P: ISSN NO.: 2394-0344 RNI No.UPBIL/2016/67980 VOL-3* ISSUE-11*(Part-2) February 2019
E: ISSN NO.: 2455-0817 Remarking An Analisation

Application of Water Quality Index for Assessment of Water Quality of Hameer Pond, Kishangarh, Ajmer

Abstract

The aimed study assesses the water quality of Hameer pond of Kishangarh, Ajmer applying National Sanitation Foundation (NSF) America developed index called Water Quality Index (WQI). The cumulative effects of anthropogenic pressure and exerted pollution load from point and non-point sources are affecting water quality of this urban water body. The water quality index value clearly reflected that Water Quality of pond was "average" and belongs to "C" category of CPCB on 100-point scale. This low value was related to human activities in the region. The implementation of WQI is necessary for public and decision makers to evaluate the water quality of the pond for sustainable management.

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Keywords: NSFWQI, Water Quality Index (WQI), CPCB, Hameer Pond.

Introduction

The efficient management of natural, physical and biological resources of any region leads to successful economic development and stability of the systems. Proper combination of land and water resources in space and time sets the upper limit of the population and carrying capacity of the area (Sharma et al. 1999). As a matter of fact water resources, one of the important life support system on the earth, cover about 70 percent of the planet, and glaciers, ice-caps and clouds cover additional area(1.993%), but very limited quantity (0.00192%) is available and suitable for sustenance of fresh water dependent life (Cassardo and Jones, 2011). In India, sustainable and equitable use of water in the past has been ensured by cultural and social advocacy and adaptation to water availability through water conservation technologies, agricultural practices adapted to different climatic zones. But in last few decades, the consequences of population growth, progressive industrialization and urbanization, rehabilitation of arid areas, drive for development and the associated consumerist culture have led to overuse, abuse and pollution of our vital water resources and disturbed the quality and the natural cleansing capacity of water. (Swaminathan and Manonmani,1997). Environmental pollution of water resources has become a major worldwide issue, including developing countries which have been suffering from the impact of pollution due to poor socio economic growth associated with the exploitation of natural resources. As a result of it, water is considered as the highest risk to the world for future due to increase in demand as well as increase in pollution. On a global scale, total water quantity is not the problem; the main problem is of water availability in the right place at the right time in the right form. The healthiness of the aquatic ecosystem is determined by the water quality parameter which includes the physical, chemical, and biological characteristics (Sargaonkar and Deshpande 2003).Assessment of water quality involves the measurement of a large number of parameters and expressing the quality with respect to particular uses may be a complex issues. Many methods have been planned and adopted for testing of water quality. As there is lack of consensus among different experts and end users regarding perceptions and interpretation of various parameters of water quality. Therefore it is necessary to translate water quality data in widely acceptable and unambiguous term. One of the most effective approaches for studying water quality is using of suitable indices which provide single value to the water quality in order to reach comprehensive, dynamic and consistent picture of pollution load of water body. (Sanchez et al., 2007, Prati 1971, Brown et al. 1970). In general water quality indices incorporate data from numerous water quality parameters into mathematical equation that rates the healthiness of water body with a single number. That number is placed on a relative scale to validate the water quality in category ranging from very bad to excellent for simplicity and consumers unambiguousness. A number of indices have been developed to summarize water quality data for communication to the general public in an effective way. A commonly widely used WQI was developed by the National Sanitation Foundation (NSF) in 1970 (Brown et al., 1970). Essentially, the NSFWQI converts the concentration data for nine analytes into one of five water quality classes, ranging from very bad" to excellent. Therefore present study is carried out to achieve water quality status of Hameer pond by using NSFWQI.

Review of Literature

Padmanabha and Belagaii (2006) calculated Water Quality Index of four lakes of Mysore. The study revealed that the Dalvoi Lake was less polluted as compare to Kamana Lake, Karanji Lake and Kukkarahally Lake.

The Friends of Good spirit Lake Inc. (2007) reported high water quality index (>90) at Good Spirit Lake and found slightly higher amount of suspended solids.

Bhatnagar et al. (2009) studied water tank Brahmsarovar, at Kurukshetra to assess the impact of mass bathing during new moon day (called as Amavasya in India) in terms of physico-chemical and biological characteristics. Overall water quality index was calculated using online calculator. Results have revealed significant ($P<0.05$) increase in organic pollution due to high organic matter of animal origin.

P. J. Puri, M. K. N. Yenkie et al., (2011), worked on three different lakes for water quality index (WQI) on surface waters. They have done comparison of three seasons as summer, winter and rainy on water quality index calculator given by National Sanitation Foundation (NSF) information system. The result of various studies on lakes showed fair water quality in monsoon season which then changed to medium in winter and poor for summer season.

Rakesh and Joseph (2013) studied Chakkamkandam Lake of Kerala (India) using CCME Water Quality Index and found poor water quality status.

Singh and Singh (2014) calculated Water Quality Index for Mansi Ganga, Radha and Shyam kunds in Govardhan at Mathura. WQI for these three water bodies was ranging from 45 to 49, indicating poor water quality particularly due to high BOD, TSS, and faecal coliforms.

Shirk et al. (2014) studied Kavanoor and Arakkonam Lakes of Vellore (Tamil Nadu) using Palmer Pollution Index. They calculated pollution index of 26 for Arakkonam Lake due to disposal of sewage waste, while Kavanoor Lake was low in organic contents (index value 19) due to less anthropogenic influence.

Deepika and Singh (2015) estimated WQI of Bhalswa Lake in New Delhi and found high organic contamination in lake.

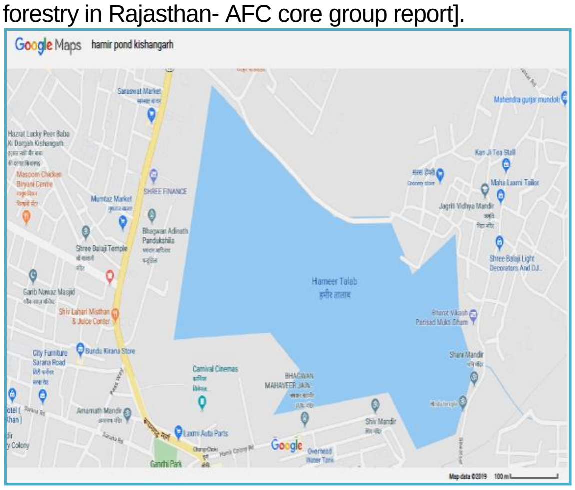
Waribam et al. (2015) analysed WQI of Nambol River that drain in Loktak Lake (a Ramsar site) situated in Bishnupur district of Manipur (India).They found highest WQI of 85.27 at Yangoi Macha just near intake point of Loktak Lake due to direct disposal of sewage waste and industrial effluents.

Sharma et al. (2016) found that anthropogenic meddling, agricultural runoff, sewerage disposal etc. resulted in poor water quality. They found Anasagar Lake at Ajmer having low WQI value (49.78) on 100 point scale, corresponding to D category of CPCB.

Mukhtar, F., et al. (2017) evaluated water quality in terms of the physicochemical parameters of the Brari-Nambal lagoon of Dal Lake, Kashmir and found water Quality Index (WQI) was very poor and water quality falls under grade 'D' with values >75.

Study Area

Hameer pond is situated in Kishangarh city, known for Kishangarh style of painting Bani Thani, is an important industrial city of Ajmer district. Topographically, this region is an ecotone region between arid Thar Desert and semi arid eastern plain and characterized by more or less a plain surface interrupted with low hills. [Source: Status of Social forestry in Rajasthan- AFC core group report].



Study area Hameer Pond is one of the many perennial shallow water bodies around Kishangarh, of which Santolav Pond, Gundolav ponds are important. Totally rain-fed Hameer pond is a manmade pond amidst low hills erected on almost plain surface of eastern semiarid agro-climatic zone, located at $26^0$35'24 to $26^0$35'44 North latitude and $74^0$51'04 to $74^0$51'34 East longitude at 500 m above MSL in the center of Kishangarh. Hameer Rao the resident of old Kishangarh city, laid the foundation of pond, amidst beautiful surroundings of hills and panoramic environment (Source: Kishangarh Tavarikh).The area experience moderate climate with all four seasons. Here soil is sandy loam to sand clay in texture and low fertile as low in nitrogen and moderate in phosphorous and potassium. The total catchment area of the pond is 13.44 sq. km. and the terrain is semi hilly and rocky. Pond is surrounded by the human habitation and receives sewage and wastewater through number of unlined drains deteriorating the water quality of the pond day-by-day.The present study was intended to develop a water quality index for Hameer pond in order to assess the water pollution status due to anthropogenic meddling.

Material and Methods

To assess water quality of this water body, Brown's water quality index was used. A water quality index provides single value to the water quality. It integrate data generated from physicochemical and microbial analysis after assigning due weights to different parameter. The index can be used to compare different study sites where same objectives and variables are used (Kankal et al., 2012). Samples were collected in polythene bottles from four sampling sites and analyzed for various water quality parameters as per standard procedures (Table 1) given in APHA (2005). The final calculation of Water Quality Index (WQI) is done by aggregation of sub-indices using weighted sum index method. The index is given by

$$WQI = \sum_{i=1}^{n} w_i q_i$$

Where, qi = the quality of the ith parameter (0-100, from sub-index graph)

wi = the weight of the ith parameter.

Table-1
Parameters and Methods Used

S. No.	Parameters	Analytic method & method No.	Weight
1	Water Temperature	Thermometric method (2550)	0.10
2	Turbidity	Nephelometric method (2130-B)	0.08
3	pH	pH metric method (4500-H+: B)	0.12
4	Total Dissolved Solids	Gravimetric method (2540-B)	0.08
5	Dissolved Oxygen	Titrimetric method (4500-O: C)	0.17
6	BOD– 5 Day	Titrimetric method (5210-B)	0.10
7	Dissolved Phosphates	Titrimetric method (4500-P: D)	0.10
8	Nitrate	Spectrophotometric method (4500-NO_3^-)	0.10
9	Fecal coliform	Membrane filtration & Culture (9222-D)	0.15

Hypothesis

H_o: The pollution load in Hameer Pond remains within its natural resilience limit and does not affect the water quality to a considerable level spatially as well as temporally within the pond system.

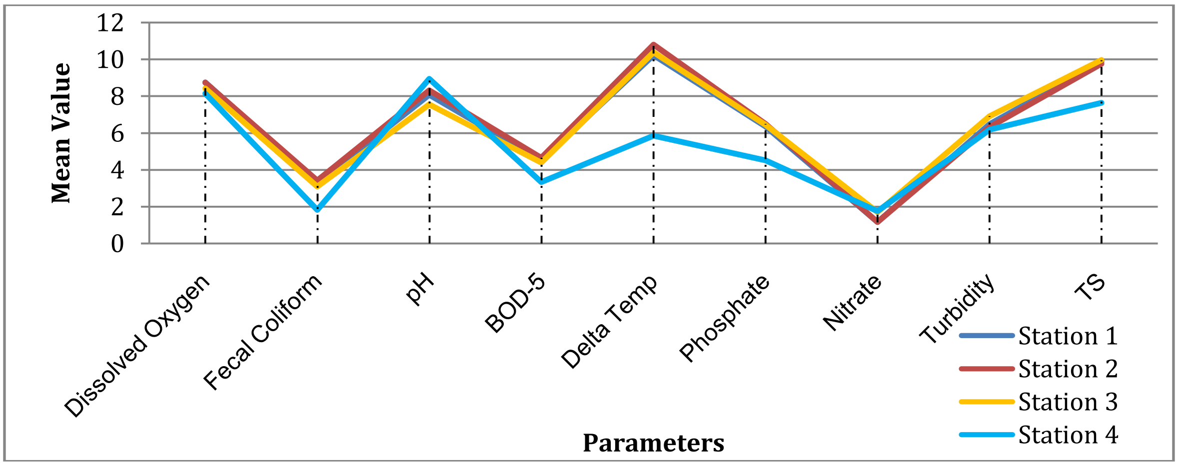
H_a: The pollution load in Hameer Pond is variable beyond it's natural resilience limit and affect the water quality to a considerable level spatially as well as temporally within the pond system.

Results and Discussion

Many methods of water quality determination have been discussed. Water quality index (WQI) is regarded as one of the most effective way to communicate water quality. In this study, the physico-chemical characteristics of water samples were estimated, and the water quality index of NSF was evaluated. National Sanitation Foundation water quality index (NSFWQI) for each of the parameters and their attributes for Hameer pond over a year presented in the tables 2 and 3.

Table 2: Station-wise Mean Values of Parameters

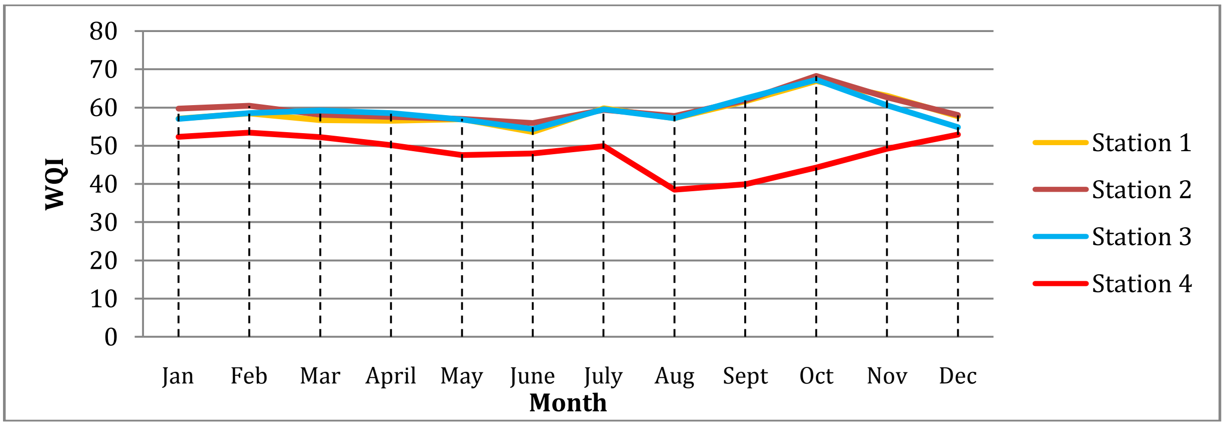
Parameters	Unit	Station 1	Station 2	Station 3	Station 4
Dissolved Oxygen	% Saturation	8.75	8.73	8.42	8.14
Fecal Coliform	#/100 mL	3.27	3.42	3.08	1.82
pH	CV	8.08	8.31	7.55	8.94
BOD-5	mg/L	4.50	4.65	4.39	3.33
Delta Temp	degrees C	10.23	10.80	10.38	5.85
Phosphate	mg/L	6.36	6.49	6.43	4.51
Nitrate	mg/L	1.15	1.15	1.70	1.75
Turbidity	NTU	6.48	6.31	6.91	6.18
TS	mg/L	9.86	9.76	9.96	7.64



The above Table 2 and Graph illustrate about mean values of dissolved oxygen, fecal coliform, pH, BOD-5, Temperature Change, Phosphate, Nitrate, Turbidity and Total Solids. Station number 1, 2 and 3 are showing approximately same magnitude of parameters under study but the Station number 4 is showing extraordinary deviation/change in the magnitude of parameters. It shows that the effluents coming inward and outward are more polluted than others.

Table 3: Month-wise and Station-wise WQI

Station/Month	Jan	Feb	Mar	April	May	June
Station 1	57.06	58.41	56.62	56.44	56.87	53.52
Station 2	59.65	60.39	58.05	57.44	57.01	55.88
Station 3	57.03	58.54	59.23	58.51	56.87	54.35
Station 4	52.372	53.43	52.27	50.12	47.53	47.93
Station/Month	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Station 1	59.72	57.09	61.54	66.85	62.97	57.64
Station 2	59.29	57.74	61.79	68.19	62.61	57.95
Station 3	59.57	57.19	62.38	67.26	60.52	54.86
Station 4	49.89	38.47	39.91	44.26	49.2	52.91



The above stated table 3 and graph shows that Station number 1, 2 and 3 are showing approximately same WQI values but the Station number 4 (*chamdaghar nalla*) is showing lower values of WQI due to inflow of domestic sewage, municipal waste and effluents of organic waste of animal and human origin into the pond. The WQI is decreasing in the month of July which again keeps on decreasing in the month of August for few days but after the month of September the WQI started upward movement and up to December it achieves normal WQI as other Stations. Based on these findings water quality of Hameer pond is rated medium during all the month of study and all the stations (table no.2) except at station 4 (*chamdaghar nalla*) which lie within the range of a bad situation. According to above WQI values of different stations there is general progressive decline in WQI values which indicated that as the rainy season commence the quality of water get started to degrade. The conditions in it often stray from the normal levels it is evident from the results that water quality in the pond under study is degraded considerably due to contamination of water by sewage from the nearby residential colonies and diverse anthropogenic activities. This finding is also in line with the similar studies conducted by Sinha (1995) and Dhamija (1995) who investigated the Water quality of two village ponds at Mujaffarpur and found water of ponds was unsuitable for the intended purpose as a result of lowered WQI. As established in the present investigation they also found decrease in the WQI value for BOD, DO, pH, TDS, FC and turbidity, in clear association with the organic load in the water body. Similar trend were also observed by Dhamija (1995) who calcualted WQI for Hanumantal Lake at Jabalpur M.P. in that study Dhamija found lower WQI due to organic pollution in the water body. The findings of the present study is also consistent with the results of a study conducted by Lal (1996) who studied the physico-chemical properties of “Pushkar Sarovar” and observed increase in BOD, TDS, turbidity and fecal coliform after Pushkar fair. He also found associated decrease in DO and pH which is clear indicative of organic pollution.

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Avg.-Parameter	9	6.11	2.934	0.978
WQI-Avg.	4	56.360	5.462	2.73

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Avg.-Parameter	6.248	8	0.000	6.111	3.86	8.37
WQI-Avg.	20.636	3	0.000	56.360	47.669	65.052

Means of Parameters under study and WQI were compared using t-statistics and found that the Parameters and WQI have significant difference means having t-value of 6.248 and 20.636 respectively and p-value of 0.000 for both variables. Therefore, the null hypothesis that the pollution load in Hameer Pond remains within its natural resilience limit and does not affect the nutrient level to a considerable level spatially as well as temporally within the pond system, is rejected.

Conclusion

In essence the water quality status of the Pond reveals that deterioration of water quality is assuming alarming state in pond due to casual attitude of people concerned with development of urban population. If waste input is not checked then it will severely impair water dynamics of the entire system. In nutshell, the results depict that the water quality of Hameer Pond rated “Average or medium ”and belongs to “C” category of CPCB during the all the month of study and all the stations except station 4. Based on these findings, the stations located at the entrance of the pollutants showed lower WQI throughout the study period because of discharge of untreated sewage, rich in organic waste, both from point sources (viz. *Chamda Ghar Nalla*), and non point sources. The water quality index value of this pond was found much lowered during rainy season.The According to the results of this study, NSF water quality index is a good index for evaluation of the quality of Hameer pond water in which it can be used to determine the water quality at designated stations used for a variety of uses.

Recommendations

In order to assist recuperation of the pond and to explore it in sustainable manner; immediate priority should be given to identification and abatement of lacuna in existing information and tools failing to conserve the pond and catchment area. Due to rapid population growth and the subsequent development of urban and industrial centers around the pond, if a quick action is not taken seriously, the pollution in the pond will threaten human health and other organisms. It is necessary to identify the grounds of pollution-source expansion and to check them, to strengthen administrative coordination and explore possibilities of Public Private Partnership (PPP). It is also necessary to prepare action plan on pond restoration providing sufficient space to beautification in order to develop economic subsystem. Aforestation in catchment area, prohibition of construction and garbage disposal near pond should be enforced. Sewer network and sewage treatment plant should be materialized to limit nutrient entry in the pond system. Besides source control, some palliative actions should be commenced with prime importance in order to cope up the problem of eutrophication in the pond system. Community based indigenous knowledge system for water harvesting should be materialized to aware and insures involvement of community in efforts for conservation of this natural wealth. Therefore, coordinated efforts of various stakeholders and proper commnity involvement are the primary needs to restore the ecological subsystem of the pond and to make it useful for further social and economic exploration.

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