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The Present status of the Coastal Ecological Estuarine Water bodies and Its Water Quality Analysis through Geospatial Technology and Assessment of fishery resources in Sundarban, West Bengal, India

Panchanan Das[*1] and Jatisankar Bandyopadhyay[2]

[1*]Department of Remote Sensing and GIS, Vidyasagar University, Midnapore, Vidyasagar University Rd, Rangamati, Medinipur, West Bengal 721102, West Bengal, Email: das.panchanan11@gmail.com

[2]Department of Remote Sensing and GIS, Vidyasagar University, Midnapore, West Bengal, Email: jatib@mail.vidyasagar.ac.in

ABSTRACT:

Sundarban wetland is considered to be the most potential fishery resources productive zone. Almost in every direction the wetlands are interlaced in the Sundarban area where is the small & large river, morasses, swamps, estuaries & canals. The major channels in this region are Muringanga, Saptamukhi and Thakuran-Matla, while the smaller estuaries are Moni, Karati, Gosaba, Kulti, Bidyadhari, Gomas and Haldi. The wetland area are extracted from landsat 7 etm+ imagery through spatial technique besides the G.P.S survey has been done to compare the ground truthing with Satellite images. The water body map is prepared through image processing technique to show the total stretch of wetlands in Sundarban area. The mapping waterbody where its analysis of water quality parameters such as Temperature, pH, Salinity, BOD, dissolved oxygen (DO), TDS, Turbidity for assessment of health of water and ecology of fish life. A huge fish diversity is available there, that includes freshwater and saline water species where analysis of conduction of resources. The some fishing community is depending on fishery resources for livelihood in this region. In this present study an attempt has been made to the waterbody mapping and its quality assessment and analysis of fishery resources activity in Sundarban.

KEYWORD: The Sundarban, Fish Resources, Estuaries, Wetlands, spatial technique.

*Corresponding author

Panchanan Das

Research Scholar,

Department of Remote Sensing and GIS,

Vidyasagar University, Midnapore,

Vidyasagar University Rd, Rangamati, Medinipur,

West Bengal 721102, West Bengal,

Email: das.panchanan11@gmail.com

INTRODUCTION

The estuaries are a considered as buffer zone between freshwater and marine water habitats. The estuaries of Indian Sundarbans is a perfect test bed to carry on such experiments because of its proximity to highly urbanized city of Kolkata (the direct cause of carbon dioxide emission) (Mitra[1], 1992; Mitra[2] et al., 2010) and presence of about 2110 sq km of mangroves (Sengupta[3] et al., 2013; Raha[4] et al., 2013). It is an area of land to sea and fresh water and salt water are mixed to provide a unique ecosystem. This ecosystem is composed of brackish water which is made up by fresh water and marine water. The estuaries are physical and biological parameter, depending on water quality that land and ocean contribute to create a unique environment. The estuaries are developing by delta, reefs, headlands and barriers islands. It is most productive zone on the Sundarban. The ecology normally is a large area where different types of flora and fauna, such as micro plants and animals known as plankton, large plants such as grass and reeds, and also fish, curb, amphibians, reptiles and birds. The brackish ecosystems are relatively oxygen-rich and randomly changing phenomena to wetland. The comprehensive shape of aquatic ecosystem is resolved by the interaction of all its physical, chemical and biological components, which develop its ecosystems. The ecological assessment is a way of analysis of all the components of the ecosystem. This method is used towards conservation, management and sustainable utilize of natural resources.

Water pollution is a defined as the existence degradation in such quantity and of such nature as to harm to utilize water for a different purpose. The water quality is predicted on the calculating of the water and the determination of the amount of suspended solids and dissolved impurities. The water qualities are focused on physical and chemical measurement parameter, which greatly enhance the assessment and management of estuarine ecosystem. The quality of water is identified in terms of its physical, chemical and biological parameters (Sargaonkar & Deshpande[5], 2003). The Sundarban wetland is one of the economic fishery resources ground of the world. "The coastal zone and mangrove contains diverse and unique resources as well as ecosystems that are important for biological and economic productivity, functioning as an ecotone, a transitional protective area between the land and the sea (Clark[6] J.R., 1983)". "The diversity of the fishery mainly depends upon the biotic and abiotic factors and types of the ecosystem, age of the water bodies, mean depth, water level fluctuations, morphmetric features and bottom have great implications (Giri[7] et al. 2012)". "Most of the human settlements along the Indian coast are located along the estuaries and deltas (Chaves [8] et al. 2008)". The tidal rivers, channels and creek of Sundarban are very important for estuaries fishes like mullets, perches threadfins, prawns etc. The people of Sundarban who belong to the lowest economic of the society largely depend on fish resources. In view of the development of the Sundarban region of West Bengal for pisciculture, agriculture, forestry is essential for proper

utilization of the resources. The application geospatial technology in estuarine ecology is unpredicted thing, so it utilize has been data management, mapping of different segments and analysis of attributes. The difficulty studying an estuarine ecology is that highly dynamic. So, the water parameter likes pH, Salinity, BOD, TDS and Turbidity etc. are changed automatically. The Geospatial technology provides an easy technique to current data concerning the spatial investigation of an estuary. The Spatial base models are used to predict the effects of different object of the environment.

This study seeks to find the fishery resources of important estuaries in Sundarban through spatial technology. The aim of the study is that the present status of the ecological estuarine water bodies and its water quality analysis through spatial technology and assessment of fishery resources in Sundarban, West Bengal, India. The objectives of research work are the ecological status of estuaries and wetland mapping through geospatial technology. So here, this type's work does not do so that, we prepared a paper to shows scenario of actual situation of the ecological estuarine water bodies, water quality and fishery resources. It is also the analysis of water quality parameters and assessment fishery resources management to uplift of the society. The Sundarban estuaries wetland (Fig.1) is involved of Hooghly-Matla-Bidyadhari River to create a fishing ground. It is located between latitude 22^0 41' 47" to 21^0 29' 34" N and longitude 88^0 2' 13" to 89^0 6' 35''E of 24pargona in West Bengal, India. The Sundarban estuaries are low flat alluvial plain covered by mangrove swamps and so many types of tidal rivers crisscross the region. The Hooghly river received great amount of freshwater and sediment from the Ganga river.
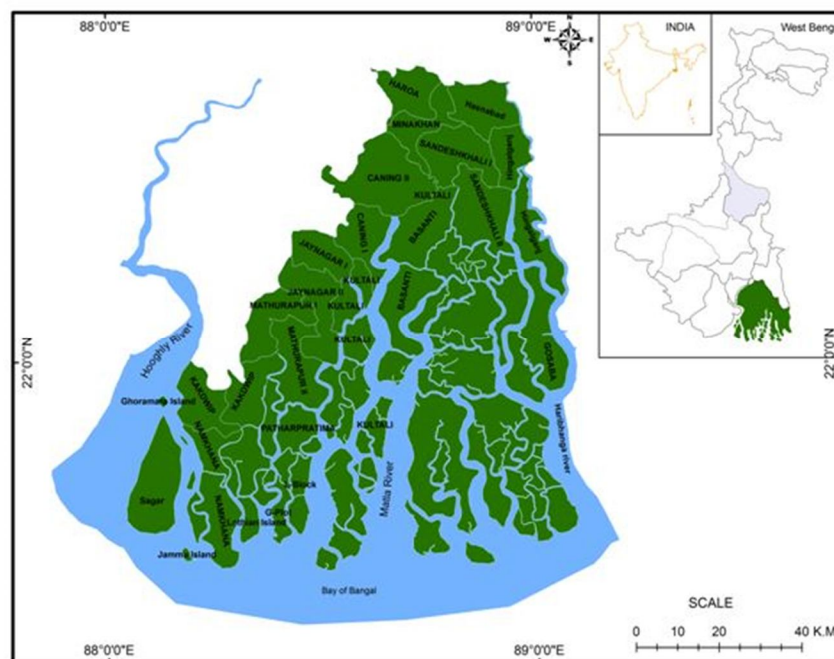

Fig. 1: Location Map

MATERIALS AND METHODS

Data Used

The Landsat 7 ETM+ data (Sources- GLCF http://glcf.umd.edu/) is used to prepare estuary and wetland Mapping. The Unsupervised classification technique is used to extract for wetland resources. The several steps are involved from selection of satellite image data, spatial resolution, and geo-referencing, image processing and unsupervised classification. In the study, the unsupervised classification technique has been applied to extract the waterbody from image. The LANDSAT 7 ETM⁺ data have been used to map and analyze, it is downloaded from GLCF website. The Fish base website database gateway is used for fish documentation, identification and analysis of present status in the Sundarban region.

Physiographic of Coastal Ecological Estuarine Wetland:

The water temperature ranges between 19.0 - 34.2 ^{O}C. It reaches the maximum in May-June and lowest in December-January. During monsoon, flood water dominates limiting the influence of seawater. The high temperature of summer increases evaporation, resulting in high salinity. (T. Srinivasa Kumar[9] et al. 2011). The alteration in salinity has a high probability to disrupt the phytoplankton community (Mitra[10] et al. 2005). The water masses are the most necessary criteria for salinity and temperature. The Alluvial & Salty clay soil types dominate the estuary (Fig. 2). The Sundarban wetland is a compressive ecosystem around by Hooghly River, Matla River and Harinbhanga River. So, it is involving of different type's flora and fauna. Here so many types of delta like that is muringanga, Saptamukhi, Thakuran-Matla, Bidya, moni, Karati, Gosaba, Kulti, Bidyadhari, Gomas, Gnasuba and Haldi.

Physico- Chemical Assessment of Water Quality:

The physical, chemical Parameter had defined those characteristics of water quality.

Temperature: Temperature is one of the important parameter that impact on the physical chemical and biological aspects belong to water. The temperature is calculated in the survey using a thermometer instatement with a Celsius scale.

pH: Potential Hydrogen is the measure of the concentration of hydrogen ions. It is impacting the measurement scale of 0-14 in pH.

Salinity: Salinity is the measure of all the salt dissolved in water. So, it's usually assessing in parts per thousand that measure of every kilogram of sea water where 35% are salt.

BOD: Biochemical oxygen demand (BOD) in the measure of dissolved oxygen require by shape of water. BOD measurement in the assumption on two way, one is measured instantly for dissolved

oxygen and the second is incubated in the lab for 5days and then tested for the amount of dissolved oxygen.

Dissolved Oxygen (DO): The important of dissolved oxygen (DO) are connected with fish life and aquatic organisms. The water quality is suitable for fish ecology status habitats. DO content is a process of bio-chemical Indicates the health and ability of the water.

TDS: Total dissolved solids are measures of the connected content of all organic and inorganic substances carry out in a liquid in molecular and micro-suspended form. The main application of TDS is in the study of water quality for different waterbody.

Turbidity: Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulates.

Field observation data have been accumulated from the period of November to February in the year 2017-18. The samples are collected from different site in Sundarban region. The GPS survey has been done for ground truth verification and validation. The People of Sundarban are depending on agriculture, livestock, fisheries & forestry. In Sundarban, Forty four percent of total population belong to SC and ST. The level of literacy as well as per capital income is much lower in Sundarban than in other parts of West Bengal.

RESULTS AND DISCUSSIONS

Waterbody Mapping and Water Quality Analysis:

The wetland map of Sundarban & adjoin area waterbody are extracted from image to prepare a waterbody map using geo-informatics platform. The Spectral signature is an innovation of reflectance within the most important to extract waterbody from image data. The comparisons of signature with other targets are water bodies showing a weak reflectivity, manifested in the wavelength range of visible light. Because the water bodies receive strong absorption at the near IR band and mid-IR band, this wavelength range can be applied to separate water from soil, vegetation, buildings and other ground targets. The final extracted map (Fig. 2) shows the complete wetland map of Sundarban region. The wetland is engaged to lake, swamps and bheries in the Sundarban delta area. The Sundarban estuary area is crisscrossed by number of Streams, Rivulets, Creeks and Channel. Other major estuaries are Muringanga, Saptamukhi and Thakuran-Matla while the minor estuaries are moni, Karati, Gosaba, Kulti, Bidyadhari, Gomas, Haldi and now considered as estuaries inlets carrying tidal brackish water.

Water quality parameter is using the present status of water content for health of aquatic life. So, In Sundarban we are identifying eight comparative survey location site (Fig. 3) are Canning as site 1, Jharkhali as site 2, Gobindapur as site 3, Bokkhali as site 4, Freserganj as site 5, Basanti as site

6, Sandeshkhali as site 7, Gosaba as site 8 to present of parameters that is Temperature, pH, Salinity, BOD, dissolved oxygen (do), TDS, Turbidity parameters to assessment of water quality.
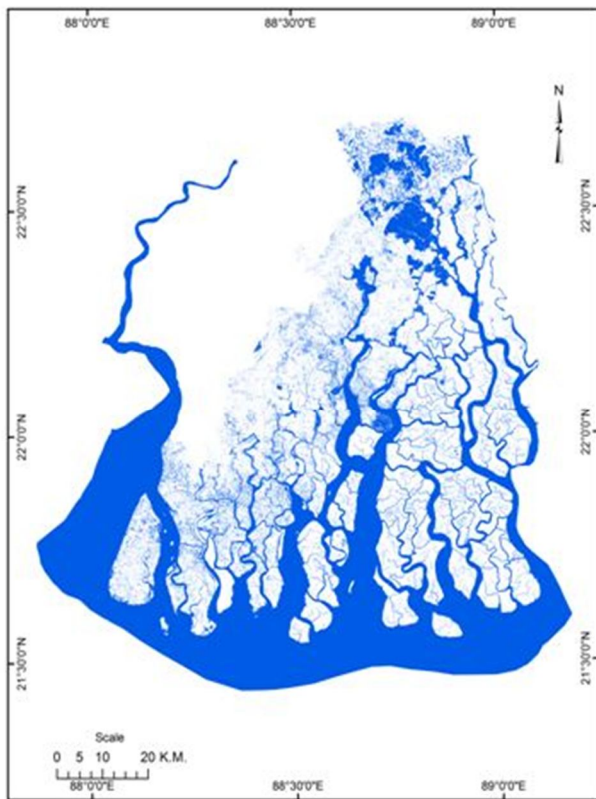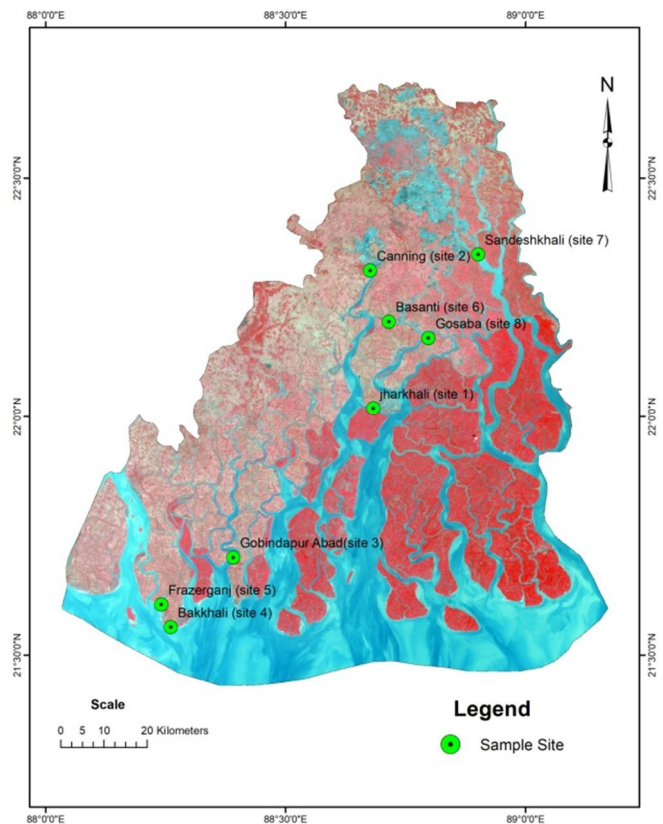

Fig. 2: Waterbody Map

Fig. 3: Sample Site Map

All parameters are collecting field data to High Tide and Low tide sequences of those sites. High tide time of Air temperatures is maximum of 26.7° C in Freserganj and minimum of 25.3°C in Gosaba where low tide time of Air temperature is maximum of 27.7°C in Sandeshkhali and minimum of 25.35°C in Canning and also (Fig.4) is showing all sight of air temperature condition of during high and low tide. During high tide of water temperatures is maximum of 25.6°C in Jharkhali and minimum of 24.8°C in Gobindapur where low tide of water temperature is maximum 26.1°C in both of Gosaba and Freserganj, and minimum of 24.2°C in Canning and also (Fig.5) is showing all sight of water temperature status of high and low tide. During high tide, pH reading is maximum of 7.9 in Bokkhali and minimum of 7.4 in both of Basanti and Sandeshkhali where during low tide; pH is maximum of 7.9 in Gosaba and minimum of 7.5 in Gobindapur and also (Fig.6) is showing all site of pH conditions of high and low tide period. In high tide, Salinity is maximum of 23.58% in Freserganj and minimum of 9.68% in Canning. Where In low tide, salinity is maximum of 23.57% in Freserganj and minimum of 9.4 % in Canning and also (Fig.7) is showing all sight of salinity status of high and low tide. During high tide of turbidity is maximum of 310 ntu in Bokkhali and minimum is

94.5 ntu in Jharkhali where in low tide, turbidity is maximum of 249ntu in Freserganj and minimum is 168.5ntu in Canning and also (Fig.8) is shows of present condition of turbidity during high and low tide. In high tide, Dissolved Oxygen is maximum of 7.68 mg/L in Canning and minimum of 6.18 mg/L in Bokkhali where low tide Dissolved Oxygen is maximum of 7.58 mg/L in Canning and minimum of 6.08 mg/L in Gobindapur and also (Fig.10) is shows of present condition of Dissolved Oxygen during high and low tide. In high tide, BOD is maximum of 3.1 mg/L in Canning and minimum of 2.43 mg/L in Gobindapur where low tide BOD is maximum of 3.2 mg/L in Sandeshkhali and minimum of 2.03 mg/L in Gobindapur and also (Fig.9) is shows of present condition of BOD during high and low tide. In high tide, TDS is maximum of 23650 mg/L in Freserganj and minimum of 17050 mg/L in Jharkhali where low tide TDS is maximum of 21000 mg/L in Freserganj and minimum of 14560 mg/L in Canning and also (Fig.11) is shows of present condition of TDS during high and low tide. So, Table-1 database are shown in bar graph diagram and analysis of data are suitable for fish ecology and habitats.
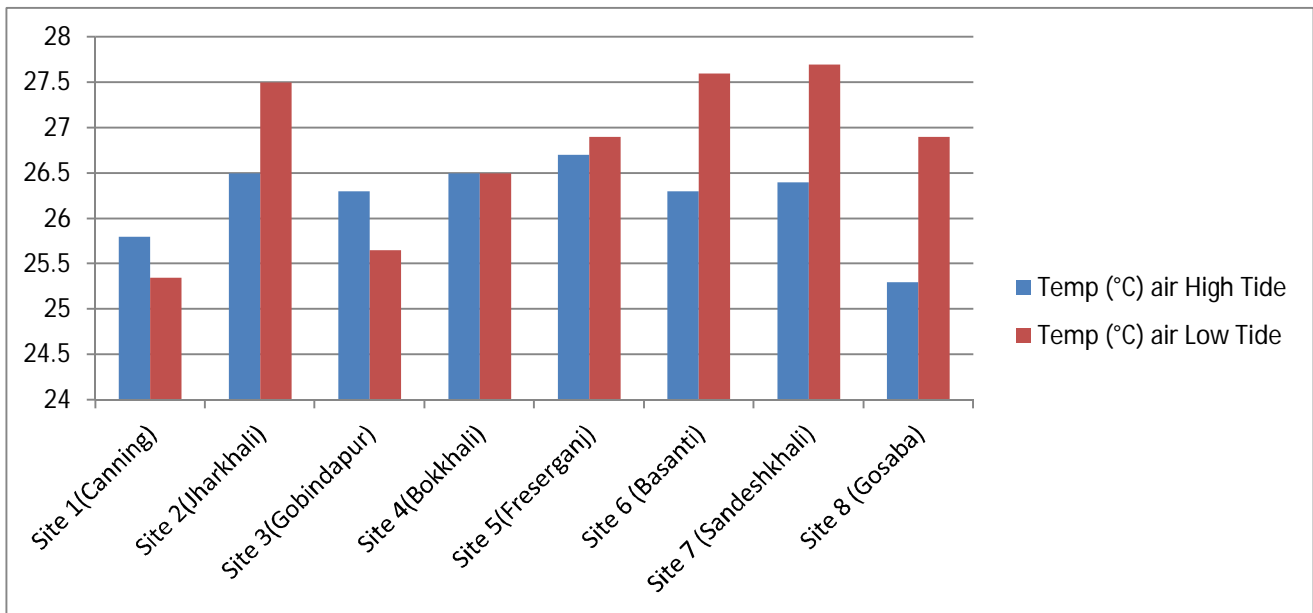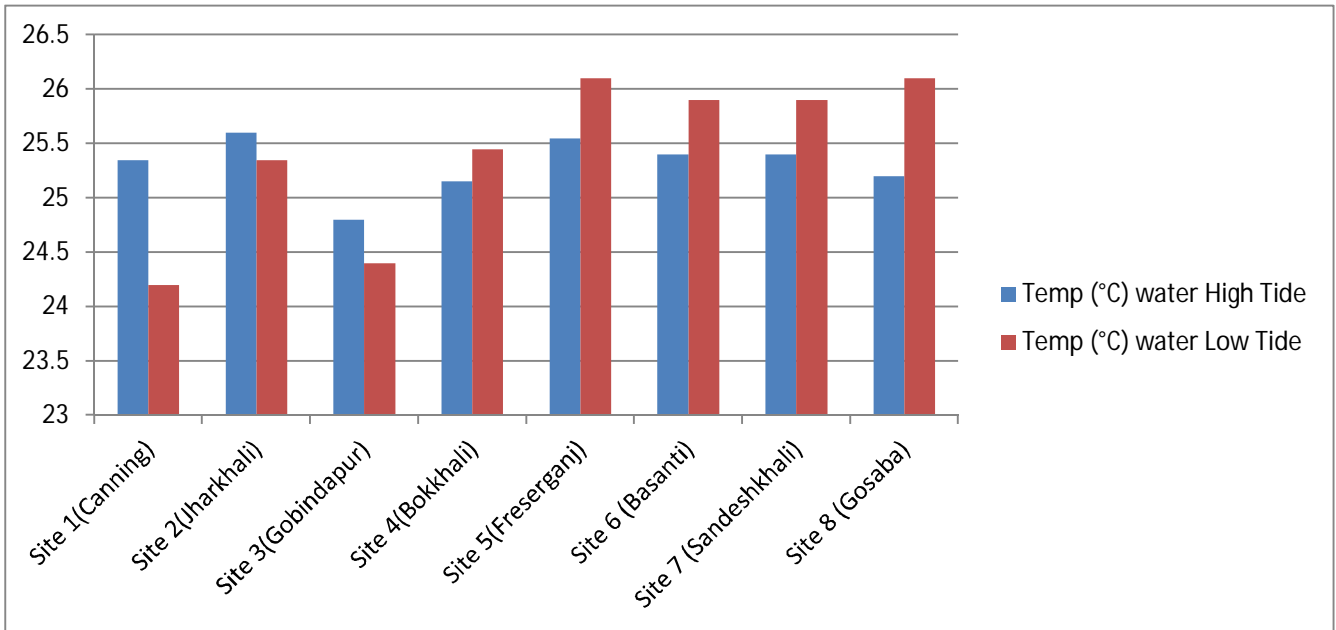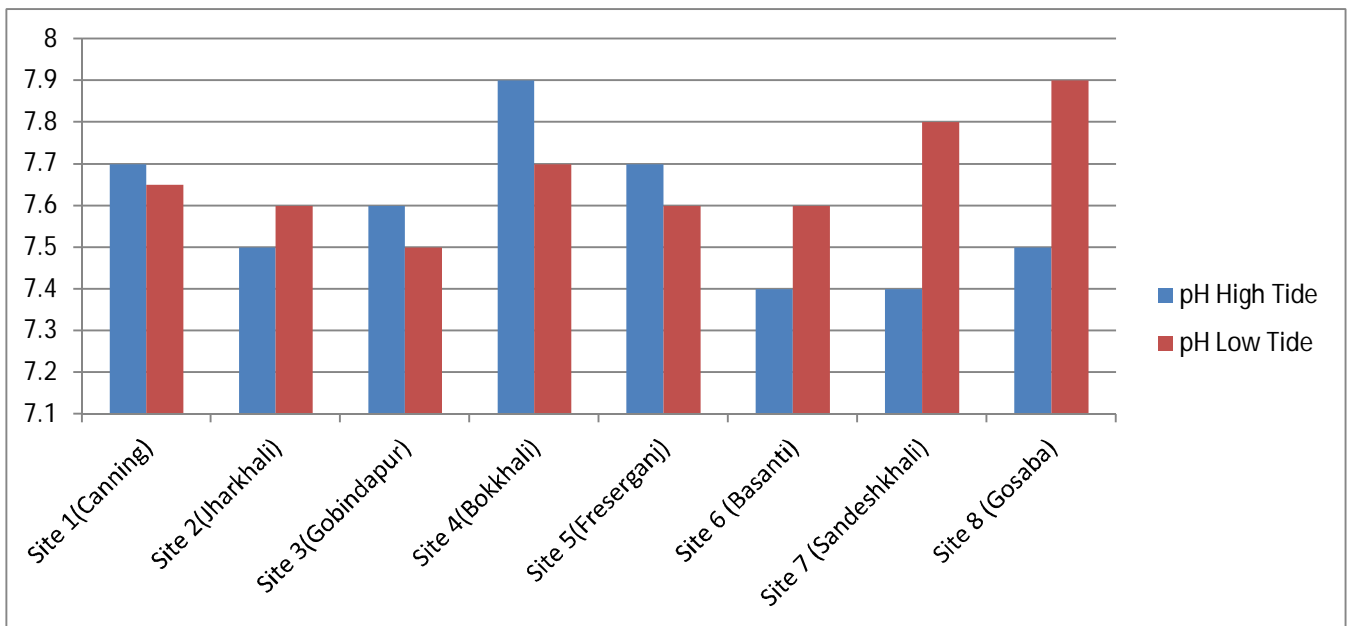

Fig.4: Air Temperature
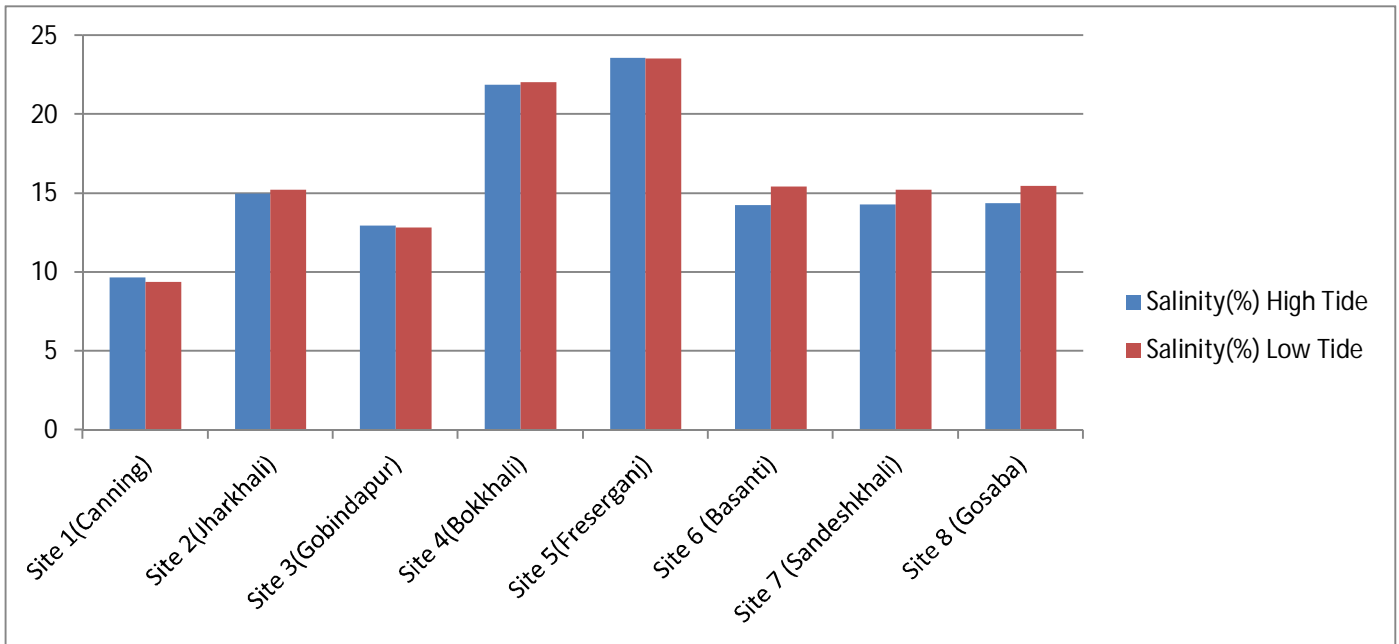
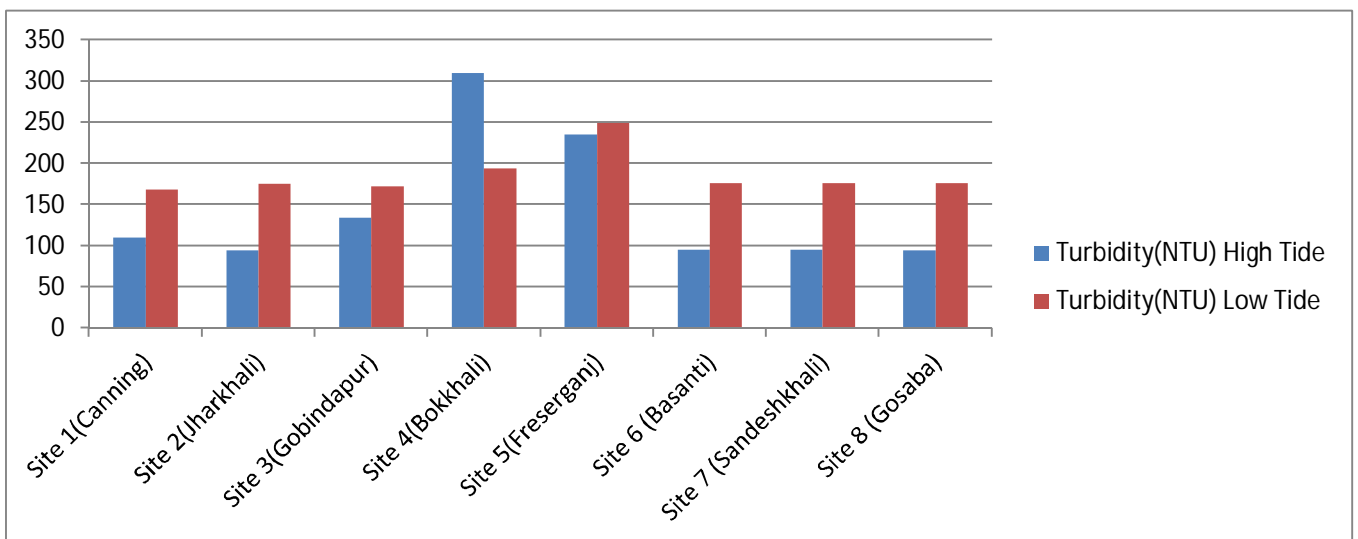**Fig. 5: Water Temperature**

Fig. 6: pH

Figure 7: Salinity

Fig.8: Turbidity
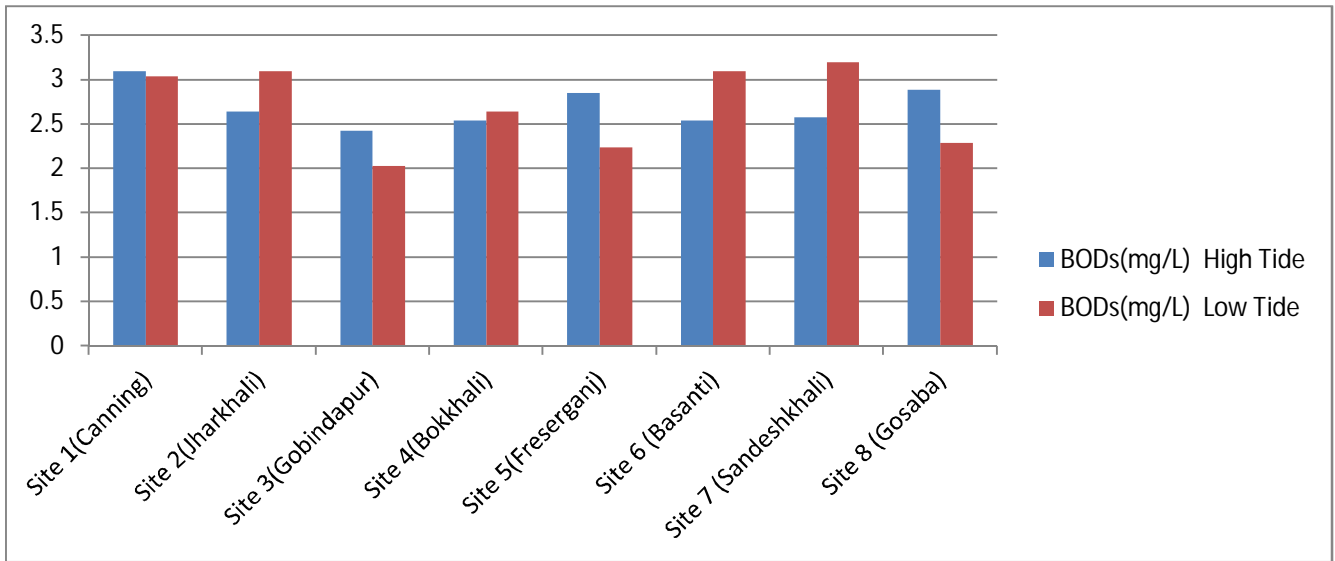
Fig. 9: BOD
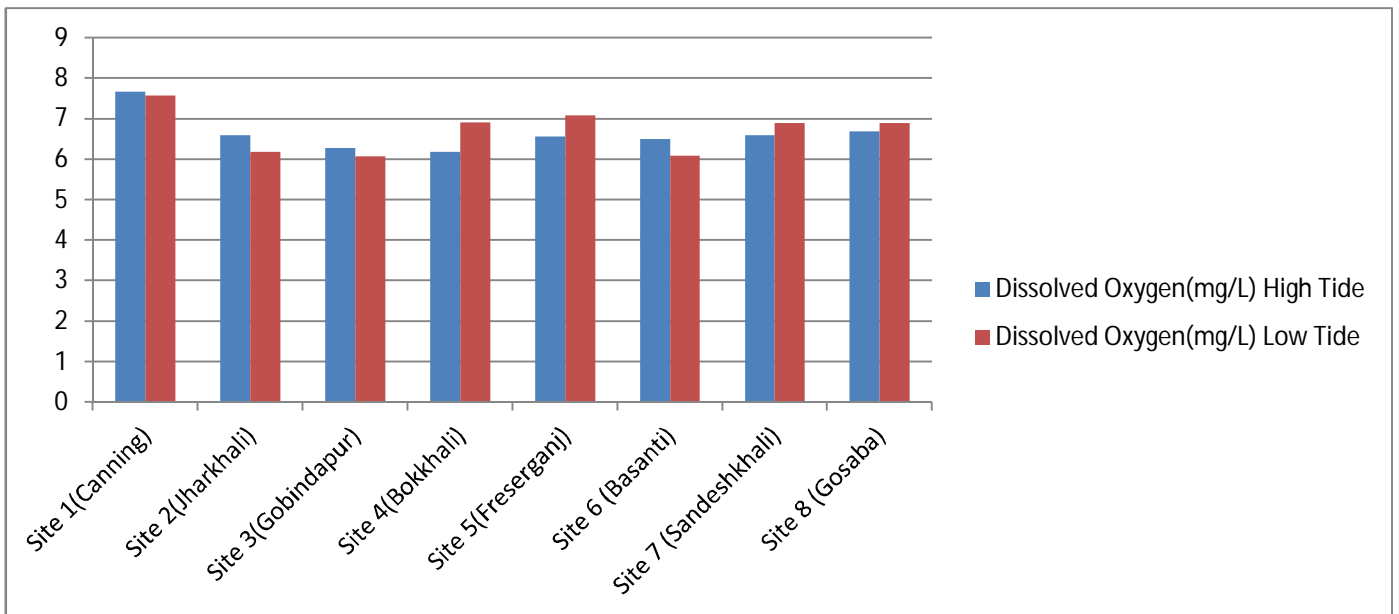
Fig. 10: Dissolved Oxygen
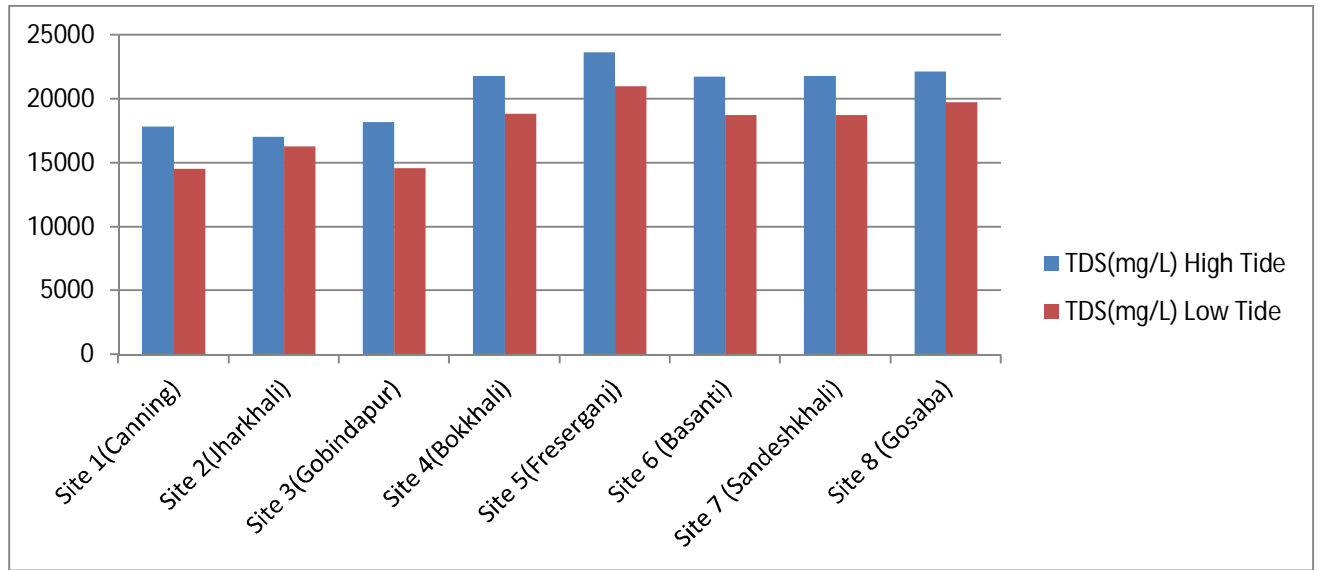
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Fig. 11: TDS

TABLE- 1: Field data collected from 8 sites in Sundarban

Parameter	High/Low Tide	Site 1(Canning)	Site 2(Jharkhali)	Site 3(Gobindapur)	Site 4(Bokkhali)	Site 5(Freserganj)	Site 6 (Basanti)	Site 7 (Sandeshkhali)	Site 8 (Gosaba)
Temp (°C) air	HT	25.8	26.5	26.3	26.5	26.7	26.3	26.4	25.3
	LT	25.35	27.5	25.65	26.5	26.9	27.6	27.7	26.9
Temp (°C) water	HT	25.35	25.6	24.8	25.15	25.55	25.4	25.4	25.2
	LT	24.2	25.35	24.4	25.45	26.1	25.9	25.9	26.1
pH	HT	7.7	7.5	7.6	7.9	7.7	7.4	7.4	7.5
	LT	7.65	7.6	7.5	7.7	7.6	7.6	7.8	7.9
Salinity (g/kg)%	HT	9.68	14.97	12.94	21.9	23.58	14.27	14.29	14.39
	LT	9.4	15.23	12.85	22.06	23.57	15.43	15.24	15.49
Turbidity (NTU)	HT	110	94.5	134	310	235	94.9	95.01	94.74
	LT	168.5	175	172.5	194	249	176	175.9	176
Dissolved Oxygen(mg/L)	HT	7.68	6.6	6.28	6.18	6.57	6.5	6.6	6.7
	LT	7.58	6.19	6.08	6.92	7.09	6.09	6.9	6.9
BODs(mg/L)	HT	3.1	2.64	2.43	2.54	2.85	2.54	2.58	2.89
	LT	3.04	3.1	2.03	2.64	2.24	3.1	3.2	2.29
TDS(mg/L)	HT	17860	17050	18200	21800	23650	21780	21790	22180
	LT	14560	16280	14580	18850	21000	18730	18740	19730

Assessment of fishery resources

The Sundarban is an ideal mangrove ecosystem, which holds up a heavy group of fishes, shrimp, and edible crab and also provides food. In Sundarban mangrove, exploitation of major fish groups like white fish and marketable shrimp are diluted over the years, whereas catch of *Scylla serrata* shows an increasing movement. Its rivers, rivulets and creeks with tidal saline waters and flushing fresh waters provide the ideal ecotonal zone for the development and propagation of many populations of various fish species (Mandal[11] et al. 2013). It is the area where economic benefit fishes are identifying to 111 species in Sundarban region. The fish database is prepared for shows the fish species Scientific *Name, Class, Order, Family, IUCN Status* and *images*. The IUCN status is shown in Not *evaluated (NE), Least concern (LC),* and near threatened (NT) categories. Out of 111 fish species not evaluated are 79, least concern are 27, near threatened are two & the data deficient species are three numbers identified. The fishing landing centre map of this area is prepared to show the landing centre like as Port Canning, Basanti, Raidighi, Pathaprotima, Frazergunj, Ganga Sagar, Jambu Island & Main landing stations like as Diamond Harbour, Kakdwip and Namkhana of Sundarban adjoin area (Fig.12).
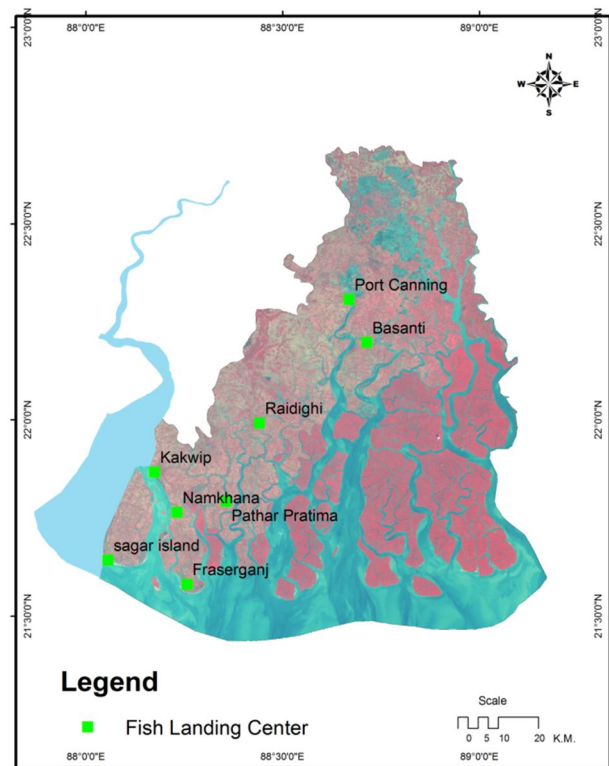

Fig.12: Fish Landing Center Map

CONCLUSION

The Sundarban fishery resources are the most fish potentiality zones and productive ground of estuarine ecosystem coastal wetland. So, the pisciculture is depended on physico-chemical and bio-chemical parameter of water quality and also ecological of habitats. The result of parameters of Temperature, pH, Salinity, BOD, dissolved oxygen (DO), TDS, Turbidity is assessments that positive for health of water and aquatic life growth. So, the water bodies are needed for mapping to management and conservation those areas where fishery resource is near threatened and substance of ecology. So, the area of Sundarban has required immediate attention for fishery resource management and conservation for upliftment of the society.

REFERENCES

1. Mitra A, Choudhury A, Zamaddar YA. :Seasonal variations in metal content in the gastropod Cerithedia (Cerithideopsis) cingulata, Proc Zool Soc, 1992; 45: 497-500

2. Mitra A, Mondal K, Banerjee K. :Concentration of heavy metals in fish juveniles of Gangetic delta of West Bengal, India., Res. J. Fish & Hydrobiol., 2010; 5(1); 21-26

3. Sengupta K, Roy Chowdhury M, Bhattacharya SB, Raha A, Zaman S, Mitra A. :Spatial variation of stored carbon in Avicennia alba of Indian Sundarbans., Discovery Nature. 2013; 3(8), 19-24

4. Raha AK, Bhattacharyya SB, Zaman S, Banerjee K, Sengupta K, Sinha S, Sett S, Chakraborty S, Datta S, Dasgupta S, Chowdhury MR, Ghosh R, Mondal K, Pramanick P, Mitra A. :Carbon census of mangrove vegetation in Indian Sundarbans., Jr of Energy and Evn Sci (In Press)., 2013

5. Sargaonkar, A., & Deshpande, V., :Development of an overall index of pollution for surface water based on a general classification scheme in Indian context., Environmental Monitoring and Assessment, 2003; 89: 43-67.

6. Clark, J.R. 1983. In: :Coastal ecosystem management (a technical manual for the conservation of coastal zone resources), John Wiley and Sons, New York 1983; 928.

7. Sunirmal Giri and Susanta Kumar Chakraborty, **:**Assessment of fishery resources in relation to some physico-chemical parameter of water in Sundarbans Mangrove Ecosystem, India, Advances in Applied Science Research, 2012; 3(4):2337-2345, ISSN: 0976-8610

8. Chaves Abhijeet Bernard and C. Lakshumanan, :Remote Sensing and GIS- Based Integrated Study and Analysis for MangroveWetland Restoration in Ennore Creek, Chennai, South India., Centre for Remote Sensing, Bharathidasan University, Khajamalai Campus, Trichirappalli-620 023, Tamil Nadu, India. Proceedings of Taal2007: The 12th World Lake Conference: 2008; 685-690.

9. T. Srinivasa Kumar & R. S. Mahendra & Shailesh Nayak & K. Radhakrishnan & Kali C. Sahu (2011) :Identification of hot spots and well managed areas of Pichavaram mangrove using Landsat TM and Resourcesat—1 LISS IV: an example of coastal resource conservation along Tamil Nadu Coast, India., Springer Science + Business Media B.V.,

10. Mitra A, Banerjee K and Bhattacharyya DP (2005) :Ecological profile of Indian Sundarbans: pelagic primary producer community, vol. I. WWF-India, West Bengal State Office.,

11. Banani Mandal, Arunava Mukherjee, Samir Banerjee :A review on the ichthyofaunal diversity in mangrove based estuary of Sundarbans., Rev Fish Biol Fisheries, 2011; 23:365–374.