class and phylum (Table 1).

DISCUSSION

A. Features of the lake water

Analysis of water samples from Odathurai lake shows wide range of information regarding sources of water contamination and other features. pH of the lake water during most part of the year remained in basic range and reached a maximum during April and this may be due to high algal growth. The observation regarding summer maximum pH was supported by Kelly and Linda (1996). Because of increased algal concentration and high bio-turbation activities it was measured more turbidity during summer. This particular aspect of the lake water turbidity was supported by the study of Parashar *et al.* (2006). Concentration effect and increased algal population were the major factors responsible for the increase of the lake water TDS during summer (Arain *et al.,* 2008). In the present study, suspended solids of the lake water were maximum due to the algal scum developed on water surface made transparency of the water poor. Thus, little or no sunlight could penetrate into water and the photosynthesis of plants under the water was either weakened or even stopped altogether (Yang *et al.,* 2008). Variations in total hardness of the lake water could be due to reduced water volume, increased evaporation rate (Hujare, 2008). Due to reduced water volume, high algal population and high decomposition rate, the phenolphthalein alkalinity of the lake water was high during summer. Reduced water volume and increased concentration of salts resulted in the high alkalinity levels during summer months. In addition, high algal population of the lake water was also considered as another factor responsible for the high alkalinity during summer months (Kelly and Linda, 1996). The nutrients play a decisive role for the environmental state of the lake because of the fact that the primary production of a lake is strongly limited by the availability of macronutrients. Increase in nutrients input leads to enhanced lake productivity with cascading effects on the remaining trophic levels. Nitrites are much less toxic to other biota than fish, because it affects different fish species at different concentrations (Russo, 1985). The phosphates of the lake water could be contributed by the mode of drainage, microbial decomposition of the bottom sediment, reduced water volume and excrete of bird droppings have reported that the high temperature may also responsible for release of phosphates from the lake sediment (Rajasekar, 2003). Potassium was highly fluctuated due to reduction in water volume. It was measured maximum during August 2013 and September 2013 due to inflow of water. The fact was well supported by Purohit and Saxena (1992). Reduction of water volume and decomposition of dead organisms cause variations in the levels of sodium, calcium and magnesium (Badge and Verma, 1985). Reduction in water volume and sudden raise in the inflow led to the variations in the levels of chlorides and sulphates (Adoni, 1975). Variations in the concentration of bicarbonates and carbonate of the lake water were caused by high algal population, decomposition of organic matter and reduction of water volume. High water temperature and availability of nutrients resulted in the high populations of coliform bacteria. Fluctuation of water quality index was resulted by the own kind of contributions of every parameter.

B. Characteristics of the lake sediment

The composition of the sediment texture has less variation and predominately comprised with lay and silt. Inflow during late monsoon was resulted in maximum pH and EC. The levels of total organic matter, total organic carbon, nitrites, nitrates, total nitrogen, total phosphates, total potassium, chlorides and magnesium were measured more due to addition of addition of sewage water, dead and decomposition of algae and aquatic organisms (Boggess *et al.,* 1995)

C. Role of the sediment on water quality of the lakes

Electrical conductivity of the lake water was highly contributed by the ionic release by microbial activities in the lake bottom (Foster and Charles worth, 1994).The sediment of the lakes may be in direct contact with the photic zone during the summer season that together with a higher sediment surface per volume of water as water depth decreases which increased the importance of sediment-water interactions (Nixdorf and Deneke, 1995). Numerous studies support the release of P, if the overlying water is aerobic (Jeppesen *et al* 1997) and that P released from the sediments of shallow lakes constitute a substantial part of the total loading and sometimes even exceeds the external loading of P (Sondergaard *et al*., 2001). Micronutrients such as chlorides, sulphates, calcium, magnesium and sodium of lake sediment were shared their contributions with the lake water due to reduced water volume during summer (Brenner *et al.,* 2001). Thus the lake sediment plays very irritable role on water quality of the lakes. High fluctuations in the water level affected the physico-chemical and biological characteristics of the lake water. In particular, release of nutrients from sediment to water column, reduced rate of photosynthesis, changes in the composition of planktons and other aquatic biota and high level of human interventions to the core area. Bacteriological test results and other general observations clearly witnessed that the Odathruai lake is very much affected by wide range of anthropological features like input of sewage, effluents, defecation, fishing, washing, etc. Thus, Odathurai lake is supporting only less number of plants including 16 medicinal plants.

Conclusion

Present ethano-botanical investigation exhibits diversity of medicinal plants of Odathruai lake of Erode district were highly affected by factors like urbanization, anthropological activities, water level reduction, industrialization, cattle rearing and less awareness of local population. Observations of the present study were collectively elucidating that ethano-botanical resources of our lakes are carelessly eliminated from their own home. Especially, improper maintenance of lake was considered as a prime factor. Therefore, our future generations may totally devoid from these natural drug potentials. It is time to take aware our local communities and also young generations on potential uses of medicinal plants and importance of inland lakes on diversity of medicinal plants.

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