Asian Journal of Environment & Ecology

8(2): 1-8, 2018; Article no.AJEE.45720
ISSN: 2456-690X

Physicochemical Assessment of Some Pond Water in Patna (India)

Manish Kumar Kanth[1*], Sushil Kumar Singh[1], Abhijeet Kashyap[1], Smita Shalini[1†], Aprajita[1†], Rupam Kumari[1†], Shivangni Singh[1†], Ankita Kumari[1†] and Kumari Puja[1†]

[1]Department of Biotechnology, A. N. College, Patna, Bihar 800013, India.

Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJEE/2018/45720
Editor(s):
(1) Dr. Onofre S. Corpuz, CFCST-Doroluman Arakan 9417 Cotabato, Philippines.
Reviewers:
(1) Farhaoui Mohamed, National Office of Electricity and Drinking Water, Morocco.
(2) Narcis Barsan, "Vasile Alecsandri" University of Bacau, Romania.
(3) Neşe Yilmaz, Istanbul University Faculty of Aquatic Sciences, Turkey.
(4) Arun Kumar Shrestha, Damak Multiple Campus, Nepal.
Complete Peer review History: http://www.sdiarticle3.com/review-history/45720

Original Research Article

Received 19 September 2018
Accepted 05 January 2019
Published 12 January 2019

ABSTRACT

Physicochemical analysis of six ponds situated in different locations in the urban area of Patna, Bihar, India was investigated to evaluate the water quality of the pond. Samples were analyzed on various physicochemical parameters like Electrical Conductivity, Total Dissolved Solids, Alkalinity, Chloride, Total Hardness, orthophosphate, Dissolved oxygen and pH by using the standard methods and procedure. The observed value (average) of parameters recorded as Electrical Conductivity was 864.83 µS/cm, Total Dissolved Solids 565.83 mg/L, Alkalinity 303.33 mg/L, Chloride 70.00 mg/L, Total Hardness 260.66 mg/L, Orthophosphate 1.84 mg/L, Dissolved Oxygen 4.91 mg/L and pH 8.02. All pond's water pH come under BIS standard. Except P6 all ponds had DO below the standards of BIS. Except P6, Orthophosphate of all samples were within standard value of the WHO. Increased level of TDS shown by (P1, P3, P4 and P6) from the standard value of BIS. Out of six samples, four had chloride value below the BIS standard. Total Hardness for P4 and P6 had value above the permissible limit of BIS standard. These six ponds are not suitable for domestic and drinking purpose, pre treatment of water is necessary. Result focused on regular monitoring of the water quality to detect contaminants.

**Corresponding author: E-mail: kanth.patna@gmail.com;*
† Contributed equally

Keywords: Physicochemical; Patna; pond water; dissolved oxygen; water quality.

ABBREVIATIONS

EC : Electrical Conductivity
TDS : Total Dissolved Solids
Cl⁻ : Chloride
TH : Total Hardness
PO_4^{3-} : Phosphate (orthophosphate)
DO : Dissolved Oxygen
µS/cm : Mhos siemens per centimeter
mg/L : Milligram per liters
BIS : Bureau of Indian Standards
WHO : World Health Organization
APHA : American Public Health Association

1. INTRODUCTION

Water has a great contribution in developing a prosperous society. It most necessary and abundant substance on earth [1]. Life on earth depends upon water. Water covers about 70% of the earth's surface [2]. Ponds contain surface water [3]. India has a large network of river system spread all over the country [4]. Water plays central role in developing prosperous life [5]. Today the most obnoxious crisis which we are facing is the environmental pollution. Air, water and soil are three major amenities for living system. These were pure, uncontaminated and healthy in past, but today just the reverse situation because of globalization leads to environmental pollution and threat to mankind. Anthropogenic activities towards the nature are the main cause of environmental pollution (Black M, 2005). Decrease in the quality of land water (river, lake and ground water) leads to water pollution [6]. Water available on earth is mostly saline in nature. Less than 3% water only exist as fresh water which are available to man for drinking and other purpose [7]. In India ponds have been used as a traditional source of water. Ponds are categorized into artificial or natural water body. The present study involves the analysis of physicochemical parameters of pond water from Patna, Bihar, India.

2. MATERIALS AND METHODS

2.1 Study Site

Patna is the capital of the state of Bihar. Total geographical area of Patna is 3,202 sq Km. It is divided into six subdivisions. Patna district is very well connected to other parts of country through road, rail, and air. Patna is situated between 24° 97'- 25° 27' North latitude and 84° 44'- 86° 57' East longitude at an elevation of about 129 meters above mean sea level. It is about 20 km long (from east to west) and 4 km width (from north to south) [8]. Hot summer and pleasant winter season characterize the climate of Patna. Map of study area is shown in Fig. 1. The cold season starts from November to February, summer starts from March to June and the Monsoon from July to September. The other months are transients months. The Annual temperature varies from 45°C to 5°C. The normal annual rainfall in the district is around 1076 mm. The timely and well distributed rainfall during kharif and rabi has decieding influence on the land use and cropping pattern of the District. Current population density (2011) is 182 person/ha.

The pond water is used for different purposes such as irrigation, bathing, washing, and drinking by animals. In the near future, citizizens of Patna may face a severe water crisis because of the depletion of its natural water resources. Earlier Patna has many small ponds with full of aquatic flora and fauna. Gradually most of them have either been reduced to dumping domestic waste or overtaken by human settlement. The aim of this study is to assess the change in the physicochemical properties of six different selected ponds at the Patna urban area, Bihar.

2.2 Sampling and Analyses

Water samples were collected from six different ponds in the Patna urban area. Samples were collected at morning time in sterile containers with a capacity of 1000 ml. This work was done between December, 2017 to February, 2018 [9]. Selected ponds were Mithapur talab (P1), Manikchand talab (P2), Kachhi talab (P3), Adalatganj talab (P4), Mangal talab (P5) and Ranipur talab (P6) samples were collected in sterile plastic bottles with airtight cap between 7.00-8.00 am. Analyses of samples were performed in accordance with standard methods of APHA [10] and WHO [11]. The pH value of the samples was measured with the help of Systronics micro pH system 361. Electrical conductivity and Total Dissolve Solids were measured by Systronics water analyzer 371 and Phosphate was measured by Systronics double

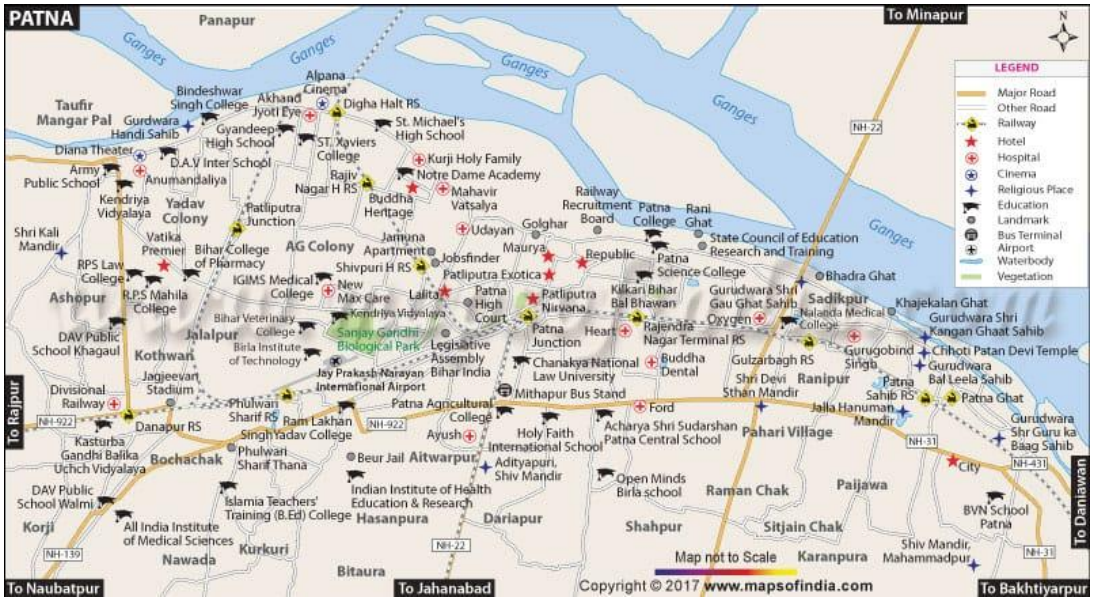

Fig. 1. Map of study area

beam spectrophotometer 2201. Total Hardness was calculated by EDTA titration method, for that 50 ml of the water sample was pipette out in a conical flask. One ml of ammonia ammonium chloride buffer solution and 2-3 drops of Eriochrome black T indicator were added in the water sample. The color of the solution turns on wine red. This solution was titrated against previously standardized EDTA solution taken in the burette until the color changes from wine red to sky blue, which indicates the end point. The final reading of the burette was noted and the titration was repeated to get total concordant value. Finally, using the analytical calculation, total hardness of water samples was determined in terms of mg/L of $CaCO_3$ [12]. DO was measured by the wrinkle's azide method, samples were collected in the B.O.D. bottle (Borosil 300 ml) and they were fixed at the site and brought immediately to the laboratory and were analyzed [12]. Total alkalinity and Chloride were determined by the titration method. For alkalinity, 100 ml of sample were taken. In a first step 2-3 drops of phenolphthalein indicator were added in the sample, then titrated against 0.02N H_2SO_4 to colourless. In the second step, again 2-3 drops of methyl orange were added to the same sample and titrate it till the yellow colour turns to orange. For chloride estimation, 1 mL of K_2CrO_4 indicator solution was added to 100 mL sample and titrated with $AgNo_3$ solution till pinkish yellow colour at end point.

3. RESULTS AND DISCUSSION

Physicochemical analyses of all six samples were done and results obtained are enlisted in Figs. 2-9, permissible limit and average value of parameters is inlisted in Table 1.

3.1 Electrical Conductivity

Electrical conductivity of water is a measure of its capacity to conduct electrical current. Conductivity of water varies directly with the temperature and is proportional to its dissolved inorganic solids. Conductivity can be expressed as mili Siemens per meter (ms/m) or µ Siemens/cm at temperature 25°C. The permissible limit of the conductivity of the drinking water is 1000 µs/cm [13]. Electrical conductivity values vary from ranges 598 to 1217 µS/cm. Mangal talab (P5) shows minimum value 598 µS/cm while Ranipur talab (P6) shows a maximum value of 1217 µS/cm of electrical conductivity. The P6 shows increased EC which is loaded with waste water and domestic sewage from near houses showed a maximum level of conductance in pond water.

3.2 Total Dissolved Solids

Dissolved solids are the portion of solids that passes through a filter of 2.0 µm (or smaller) nominal pore size under specified conditions. A well mixed sample is filtered through a standard

glass fiber filter and the filtrate is evaporated to dryness in a pre-weighed dish and dried to constant weight at 180°C. The increase in dish weight represents the total dissolved solids. The permissible limit of the Total Dissolved Solids of the drinking water is 500 mg/L [14]. Total Dissolved Solids value ranges between 390 to 793 mg/L for six water samples. Mangal talab (P5) has lowest TDS value of 390 mg/L, while Ranipur talab (P6) shows the maximum TDS value of 793 mg/L. Exceed TDS values shown by P1, P3, P4 and P6. High TDS caused by the presence of K, Cl and Na ions.Toxic ions like arsenic, cadmium etc. may also be dissolved in water, which are hazardous.

3.3 Alkalinity

Alkalinity of water is total acid neutralizing capacity of all its tritrable bases. Alkalinity of water is due to the presence of carbonate, bicarbonate and hydroxide ions. The permissible limit of the Alkalinity of the drinking water is 600 mg/L [13]. Alkalinity value ranges between 204 to 408 mg/L for the water samples. Mangal talab (P5) shows 204 mg/L which is the minimum value while Ranipur talab (P6) shows maximum value 408 mg/L. Water bodies has a bitter taste due to the alkalinity. High alkalinity is good for the body's internal environment, where as low alkalinity aid the growth of disease within the body.

3.4 Chloride

Chlorine in the form of the chloride anion (Cl^-) is generally present in natural waters. The presence of chloride in natural waters can be attributed to dissolution of salt deposit and discharge of effluent from chemical industries. The chloride concentration is higher in waste water than in raw water. The permissible limit of the drinking water for the chloride present in water is 600 mg/L [13]. A value of Chloride ranges between 40 to 100 mg/L. Mangal talab (P5) shows minimum values of Chloride i.e. 40 mg/L, while Ranipur talab (P6) shows maximum values of 100 mg/L. This may be due to contaminated with local drains and dumpings of various waste products.

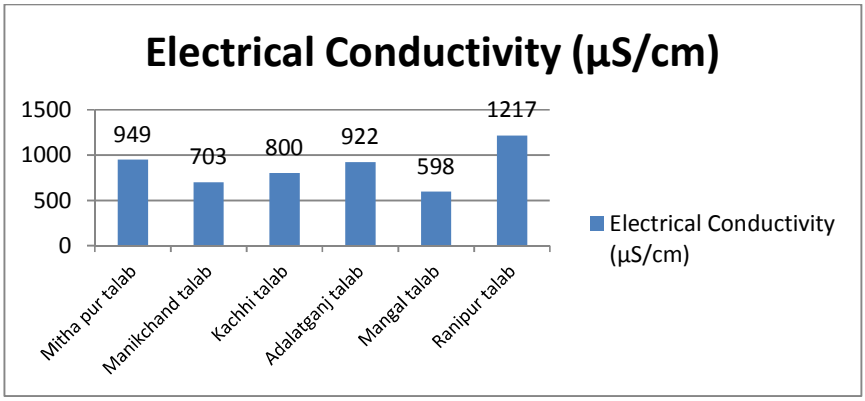

Fig. 2. Measured electrical conductivity values of pond water

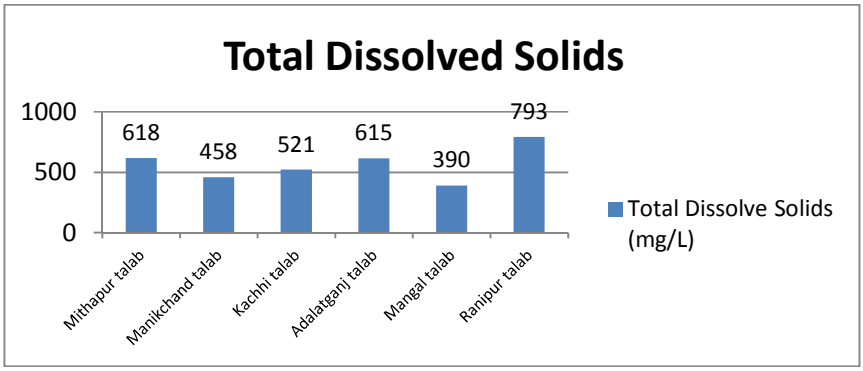

Fig. 3. Measured total dissolved solid values of pond water

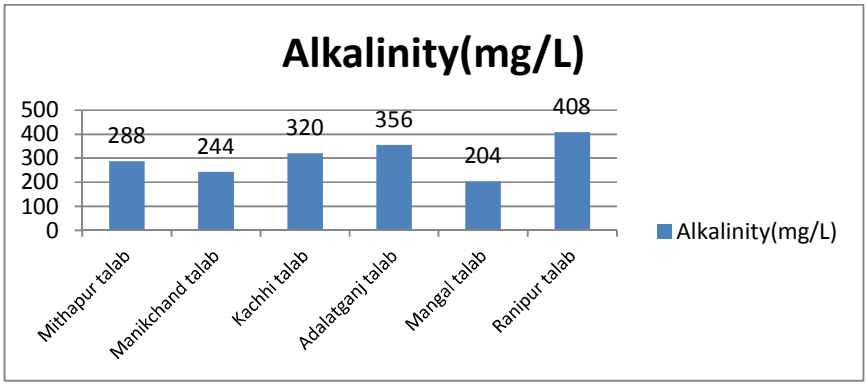

Fig. 4. Measured alkalinity value of pond water

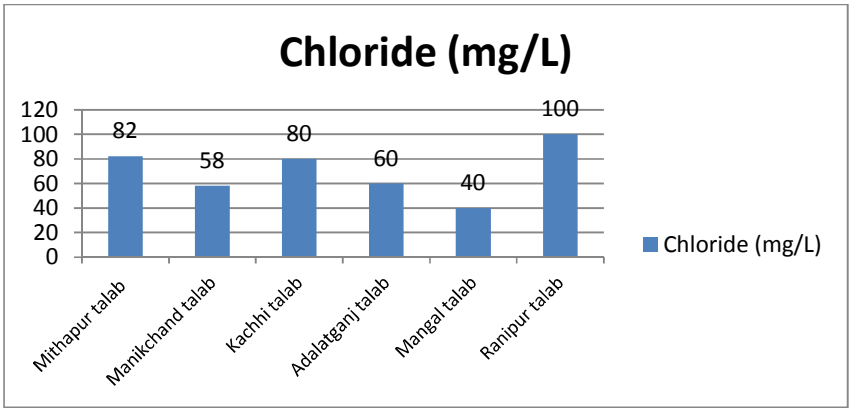

Fig. 5. Measured chloride values of pond water

3.5 Total Hardness

Water hardness is the traditional way to measure the capacity of water to react with soap; hard water requires considerable amount of soap to produce lather. The principal hardness causing ions are calcium (Ca) and magnesium (Mg). The iron, strontium, barium and manganese also contribute to hardness in the water. The permissible limit of Total Hardness of the drinking water is 300 mg/L [15]. Total Hardness for samples were ranging between 148 to 384 mg/L. Mangal talab (P5) shows minimum values of hardness i.e. 148 mg/L while Ranipur talab (P6) shows maximum values of 384 mg/L. Exceed value of hardness are probably due to regular addition of large quantities of sewage and soaps into the pond from the neighbouring areas. Hard water is generally not harmful to human health.

3.6 Phosphate (Orthophosphate)

Phosphorous occurs in natural waters and in waste-water as orthophosphate, meta or poly phosphate and organic compound phosphate. Presence of phosphate in water and waste water analysis has a great significance. The orthophosphate in acidic medium reacts with ammonium molybdate and potassium antimonyl tartrate to form phosphomolybdic acid, which is reduced by ascorbic acid to intensely coloured molybdenum blue which is measured at 880 nm. The permissible limit of drinking water for the phosphate as an orthophosphate is 5 mg/L [16]. Phosphate becomes determined when they over fertilize aquatic plants and cause stepped up eutrophication, which is a natural ageing process of pond. The value of Phosphate as a (orthophosphate) ranges between 0.442 to 5.904 mg/L. Adalatganj talab (P4) shows minimum values of 0.442 mg/L, while Ranipur talab (P6) shows maximum values of 5.904 mg/L. This may be due to discharge of domestic sewage, street runoff and washing of clothes.

3.7 Dissolved Oxygen

Dissolved oxygen levels in natural and waste water depend on the physical, chemical, and

biochemical activities in the water. DO is the main coin of the life for all organisms lived in water and land. The permissible limit of the Dissolved Oxygen in the drinking water is 5 mg/L [15]. Dissolved Oxygen varies from 3.8 to 6.3 mg/L. Mithapur talab (P1) water sample have lowest DO values 3.8 mg/L, while Ranipur talab (P6) water sample have highest DO level 6.3 mg/L. Results show fluctuating DO, depending upon the temperature and depth of the pond. Decrease level of DO may be due to absence of little turbulence in the water sample.

3.8 pH

It is the negative logarithm of the H^+ ion activity in a solution. The pH value is determined by measurement of the electromotive force of a cell consisting of an indicator electrode (an electrode responsive to hydrogen ions such as a glass electrode) immersed in the test solution and a reference electrode (usually mercury/calomel electrode), Contact between the test solution and the reference electrode is usually achieved by means of a liquid junction, which forms part of the reference electrode. The electromotive force is measured with a pH meter, that is, a high impedance voltmeter calibrated in terms of pH. The permissible limit of pH in the drinking water is 6.5- 8.5 [14]. The pH value for all six samples is ranging between 7.69 to 8.30. Mangal talab (P5) has minimum value 7.69 and Mithapur talab (P1) which has the maximum value of 8.30. The obtained results indicate that the water of all six ponds was slightly alkaline, which can be due to accumulated domestic waste. The use of such pond water is unsuitable for drinking purposes.

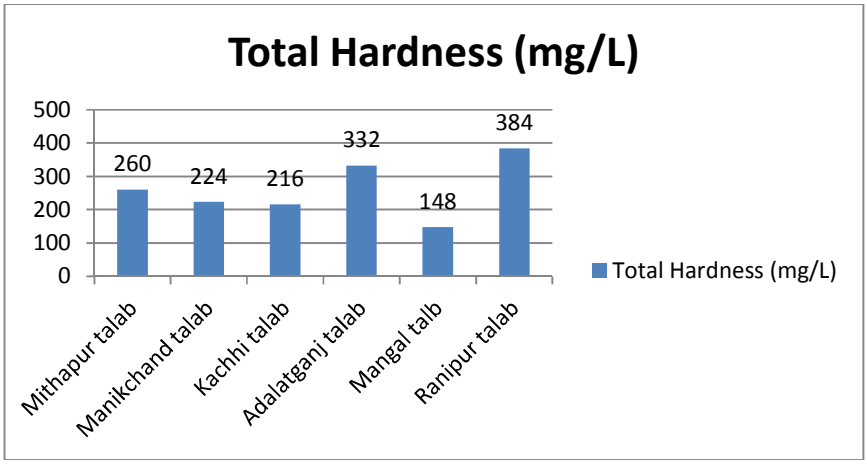

Fig. 6. Measured total hardness values of pond water

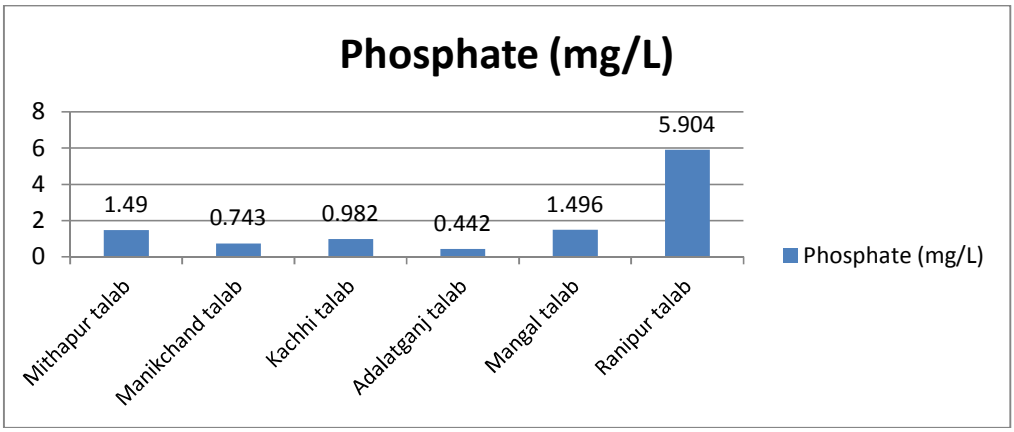

Fig. 7. Measured phosphate (orthophosphate) values of pond water

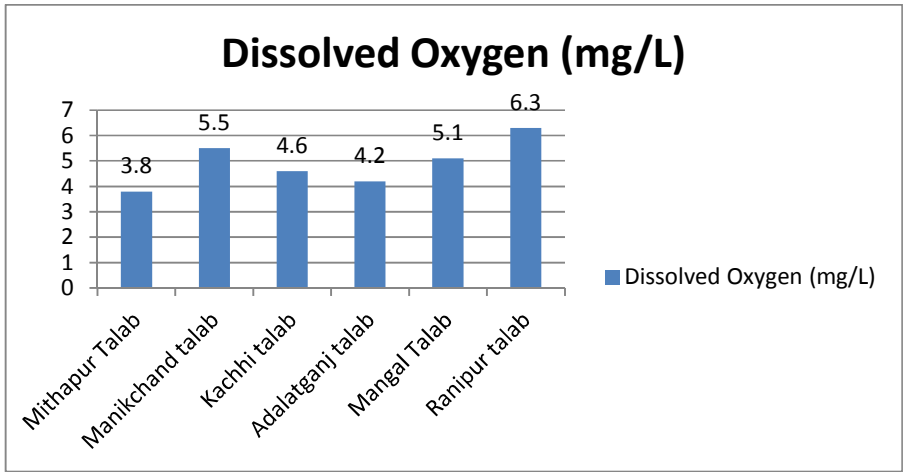

Fig. 8. The value of dissolved oxygen of six pond water

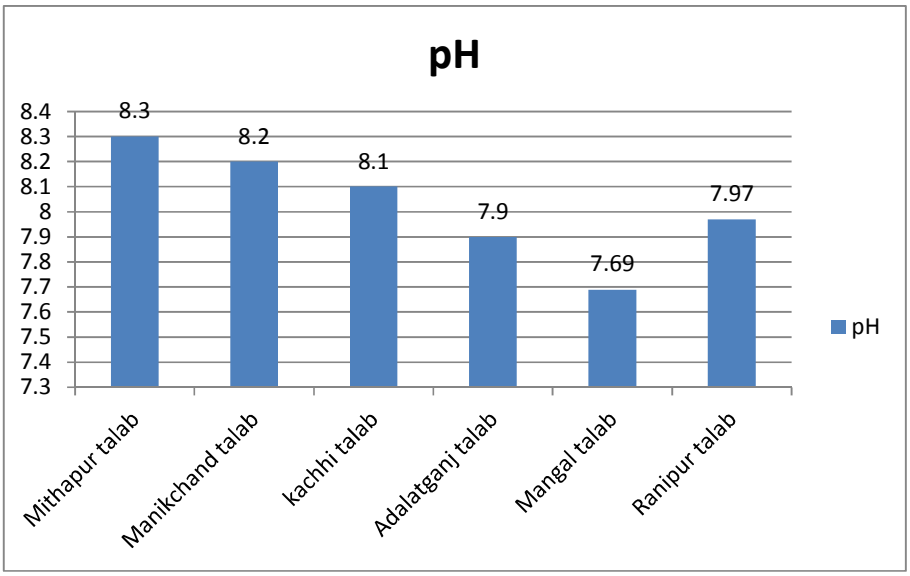

Fig. 9. Measured pH values of pond water

Table 1. Permissible limit of different parameter with average value

Parameters	Permisible limit	Source	Average value
EC	1000 (µS/cm)	BIS, 1991 (Reference No-13)	864.83 µS/cm
TDS	500 (mg/L)	BIS, 2012 (Reference No-14)	565.83 mg/L
Alkalinity	200-600 (mg/L)	BIS, 1991 (Reference No-13)	303.33 mg/L
Chloride	600 (mg/L)	BIS, 1991 (Reference No-13)	70.00 mg/L
TH	300 (mg/L)	BIS, 1992 (Reference No-15)	260.66 mg/L
Orthophosphate	5(mg/L)	WHO, 1963 (Reference No-16)	1.84 mg/L
DO	5(mg/L)	BIS, 1992 (Reference No-15)	4.91 mg/L
Ph	6.5-8.5	BIS, 2012 (Reference No-14)	8.02

4. CONCLUSION

The water samples which were taken from the selected pond in the Patna urban area were analysed. This study reveals that the selected ponds of Patna have a heavy load of domestic waste, municipal waste, food waste and plastics waste. These are harmful to human as well as aquatic habitat. All six ponds are contaminated. Electrical Conductivity level crossed the

permissible limit in P6. Total Dissolved Solids level crossed the permissible limit in P1, P3, P4 and P6. Alkalinity level within the permissible limit. Chloride level within the permissible limit. Total Hardness level crossed the permissible limit in P4 and P6. The Ortophosphate level crossed the permissible limit of P6. Dissolved Oxygen level below the permissible limit in P1, P3 and P4. The pH level of all water sample is coming under the permissible limit. Water quality decreases due to external factors like discharge of domestic waste, human interference.

Therefore, there is a need of protection of these ponds from the gradual increase of contamination by human and animal waste; to protect aquatic bodies from disturbance. A regular monitoring of water quality parameters is needed to protect these ponds from contamination.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ghosh BB, Basu AK. Observation on estuarine pollution of the Hooghly by the effluents from a chemical factory complex at Rashasa, West Bengal. Env. Health. 1968;10:29-218.
2. Mishra BP. Poll. Res. 2008;27(3):395-400.
3. Ghosh GK. Water of India. A.P.H. Publishing Corporation; 2002.
4. Gray NF. Water technology. An Introduction for Environmental Scientists and Engineers. 2nd Edition, Publishing Butter Worth. Heinemam; 2005.
5. Gerstein M, Levitt M. Simulating water and the molecules of life. Scientific American. 1998;279:100-105.
6. Mathur I, Chodhary SS. Introduction, In: Industrial Pollution and Its Control, Avishkar Publishers, Distributors, Jaipur, India. 2004;1-2.
7. Gupta S, Shukla DN. Physico-chemical analysis of sewage water and its effects on seed germination and seedling growth of *Sesamum indicum*. J Nat Ras. A Development. 2006;1:5-19.
8. Kanth MK, Singh SK, Kashyap A, Gupta VK, Shalini S, Kumari S, Kumari R, Puja K. American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS). 2017;38(2):161-167. ISSN: 2313-4402.
9. Kanth MK, Singh SK, Kashyap A, Gupta VK, Shalini S, Kumari S, Kumari R, Puja K. Bacteriological assessment of drinking water supplied inside the Government Schools of Patna District, Bihar, India. American Journal of Environmental Protection. 2018;6(1):10-13.
   DOI: 10.12691/env-6-1-2.ISSN:2328-7241
10. American Public Health Association (APHA), and Water Pollution Control Federation. Standard methods for the examination of water and wastewater 20th Edition, Washington D.C.; 1998.
11. WHO. Guidelines for drinking water quality. Geneva. 1984;1.
12. Singh SK, Kanth MK, Kumar D, Raj R, Kashyap A, Jha PK, Anand A, Puja K, Kumari S, Ali Y, Lokesh RS, Kumar S. Physicochemical and bacteriological analysis of drinking water samples from urban area of Patna District, Bihar, India. Int. J. Life. Sci. Scienti. Res. 2017;3(5): 1355-1359.
    DOI: 10.21276/ijlssr.2017.3.5.15
13. BIS. Drinking water: Guidelines for drinking water quality. Bureau of Indian Standards. New Delhi 110002; 1991.
14. BIS. Drinking water: Guidelines for drinking water quality. Bureau of Indian Standards. New Delhi 110002; 2012.
15. BIS. Drinking water: Guidelines for drinking water quality. Bureau of Indian Standards. New Delhi 110002; 1992.
16. WHO. Guidelines for drinking water quality. 2nd Edition, Geneva. 1963;1:56.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle3.com/review-history/45720