

## **EFFECT OF URBANIZATION ON DEEPAR BEEL IN THE CITY OF GUWAHATI, ASSAM, INDIA**

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### **ABSTRACT**

Deepar Beel on which the present study is focused is a natural fresh water lake locally known as "Beel". Deepar Beel, a Ramasar site, is situated on the southern bank of river Brahmaputra. It is a wetland of riverine importance in the southwestern fringe of city of Guwahati covering an area of 4000 ha. In January 1989, the Forest Department, Govt. of Assam declared the wetland as a wildlife sanctuary. However, the sanctuary covers only 414 ha of the total Deepar Beel area. In Sept. 1993, Govt. of India declared the wetland as one of the 17 wetlands of national significance. The beel got the international recognition as a Ramasar site in October 2002. The beel serves as a major natural storm water reservoir for the entire Guwahati city. The geology of the surrounding, the hydrology of the in-flowing and outflowing streams viz. the Bharalu, Kalmani, Basistha and Khanjan and the nature of land use in the adjoining area greatly influenced the beel development and transformation in the present day status. The quality of soil and water of Deepar Beel and its connecting water bodies and the concentration of trace elements in the bottom sediments of the beel is presented herein.

### **INTRODUCTION**

In the world's wetland areas, ecology, microclimate and the local economy of the area depend on excess water. Wetland soils are at least periodically saturated, and wetland plant communities are often dominated by hydrophytes, plants that are adapted to the often severe problems posed by saturation, particularly oxygen depletion and the toxic products of anaerobic decay. Many natural wetlands are highly productive in the ecological sense, with a net primary productivity almost the same as that of rice fields and rather more than that of non-wetland vegetation, but the fruits of this productivity have been under-valued, even neglected, by man, and a sustained campaign of drainage, "reclamation" and non-sustainable exploitation has left wetland areas severely depleted. To answer all these concerns, independent investigations of the individual wetland is central to the study of wetland hydrology, as the relative significance of the various inputs, output and storage underlies the hydrological functions, water quality functions, sustainable use and the management of wetlands for conservation. This paper presents the recent status of Deepar Beel followed by an overview of important areas of interaction between the beel and its surroundings (the morphometry), relationship between the beel and rivers (the regulation function), relationship between the beel and the atmosphere (wetland hydrology), relationship between the beel and civilization (wetland anthropology) and relationship between the beel and urbanization (cause and effect).

### LOCATION OF THE STUDY AREA

The study area namely the Guwahati Metropolitan District is situated within Assam, one of the north eastern states of India. Guwahati is considered the economic capital of the north eastern region of India. The geographical area is located at 26°-10' north of equator and 92°-49' east of Greenwich. River Brahmaputra flows by north of the study area, which extends to about 24 km. (15 miles) in the south. It covers a total area of about 217.6 km<sup>2</sup>. (85 miles<sup>2</sup>). History reveals that Guwahati stands on the most stable bank of river Brhmaputra, and least, disturbed by erosion of the river Brahmaputra. Location of the study area is shown in figure 1. The Greater Guwahati area of about 243.2 km<sup>2</sup> referred to in this paper as the Guahati Metropolitan District is mostly on the south bank of the river Brhmaputra having north Guwahati and some contiguous areas measuring only about 23 km<sup>2</sup> (9 miles<sup>2</sup>) situated on northern bank of river Brhmaputra. The study area includes one municipality, two town Committees and fifteen different areas administered and occupied by public bodies like Railways, Defense Establishment, etc. and eighty two rural areas.

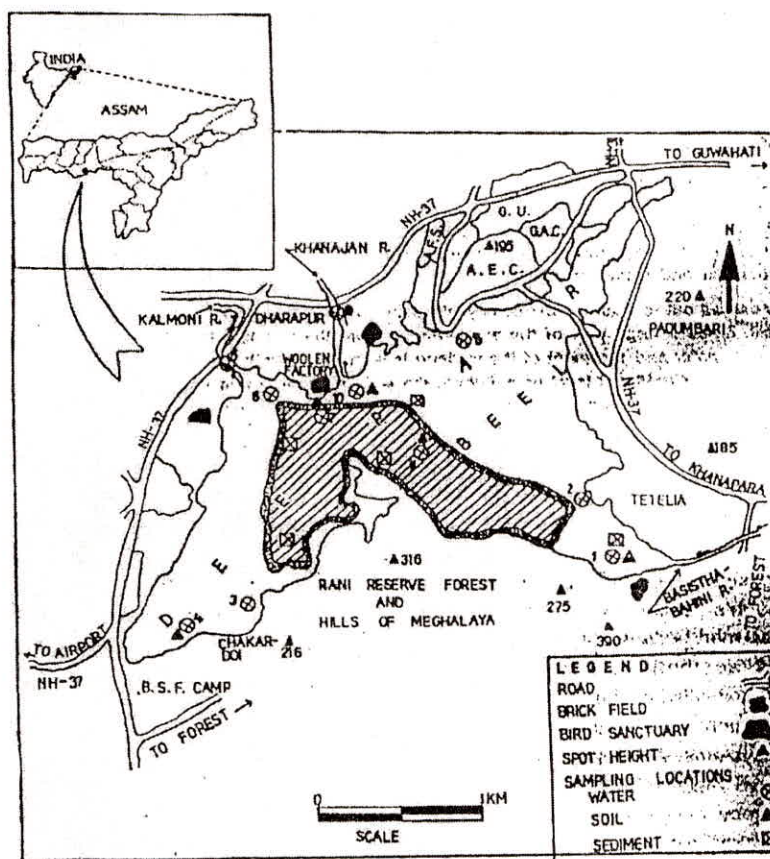


Fig. 1. Topographical location of Deepar Beel



**GEOGRAPHICAL FEATURES AND TOPOGRAPHY OF THE AREA**

Southern bank of the river Brhamputra rises up from an average ground elevation of 51.3 m. (168 ft.) and except in certain central and western portion, the area goes up to hill ranges namely Khaeghuli and Nabagraha Hill ranges rising to a maximum of 216 m. (712 ft) in the eastern portion and Nilachal hills rising to a maximum of 303 m. (9660 ft.) in the central portion. Then it falls down to a valley having a average ground level of 49 m. (160 ft.) and a minimum elevation of 41.16 m. (135 ft) after which it gradually rises again to Khasi and Jaintia Hills to a maximum elevation of 575 m. (1866 ft) which constitutes the southern boundary of the district. In the east, the area slopes down from a hill range having a general elevation of 182 m. (600 ft ) to a value having an elevation of 49 m. (160 ft) Inside the area there are (i) Fatasil range (elevation average 358 m.), (ii) Sarania Hills (elevation average 250 m.), as shown in figure 2 and figure 3. In between the hills again there are pockets of low-lying areas with an elevation of 49 m.(160 ft.) on an average. On the west is a valley land including a vast low-lying area named Deepar Beel, which occupies more than 54 km<sup>2</sup>. (21 miles<sup>2</sup>). The study area though situated within the seismic zone has a very stable foundation. Even the earthquake of 1950, which registered a magnitude 8 1/2 in the Richter scale, did not produce any major fault in the area. There is hardly any area within the Greater Guwahati Metropolitan District where there is any alluvium deposit. There is more or less continuous layer of igneous rock all through the area, the depression of this rock layer has constituted the valley areas and its outcrop, the hillocks. Geology of the study area is shown in figure 4.

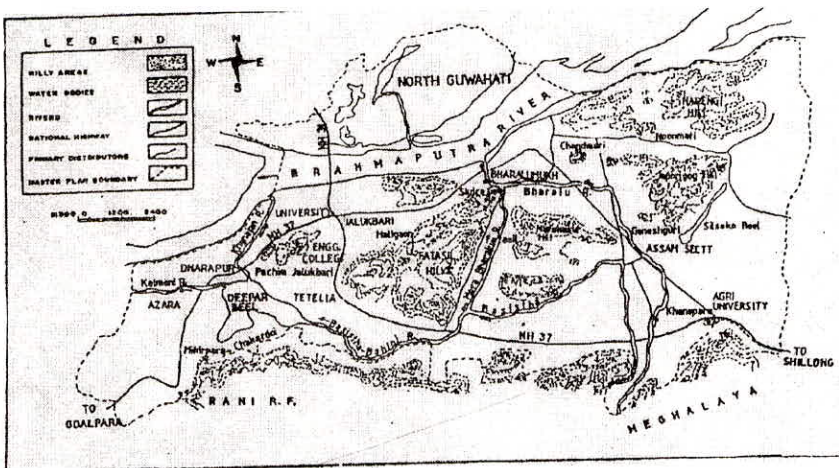


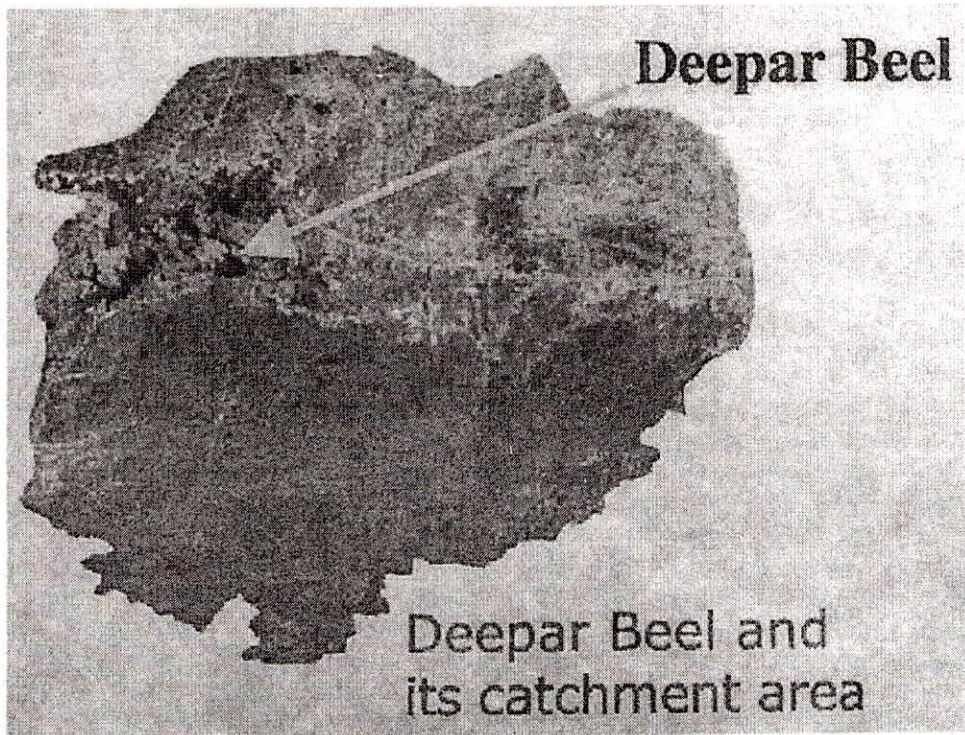
Fig. 2. Topography of basin of Deepar Beel basin





## Urban Lakes in India : *Conservation, Management and Rejuvenation*

Situated at a distance of 10 km. south west to Guwahati, Deepar Beel is a permanent freshwater lake with altitude of about 53 m. Its geographical location is within the latitude  $26^{\circ} 05' - 26^{\circ} 09' N$  and longitude  $91^{\circ} 36' - 91^{\circ} 45' E$ . Deepar beel and its catchment area is shown in figure 5. Area of the lake is 4,000 ha. Depth of the lake at the maximum flooding is 4m. and drops down to 1 m. in dry season. Principal sources of water for the beel are river Basistha, Kalmani & monsoon runoff. The lake drains into river Brhamputra. About half of the lake dries in winter and the shore is converted into rice fields. The forests to the south of the lake are being felled resulting in the soil erosion and siltation. The runoff water carries agricultural fertilizers and pesticide etc. in to the beel even though, it is a unique wetland habitat for wild and endemic flora and fauna. Several endangered, rare and threatened species of mammals, birds, amphibians, reptiles, fish and plant species occur in this beel. It is the only storm water storage basin for Guwahati city. It serves as a life line to a community of over 3000 fisher folk in the adjoining area.



### CLIMATE OF THE AREA

Climate of catchment area of Deepar Beel is more or less moderate with temperature variation between the average minimum in winter and average maximum in summer limited to around  $20^{\circ}C$ . It is outside the tropic of Cancer. The principal characteristic is a cold and foggy weather, a moderately hot spring and temperately hot but very humid summer. Monsoon in the catchment area is rather long extending from May to September. Though most of the rainfall occurs during the monsoon, occasional heavy downpour is often experienced during winter. Table 1 presents the mean temperature and rainfall within the study area.



**Table-1. Mean temperature, humidity and rainfall in catchment area of Deepar Beel**

Month	Temperature (° C)			Humidity (Recorded at 08;30 Hrs.)	Rainfall	Number of Rainy Days
	Max.	Min.	Mean			
	(° C)	(° C)	(° C)	(%)	(mm)	
JAN	24.0	11.0	12.50	88	11.4	1.2
FEB	26.3	12.8	19.55	78	18.3	1.8
MAR	30.2	16.5	23.35	71	53.4	4.2
APR	31.6	20.3	25.95	72	125.9	8.3
MAY	31.0	22.7	26.35	81	273.6	15.1
JUNE	31.5	24.7	28.1	85	301.5	15.1
JULY	32.1	25.8	28.95	85	301.5	14.2
AUG	32.2	25.8	29	84	190.1	9.5
SEPT	32.1	25.2	28.65	84	190.1	9.5
OCT	30.5	22	26.25	84	90.1	4.8
NOV	27.7	16.9	22.3	87	11.5	1.3
DEC	24.9	12.5	18.70	89	5.1	Less than 1

### INVESTIGATIONS CARRIED OUT FOR DEEPAR BEEL

Reconnaissance and preliminary survey of whole Deepar Beel area has been conducted and major features of Deepar beel such as different portion of the beel identified by their different names such as Bar Shala, Bara Beel, Kanhia Mukh, Bahini Mukh depending the depth of water and extension of water area for that depth of water were identified. In non monsoon season (December to April), depth of water in shallow portion of the beel is about 3 feet where as in deeper portion of the beel, depth of water is about 6 feet. These depths of water dry to an approximate lower depth of 2 feet and 5 feet respectively up to the onset of monsoon rainfall. During dry season there are so many islands in the beel area but during rainy season i.e. from June to October the whole area is completely submerged and the depth of water in the dry area shallow portion may go up to 10 feet and in the deeper portion up to 12 to 13 feet. Input to the beel is through river Basistha Bahini at the southwestern portion of the beel and major exit from the beel is by river Kanijhan at the north west portion of the beel. River Kanijhan meets river Brhamputra a short distance north of the beel. There is significant flow in the stream running across the beel from entry to the exit. There is another exit also by river Kalmani which merges with river Brhamputra at Palasbari at a distance of about 15 kms. from the exit of Deepar Beel. The flow from Kanijhan to Brhamputra is regulated by a sluice gate. During rainy season water level of river Brhamputra is higher than that of the Deeper Beel. Any faulty operation of sluice gate on river Kanijhan may prove to be disastrous for the city of Guwahati because drainage of Guwahati is carried to Deepar Beel through river Basistha Bahini and Bharalumukh. One stream of Bharalumukh meets river Basistha Bahini before entry of Basistha Bahini to Deepar Beel.

Railway department has constructed a permanent concrete bridge in this beel on river Basistha Bahini just near the entry to the beel for providing rail connection from Panchratna to Guwahati as shown in figure 3. For making this bridge whole width of the beel near its inlet

has been bounded by earthen banks and only a waterway of about 30 meter width has been provided. It may be anticipated that there would be considerable obstruction to the entry of water into the beel due to which river Basistha Bahini carrying the whole drainage water of Guwahati city would not be able to discharge completely resulting in back water flow through this river and subsequent immediate flooding of the city just after instant rainfall.

**EFFECT OF URBANISATION ON DEEPAR BEEL**

Water of Deepar Beel is highly polluted due to sewage disposal of Guwahati city in the beel. In the shallow portion, which is more active portion of the beel, the water quality is much worst. Deeper portion of the beel is by the foot of the Rani Hills on the eastern side of the beel. The water in deeper part is less contaminated and henceforth provides sheltering place for aquatic birds such as Ducks, local type of cranes and other migratory birds

Due to changing water quality the variety of migrating birds are also changing over years. The depth of water has also reduced over years due to heavy silts coming into the beel every year. This reason seems quiet obvious due to accelerated deforestation of the Rani hills on eastern side of the beel and cutting of the Rani hills due to which silts directly come into the beel. The incoming streams into the beel are also carrying heavy load of silts to the beel over the years. The variety and quantity of fish has also reduced considerably due to deteriorating water quality of the beel. This phenomenon is alarming because fishery and cultivation of local paddy provides livelihood to the local population. There is cultivation of local type of paddy in the beel. Due to deteriorating water quality of the beel, yield of the paddy is going down year by year. The water quality is also affecting the health of the people active in use of the beel. Water quality parameters of the Deepar beel and at different locations in its connecting water bodies as shown in figure 1 are presented in table 2.

**Table-2. Water quality parameters of Deepar Beel and its connected water bodies**

Sr.	Location	pH	Conductivity	Alkalinity	Turbidity	Total Solids	DO	BOD
			(mho CM <sup>-1</sup> )	(mg/l)	(NTU)	(mg/l)	(mg/l)	(mg/l)
1.	Inlet	7.5	549	56	79	312	1.7	13
2.	Tetelia	6.8	460	41	68	143	10.4	1.5
3.	Chakardoi	6.8	465	44	12	65	8.2	1.2
4.	B.S.F Camp	5.5	53		264	3.3	7.2	
5.	Kalmoni River	7.0	480	39	5	00	8.8	0.6
6.	Dharapur	5.4	510	58	44	75	6	3.4
7.	Woolen Factory	7.3	515	57.5	78	276	1.9	10.3
8.	A.E. C. College	6.3	470	45	12	80	7.3	3.3
9.	Khanamukh	7.0	495	41	10	40	6.7	2.0
10.	Outlet	7.0	476	43	65	214	2.7	9.7
11.	Middle of beel	6.9	470	40	64	159	2.8	8.1

A comprehensive survey of the fauna by the researchers of the Department of Zoology, Guwahati University reveals the existence of large numbers of faunal diversity. Altogether 21 zooplanktonic genera, a total of 18 genera of phytoplankton are reported only from the core



area of the beel. Altogether 220 bird species have been recorded, of which 70 species are waterfowl. Among all the avian fauna recorded, 8 species were scheduled I species of Wildlife Protection Act 1972 and 17 species are globally threatened bird species. Very high diversity of fishes, amphibian, reptiles, Helminthes, Annelids, insects, prawn, mollusks, etc. are also found in the beel.

Though the Forest as well as Department of Town and Country Planning of Govt. of Assam, Assam, India have declared Deepar Beel as a reserved area, still there are growing encroachment in the beel area. There are reclamation of lands on the northern side of the beel for construction activities, as shown in figure 7, which are disturbing the ecology of the beel. Brick making activities goes in the beel during dry season. This may not be so much harmful to the health of the beel because it takes place during dry period and leaves behind ditches which gets filled up during the rainy season. Physio-chemical trace element characteristics of soils of Deepar beel at selected sites are given in table 3, trace element concentration in bottom sediments of the Deepar beel are given in table 4 and physical properties of the beel soil at various depths are given in table 5.

**Table-3. Physio-chemical and trace element characteristics of soils of Deepar Beel and its water bodies at selected sites**

Parameters	Locations				
	Inlet	Outlet	B.S.F.Camp	Woolen Factory	Bottom of the Beel
PH	4.1	5.7	5.3	5.2	4.5
Conductivity (mho CM <sup>-1</sup> )	0.3	0.24	0.67	0.29	0.17
Alkalinity (ppm)	15.3	26.1	91.1	52.3	30
Sulphate (NTU)	109	162	340	162	100
Phosphorous (ppm)	0.106	0.08	0.096	0.09	0.096
Chloride (ppm)	17	2.9	3.9	5.0	3.0
Organic Content (%)	4.7	0.95	1.03	1.72	4.19
Carbon (%)	2.7	0.55	0.6	0.99	2.43
Boron (ppm)	5.82	3.2	4.4	3.2	3.6
Lead (ppm)	54	33	36	34	37
Zinc(Zn) (ppm)	122	208	138	140	192
Iron(Fe) (ppm)	40128	36415	26423	24681	31610
Chromium(Cr) (ppm)	129	135	110	104	139

Due to anaerobic condition of the beel water, almost all over the year, the beel is fully covered with thick green floating algae called as phumdi which is collected by the local people for providing food to the cattle. The fisherman to catch the fishes also utilizes this phumdi. Anaerobic decomposition of the phumdi during non-monsoon season is also one of the main reasons for bad water quality. During monsoon season these phumdi gets washed away due to flash flood passing through Deepar Beel. These phumdi also obstruct the flow near the sluice gate at river Kanijhan for passing the flow to river Brhamputra.



**Table 4. Trace element concentration in bottom sediments of Deepar Beel**

Elements	Site 1	Site 2	Site 3	Site 4	Site 5
Pb (ppm)	100	100	100	100	100
Sn (ppm)	10	10	10	10	10
W (ppm)	100	100	100	100	10
Ge (ppm)	10	10	10	10	10
In (ppm)	10	10	10	10	10
Co (ppm)	50	50	50	50	50
Ni (ppm)	50	50	50	50	50
Bi (ppm)	20	20	20	20	20
Ti (ppm)	500	1000	700	1000	500
Mo (ppm)	10	10	10	10	10
V (ppm)	30	100	10	10	10
Cu (ppm)	70	50	50	50	50
Ag (ppm)	1	1	1	1	1
Nb (ppm)	30	30	30	30	30
Ta (ppm)	500	500	500	500	500
Zr (ppm)	10	10	10	10	10
La (ppm)	50	50	50	50	50
Y (ppm)	30	30	30	30	30
Yb (ppm)	5	5	5	5	5
Mn (ppm)	50	30	10	10	10
Sc (ppm)	10	10	10	10	10
Be (ppm)	5	5	5	5	5
Ba (ppm)	50	30	10	10	10
Sr (ppm)	50	100	100	100	100
Zn (ppm)	125	100	100	125	125
Cd (ppm)	20	20	20	20	20
Cu O (%)	1.19	0.49	0.35	0.35	0.56
Mg O (%)	1.75	0.70	0.40	0.65	1.10
S (ppm)	1757	6355	2750	1845	6500
Fe <sub>2</sub> O <sub>3</sub> (%)	8.50	5.80	4.20	4.60	8.90
Cl (%)	0.44	0.96	0.44	0.26	0.44
P <sub>2</sub> O <sub>5</sub> (ppm)	175	500	500	100	200

**Table-5. Physical properties of Deepar Beel soil at various depth**

Depths	Specific Gravity	Liquid Limit	Plastic Limit	Plasticity Index
(m)				
0 - 1.5	2.59	44.00	18.79	25.21
1.5 - 2.1	2.625	----	----	----
2.1 - 3.0	2.59	38.44	19.03	21.41
3.0 - 3.9	2.58	----	----	---
3.9 - 4.2	2.615	52.23	25.49	26.74

## CONCLUSIONS

Deepar Beel is facing serious threat for its existence. Prior to 1990, the only major threat to the beel was the construction of railway line through the ecosystem. But after 15 years, the

major and potential threats are the land fillings, settlements, industrial development, degradation of natural ecosystems due to reckless soil cutting and removal of top soil. The intensive fishing activities, hunting of the water birds, deforestation in the catchment leading to erosion, accelerated eutrophication, untreated sewage disposal, encroachment in the beel area, industrial development within the periphery of the beel. The abundance of certain protozoan community, such as "Paramecium" group indicates the presence of putrefied organic matter. The presence of "Rotifer" group throughout the year also indicates the nutrient rich status of the beel water.

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