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EFFECT OF IDOLS IMMERSION ON ANTHROPOGENIC INFLUENCED RITUAL PONDS WATER QUALITY AT HOLY CITY VARANASI

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ABSTRACT

Many ponds of holy city Varanasi are polluted by anthropogenic activities. This is due to improper management of public and private sector. There is some religious importance of ponds in Varanasi. The concept is based on storing rain water in ponds and fulfills daily public water need. In Skandpuran (Kashi-khand) there is report for 88 Hrada (naturally developed) and man-made 62 Kunds (ponds). Ponds play major role to control pollution in holy river Ganga by sharing daily public activities. In the present investigation, physicochemical parameters of five major ponds were studied. The important water parameters studied were pH, Total Dissolve Solid (TDS), Total Suspended Solid (TSS), Dissolve Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Conductivity (TC), Total Hardness (TH), Total Alkalinity (TA), Chloride (Cl^-), Nitrate (NO_3^-), Sulphate (SO_4^{--}) Phosphate (PO_4^{---}) and Total Microbial Population (TMP).

The results suggested that selected physicochemical parameters were very high in value after idol immersion as compared to before idol immersion. Microbial results showed that water of ponds are pathogenic in nature. All five ponds were having negative report on water quality for idol immersion as per traditional literature scripts and guidelines of Central Pollution Control Board (CPCB), New Delhi, India.

KEYWORDS: Physicochemical parameters, pollution, pond water, idol immersion, microorganism.

INTRODUCTION

The population pressure, growth of small scale industries, urbanization, modern life style, lack of environmental awareness, implementation of environmental rules/regulations and untreated effluent discharged from municipalities, use of non-biodegradable materials, etc are causes for water pollution in ponds. The polluted pond water have undesirable colour, odour, organic matter contents, taste, turbidity, harmful chemical contents, toxic metals, oily materials, waste products, high TDS, organic and mineral acids, alkalis, detergent, viruses, bacteria, fungi, protozoa, worms, etc[1].

The beginning of urban concepts was based on design and architecture of Kashi which is modern time named as Varanasi. Varanasi is a unique example of civilisation in world history[2]. It is also known as city of ponds because there are 88 Hrads and 62 kunds (pond) which are naturally and/or man made[3-4]. Purpose of these ponds is to conserve water safely for survival of human being.

Varanasi is the oldest living city in the world and has been a great centre of learning through the ages. It is very difficult to ignore the mythological significance of these ponds particularly for protection of holy Ganga river. Unfortunately, these ponds are covered by making big houses, of average or low level living people, heaps of garbage, including kitchen article, plastic bags and polythene, dumped near the these ponds. The flowers along with other pooja materials used in religious functions are also left near the ponds. Thus, these ponds are polluted by anthropogenic activities. Water is visible green, black or yellow due to presence of algae, fungi, diatoms, bacteria and other chemical pollutants (Figures 2-4). The NGO's are putting efforts with the help of local people for saving ponds and are trying to clean fully without support of any district administration.

Many investigators have reported that several ponds in Varanasi are highly polluted due to various anthropogenic activities[5-7]. Anthropogenic activity on pond ultimately, deteriorates the water quality thus there is accumulation of

toxic chemical and sediment, shrinkage of catchment area which leads to loss of rituals and aesthetic value of these ponds.

The healthy condition of pond water depends upon its physicochemical and biological characteristics. In the present investigation, water samples were collected from five sites which are already declared highly polluted ponds and water is not fit for any use. On other hand, district administration has performed idol immersion in these polluted ponds for completion of rituals in the light of order of the High court, Allahabad.

EXPERIMENTAL PROCEDURE

Sampling Sites and Sample Collection

Water samples were collected from five ponds shown in figure in different areas of Varanasi holy city for the analysis of physicochemical parameters (Figure 1). The city of Varanasi is located in the middle Ganges valley of North India. The city is bounded by 25° 19' 60 N Latitude and 83° 0' 0 E Longitude. The standard methods of APHA (2005) were followed for the analysis of physicochemical parameters[8]. Samples were collected in 5 litres of plastic containers previously rinsed by double distilled water. During sampling, containers were dipped at a depth of two feet below the surface of the pond from each of the five sampling sites after agitation. The water samples were carried to the laboratory and stored at 4^0C in the refrigerator for analysis of selected parameters. The samples were analyzed for fourteen selective major parameters shown in Table 1. Each of the Ponds water samples were analyzed by using standard methods (APHA, 2005).

In the microbial analysis the total microbial population (TMP) and test for coliforms were studied by standard microbial techniques (APHA, 2005). The biochemical tests for identification of bacterial species were also studied using Bergeys' Manual[9]. Phytoplankton and zooplankton samples were collected from pond water surface.

RESULTS AND DISCUSSION

Physicochemical parameters of pond water were analyzed before and after idols immersion and results are shown in Table 1. When Idols were immersed in water bodies, these idols making materials are also added into contaminated pond water. These materials dissolve easily in the water bodies and directly affect water quality of pond.

Effect of pH, TDS, TSS, BOD, COD, TC, TH and TA

Change in the pH is accompanied by changes in the physico-chemical aspects of the aquatic medium. It is also an important parameter for determining the acid-base balance of water. It is very difficult to treat water by biological means when pH is either very low or very high[10]. In the present study, pH ranges from 7.8 to 8.10 before idols immersion which changed to 6.6 to 7.2 (Table 1).

Table 1: Physicochemical parameters of various ponds before and after idol immersion

S.No.	Parameters	KP-1		KP-2		KP-3		KP-4		KP-5	
		B	A	B	A	B	A	A	B	B	A
1.	pH	8.10	6.6	7.9	6.9	8.3	7.1	8.6	8.2	7.2	7.1
2.	TDS (mg/L)	1730	2156	1290	1823	1150	1630	1234	1560	1360	1456
3.	TSS (mg/L)	1470	1980	1060	1530	890	960	640	740	518	670
4.	DO (mg/L)	4.3	3.2	5.3	4.6	5.2	4.2	5.7	4.2	6.3	4.7
5.	BOD(mg/L)	1.3	3.4	3.6	4.2	3.9	4.4	4.2	5.7	4.7	5.8
6.	COD(mg/L)	534	874	476	640	490	634	437	587	494	548
7.	TC (mS/m)	0.42	0.78	0.33	0.65	0.28	0.43	0.23	0.36	0.20	0.29
8.	TH(mg/L)	254	390	233	352	216	287	208	254	179	216
9.	TA(mg/L)	276	373	223	307	208	287	189	243	166	210
10.	Cl^-(mg/L)	132.4	187.6	97.8	113.4	74.3	98.6	67.8	78.8	56.4	66.4
11.	NO_3^-(mg/L)	47.6	87.4	37.9	46.7	32.4	37.8	26.8	33.3	21.6	26.4
12.	SO_4^{--}(mg/L)	65.8	88.9	57.2	72.4	46.2	44.3	38.9	42.1	22.4	31.2
13.	PO_4^{---}(mg/L)	12.3	22.3	10.7	17.8	09.7	12.3	07.5	10.4	07.3	08.7
14.	TMP ($x10^4$)	3.7	5.4	2.8	3.9	2.3	3.1	1.8	2.9	1.2	2.1

KP-1= Laxmi Pond; KP-2 =Sankuldhara Pond; KP-3= Mandakini Pond; KP-4 = Machhodari Pond; KP-5 = Surya Pond

The values of TDS, TSS, BOD, COD, TC, TH, and TA of all ponds increased after idol immersion as compared to the values obtained before immersion (Table 1). The value of DO decreased. The lower DO value of Laxmi pond

might have been due to the high rate of oxygen consumption by microorganism. Dissolved oxygen is an important parameter in water quality assessment and reflects the physical and biological processes of aquatic organism. DO is not only an important for indicator of pollution but it also indicates physical, chemical and biological activities of water[11-13].

DO is one of the most important factors of water and is very necessary for all living organisms. Dissolved oxygen is essential for better growth of flora and fauna. During present study the amount of dissolved oxygen ranged between 4.3 mg/L (KP-1) to 6.3 mg/L (KP-5). The dissolved oxygen plays a major role in survival of microorganism.

BOD is the amount of oxygen required to degrade organic matter present in the water body. It depends on temperature, extent of biochemical activities, organic materials concentrations and microbial growth[14]. During the investigation, minimum BOD values were found in all ponds which increased after idols immersion (Table 1).

After idols immersion, TDS increased in each pond by dissolution of idol making materials. It represents all the charged ions, cations and anions, as well as the uncharged and molecular species. Total dissolved solids denote various kinds of minerals present in the water[15].

The total hardness of pond water is the sum of calcium and magnesium hardness concentrations and was found to be significantly higher after idol immersion (Table 1). This is similar to the findings of Bhatnagar et al., before idol immersion[16]. Low level of oxygen may be due to decay of organic matter present in water. after idol immersion. Present study was supported by the study of Chatree and Siripen[17] and Ahangar et al.[18].

Effect of Chloride, Nitrate, Sulphate and Phosphate

Chloride, Nitrate, Sulphate and Phosphate values varied significantly in each pond[19-21]. For chloride, values varied from 132.4 to187.6 in KP-1; 97.8 to 113.4 in KP-2; 74.3 to 98.6 in KP-3; from 67.8 to 78.8 in KP-4; from 56.4 to 66.4 after idol immersion. In the same fashion, nitrogen, sulphate and phosphate were also varied as shown in Table 1. The phosphorus nutrient is needed for the algal growth, which is a key element in metabolic reactions of aquatic organisms and responsible for eutrophicaton of ponds.

The water samples from all five ponds showed very objectionable water quality for idol immersion because as per traditional concept, idol immersion should only be done in clean water. The water quality all ponds deteriorate due to soaps, detergents, worship materials, polythene and direct discharge of temple effluents, animals waste, and municipal waste water.

The high concentration of phosphorus is attributed to decay and subsequent mineralization of dead organic matter, while low concentration is attributed to the utilization of nutrients by autotrophs.

Effect of TMP

The analysis of phytoplankton and zooplankton are given in Table 2. Generally ponds water is seen green in the colour due to growth of planktons. The presence of cyanophyceae species may be responsible for green colour of pond water (Figure 2). Species of both Chlorophyceae and Euglenophyceae indicate polluting condition and the species of Cyanophyceae are also responsible for creating eutrophic problem[22-24]. The results from bacterial analysis are given in Table 1. It shows positive results for all pond samples. The bacterial species found in present investigation are given in Table 3. The identified bacterial species are pathogenic in nature. It may influence people surrounding ponds causing many diseases. Moreover, fishes are dead in ponds after idol immersion (Figure 5 and 6).

Water quality of all five ponds varies considerably after idol immersion. On the basis of analyzed water quality before idol immersion and from the above investigation it can be inferred that the polluted ponds water may not be fit for idol immersion. Similarly, as per guide line of central pollution control board idols must be immersed in clean water.

Table 2 : Phytoplankton and Zooplankton from pond water

1. Phytoplankton	
(A) Chlorophyceae	**(B) Bacillariophyceae**
Actinastrum sp.	*Caloneis* sp.
Closterium sp.	*Navicula* sp.
Chlorococcum sp.	*Synedra* sp.
Chlorella sp.	*Nitzschia* sp.
Pediastrum sp.	
(C) Cyanophyceae	**(D) Euglenophyceae**

Anabaena sp.	*Euglena* sp.
Ancystis sp.	*Phacus* sp.
Scytonema sp.	
Microcystis sp.	
Nostoc sp.	
2. **Zooplankton**	
Cyclops sp. ; *Brachinous* sp. ; *Dophnia* sp. ; *Filinia* sp.; *Lecane* sp. *Keratella* sp.; *Bosmina* sp. and *Monostylus* sp.	

Table 3: bacterial species from pond water

S. No	Microorganism
1	*E. coli*
2	*Bacillus* sp.
3	*Enterobacter* sp.
4	*Pseudomonas* sp.
5	*Staphylococcus* sp.
6	*Straptococcus* sp.
7	*Micrococcus* sp.

Table 4:Main component of pond ecosystem

Abiotic Components
The abiotic substances of Pond ecosystem are formed as a result of the mixture of some organic and inorganic materials. The basic components are water, oxygen, carbon dioxide, salts of calcium and nitrogen etc**.** Only a small amount of these elements are present in soluble state in pond water, but a large amount is held in reserve solid form in the bottom sediments as well as within the organisms. Various organisms get their nourishment from these abiotic substances. The rate of release of reserve nutrients, the solar input and the cycle of temperature, day length and other climatic conditions regulate the function of the Pond ecosystem.
Biotic Components (A+B+C)
A. Producers
The producres are of two types-larger rooted and floating vegetations together termed macrophytes and phytoplanktons which are microscopic floating algae. Phytoplanktons are available up to the depth of water where light penetrates. Generally, the phytoplanktons are alga like Anabena, Oedogonium, Spirogyra, Oscillatoria, Ulothrix, and some floating plants like Microcystis, Gloeotrichina volvox etc. The macrophytes include marginal emergent plants like Acerus, Typha, Ipomea, submerged plants like Hydrilla, Nymphrea, Trapa, Utricularia,etc ; surface floating plants like Pistea ,Lemna, Wolffia, Eichhornia, Salvinia etc.
B. Consumers
Consumers of Pond ecosystem are heterotrophs which depend for their nutrition on other organisms. Zooplanktons form primary consumers, include Brachionus, Asplanchna, Lechane**,** Colops, Dilepteus, Cyclops, Stenocypris , who feed on phytoplankton. Nectic animals like insects, beetles, fishes form secondary consumers as they feed on zooplanktons. Benthic animals like snakes, big fishes live on nectic animals and are termed tertiary consumers.
C. Decomposers

Most of the decomposers of Pond ecosystem are saprophytes but some parasites are also found in ponds. Bacteria, fungi like Aspergillus Cladosporium Rhizopus, Alternaria, Fusarium, Saprolegnia etc are decomposers. Generally the decomposers either live in the soil layer beneath water or in the mud. They act on dead and decayed organic matter of plants and animals and supply raw materials to the producers.
Energy Flow in Pond Ecosystem
Phytoplanktons are the producers of pond ecosystem with floating materials. The energy produced by the autotrophs are passed through "eat and being eaten chain". In pond the larvae of insects consume autotrophs as food. So according to law of energy flow the larvae assimilate energy from autotrophs. So larvae are primary consumers. These primary consumers are taken as food by prawns, small carnivorous fishes etc and so they collect energy from larvae. They are, therefore secondary consumers. Large fishes consume secondary consumers, and are tertiary consumers.

CONCLUSIONS

Results shown the present investigation revealed that water quality of ponds is not suitable for idol immersion and is not in accordance with the traditional rules as describe in Sanskrit literature scripts. Except DO, all physicochemical parameters of various ponds increased after idol immersion. Decreased DO is dangerous for pond ecosystem (Table 4). Due to presence of pathogenic microorganism, the pond water is not useful for any purpose. So, there is an immediate requirement of treatment, purification and high administrative attention for proper management for the humanity and balancing of environmental factors and pond ecosystem.

RECOMMENDATIONS AND RECOMMENDATIONS

There is an urgent need of awareness among the local people to minimize anthropogenic activities near the ponds. The dilution of pollutants by adding fresh water in polluted pond water is not solution of the problem. Appropriate authorities should take responsibilities to manage required protection parameters, new design concept, removal of sediments from the bottom of pond, screening of floating debris from the pond water surface and by enforcement of law.

Water quality problems in rituals ponds can usually be controlled with some proper technical management. Here are some important suggestions:

1. Pond water check the periodically to determine pathogenic microbial load and to monitor the presence of any other problems which responsible to damaging water quality.
2. Maintain fish population to naturally cleaning the pond water.
3. Control growth of aquatic plants, algae, fungi and diatoms.
4. Avoid use of herbicides for cleaning of pond water.
5. Strictly inhibit sewage piping near the pond areas.
6. Check rain water flow into ponds directly.
7. Surface water cannot allow entering into ponds without proper treatment.

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Figure 1 : Map of the study sites (KP-1= Laxmi Pond; KP-2 = Sankuldhara Pond; KP-3= Mandakini Pond; KP-4 = Machhodari Pond; KP-5 = Surya Pond)

(A) ***(B)***

Figure 2 : Most polluted ritual ponds (A) Mandakini and (B) Kapil dhara

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(A) *(B)*

Figure 3 : Most polluted ritual ponds (A) Laxmi Kund and (B) Matsyodari

(A)

(B)

Figure 4 : Most polluted ritual ponds (A) Sankuldhara and (B) Uttarark

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Figure 5: Show immersions of Durga and Ganesh idols in different ritual ponds

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Figure 6: Show immersions of Durga idols in different ritual ponds and dead fishes after idol immersion.