

SPATIO-TEMPORAL CHANGE OF LOCAL WETLANDS: A CASE STUDY IN RANAGHAT-1C.D. BLOCK, NADIA, WEST BENGAL, INDIA

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B.Ed. Semester-III

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Abstract: Wetlands are called the Natural kidney of environment. Being the transitional zone between land and water, wetlands keep the balance of the ecology and ecosystem. This paper concerns with the present aspects of wetlands on Ranaghat-I C.D. Block in Nadia District of West Bengal as this C.D. Block has numerous wetlands. This is also a very important area because the river Churni flows across the Block from North-East to South-West and the river Hooghly flows along the South- West side of this Block. This paper also concentrates on the wetlands' nature of biodiversity, socio-economic benefits and the misuses of the wetlands. Both primary and secondary data are used here in the study. The C.D. block has 10 Gram Panchayates(G.P.) in total are selected for study area. It helps to integrate, analyze, and represent the spatial information and database of any resource. Satellite image with relevant GIS technique is used here to identify temporal change of the present study area. This paper also concerns about the suggestions and mitigation to minimize the problems and preserve the wetlands of the present study area.

Keywords: Biodiversity, Livelihood, Natural Kidney, Spatio-Temporal changes.

Indroduction:

Wetlands are the part and parcel of our ecosystem. The heaven of rich and varied biodiversity, they play a vital role in our ecosystem not only in the form of water purifier, erosion controller, flood regulator, but also as the supplier of food stuffs, medicinal plants, livestock grazing, water recharge pit, waste disposal ground besides providing environmental, social and cultural facilities too. According to Chatterjee (2010), "Wetlands are increasingly perceived as an environment where air, water, land and their fauna and flora meet in an attractive and delicate way." About six percent of the world's surface is taken under wetlands".

Wetlands are transitional zones, in ecological context; they lie between open water and terrestrial ecosystem endowed with specific structural and functional attribute. In Ranaghat-I C.D. Block these wetlands are one of such natural resources. These are areas of land either temporarily or permanently covered by water. Some of these are natural and some are man-made. The shifting of the rivers Hooghly and Churni along with its meandering course has created fresh water wetlands. But now-a-days the rapid development in agriculture, population, settlement these wetlands are being lost. As a result this can bring a vital environmental, economic and social problem.

Objectives:

The main objectives of the study are:

- To view the characteristics of the environment of the wetlands of Ranaghat-I C.D. Block.
- To assert the benefits received from the wetlands used.
- To assess the temporal changes in water bodies over time of the study area.
- To access the major problems of the wetlands in the study area.

Literature Review:

Different literature review have been conducted for the purpose of the present study.

Chatterjee, A. (2010) has illustrated in his article named “Water Quality and Ecological Characteristics of Natural Wetlands: Murshidabad, Nadia and North 24 Pargana Districts of West Bengal” that the concentration of water bodies in three districts- Murshidabad, Nadia and North 24 Pargana. And also stated that there is high number of wetland due to the meandering course of the Churni and Bhagirathi-Hooghly rivers.

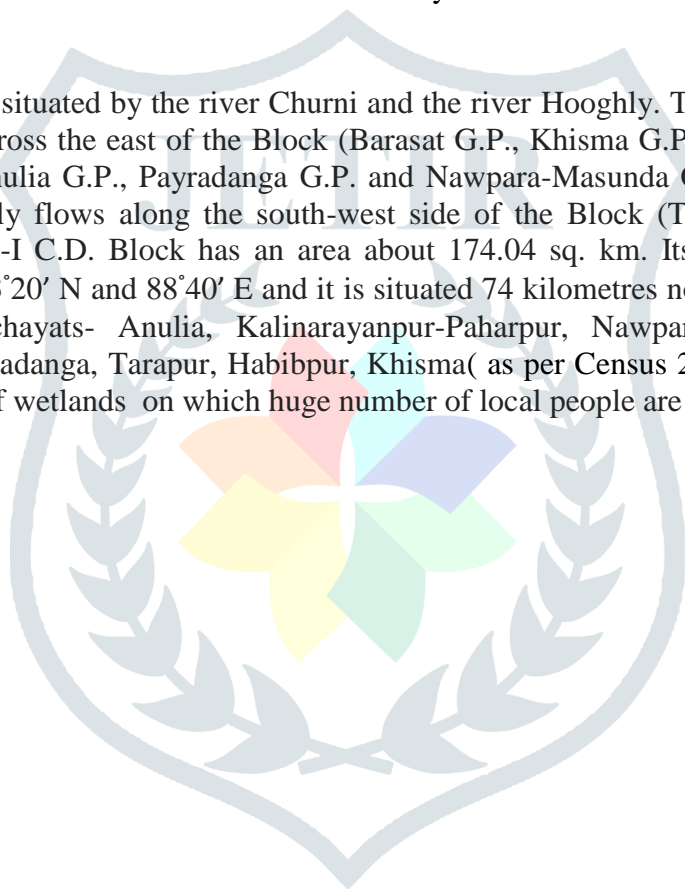
Mondal, A. and Chakma, N. (2010) assessed that the water body areas are continuously changing in Burdwan Municipality due to the land-capture, urbanization.

Bala, G. and Mukherjee, A. (2010) have asserted a number of wetlands in Nadia District in their journal named ‘Inventory of Wetlands in Nadia District, West Bengal, India and Their Characterization as Natural Resources’ which are being lost and degraded as the effect of the anthropogenic causes.

Mukhopadhyay, S.C. (2011) has opined about the wetlands of Sikkim and North Bengal that wetlands play as the transitional zone between the water and terrestrial ecosystem both economically and ecologically

Study Area:

Geographically this area is situated by the river Churni and the river Hooghly. The river Churni flows from north-east to south-west across the east of the Block (Barasat G.P., Khisma G.P., Kalinarayanpur-Paharpur G.P., Ramnagar-I G.P., Anulia G.P., Payradanga G.P. and Nawpara-Masunda G.P.) and courses at south-west into the river Hooghly flows along the south-west side of the Block (Tarapur G.P. and Nawpara-Masunda G.P.). Ranaghat -I C.D. Block has an area about 174.04 sq. km. Its geographical extent from 23°05' N and 88°25' E to 23°20' N and 88°40' E and it is situated 74 kilometres north of Kolkata. This Block comprises 10 gram panchayats- Anulia, Kalinarayanpur-Paharpur, Nawpara-Masunda, Ramnagar I, Ramnagar II, Barasat, Payradanga, Tarapur, Habibpur, Khisma (as per Census 2011). There are dispersedly placed enormous number of wetlands on which huge number of local people are dependent.



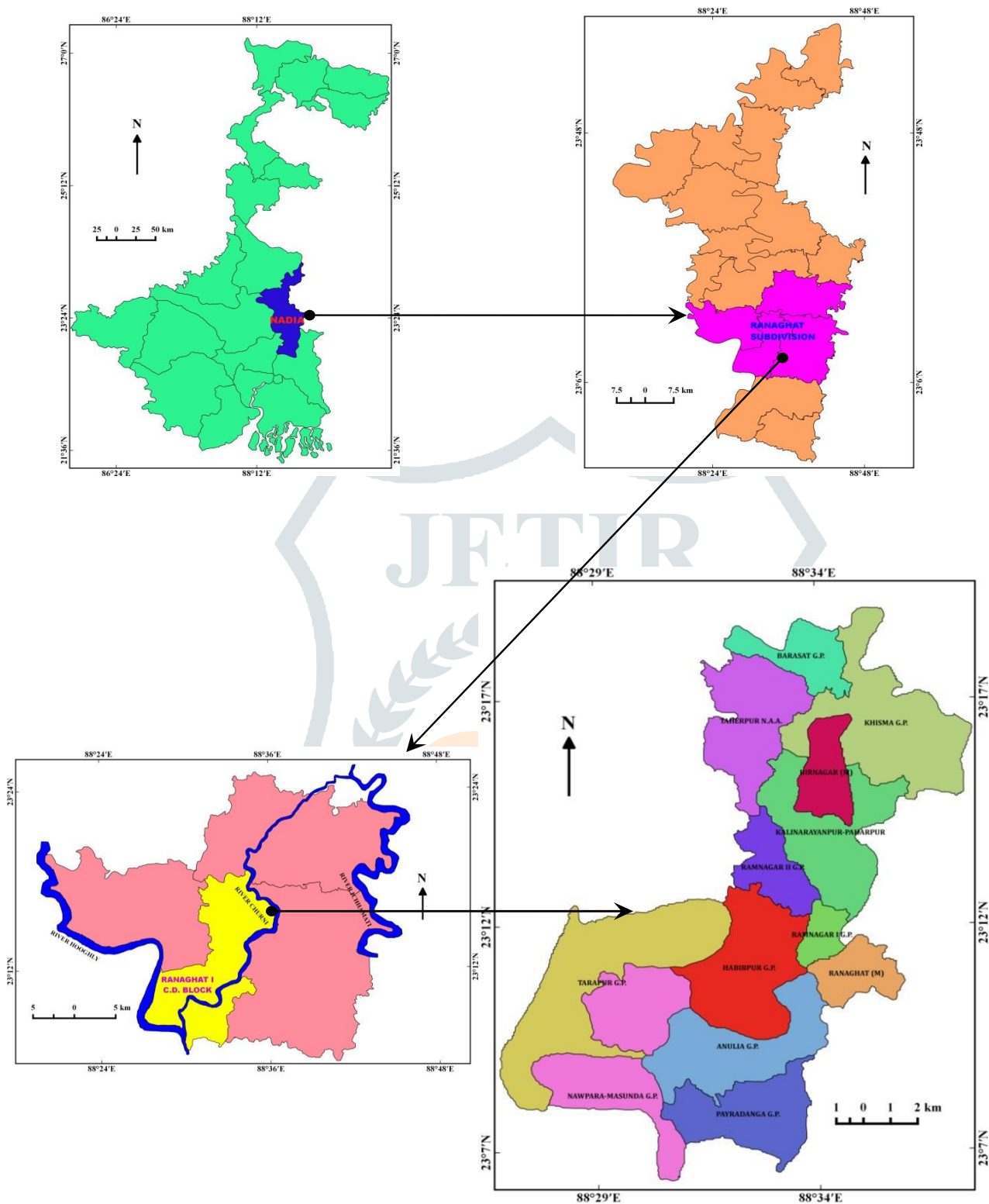


Figure 1: Location map of the study area

Research Methodology:

Present study over wetlands condition in spatio-temporal aspect includes some aspect of methodology. In this regard proper sample design, database, theoretical framework and use of some equation have been properly framed in the entire study network.

Sample Size:

The C.D. block has 10 Gram Panchayates (G.P.) in total, 2 Municipalities (M) and 1 Notified Area (NA) are selected for study area. About As per Bing Aerial 2018 map, 773 wetlands are identified. All of the

wetlands are taken as survey purpose. The areas are taken as sample survey are: Birnagar Municipality, Kalinarayanpur-Paharpur G. P., Ramnagar I and II G.P., Ranaghat Municipality, Habibpur G.P., Barasat G.P., Khsima G.P., Anulia G.P., Payradanga G.P., Nawpara-Masunda G.P. and Tarapur G.P., Taherpur Notified Area (Na). Selection of the wetlands was based on Purposive Random Sampling.

Data and Source of Data:

Present study in Ranaghat-I C.D. Block includes both primary and secondary data collection. For Primary data collection personal household survey, interview has been committed with the local people and wetland owners in the area via random basis in the timeframe from July to October (2018). Secondary data like information about wetlands, Block map of Ranaghat-I C.D. have been collected from Block Development Office of Ranaghat-I C.D. Block. The satellite Images of this area have been collected from the website of USGS (of the year 2008 and 2018) which helps to indicate the temporal changes of the wetlands in Ranaghat-I C.D. Block.

Theoretical Framework:

The studies on wetlands of Ranaghat-I C.D. Block were performed into three stages. These are-

- ***Pre-Field Stage:*** This stage is involved study of wetlands of the study area, its importance on human life and environment and its problem. This is accomplished through gather of secondary information like satellite images, different journals and articles, maps etc.
- ***Field Stage:*** This stage is involved field study, sample survey by random sampling method and primary data collection through questionnaire and personal interviews. For better work, secondary data also collected Block Development office of Ranaghat-I C.D. Block.
- ***Post Field Stage:*** This stage is engaged in data compilation, calculation, processing and analysis to draw some remarkable statements. This data analysis has been done through different techniques of Remote Sensing and GIS softwares, such as, Google Earth, Q GIS v2.10. Some Digital Indices are used to identify the present condition and temporal change of the wetlands in the present study area. It includes Normalised Difference Water Index (NDWI) = (Green - NIR) / (Green + NIR), Modified Normalised Difference Water Index (MNDWI) = (Green - MIR) / (Green + MIR), Normalised Difference Vegetation Index (NDVI) = (NIR - Red) / (NIR + Red). Microsoft Office Excel 2010 has also been used to create various diagrams. To satisfy the objectives of the study mainly statistical calculations like Gram Panchayat wise percentage of wetland area and percentage of Gram Panchayat wise wetland area under total wetland area of the Ranaghat-I C.D. Block has been incorporated. Constant use of Microsoft Word 2010 has accompanied this entire work.

Equation used:

In the whole study two equations are used to find out the condition of the wetlands in the study area. In following the equations are discussed:

- **Area Wise Percentage of Total Wetland Area** = (Area wise total wetland area / Total area) × 100
- **Area wise Percentage of Total Wetland area to Total Block Wetland area** = (Area wise total wetland area / Total Block wetland area) × 100

Results and Discussion: The entire study shows different aspects over spatio-temporal viewpoints. Different results are found here in significant viewpoints.

Sample Wetlands:

Ranaghat-I C.D. Block has been chosen as my study area because of its numerous wetlands. Maximum wetlands are very old in age and some are man-made which are new in age. From the Bing Aerial (2018) it has been found that the total numbers of wetlands of the study area are 773. Some of them are perennial and some are seasonal. All total wetlands have been taken from different Gram Panchayates, two municipalities and one Notifies Area of the Ranaghat-I C.D. Block for the survey. This survey mainly focuses on the use, misuse, environment, characteristics and present condition of them.

Distribution of Wetlands:

The distribution speaks about the spatial location of wetlands in the study area. According to the satellite view from Bing Aerial (2018), total number of wetlands of the study area has been recorded as 773, which are dispersedly located into the different Gram Panchayats. The maximum numbers of wetlands are natural in this study area and some are man-made. Among the wetlands most of them are perennial and few are seasonal. Tarapur G.P., Kalinarayanpur-Paharpur G.P., Nawapara-Masunda G.P. are occupying most of the wetlands in area as well as number. Among 10 gram Panchayats, Nawpara-Masunda Gram Panchayat and Ramnagar II Gram Panchayat occupied the highest area of wetlands with compare to the area of Gram Panchayats and the lowest wetland area captured by Khisma and Barasat Gram Panchayat .Out of total Block area of 173976533.60 sq. meter, 3435898 sq. metre that is 2% of the entire study area are occupied by total wetland area. This Ranaghat-I C.D. Block includes 10 Gram Panchayat area, 1 Notified Area(NA) and 2 Municipality areas in which Ramnagar II, Nawpara-Masunda Gram Panchayat and Ranaghat municipality has more than 4% of wetlands in respect to its own area(Table 1).

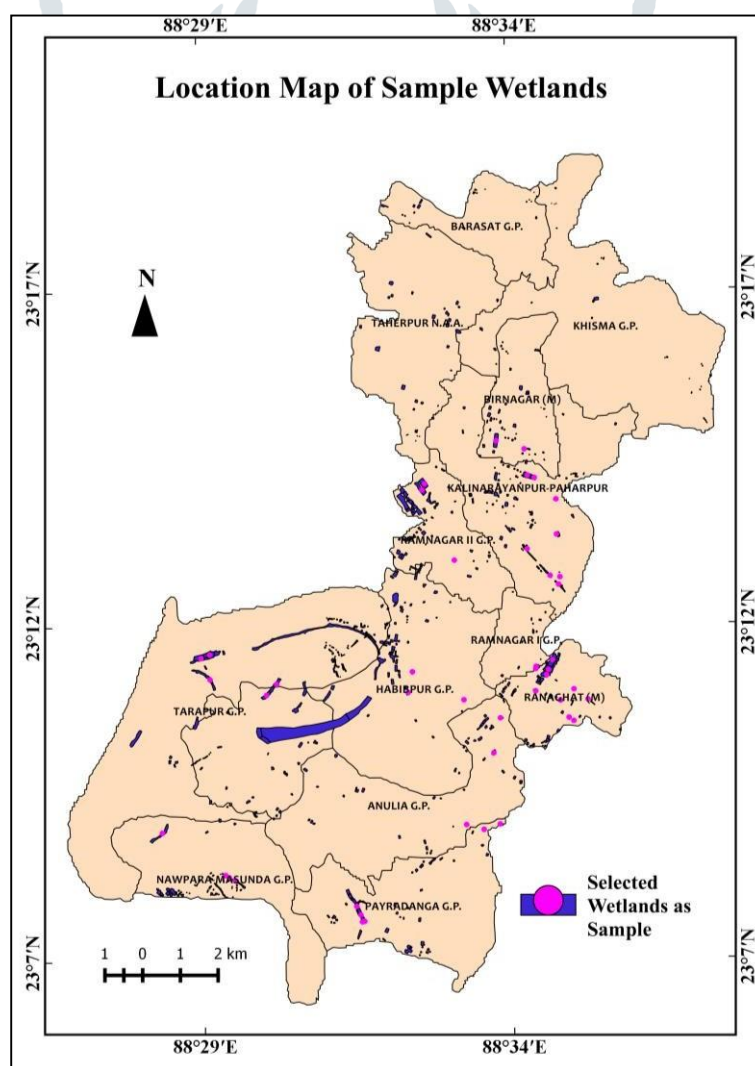


Figure 2: Sample wetlands of the study area
(source: Bing areal,2018 and field survey by the author,2018)

Sl.No.	Name of the Area under Ranaghat-I C.D. Block	Total Area of the Gram Panchayates/ Municipality/ Notified Area (Sq. Meter)	Total No. of the Wetland	Wetland Area (Sq. Meter)	Percentage (%) of Total Wetland Area	Percentage (%) of wetland Area to Block wise total Wetland Area
1	Barasat G.P.	6847382.38	23	28928.42	0.5	0.85
2	Khisma G.P.	21760744.54	30	31705.68	0.2	0.9
3	Taherpur N.A.A.	14709721.54	35	104876.77	0.7	3.1
4	Birnagar Municipality	6307388.54	44	120507.21	1.9	3.5
5	Kalinarayanpur-Paharpur G.P.	15854416.74	104	260879.60	1.7	7.6
6	Ramnagar-I G.P.	3117707.76	17	21633.70	0.7	0.6
7	Ramnagar-II G.P.	6914548.61	64	339424.75	5.0	9.9
8	Habibpur G.P.	17311094.51	70	406620.43	2.5	11.8
9	Ranaghat Municipality	5920069.85	58	264758.98	4.5	7.7
10	Anulia G.P.	15811631.06	45	139136.42	0.9	4.1
11	Tarapur G.P.	25774814.32	139	531929.66	2.5	15.5
12	Nawpara-Masunda G.P.	20846208	100	970552.77	4.7	28.3
13	Payradanga G.P.	12800805.72	59	214943.61	1.7	6.2
		Total Area = 173976533.60 sq. meter / 173.9765336 sq. km	Total = 773	Total Wetland area = 3435898 sq.meter		

Table 1: Areal Coverage of Wetlands in Ranaghat-I C.D. Block

(Data Source: Annual Report Block Development Office, Ranaghat-I C.D. Block, 2017-2018)

Tarapur, Habibpur Gram panchayat and Birnagar Municipality have occupied more than 3% of the wetland area in respect to their own panchayat area. Due to the settlement concentration (source: Census ,2011) Barasat and Khisma Gram Panchayat have the lowest wetland percentage i.e. 0.5% and 0.2% respectively in respect to their own area. Among the areas under Ranaghat-I C.D. Block Nawpara-Masunda Gram Panchayat has the highest percentage of wetland in respect to the total Block wetland area. It consists of 28.3% of wetlands under total wetland area. Besides that Tarapur and Habibpur Gram Panchayat have also a large number of wetlands i.e. more than 15% of wetlands and Ramnagar-I, Barasat and Khisma gram panchayat have the lowest percentage of wetlands i.e. less than 1%, in compare to all gram panchayats. The

main reason of this huge percentage is that, the flood plain of the river Hooghly and Churni and there is the estuary of those two rivers also.

Wetlands' Physical Condition:

In the present study area some of the wetlands made by the humans as the river of that area are far away or there soil is so matured. On the other hand there are huge numbers of wetlands which are natural in origin. The total number of the man- made wetlands are 187 and natural wetlands are 586. Present area is designated with different sizes of wetlands. Their size ranges from 267.6 sq. meter to 127100.50 sq. meter.(source: Annual Report of Block Development Office, Ranaghat-I C.D. Block,2016-2017). The total area covered by 773 wetlands is 3435898 sq. meter area and the average area of each wetland is 4445 sq. meter. The maximum wetlands lie in the group of 5000 sq. meters to 10000 sq. meters (source: Annual Report of Block Development Office, Ranaghat-I C.D. Block,2016-2017).

In accordance to the field survey it has been shown that the adjacent scenario of the wetlands are different. There is some agricultural field around more than 50% of the wetlands. Some settlements have been seen around the 20% of the wetlands. Besides that there is some forestry such as bamboo forest, big trees etc., and some grassland such as bushes have been seen also around the wetlands. The wetlands, which have the direct sewage connection, have some wastelands also around them.

About 90% of the wetlands have transformed into fishery(Annual Report of Block Development Office,Ranaghat-I C.D. Block, 2016-2017). Rest of them turned into agricultural land as they are seasonal and those wetlands become dry throughout the xeric period. And some wetlands turned into the wastelands too.

On the basis of Report of the Block Development Office, Ranaghat-I C.D. Block, of the years 2016-17and 2017-18 the water quality of the present wetlands are divided into 3 halves i.e. good, moderate and bad condition. There are 28 wetlands, which is 62% of the whole are of good conditioned water quality. Moderate water quality wetlands numbers are 13, which is 29% and rest of them 4 wetlands have the bad water condition. Among 45 surveyed wetlands 41 wetlands have fresh water type as they are in either good or moderate conditioned. And remaining 4 wetlands having the direct sewage link they have brackish type of water. The colour of the wetlands which are good and moderate water quality condition have the green colour of water and the rest of the colour of the wetlands are blackish. As the large numbers of the wetlands are used for pisciculture, their water are regularly tested and cleaned.

Biodiversity of the Wetlands:

Wetlands are increasingly perceived as an environment where air, water, land and their fauna and flora meet in an attractive and delicate way. As being the transitional zone of land and water the wetlands are consisted of a large number of biodiversity. In this study area Ranaghat-I C.D. Block wetlands have enormous plant and animal diversities. Hydrology of a particular wetland plays a very important role to determine three distinguishing ecological features like soils, flora and fauna. Wetlands soils are physically volatile and are in constant flux with the decomposition of the dead vegetation and erosion of sediments with river flow, flood and tidal shift. Hence the wetland vegetation is adapted to the wet conditions (hydrophytes) as it is water covered for at least a part of growing season and thus deficient in oxygen. In this way the wetlands transformed into the most productive ecosystem in the world for the mankind. A huge amount of floral diversity is found here in thee wetlands. Table 2 significantly depicts the different floral accumulation in this area. Different kinds of birds (local and migratory), fishes, snakes, frogs are found in the wetlands. Table 3 asserts the different faunas found in the present area. Mainly these wetlands are treated as fishing ground of different fishes.

Sl No.	Plant Species	Vernacular Name
1	<i>Alternanthera sessilis</i> (L) DC	Chanchi
2	<i>Nelumbo nucifera</i> Gaertn.	Padma
3	<i>Marsilea minuta</i> L.	Sushni shak

4	<i>Ipomoea aquatic</i> Forrsk.	Kalmi-lata
5	<i>Hygrophila schulli</i> (L.F.) Royle	Kulekhara
6	<i>Eichhornia crassipes</i> (Mart.) Solms	Kachuripana
7	<i>Ceratophyllum demersum</i> L.	Jhanjhi, Sheoyala
8	<i>Eclipta alba</i> (L.) Hassk.	Kesuti
9	<i>Enydra fluctuans</i> Lour.	Hingcha
10	<i>Trapa bispinosa</i> Roxb.	Paniphal

Table 2: Different Flora found in wetlands of Ranaghat-I C.D. Block, Nadia, West Bengal

(source: Block Development Office Report : 2016-17, Ranaghat-I C.D. Block, Nadia, West Bengal)

Table 3: Different Faunas found in wetlands of Ranaghat-I C.D. Block, Nadia, West Bengal

Different Fauna	Name
Birds	Kingfisher (<i>Alcedinidae</i>), Black Cormorant (<i>Phalacrocorax carbo</i>), Common Duck (<i>Anas platyrhynchos</i>), Cotton Pygmy-Goose (<i>Nettapus coromandelianus</i>), Common Teal (<i>Anas crecca</i>), White-breasted Waterhen (<i>Amaurornis phoenicurus</i>), Common Moorhen (<i>Gallinula chloropus</i>), Stork-Billed Kingfisher (<i>Pelargopsis capensis</i>), White-throated Kingfisher (<i>Halcyon smyrnensis</i>), Brahminy Kite (<i>Haliastur indus</i>), Grey-headed Fish Eagle (<i>Ichthyophaga ichthyaetus</i>), Little Egret (<i>Egretta garzetta</i>), Asian Openbill (<i>Anastomus oscitans</i>).
Migratory Birds	Black Cormorant Bird (<i>Phalacrocorax carbo</i>), Asian Open bill Bird (<i>Anastomus oscitans</i>), Common Coot Bird (<i>Fulica atra</i>), Common Moorhen Bird (<i>Gallinula chloropus</i>).
Fishes	Bata (<i>Labeo bata</i>), Scribbled goby / Bele fish (<i>Awaous grammepomus</i>), Pool barb / Punti Fish (<i>Puntius sophore</i>), Honey gourami / Chuno Fish (<i>Trichogaster chuna</i>), Common Carp Fish (<i>Cyprinus carpio carpi</i>), Grass carp (<i>Ctenopharyngodon idella</i>), Jamuna ailia / Kajuli Fish (<i>Ailiichthys punctate</i>), Catla (<i>Catla catla</i>), African catfish / North African catfish / Magur Fish (<i>Clarias gariepinus</i>), Mrigal (<i>Cirrhinus cirrhosis</i>), Pabo catfish / Pabda Fish (<i>Ompok pabo</i>), Ruhi / Rui Fish (<i>Labeo rohita</i>), Stinging catfish / Shingi Fish (<i>Heteropneustes fossilis</i>), Silver carp (<i>Hypophthalmichthys molitrix</i>), Olive barb / Sar Punti Fish (<i>Puntius sarana</i>).
Snakes	Dhonra Snake (<i>Xenochrophis piscator</i>), Hele Snake (<i>Amphiesma stolatum</i>), Gokhro Snake (<i>Naja naja</i>), Joldhora Snake (<i>Xenochrophis piscator</i>), Darash Snake (<i>Ptyas mucosa</i>), Chandrabora Snake (<i>Indian Russell's viper</i>) etc.
Frogs	Sona Bang (<i>Hoplobatrachus tigerinus</i>) Kuno Bang (<i>Duttaphrynus melanostictus</i>) etc.

(source: Block Development Office Report : 2016-17, Ranaghat-I C.D. Block, Nadia, West Bengal)

Socio Economic Benefits from the Wetlands:

Local people of the study area get socio-economic benefits from wetlands. The local people are aware of the functions and values of the wetlands. The wetlands are mainly used for domestic use, environmental use, economic use, social purpose, cultural purpose, safety purpose and sewerage purpose.

Domestic Benefit: The wetlands are used in domestic use, such as for drinking purpose, for washing utensils and clothes, washing cattle and cars and bathing purposes. In case of environmental purpose the wetlands helps in the climate control. Besides that they also used as an open space of any locality, and also play an important role in keeping the biodiversity of the area. Thus they keep the balance of the aquatic ecology.

Environmental Benefit: In case of environmental purpose the wetlands helps in the climate control. Besides that they also used as an open space of any locality, and also play an important role in keeping the biodiversity of the area. Thus they keep the balance of the aquatic ecology. There are many trees around the wetlands in this study area, which makes the environment clean, cool and green. The trees are: Coconut, Bamboo, Mango, Banana, Guava, Betel Nut, Arjuna, Burflower tree or Kadamba tree and other bushes. Besides that in the time of rainy season, it can prevent the flood and protect the locality.

Piscicultural Benefit: From the field survey (2018), it has been found that almost 754 wetlands out of 773 total wetlands are engaged into piscicultural activities (i.e.97.54% of total wetlands). Among the wetlands 709 wetlands are regularly engaged in pisciculture, 45 wetlands are periodically engaged. Different fish cultivation practice is found here as already mentioned in Table 3. It clearly indicates economic profits of the people engaged with it. Natural environment helps to rare different species of fishes and people gets profit by pisciculture practice.

Agricultural Benefit: In general wetlands are used for piscicultural activities. But some wetlands are used for agricultural activities also. The people use the seasonal wetlands for agriculture, when the wetlands become dry they cultivate some crops and vegetables and from that they also get the profits and the rest of the time they practice fishing activities. Payradanga G.P., Nawpara-Masunda G.P. the wetlands are used for the jute retting purpose. They use the water of the wetlands separately, as the wetlands are highly maintained for fishing purpose.

Socio-cultural Benefit: Social Purpose means community gathering, building a club or creating the tourism around it. Some wetlands are used as such purposes in the area of Payradanga G.P., Tarapur G.P., Nawpara-Masunda G.P. For cultural believes these wetlands are believed to be holy by the local people and they use it's water in their marriage, different occasions, commemoration purposes, immersion of idols and other holy rituals purposes.

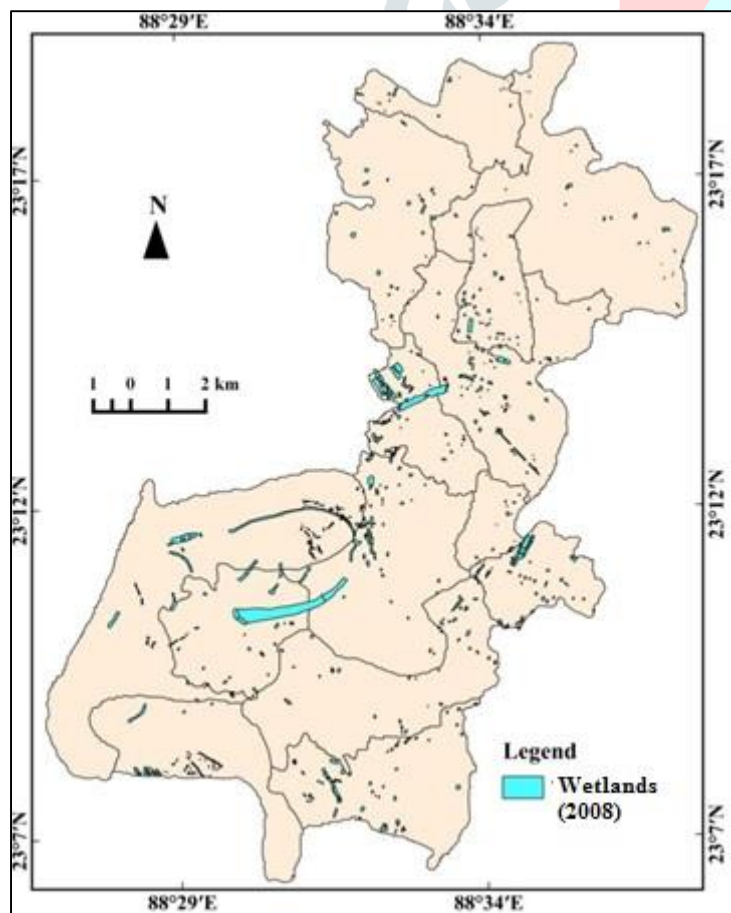


Figure3: Different Wetlands in year 2008

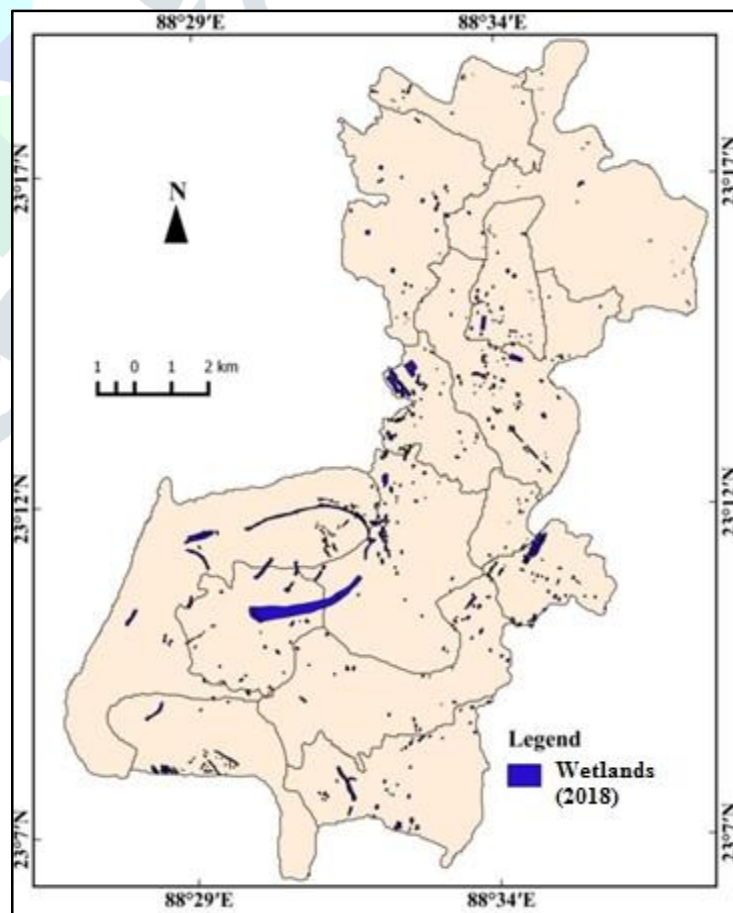


Figure4: Different Wetlands in year 2018

Temporal Change of Wetlands:

A drastic decrease in the coverage of wetlands, which contribute to a concomitant increase mainly in built

up area and activities to develop the necessary infrastructure to the growing population, like roads, markets, multi-strayed building. The temporal changes have been identified with the help of Landsat Image of 2008 and 2018 with certain different Index. According to Bing Aerial and Google Earth, total wetland area in 2008 and 2018(Figure3 and Figure4) has been calculated as 3435898 sq. meter and 3679838 sq. meter respectively. It is determined that 15 wetlands were lost and 243940 sq. meter of area has been decreased.

Landuse Classification: Landuse classification has been done of the years 2008 and 2018 over the present area. In the 2008 Landuse classification (figure 5) it is easily found that in the whole area there are many wetlands and water bodies many vegetation and agricultural lands. Settlement concentration is not so much accumulated over the area. In the 2018 Landuse classification (figure 6) it can be easily identified that in this study area there are huge number of settlements. Due to time period and modernization, urbanization, the agricultural land, vegetation has been decreased along with the filling up of the wetlands. There are some marshy lands also be seen in this classification.

Normalised Difference Water Index (NDWI): In the present study Normalised Difference Vegetation Index has been adopted. This digital index is a technique where the entire blue value are occurring in the image are divided into analyst specified intervals. This process divided the image into water and vegetation pixels. This Normalised Difference Water Index (NDWI) ranges from -1 to +1 (McFeeters 1996). In this paper LANDSAT 7 map of the year 2008 (Figure 7) and LANDSAT 8 map of the year 2018 (Figure 8) have been used to delineate the temporal changes of the water bodies or wetlands of the study area. From these two maps it is evitable that wetlands are decreased from the year 2008 to 2018. Here in the year 2008 the NDWI ranges from -0.389 to +0.036 and the year 2018 it ranges from -0.334 to +0.073. Positive value shows the water bodies and negative value shows the vegetation and land. Hence the ranges of the two year depict that there are huge decrease of wetlands in current years from the 10 years ago.

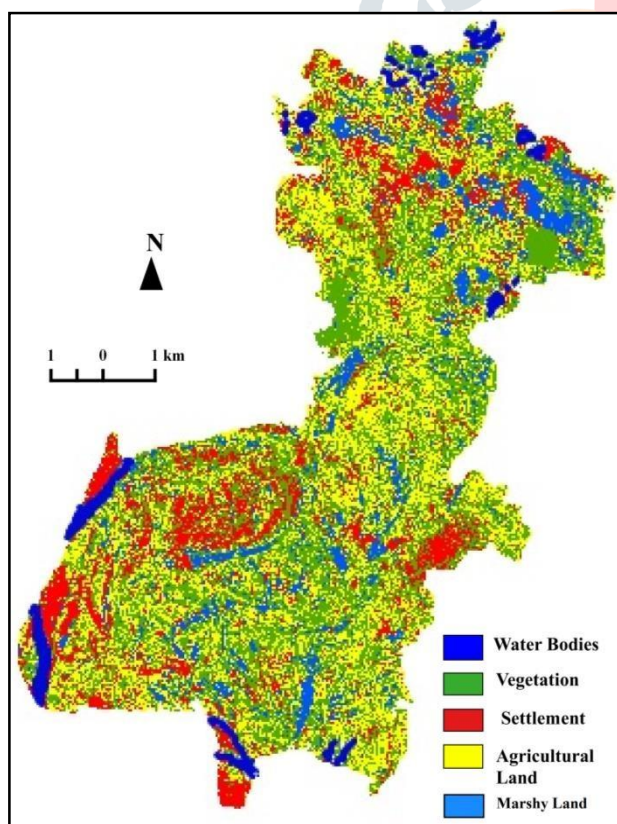


Figure 5: Landuse Classification Map of Ranaghat-I C.D. Block, C.D. Block,

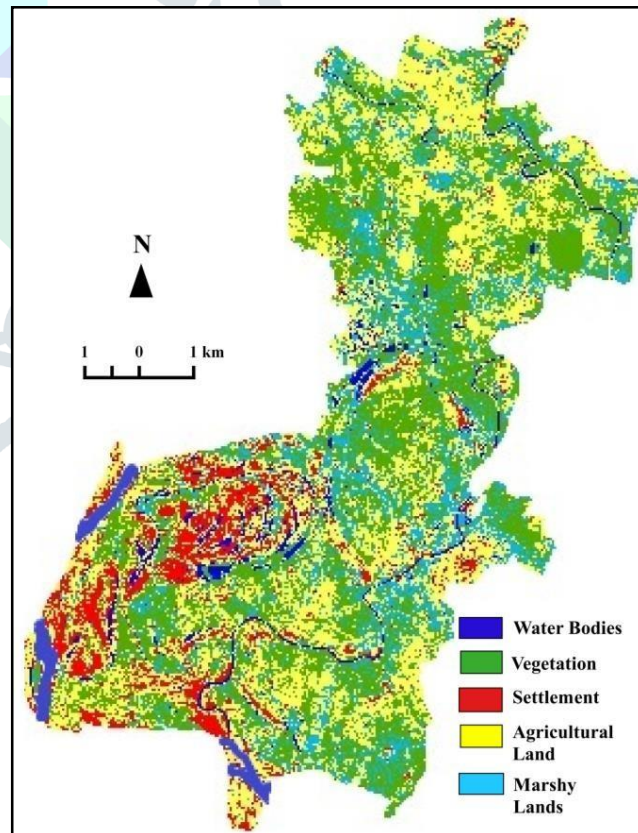


Figure 6: Landuse Classification Map of Ranaghat-I C.D. Block, 2018

NDWI is calculated with the following formula :

(Green - Near Infrared)

$$\text{NDWI} = \frac{\text{Green} - \text{Near Infrared}}{\text{Green} + \text{Near Infrared}}$$

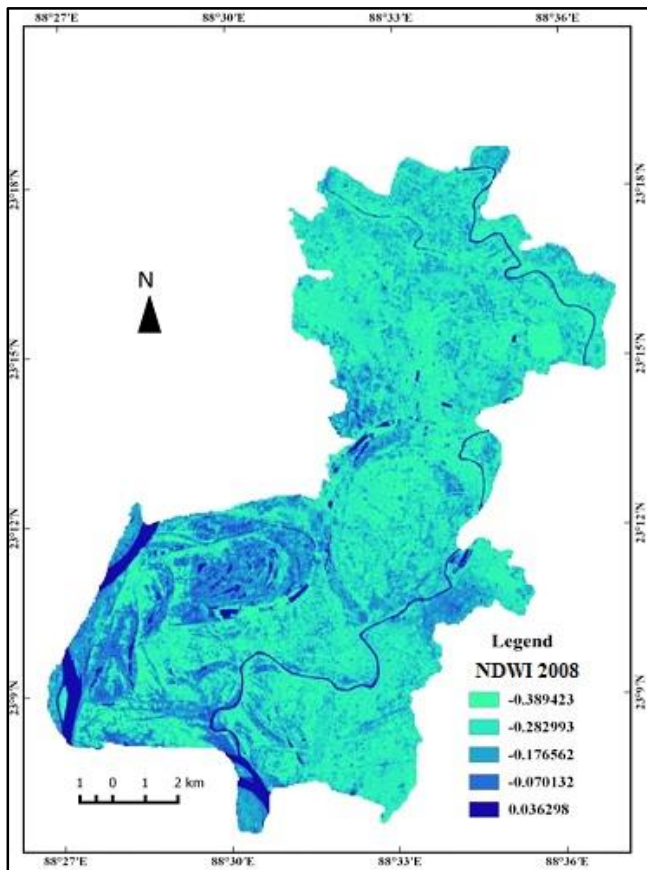


Figure 7: Normalised Difference Water Index, 2008

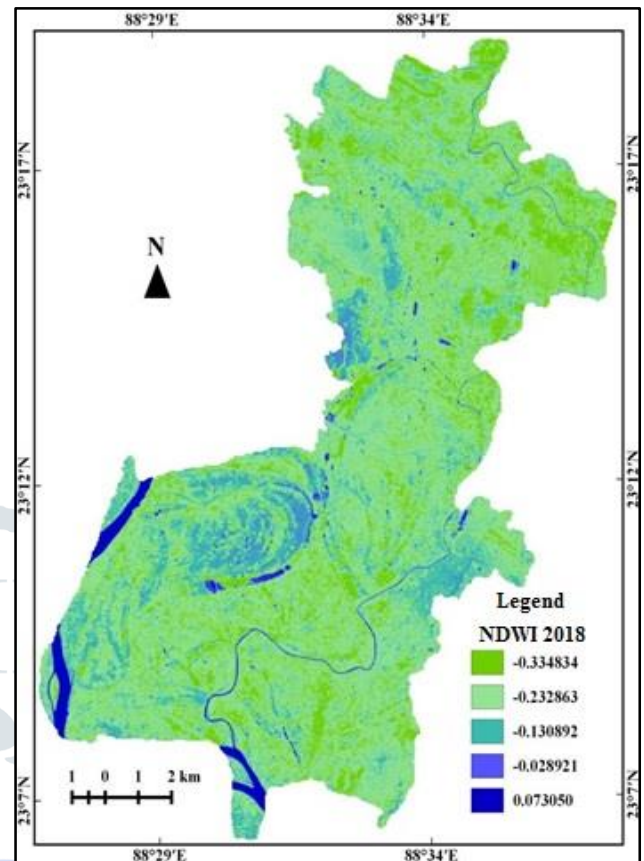


Figure 8: Normalised Difference Water Index,

2018

Modified Normalised Difference Water Index (MNDWI): After the NDWI (Normalised Difference Vegetation Index) of McFeeters (1996), this technique has been modified. This Modified Normalised Difference Water Index (MNDWI) is slightly similar to NDWI and it was first formulated by Hanqiu Xu (2006). This digital index has more positive value for water than NDWI. And it points out the soil and vegetation in negative values. This digital technique is done with the help of Green and Mid Infrared Bands of satellite imageries. In this present project report MNDWI has been used for the years 2008 and 2018 to delineate the temporal changes of the wetlands. Here in the year 2008 (Figure 9) the MNDWI ranges from -0.437 to +0.198 and the year 2018 (Figure 10) it ranges from -0.204 to +0.104. Positive value shows the water bodies and negative value shows the vegetation and land. It depicts clearly that there are huge decrease of wetlands in this one decade. MNDWI is calculated with the following formula:

$$\text{MNDWI} = \frac{\text{Green} - \text{Mid infrared}}{\text{Green} + \text{Mid Infrared}}$$

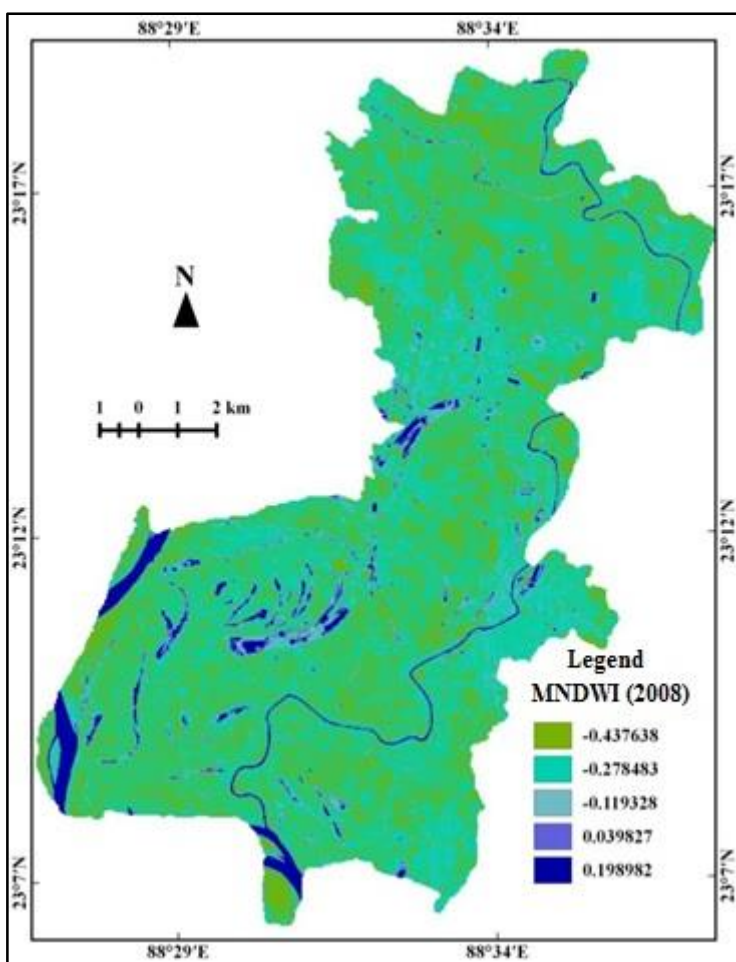


Figure 9: Modified Normalised Difference Water Index, 2008

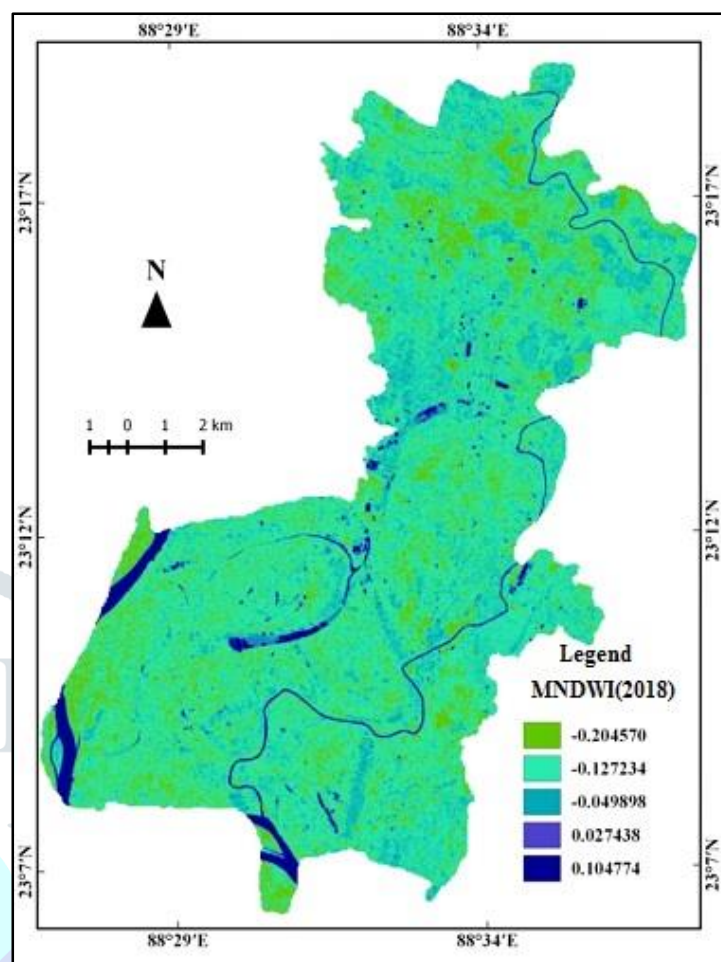


Figure 10: Modified Normalised Difference Water Index, 2018

Normalised Difference Vegetation Index (NDVI): Normalised Difference Vegetation index (NDVI) was first used in 1973 by J. W. Rouse et al. This digital index is used for detecting the changes of the vegetation of an area. Here it is used for the vegetation of the wetlands. The aquatic vegetation in the wetland is an indicator of the trophic status of the wetland which has a bearing on the water quality. The excessive presence of aquatic vegetation both deteriorates the water quality and affects the stability of the ecosystem. So the NDVI technique has been adopted here to assess the qualitative status of aquatic vegetation in the wetlands. In this study NDVI has been used for the years 2008 (Figure 7) and 2018 (Figure 8) to delineate the temporal changes of the wetland's aquatic vegetation. Here in the study it is found that in the year 2008 (Figure 11) the NDVI ranges from -0.0003 to +0.436 and the year 2018 (Figure 12) it ranges from -0.018 to +0.390. Positive value shows the vegetation and negative value shows the water bodies. It is clear that with time the concentration of aquatic vegetation is increasing in the area. NDVI has been calculated with the help of the following formula:

$$NDVI = \frac{(\text{Near Infrared} - \text{Red})}{(\text{Near Infrared} + \text{Red})}$$

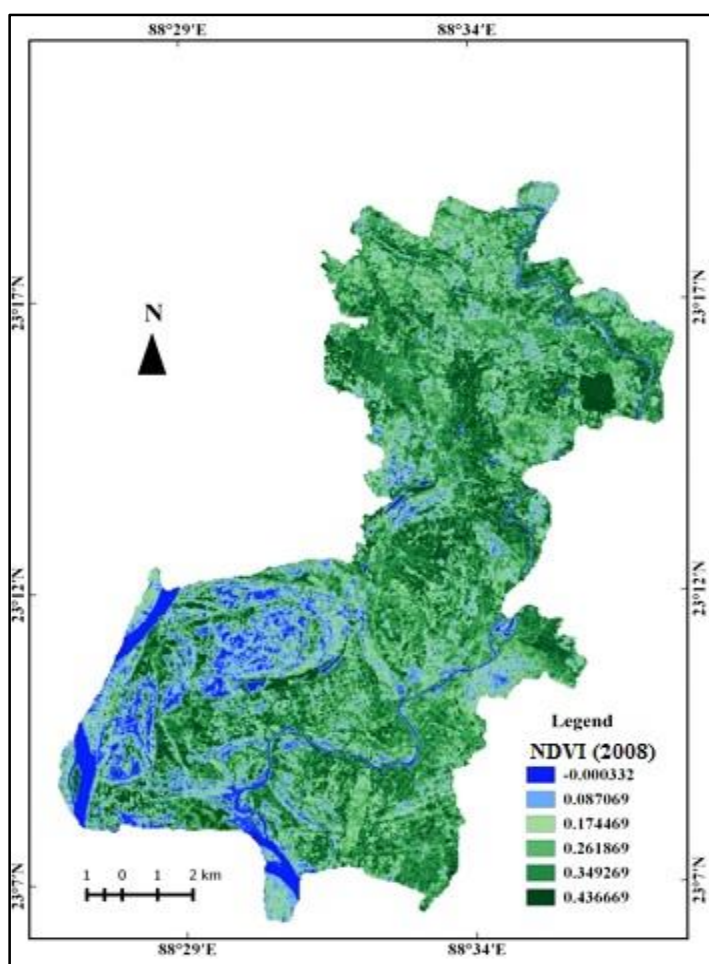


Figure 11: Normalised Difference Vegetation Index, 2008 Index, 2018

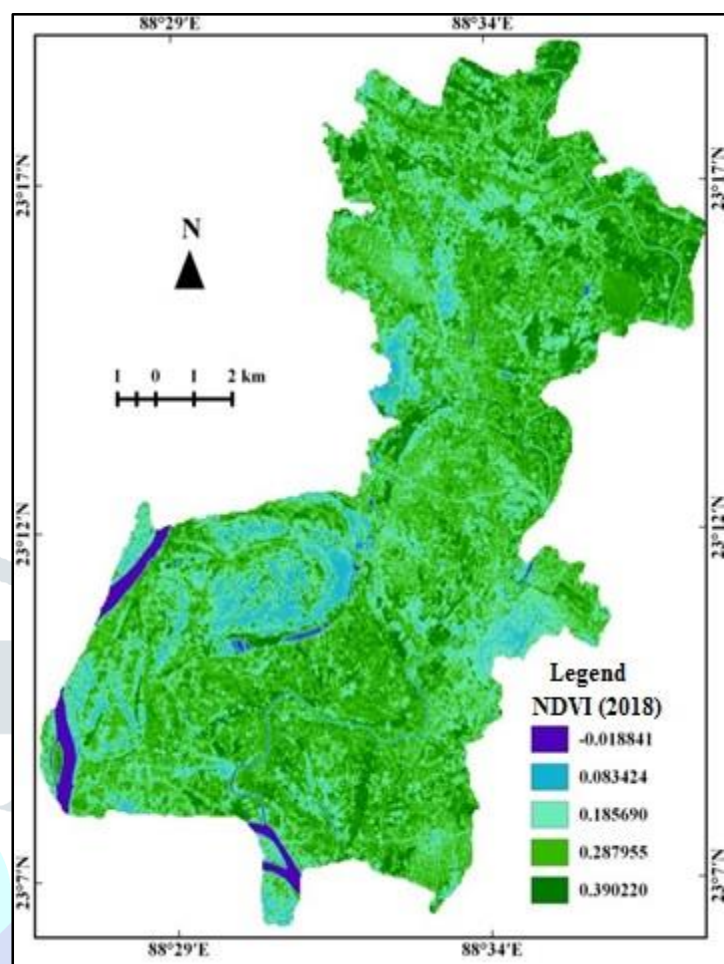


Figure 12: Normalised Difference Vegetation Index, 2018

Impact of Wetland loss to local Environment:

Several effects are seen in the present area due to decline of wetlands. It's nature is drastic in nature and growing days by days. The main effects which are noticed are:

Decline of Fish Production: A huge amount of solid waste make a thick layer of plastic and silt under the wetland as an obstruction of the fishes to go deeper in the water. Therefore, the fishes have to float on the surface level that virtually brings death to them. Besides that, deposition of solid wastes makes a layer of floating plants, which can be the main cause of biological oxygen demand (B.O.D.) and the eutrophication. For these causes the fish are unable to get oxygen from air and sunlight also and they become dead. As a result of these problems fish production is constantly declining and the local people have to suffer from it.

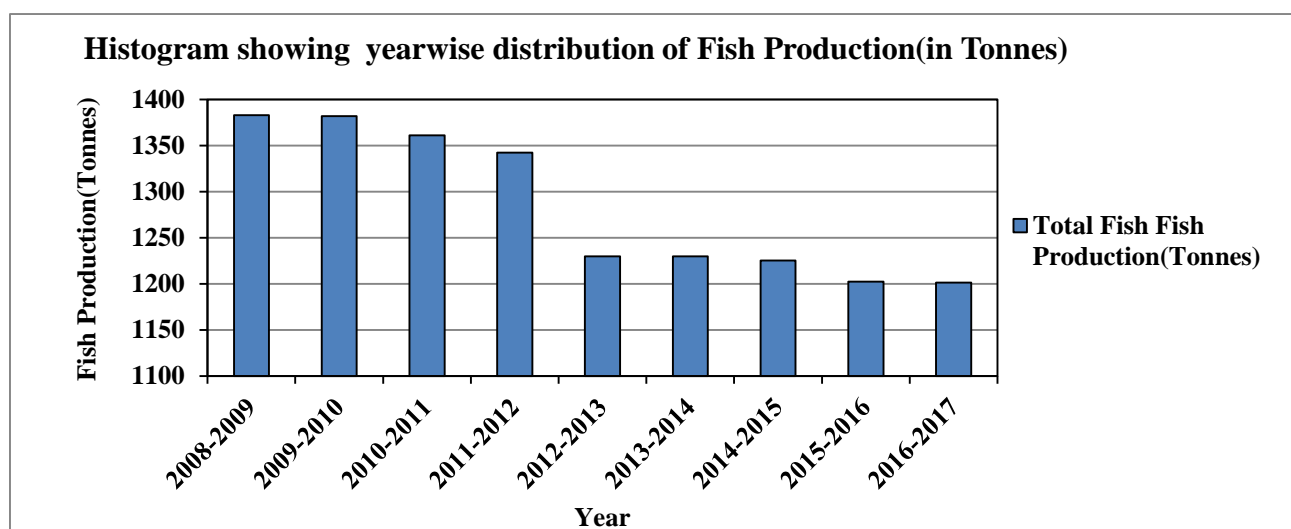


Figure13: Year wise distribution of Total Fish Production in wetlands area in Ranaghat-I C.D. Block
(Data source: Block Development Office, Ranaghat-I C.D. Block)

Reduction of Using Wetland Water in Domestic Purpose: As a result of water pollution the local people are unable to use the water for their daily domestic purpose. Besides that unlimited use of domestic purpose of the wetlands the water is continuously being polluted. In the other side as a result of degradation of water quality the local people cannot use the wetlands for rainwater harvesting, bathing and cattle bathing.

Loss of Biodiversity and Unbalanced Ecosystem: Due to the growth of urbanization there is an encroachment of wetlands to mitigate the ever increasing demands of residential settlement, commercial facilities and so on. The wetlands are the reservoir of many kinds of flora and fauna species, including various types of insects also. This reduction of wetlands and poor quality of water do not allow the species of wetlands to continue their life-cycle, by hampering the ecosystem. It is really shocking to note that few decades ago, there are the large numbers of species, but now-a-days these are gradually decreasing into disappearance. As a result of this loss of biodiversity the pond ecology is also hampered and the fish production is delimiting and the local people have to suffer from it. Table 4 and 5 depict different flora and fauna which are found just two decade ago but not found in recent times.

Table 4: Different disappearing Flora in different wetlands of Ranaghat-I C.D. Block

Sl.No.	Name of the Floras
1	Baro Shama(<i>Echinochloa crus-galli</i> (L)P)
2	KantaKalia(<i>Hygrophila schulli</i> (L.F.) Royle)
3	Dhol Kalmi(<i>Ipomoea carnea</i> Jacq. ssp. <i>Fitulosa</i> (Mart. ex choisy) D. Austin)
4	Shama(<i>Eclipta alba</i> (L.) Hassk.)

(Data source: Block Development office, Ranaghat-I C.D. Block)

Table 5: Different disappearing Faunas in different wetlands of Ranaghat-I C.D. block

Sl.No.	Name of the Faunas
1	Tangra Fish(<i>Batasio batasio</i> , <i>Mystus tengara</i>)
2	Magur Fish (<i>Gagata youssoufi</i>)
3	Indian Pond-Heron (Konch bok)

(Data Source: Block Development office, Ranaghat-I C.D. Block)

Decrease of Migrated Birds: Migrated birds are also an important species of wetlands. These can beautify

the wetlands also. But the in today's life the wetlands are continuously filled up, so the ecosystem is being damaged and the migrated birds are not able to come here in their particular seasons. So there is the decreasing of migrated birds. It is found that recently the migratory birds are not noticed in the wetlands due to excessive pollution, stagnation of water mass. Table 6 clearly depicts the year wise decline nature of Migratory Birds concentration in these wetlands.

Table 6: Year wise Concentration of different Migratory birds in all Wetlands of Ranaghat-I C.D. Block, Nadia

Year	No. of Migratory Birds throughout the Year
2010-2011	349
2011-2012	304
2012-2013	281
2013-2014	279
2014-2015	272
2015-2016	264
2016-2017	245

(Data Source: Block Development Office, Ranaghat-I C.D. Block, Nadia)

Suggestive Measures:

The paper focuses that wetlands are most productive ecosystems on earth, demonstrating a great diversity in both floral and faunal distribution. Here are some probable suggestive measures which can be treated as probable solutions of present wetland problems. The conservation of wetlands must involve activities to protect, restore, manipulate and provide for functions and values emphasizing both quality and acreage by advocating their sustainable path of usage.

Awareness of people must be vital for not to dispose any sewage in the wetlands. Some wetlands must be treated strictly with prohibition of the immersion of idols and domestic usages. The Government must regularly clean the wetlands by some medicines, pesticides.

Some important trees must be planted around the wetlands to keep the balance of the ecology of the wetlands. To prohibit constructing the drainage link between domestic sewages and wetlands safe sanitation service for the slum dwellers must also been constructed.

Concluding Remarks:

The entire paper asserts different sphere of areas in the viewpoint of wetland concentration in Ranaghat-I C.D. Block. The Spatio- Temporal concentration certainly envisages that wetlands are the basis of stability in between land and waterbody in the present area. The wetlands of present study area accumulate large number of flora-fauna concentration. The local livelihood is intimately depending over the wetlands. But in time frame the concentration of wetlands is lost due to various anthropogenic causes like population expansion, misuse of water, pollution etc. It directly affects the biodiversity, water quality, spatial extension of the wetlands. At last some tentative solutions are put forward to mitigate the present scenario.

Acknowledgement:

It is my honor to acknowledge those who helps me a lot in this entire study. I am grateful to Dr. Rakhi Mukherjee, Guest Lecturer, University of Kalyani, Kalyani, Nadia and Mr. Tirtha Pratim Mal, Assistant Professor, Shimurali Sachinandan College of Education, Shimurali, Nadia for their kind advise to me. I am also thankful to all of the members of Block Development Office, Ranaghat-I C.D. Block, Ranaghat, Nadia, West Bengal. I am grateful to Dr. Nandita Deb for giving her valuable comments over the present study. I am thankful to Debarati Sarkar, Debarati Das, Labani Karmakar and Kingshuk Biswas for their kind viewpoints to me regarding this study.

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