

STUDY OF WATER QUALITY OF DEEPOR BEEL DURING MONSOON SEASON USING WATER QUALITY INDEX METHOD

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Abstract –The aim of this paper is to study the water quality of Deepor Beel in terms of Water Quality index (WQI) and identify different pollution zone. For determining water quality of this beel, eight different sites within Deepor beel were selected. Samples were collected from this sites during monsoon season (April to September). Different physio-chemical test were performed in the laboratory of Assam Engineering College. From this test results water quality index at different sites are calculated. Using this water quality index value, spatial distribution map using QGIS had been prepared. Water samples of Pamohi, Boragaon and Chakradeo are fall in class IV category of pollution scale during 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.

Key Words: Deepor Beel, Water Quality, Water Quality Index, QGIS, Spatial distribution, Monsoon

1. INTRODUCTION

Deepor Beel provides large habitat for several organism as well as many economically important and endangered flora and fauna. The ecosystem of this wetland provides important breeding and feeding grounds for water birds consisting of over seventy migratory species. This Beel also habitat for various IUCN red listed species like Spot-billed Pelican (*Pelecanus philippensis*), Baers Pochard (*Aythya baeri*), Lesser Adjutant Stork (*Leptoptilos javanicus*), Many migratory birds have been visited this wetland particularly during winter season. Deepor Beel supports indigenous freshwater fish of over 50 species belonging to 19 families. 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 are 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. Falling of oxygen level resulting in death of fish and other aquatic life. In recent years, dead fishes floating on the surface of Deepor Beel. So, this study try to analyses the water sample of this wetland and to know the level of pollution.

2. STUDY AREA

Deepor Beel is located in the district of Kamrup (Metro) of Assam. It is the single Ramsar site located in Assam. Deepor Beel was declared as “Wetlands of International Importance” in the Ramsar Convention on wetlands, 1971. Area of Deepor Beel is 40 square kilometer. It is located in between 26°05'-26°12' N latitude and 91°34'- 91°44' E longitude and situated in the southwest direction of Guwahati city. This beautiful beel surrounded by residential, commercial, institutional & industrial areas. Many reputed educational institute has been set up near this Ramsar sites, for e.g. Gauhati University, Assam Engineering College, Assam Ayurvedic College, Forest School, Assam Science and Technology University and Tata Institute of Social Science. NH 37 touches its periphery on the northern side of the wetland . Human activities like encroachment, pollution, fishing, killing of migratory birds, excessive fodder practices lower down the environment value. This has increased the importance of conservation and restoration of the beel. Beel . Many stone quarries, industries are grown up in the boundary of Deepor Beel. During monsoon period the mud water from high area reaches the beel and causes siltation which decreases the depth of the Beel.



Fig -1: Deepor Beel



Fig -2: Dumping site at Boragaon

3. METHODOLOGY

Water samples were collected from Pamohi, Deepor beel point, Dharapur, Azara Railway Station, ASTU, Boragaon, Chakradeo and AEC campus. Collected water samples are tested for different parameters in the laboratory of Environmental Engineering, Assam Engineering College. Various physical and chemical parameters like P^H , Turbidity, Hardness, Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO), Chloride, Total Solids and Alkalinity have been monitored for different locations.

With the reference of this test results, water quality index (WQI) is calculated. It reflects the combined effects of various water quality parameters are taken into consideration

for the water quality assessment. Co-ordinates of each station are collected by “GPS Status” applications.

Table -1: Co-ordinates of Sample collection sites

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

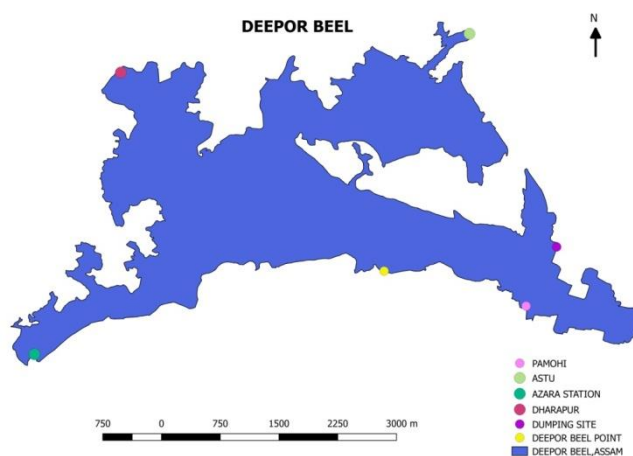


Fig -3: Map of Deepor Beel



Fig -4: Laboratory Experiments

A. Weighted Arithmetic Water Quality Index

Weighted Arithmetic Water Quality Index 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

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

Where V_i = estimated concentration of i th parameter in the analysed water

V_o = the ideal value of this parameter in pure water

S_i = recommended standard value of i th parameter

The unit weight (W_i) for each water quality parameter is calculated by

$$W_i = K / S_i$$

Where, K = proportionality constant

Table -2: Weightage Arithmetic Method Water Quality Rating

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

In this methods six parameters are considered for the water quality assessment of the beel. With the help of this parameter means DO, BOD, COD, Suspended Solids, Ammoniacal nitrogen and pH , water quality index (WQI) is calculated. In this method. different water parameters carry different weightage which is listed in Table-3.

Table -3: 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
pH	0.12

Source: Ministry of Environment (MOE)

The recorded value of different parameters are converted into sub-indices (SI). Sub-indices are calculated according to the best fit relation prescribed by MOE, The formula used to evaluate water quality index is

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

Table-4 shows the best fit equations of sub index values for different ranges

Table -4: Best fit sub index equation

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

Table -5(a): Test Results During Monsoon Season

Test Location	Alkalinity	Hardness	pH	Turbidity
Pamohi	38.6	124	7.55	11
Deepor Beel Point	37.5	108	7.36	7
Azara	37.6	120.6	7.08	6
Dharapur	42	110	7.32	10
ASTU	35	116	7.16	6
Boragaon	40.5	168	7.5	12
Chakradeo	41	118	7.28	8
AEC	32	100	7.4	5

Table -5(b): Test Results during Monsoon Season

Test Location	Chlorides	DO	BOD	TSS
Pamohi	49.1	3.45	6.59	90
Deepor Beel Point	37	6.1	5.17	70
Azara	64	9.12	4.862	80
Dharapur	61	6.9	5.17	60
ASTU	48	8.9	4.35	70
Boragaon	44	3.45	10.03	120
Chakradeo	46	7.7	3.94	110
AEC	36	8.21	3.65	60

4. RESULT AND DISCUSSION

Water samples after collecting from site were tested in the Environmental Engineering laboratory, Assam Engineering College. Test results of different parameter during Monsoon season are shown in table-5(a), 5(b) and table-5©. BOD level at Boragaon is found over 10 mg/l. One of the important parameter Dissolved Oxygen value at Pamohi and Boragaon is below permissible value of 4mg/l. Mainly due to flow of mud water from the surroundings the turbidity level of water sample of Deepor beel is on the higher side during monsoon season.

Table -5(c): Test Results during Monsoon Season

Test Location	TDS	COD
Pamohi	210	45.2
Deepor Beel Point	190	28
Azara	140	30.8
Dharapur	160	13.2
ASTU	110	17.2
Boragaon	280	48
Chakradeo	150	25.2
AEC	100	13.2

			III		III
		Non Monsoon		Monsoon	
		WQI	Class	WQI	Class
5	ASTU	64.14	Class III	63.32	Class III
6	Boragaon	56.56	Class IV	47.26	Class IV
7	Chakradeo	59.29	Class IV	56.35	Class IV
8	AEC	64.67	Class III	65	Class III

A. Water Quality Index (WQI)

WQI values of Deepor Beel at different sites during monsoon season ranges from 47.26 to 65. WQI values of Site Pamohi, Boragaon, Chakradeo are falls under class IV, i.e. these points are in polluted region. Other five sites are falls in class III category which is slightly polluted.. Table 6 shows the WQI values during monsoon season compare with that of non-monsoon season (Dadhara MP et.al). It suggest that water of Deepor Beel is good for handy fish and course fish but in some location it is doubtful for sensitive fish.

Table-6 Water Quality Index values

Sl no	Location	Non Monsoon		Monsoon	
		WQI	Class	WQI	Class
1	Pamohi	58.65	Class IV	50.08	Class IV
2	Deepor Beel Point	59.12	Class IV	60.35	Class III
3	Azara	63.26	Class III	60.19	Class III
4	Dharapur	63.31	Class	63.74	Class

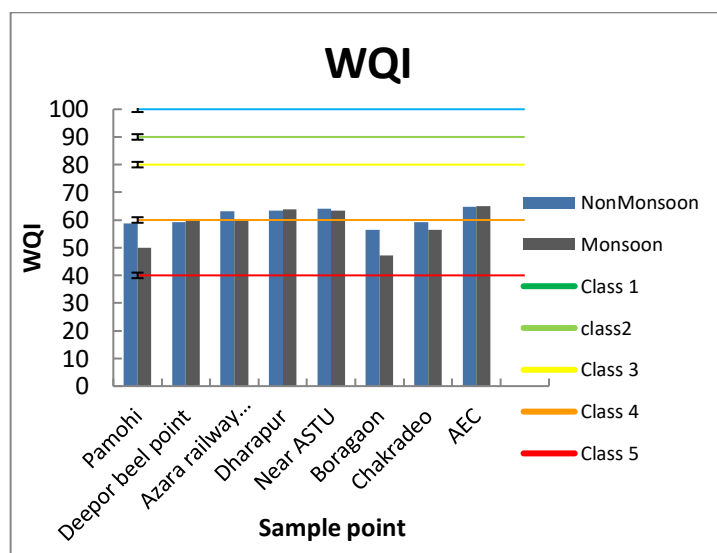


Fig -5: Water Quality Index vs Sample collection sites

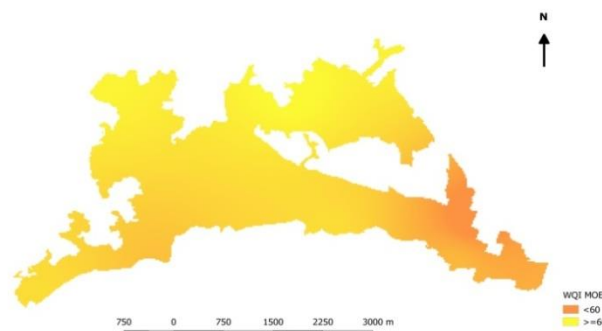


Fig -6: Spatial Distribution Map of Water Quality Index
for Monsoon season

B. Arithmetic Weightage Water Quality Index

In table 7 arithmetic weightage WQI values at different sites for non monsoon season (Dadhara MP et.al) are tabulated and in table 8, arithmetic weightage WQI values at different sites for monsoon season. From these two table we can compare the values during both seasons. Boragaon is the highest polluted during both seasons and ASTU and AEC is the least polluted zone during non monsoon and monsoon season respectively.

Table-7 Arithmetic Weightage WQI values at different sites
for non-monsoon season

Sample Site	Non Monsoon	
	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)

Table-8 Arithmetic Weightage WQI values at different sites
for monsoon season

Sample Site	Monsoon	
	WQI	Class
Pamohi	86.19	D(polluted)
Deepor Beel Point	61.87	C (moderately polluted)
Azara	52.58	C (moderately polluted)
Dharapur	66.9	C (moderately polluted)
ASTU	58.83	C (moderately polluted)
Boragaon	111.22	E (Highly Polluted)
Chakradeo	54.45	C (moderately polluted)
AEC	46.16	B(Slightly polluted)

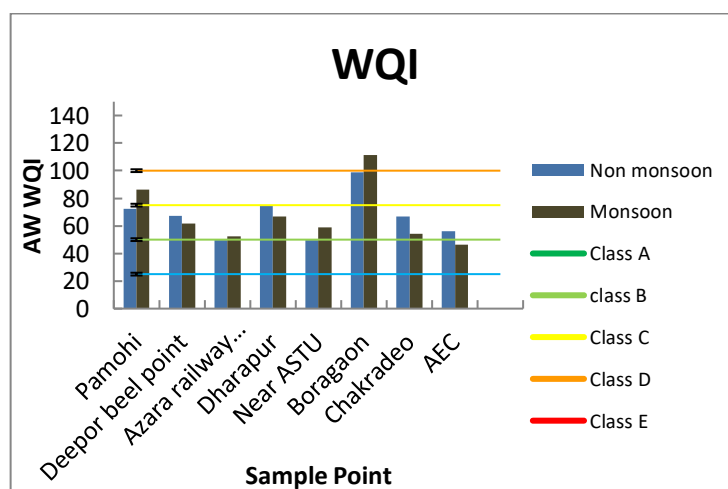


Fig -7: AW WQI vs Sample collection sites

In fig 7, comparison of AW WQI values for both the seasons are shown.

Fig 8 depicts the spatial distribution map of arithmetic weightage water quality index values for monsoon season which is prepared in QGIS.

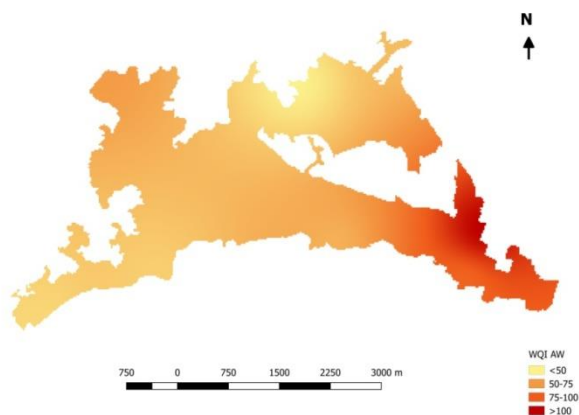


Fig -8: Spatial Distribution Map of AW Water Quality Index for Monsoon season

5. CONCLUSIONS

During this project samples were collected from eight sites; Pamohi, Deepor beel point, near Azara railway station, Dharapur, near ASTU, near dumping site (Boragaon), Chakradeo and near AEC campus. Physical -chemical water quality parameter like alkalinity, hardness, P^H , turbidity, chloride, DO, BOD, COD and total solids have been tested to find out water quality index. Alkalinity level of all test samples during monsoon season found below permissible level. P^H ranges from 7.08 to 7.55 (Table 5(a)). The turbidity level of water samples collected from Boragaon, Pamohi is above permissible limit (Table 5 (a)). Chlorides concentration of all the tested water samples is found within permissible limit (Table 5(b)). DO and BOD level at Boragaon and Pamohi is not within permissible limit which indicates the level of pollution in that regions. With the help test results, water quality index at all the testing sites of Deepor beel is calculated. Boragaon, Pamohi and Chakradeo sites falls under zone IV and other five sites are falls under zone III, i.e

moderately polluted. From the comparison it is seen that pollution level during monsoon season is more than that of non monsoon season. it may be mainly due to the flow of pollutant, garbage from the surroundings to beel water. To counteract the environmental imbalance of Guwahati city, Deepor beel can play a major role. So it is duty of our Government and concerned authority and also our duty as a responsible citizen to make a step towards the safeguard of this beautiful beel.

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