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Water Quality Assessment of Deepor Beel

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Abstract: It is well known fact that clean water is absolutely essential for healthy living. Adequate supply of fresh and clean water is a basic need for all human beings and also for aquatic life, yet it has been observed that millions of people world wise are deprived of this. Clean water being a prime concern in many communities across the globe. This project demonstrates the study of water quality assessment of Deepor Beel during non monsoon season (October-March). Water samples has been collected from eight different sites around Deepor Beel to perform different physical-chemical laboratory test to know the quality of water. Moreover main aim was to find out the water quality index and preparation of spatial distribution map using QGIS. With the reference of this test results water quality index is calculated. Water samples of Pamohi, Boragaon and Chakradeo are fall in class IV category of pollution scale during non monsoon season, while other samples fall in class III of pollution scale. Class IV pollution means very polluted and class III pollution represents slightly polluted.

Keywords: Include at least 4 keywords or phrases.

I. INTRODUCTION

Deepor beel, a perennial freshwater lake of Assam is now on the verge of pollution. To know the level of water pollution in Deepor Beel, water samples are collected from eight different location of the beel during monsoon and non monsoon season. Collected water samples are then tested for alkalinity test, hardness test, chloride test, ^{PH} test, turbidity test, BOD test, DO test, COD test, Total solids and total suspended solids test.

Deepor Beel provides large habitat for several organism as well as many economically important and endangered flora and fauna. Many migratory birds have been visited this wetland particularly during winter season. During last decade or so, due to industrialization, forest cover change, agricultural activity and human settlement within wetland, it has undergone fast modification which imbalance the ecosystem of Deepor Beel. Most of the aquatic life such as waterfowl, fishes, aquatic reptiles etc is on the verge of extinction because of threats to the ecosystem. The spread of surrounding settlements, roads and industrial facilities has exacerbated the pollution problem. In recent years, dead fishes floating on the surface of Deepor Beel. So, this paper tries to analyse the water sample of this wetland and to know the level of pollution.

II. STUDY AREA

Deepor Beel is situated in the Kamrup (M) district and it is the only Ramsar site in Assam. In Ramsar Convention on wetlands, 1971, Deepor Beel was declared as “Wetlands of International Importance” .Deepor beel was declared as Ramsar site in 2002 . (source: Wikipedia) It is located between latitude 26°05'-26°12' N, and longitude 91°34'- 91°44' E and situated 10 km southwest of Guwahati city, surrounded by residential, commercial, institutional & industrial areas. This beautiful beel covers an area of about 40 square kilometer and thus it is categorized as a large oxbow lake. On the northern side of the beel, national highway 37 (old numbering) touches its boundary at different places like Azara, Dharapur etc. Many educational institute like Gauhati University, Assam Engineering College, Assam Ayurvedic College, Forest School and Tata institute of social science are located in the boundary of this beautiful wetland. Adverse human activities like encroachment, cutting the sides of wetlands, pollution, fishing, killing of migratory birds, excessive fodder practices degrade the environment value. Water quality degradation, sedimentation in the beel surface, deforestation activities in and around the beel area, death of fish and migratory birds has increased the importance of conservation and restoration of the beel. Many diseases occur among the birds and fishes because of industrial products. The industrial sewages come to the dumping site without any treatment that creates high chances of water pollution. Moreover the railway track which goes through the beel also creates problem. The sound of trains

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creates disturbance to the peaceful environment of the beel and creates anxiety among the birds. Picnic parties are also be need to blame for creating disturbance an polluting the water. Many private as well as the government organizations have occupied the northern and eastern parts of the Beel . Encroachment leads to blockage the natural drainage pattern of the Deepor Beel that creates the water level imbalance in the Beel. Due to soil erosion, improper catchment treatment and bad agricultural practices results sedimentation in the Beel. Many stone quarries are grown up in the Rani hill. During monsoon period another problem arises, the mud water coming from high level and arrives the bill that causes siltation and also decreases the depth of the Beel. We should do something for the conservation of the beel otherwise in near future it will be lost forever.

Fig. 1 Dumping site at Boragaon

Fig. 2 Deepor Beel

III. METHODOLOGY

Water samples were collected from eight different stations and those are namely at Pamohi, Deepor beel point,Dharapur, Azara Railway Station, ASTU, Boragaon, Chakradeo and AEC campus. Water samples were collected in 2 liter plastic bottles. Each bottle was cleaned with distilled water. Name of sample collection place and date of collecting sample were clearly mentioned on the face of each bottle. Collected water samples are tested for different parameters in the laboratory of Environmental Engineering, Assam Engineering College. To determine the WQI of water, parameters was selected for testing namely P^H, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Hardness, Alkalinity, Chloride and Turbidity, COD, Total Solids. Latitude and longitude of each station is collected by "GPSStatus"applications.

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TABLE I SAMPLE COLLECTION SITES WITH LATITUDE AND LONGITUDE

Sl no.	Station	Latitude	Longitude
1	Pamohi	$26^0$6’28” N	$91^0$40’18” E
2	Deepor beel point	$26^0$6’47” N	$91^0$39’23” E
3	Azara Railway station	$26^0$6’9” N	$91^0$37’2” E
4	Dharapur	$26^0$8’9” N	$91^0$37’35” E
5	ASTU	$26^0$8’26” N	$91^0$39’56” E
6	Dumping Site	$26^0$6’57” N	$91^0$40’35” E
7	Chakradeo	$26^0$6’33” N	$91^0$37’59” E
8	AEC campus	$26^0$8’5” N	$91^0$39’6” E

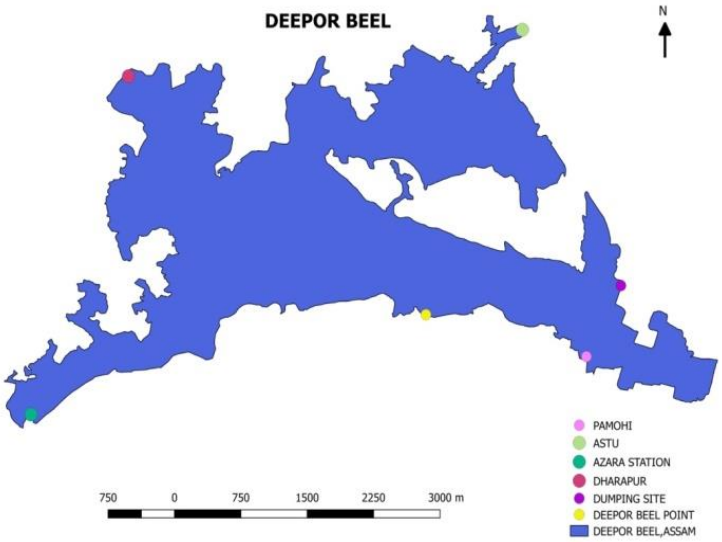

Fig. 3 Deepor beel map showing water sample collection sites

A. Weighted Arithmetic Water Quality Index

Weighted Arithmetic WQI method classifies the water quality according to the degree of purity with the help of the most commonly measured water quality parameters WQI is calculated using the following equation

$$WQI = \sum Q_i W_i / \sum W_i$$

The quality rating scale (Q_i) for each parameter is calculated by

$$Q_i = 100\{(V_i - V_o / S_i - V_o)\}$$

V_i = estimated concentration of ith parameter in the analysed water

V_o= the ideal value of this parameter in pure water,

S_i = recommended standard value of ith parameter

The unit weight (W_i) for each water quality parameter is calculated by using the following formula

$$W_i = K/S_i$$

Where, K= proportionality constant

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TABLE II WATER QUALITY RATING AS PER ARITHMATIC WEIGHTAGE METHOD

WQI	Rating of Water Quality	Grading
0-25	Excellent	A
26-50	Good	B
51-75	Poor	C
76-100	Very Poor	D
>100	Polluted	E

Source: Kumar et al. (2017)

B. Water Quality Index

Total six parameters are considered for the water quality assessment of the beel for tis method. These parameters are DO, BOD, COD, Suspended Solids, Ammoniacal nitrogen and P^H. In the WQI approved by Ministry of Environment, different water parameters carry different weightage.

TABLE III WEIGHTAGE OF DIFFERENT PARAMETER IN WQI

Parameter	Weightage
Dissolved oxygen	0.22
Biochemical Oxygen Demand	0.19
Chemical Oxygen Demand	0.16
Ammonical Nitrogen	0.15
Total Suspended Solids	0.16
P^H	0.12

Source: Ministry of Environment

The value of these parameters is transformed into sub indices (SI), i.e. convert all the values into a same unit. Sub indices are calculated according to the best fit relation given by Ministry of Environment. The formula used to evaluate water quality index is

$$WQI = 0.22\ SI_{DO} + 0.19\ SI_{BOD} + 0.16\ SI_{COD} + 0.15\ SI_{AN} + 0.16\ SI_{TSS} + 0.12\ SI_{PH}$$

Following table shows the best fit equations of sub index values and their ranges

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TABLE IV BEST FIT SUB INDEX EQUATION (MOE)

Sub Index	Sub Index Calculation	For the range
DO	0	$x \leq 8$
	100	$x \geq 92$
	$-0.395 = 0.03\ x^2 - 0.0002$	$8 < x < 92$
BOD	$100.4 - 4.23\ x$	$x \leq 5$
	$108\ e^{0.055x} - 0.1\ x$	$x > 5$
COD	$-1.33\ x + 99.1$	$x \leq 20$
	$103\ e^{0.0157x} - 0.04\ x$	$x > 20$
AN	$100.5 - 105\ x$	$x \leq 0.3$
	$94\ e^{0.573x} - 5\ x - 2$	$0.3 < x < 4$
	0	$x \geq 4$
TSS	$97.5\ e^{0.00676x} + 0.05\ x$	$x \leq 100$
	$71\ e^{0.0061x} - 0.015\ x$	$100 < x < 1000$
	0	$x \geq 1000$
P^H	$17.2 - 17.2\ x + 5.02\ x^2$	$x < 5.5$
	$-242 + 95.5\ x - 6.67\ x^2$	$5.5 \leq x < 7$
	$-181 + 82.4x - 6.05\ x^2$	$7 \leq x < 8.75$
	$536 - 77\ x + 2.76\ x^2$	$x \geq 8.75$

IV. RESULT AND DISCUSSION

Collected water samples are tested in the Environmental Engineering laboratory, Assam Engineering College. Overall test results of all the samples during Non Monsoon season are summarised in table V. From this table it is clearly noticed that the turbidity level of Chakradeo and Boragaon are on the higher sides (more than 10 NTU). Another parameter which concern the water quality of Deepor beel is the Dissolved Oxygen level. DO level at Boragaon is 3.84 mg/l.

TABLE V TEST RESULTS DURING NON MONSOON SEASON

Test / Location	Alkalinity	Hardness	P^H	Turbidity	Chlorides	DO	BOD	TSS	TDS	COD
Pamohi	42	90	7.8	5	40	4.2	6.29	70	150	28
Deepor Beel Point	38	120	7.62	10	20	7.1	4.26	50	130	21.6
Azara	41	120	7.4	5	80	8.11	4.27	40	140	24
Dharapur	41	100	7.68	10	61	6.49	5.27	40	120	17.2
ASTU	37	110	7.2	5	24	8.49	4.66	50	110	14.8
Boragaon	44	150	7.8	15	34	3.84	7.10	70	210	30.8
Chakradeo	41	118	7.46	11	48	7.39	4.3	40	120	21.6
AEC	38	110	7.5	7	29	8.01	4.16	50	90	13.2

A. Water Quality Index (WQI)

WQI values of Deepor Beel durng non monsoon season ranges from 56.56 to 64.67. WQI values of Site 1, Site 2, Site 6, Site 7 are falls under class IV, i.e these points are in polluted region. Other four sites are falls under class III category which is slightly polluted.. Table 6 suggests that water of Deepor Beel is good for handy fish and course fish but in some location it is doubtful for sensitive fish.

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TABLE VI WATER QUALITY INDEX VALUES

Sl no	Location	WQI	Class
1	Pamohi	58.65	Class IV
2	Deepor Beel Point	59.12	Class IV
3	Azara	63.26	Class III
4	Dharapur	63.31	Class III
5	ASTU	64.14	Class III
6	Boragaon	56.56	Class IV
7	Chakradeo	59.29	Class IV
8	AEC	64.67	Class III

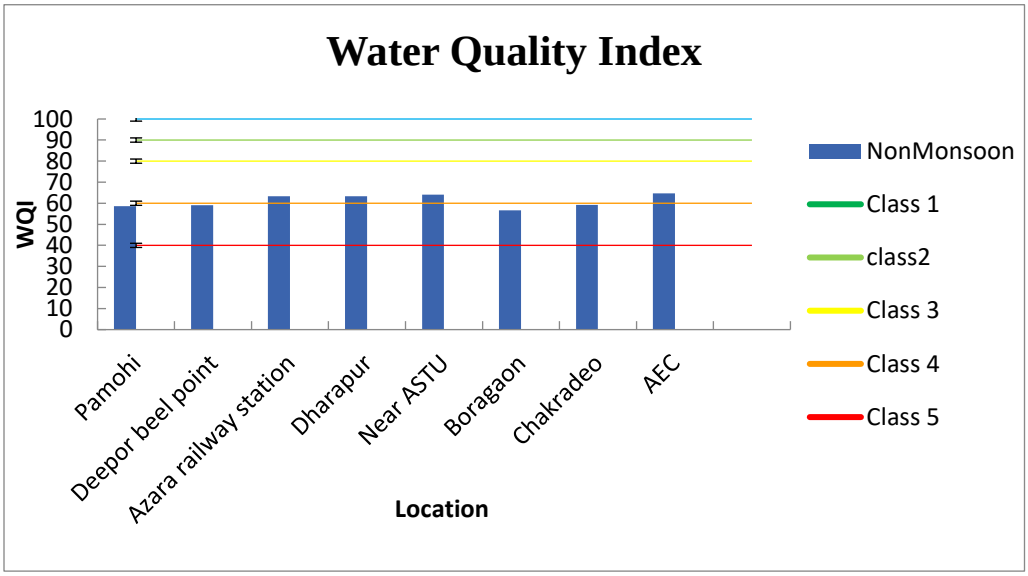

Fig. 4 Water Quality Index vs Sample collection sites

Fig 5 depicts the spatial distribution of water quality index value of different sites. From this figure it is seen that most of the southern and eastern part of the beel are fall in orange zone of water pollution and most of northern part are fall in yellow zone of water pollution. Orange zone belongs to zone iv of water pollution and yellow zone belongs to zone iii of water pollution.

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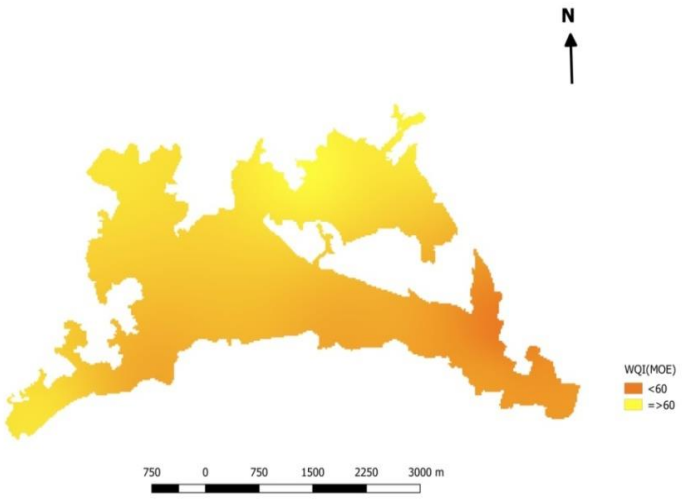

Fig. 5 Spatial Distribution Map of Water Quality Index for Non Monsoon season

B. Arithmetic Weightage Water Quality Index

TABLE VII ARITHMETIC WEIGHTAGE WATER QUALITY INDEX VALUES

Sample Site	WQI	Class
Pamohi	72.54	C (moderately polluted)
Deepor Beel Point	67.38	C (moderately polluted)
Azara	49.64	B (Slightly polluted)
Dharapur	74.52	C (moderately polluted)
ASTU	49.42	B(Slightly polluted)
Boragaon	98.70	D(polluted)
Chakradeo	66.97	C (moderately polluted)
AEC	56.32	C (moderately polluted)

The Arithmetic Water Quality Index values of Deepor beel ranges from 49.42 to 98.70. According to Arithmetic Weightage Water Quality Index values water sample of Boragaon is mostly polluted among all the collected water sample, which is falls under category D, i.e. polluted.

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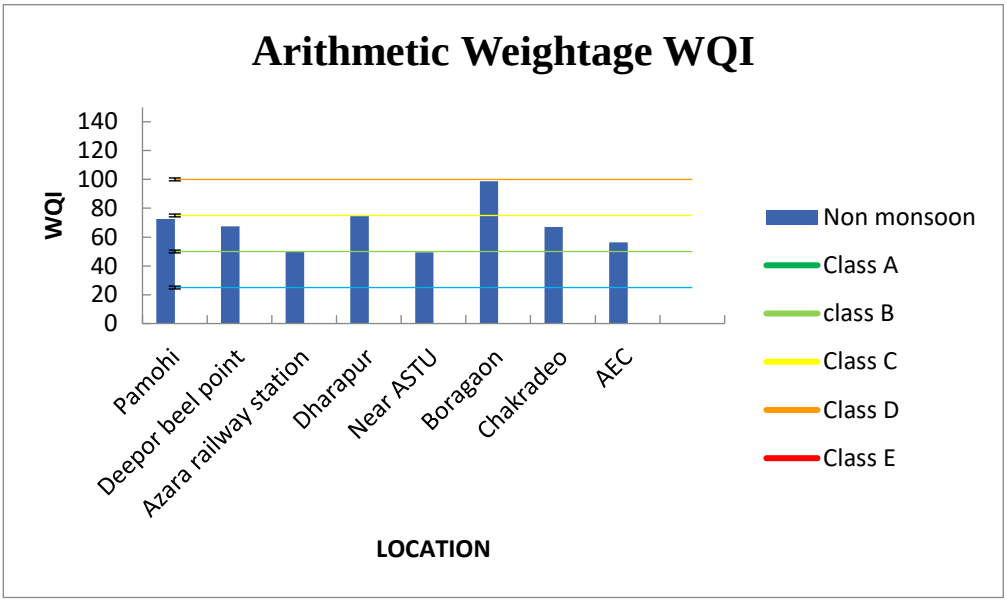

Fig. 6 Arithmetic Weightage WQI vs Sample collection sites

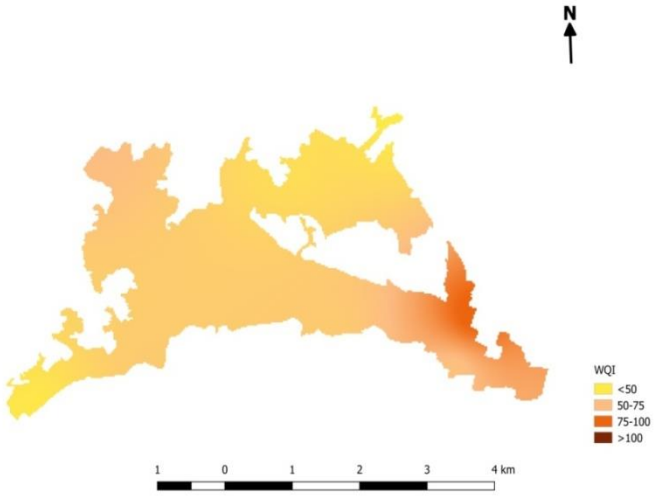

Fig. 7 Spatial Distribution Map of Arithmatic Weightage WQI for Non Monsoon season

Durng non monsoon season the arithmetic weightage water quality index value of the water sample at Boragaon (Red zone) s near to 100 which results that the sample of Boragaon is polluted. The reason behind high pollution s that waste product dumps near the bans flows to the beel.

V. CONCLUSION

During the project work water samples have been collected from Pamohi, Deepor beel point, near Azara railway station, Dharapur, near ASTU, near dumping site (Boragaon), Chakradeo and near AEC campus. Nine physical -chemical water quality pararmeter named as alkalinity, hardness, P^H, turbidity, chloride, DO,BOD, COD and total solids have been tested. Alkalinity level of all test samples during non monsoon season found below permissible level. The total hardness concentration of Boragaon is found beyond permissible limit. P^H ranges from 7.2 to7.8 (Table V). The turbidity level of water samples collected from Boragaon is above permissible limit (Table V). Chlorides concentration of all the tested water samples is found within permissible limit (Table V). DO level of the water samples

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of Boragaon is very low. BOD concentration at Pamohi and Boragaon is on the higher side (above 6 mg/l), this indicates heavy amount of pollution at these locations (Table V).. TDS values of all the location are within permissible limit. COD values of all the test samples are below 50 mg/l (Table V).. With the help of the above mentioned test results, water quality index at different point of Deepor beel is calculated. Water Quality Index helps to understand the level of pollution. WQI divides the beel into different pollution zones. Sites likes Boragaon, Pamohi and Chakradeo falls under zone IV and other five sites are falls under zone III, i.e moderately polluted. Flora and fauna across this wetlands are in danger, so it is duty of our Government and concerned authority to look after this matter as soon as possible.

A. Scope for Future Study

From the study it is seen that dumping site at Boragaon is the main reason of pollution.. Minimise the use of one time plastic, recycling of plastic waste is an option to control the pollution. It is the time for the government, the concerned authority and also the responsible citizen to thinking about to save this natural creature and its surrounding enviroment. As a primary action, try to segregate the waste into biodegradable and non biodegradable waste at source point. People of Guwahati can help in this process by throwing their waste into proper dustbin (biodegradable waste into green dustbin and non biodegradable into blue dustbin). Segregated waste can be used in productive manner. Fertilisers can be produced from biodegradable waste. One fertilisers unit is set up near Boragaon where fertilisers have been produced which mainly used in tea garden. Many European and developed countries have developed energy from biodegradable waste. Non biodegradable waste especially plastic waste can be recycled to make floor tiles, polyester etc. Now a days plastic waste are also used in bitumen road construction. This will definitely help to reduce the pollution level created from urban waste to some extent. Government also thinking about to shift the dumping site to a new location where vulnerability to ecosystem is less. Proper solid waste management surely help to reduce the loads on landfill and in future helps to become a zero waste city.

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