IDENTIFYING AND QUANTIFYING BRACKISH WATER BHERI-CULTURE IN NORTH 24 PARGANAS DISTRICT, WB, INDIA: A REMOTE SENSING AND GIS APPROACH

Dr. Sipra Biswas,
Assistant Professor, Department of Geography,
Kultali Dr. B. R. Ambedkar College, University of Calcutta

Dr. Tapan Kumar Das
Assistant Professor, Department of Geography
Cooch Behar College, Cooch Behar Panchanan Barma University.

Abstract:

The age-old bheri-culture has emerged in North 24 Parganas District in its south and eastern skirts centering lower course of the Bidyadhari River. Salinity in bheri-water is sourced from brackish sea-water entered through rivers and canals. Satellite imagery was employed for identifying and quantifying the bheries in individual block of the district. Over 230% increase of bheri-area has been estimated in the study during a period of 38 years since 1980-81 with 50570ha area in 2018. More than 50% of geographical area of Haroa and Minakhan Blocks is found to have occupied by bheri-farming and Sandeshkhali-I Block with about 49%. Such increasing of bheri-area resulted in decreasing of agricultural lands to a great extent, which would in turn invite various environmental and socio-economic implications as well.

Key words: Increase, swallowing, agricultural land, socio-economic impacts.

Introduction:

In West Bengal, India brackish water shrimp-culture is generally carried out in typical shallow wetlands impounded with earthen embankments all round, locally known as *bheri*. Such culture is found to be practiced almost all over the Indian coastal states spread over 3,00,000 ha estuarine areas (Sugunan, 2003). Water in the impounding is exchanged with tidal and brackish sea-water through the typically built channels at convenient occasions maintaining depth about 1 meter (Ghosh, 2002). This culture-based shallow fishery is locally known as bhasabadha, gheri, gher, jolkar or bheri in WB, pokkali in Kerala, gazanis in Karnataka, Kazanas in Goa and Saltpans or kharland in Maharastra (Biswas et. al., 1991 and Ghosh, 1990).

Traditional bheri-fishery in West Bengal (WB) is represented to have been practiced through ages in its Hooghly-Matlah estuaries, but with scientific practice in mid-1980's (NABARD's Initiatives, 2007). The state (WB) bears brackish water resources in the tune of 2,10,000ha in three districts viz- North 24 Parganas, South 24 Parganas and Purba Medinipur, of which only an estimated 60,000ha (29%) has presently been brought under culture-fishery.

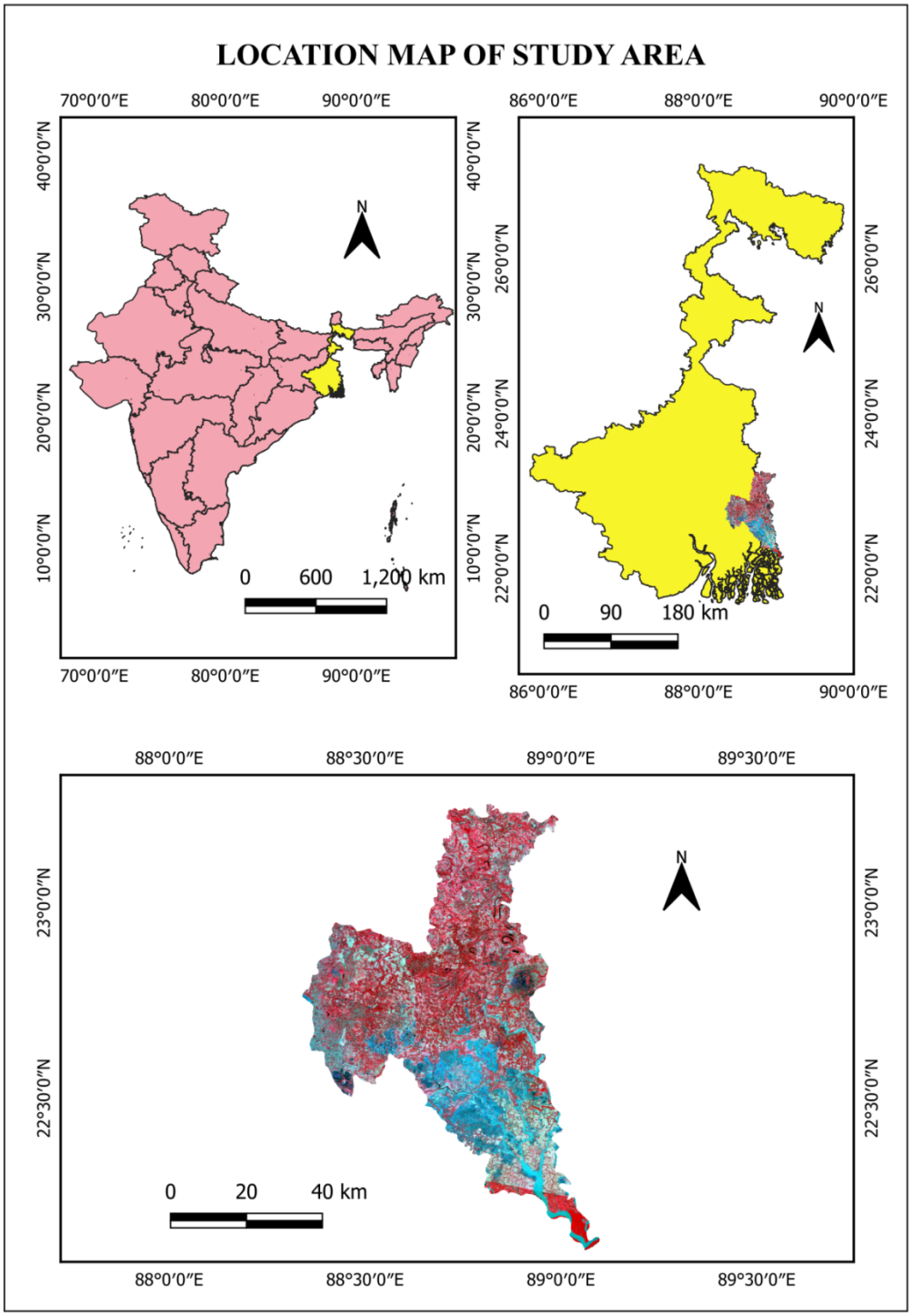
In the south-eastern parts of present North 24 Parganas district-territory such type of aquaculture is found to be rehearsed particularly in the mudflats, swamps, marshes or paddy-fields centering the spill zones of the Bidyadhari River, where agricultural cultivation is not so viable due to want of suitable irrigable water. As a result, paddy cum fish and/ or shrimp culture was significantly developed in those low-lying areas. However, bheri-culture in the district has a considerable effect on the way of life and agricultural practices of the local people along with the state and even the country- in terms of meeting protein-demand and earning foreign currencies.

Study Area:

The district of North 24 Parganas is located in the south eastern part of the state West Bengal (India) adjoining Bangladesh and almost in the heart of Bengal Delta bounded by the river Hooghly and Nadia district to the west, Bangladesh and Nadia to the north, Bangladesh to the east, South 24 Pargana to the south and Kolkata to the south-west. It lies within 22˚11' 06" N to 23˚01' 02" N latitudinal extensions and 88˚20' E to 89˚05' E longitudes (Figure:1) covering an area of 4,094 sq Km and a population of 1,00,09,781 (2011 Census). The district has 22 community development (CD) blocks, though brackish water bheri-fishery is usually found to exist in its 13 blocks in the south and eastern skirts viz- Barasat-II, Swarupnagar, Deganga, Rajarhat, Baduria, Haroa, Minakhan, Hasnabad, Hingalgunj, Sandeshkhali-I, Sandeshkhali-II, Bashirhat-I and Bashirhat-II as has been depicted in map 1 as per satellite image.

The district falls within the new alluvium sub-region of the lower Gangetic Plain (Zone-III) and found to be very fertile for crop production. The main rivers are Ichhamati, Hooghly, Raimangal, Kalindi, Dansa, Benti, Haribhanga, Bidyadhari etc and the physiographic structure is mostly plain and the soils of the southern side are characterized with clay loam. The climate is featured with warm and humid tropical one, south west monsoon usually from June to September, average annual rainfall 1750mm and mean temperature variation from 12^0C to 32^0C.

Figure: 1 – Location of North 24 Parganas District in India



Materials and Methods

Data Sources

Both primary and secondary data and information have been utilized in carrying out the study. The data available from Department of Fisheries, Government of west Bengal and various journal and periodicals are worth mentioning among the secondary sources. And the satellite image of the **LANDSAT 8** of United State Geological Survey (USGS) retrieved on 27.01.2018 with spatial resolution of 30 m has been sourced and formulated in the study.

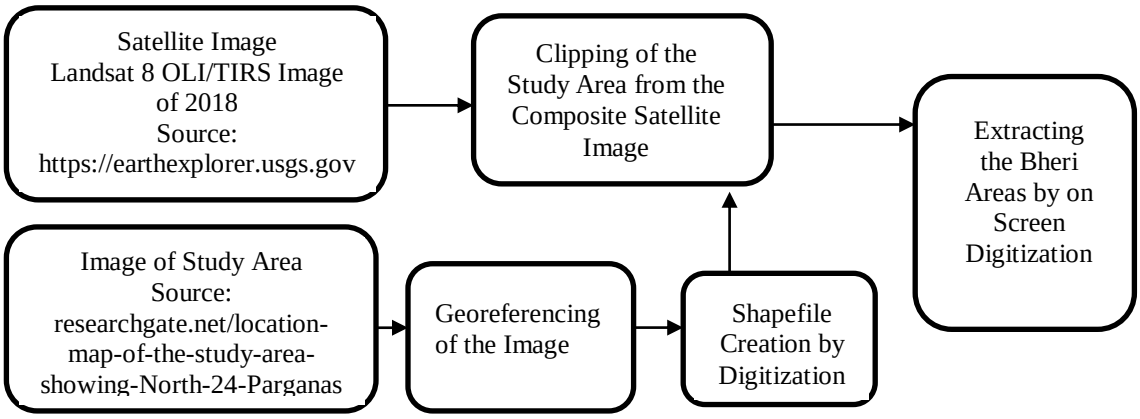
Software used

The QGIS 3.10 software has been used for raster analysis, vector generation & analysis, editing, composition, clipping, overlaying, change detection, quantification etc of the referenced as well as digitized map.

Methodology

Field survey has been conducted with reference to the locations of bheri identified in the map extracted from the satellite-image and the local people were interacted in informal way. However, the methodology in hauling out of bheri from the satellite-image is depicted in Figure: 2 in a flow chart.

Figure: 2 – Flow Chart Showing the Method of Map Preparation



Result and Discussion

Background of Initiation of Bheri-fishery in North 24 Parganas District

The British rulers started clearing of jungles in the southern-most uninhibited tracts of the then 24 Parganas in planned and organized ways when no river or marsh was embanked for reclamation or extension of cultivation (Hunter, 1998). Though embankments were used to be constructed at the inlets of the channels to keep the entry of outside-water away from the marshes or the lands just behind the higher banks of the rivers and also to open the same to release the stagnant water inside the low lands to the rivers during low tides. However, by this way a considerable part of the lands could be rendered culturable (Hunter, 1998) and the inhabitants of the Sundarban had started fishing in brackish water along with agriculture from the very beginning of clearing the Sundarban mangrove forests (Naskar et. al., 1987). When the Bidyadhari River got deteriorated severely to carry the sewage of Calcutta City, the Kulti River was selected to carry away the growing sewage-load instead.

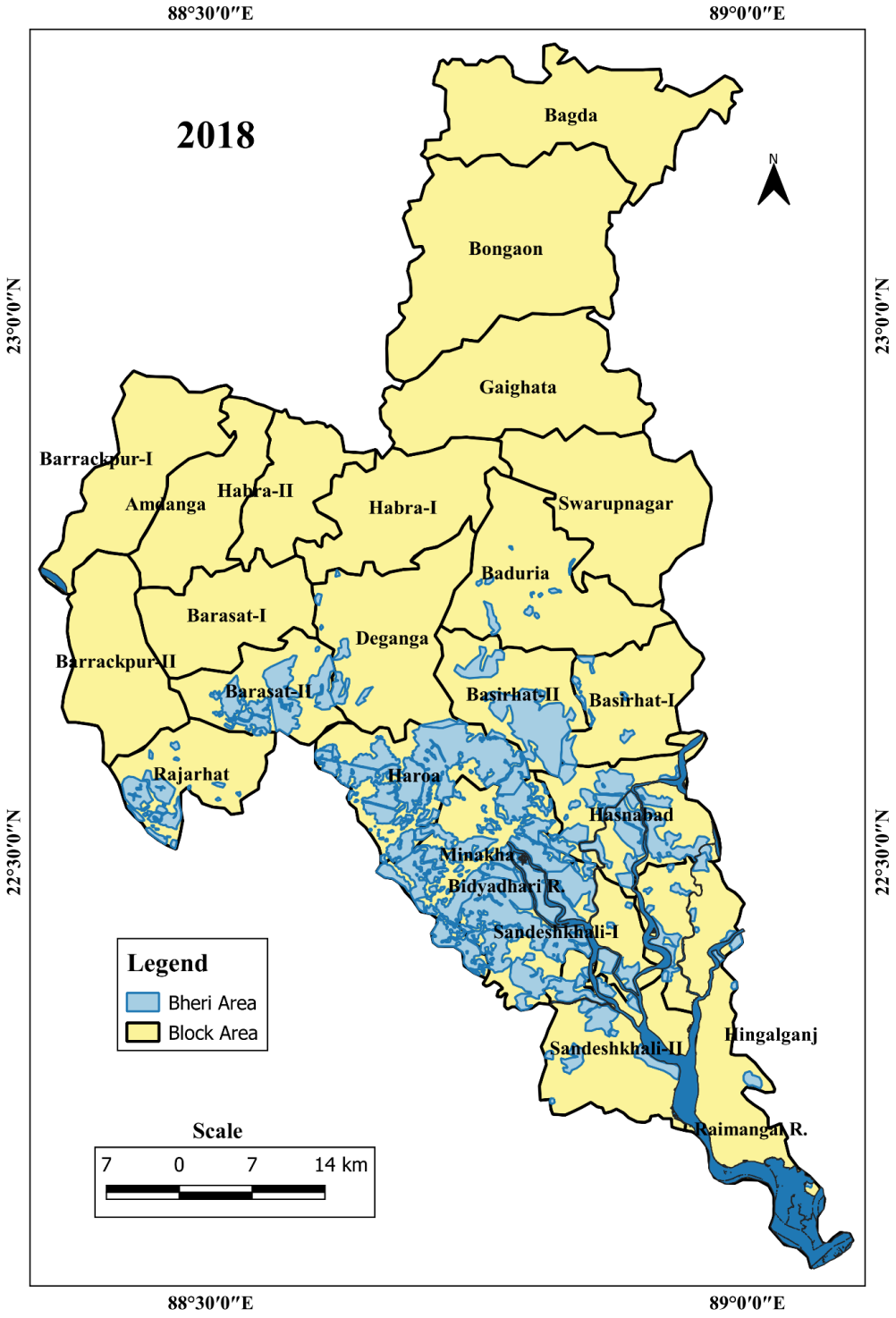
But the Kulti River (Distributary of Bidyadhari) was suddenly collapsed in the month of March, 1967 resulting in a violent flood and affecting the concerned kharif cultivation in the areas (Naskar et. al., 1987). To make an escape and protect the people's property the then Irrigation Department raised ring-dykes or semicircular bunds at a more back side of the river on more stable and suitable locations. As a result of this a considerable part of the land which was previously used for agricultural purposes remained discarded inside the river-banks. And some sort of additional embankments was constructed by the local people inside the river bed not to leave their lands on the gulf of the river. In this process some farmers were able to save some of their lost lands. The protected area thus looked like a pond and the owners started allowing ingression of (brackish) river water. The poor farmers observed that seeds and fingerlings of different types of prawns and fishes began to enter those dikes area which used to grow up satisfactorily on natural feeds. Some farmers used to cultivate salt-tolerant *khariff* paddy simultaneously with fish and prawn. This culture proved successful and profitable which can be considered as the milestone of starting so called embanked brackish water aquaculture in North 24 Parganas. The local people thus were economically improved with the return of this aqua-culture and the sewage mixed water was then called 'liquid gold' (Naskar, 1985).

Bheries Identified in the District Almost all the bheries in the district utilize brackish water, except some sewage-fed bheries in Rajarhat Block. The brackish water bheries are identified in the following villages (Table: 1) according to blocks:

Table: 1 – List of Villages Where Bheries are Present

Sl. No.	Block	Name of the villages (J. L. Number) where bheri appears presently
1	Barasat - II	Shanberia Bada (JL No.192), Mahisgadi (190), Matiagachha (187), Kamduni (188), Kharibari (189), Sasan (197), Dugdia (163), Kalikapur (200), Aminpur (161)
2	Deganga	Telia (085), Chak Kulia (078), Gobardhanpur (079), Gangulia (086), Gangdhulat (087),
3	Rajarhat	Bagdobamachhi Bhanga (046), Panapukuria (047), Mobarekpur (045)
4	Baduria	Tildanga (075), Dakshindiara (076), Shrikati (078), Arsula(068), Mahespur (080)
5	Haroa	Samaspur (047), Radhanagar Abhirampur (046), Makhali (049), Samla (102), Tentulia Abad (137), Nebutala Abada (138), Munsi Gheri (122), Ramchakir Gheri (121), Atghara (111), Shankarpur (024), Narayanpur (041), Kalianai (038), Kuchhia Mora (036),
6	Minakhan	Bargan Gopalpur (071), Dhuturdaha (069), Tentulberia (065), Shibpur (053), Bamanpukuria (090), Behari (101), Kachurhula (099), Ramjoy Gheri (097), Muchikhola (096), Niruli Abad (145), Golaghata (160), Chaital (163), Minakhan (092), Kushangra (091), Simuldaha (086)
7	Hasnabad	Ghoshalati (077), Kharampur Abad (018), Dakshin Bhebia (017), Ichhapur (079), Bhurkunda (076), Shulkuni Abad (075), Barunhat (065), Rajnagar (124), Kuliadanga Abad (027), Sadarpur (008), Pipharaghabpur (010)
8	Hingalganj	Mamudpur(096), Hingalganj(097), Bainara(088), Kumirmari(089), Patghara(116), Ramapur (114)
9	Sandeshkhali - I	Fakirtakia (010), Agarhati (009), Laukhali Patharghata (008), Chunchura (007), Khassankdaha (004), Mathbari Abad (001), Sankardaha Abad (005), Bayarmari (006), Rajbari (014), Natkora (015), Kanmari (018), Dheknamari (002), Baunia Abad (020)
10	Sandeshkhali - II	Daudpur (049), Gabbaria (048), Rampur (011), Bhangatushkhali (044), Sitalia (041), Atapur (042), Tushkhali (043), Dhamakhali (012), Dwarir Jangle (037)
11	Basirhat - I	Pipha (073), Shwetput (089), Tajpur (090), Nalkora (123), Dhaltitha (122), Gachha (117)
12	Basirhat - II	Dhopaberia (069), Rajendrapur (072), Chuknagar (068), Chandigari (091), Karulia (013), Begampur (009), Dhanyakuria (CT)

Figure: 3 – Bheri Area Extracted from Satellite Image of 2018



Salinity in the Bheri-Water in North 24 Parganas

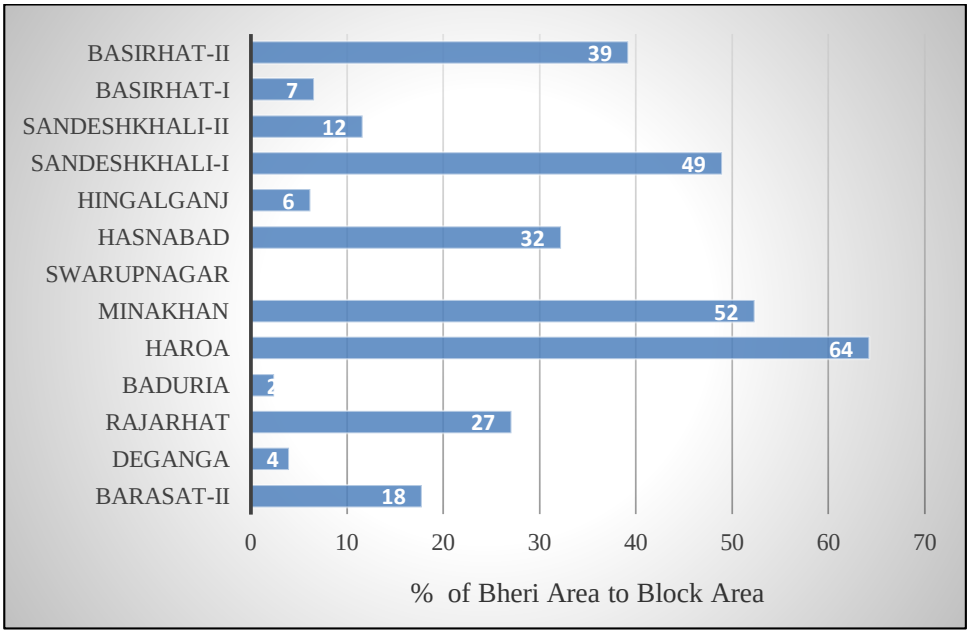
The brackish river or canal-water is ingressed into the bheries when tidal amplitudes are found high, preferably during new Moon and full Moon-periods. Salinity in the bheri gets slightly low immediate after taking into such brackish water and gets higher with long evaporation. And during the monsoon bheri-water gets minimum brackishness because of precipitation.

Salinity of bheri-water also depends on the distances from the sea-face. The bheries situated in Barasat-II, Deganga, part of Haroa, Minakhan, Hasnabad, Basirhat-I and Basirhat-II blocks are farthest from the sea face, and hence have lower salinity-concentration all the yearlong. Whereas, the bheries situated in the blocks Hingalgunj, Sandeshkhali-I, Sandeshkhali-II, part of Haroa, Minakhan, Hasnabad, Basirhat-I and Basirhat-II and are nearer to the sea face and Ichhamati River, and hence have comparatively more saline regime. Thus, the bheries in the farthest end from sea-water have low salinity (that remains below 10ppt) and those nearer to rivers and sea-water have medium salinity (where salinity never exceeds 20ppt) (Biswas, 2014).

Upsurge of Bheri-Area in North 24 Parganas

Market-oriented and export-driven prawn culture leads to convert the lands which were previously used for agriculture, mangrove, settlement, grazing etc to bheri-fishery. In the 1980's such transformation took a particular accelerated pace as a result of various measures and policies taken by the Government to encourage inland fishery since marine-shrimp catch was then getting saturated steadily. However, after 1990's the conversion took the highest pace because of adopting new economic policies by the Government in 1990s. The farmers were bringing more and more lands under bheri-culture being attracted by the prospects of high economic return from bheri. Consequently, the lands that were previously used for other purposes like agricultural activities, grazing of livestock (fallow land), production of indigenous and capture fish etc, were then brought under bheri-farming. Thus, the bheri-area increased from 15249ha in 1980-81 to 33850ha in 2007-08 (i.e., more than 120% boosting in 27 years) and about 50% over the next 10 years (50570ha in 2018) as a whole in the district. The Figure: 5 shows the incremental change of bheri area in individual block from 1981-82 to 2007-08 to 2018. And the new bheries have been emerging swallowing the lands that were previously being used for other purposes. This conversion of land from other purposes to bheri-farming is found as a continuous process of practice in the district.

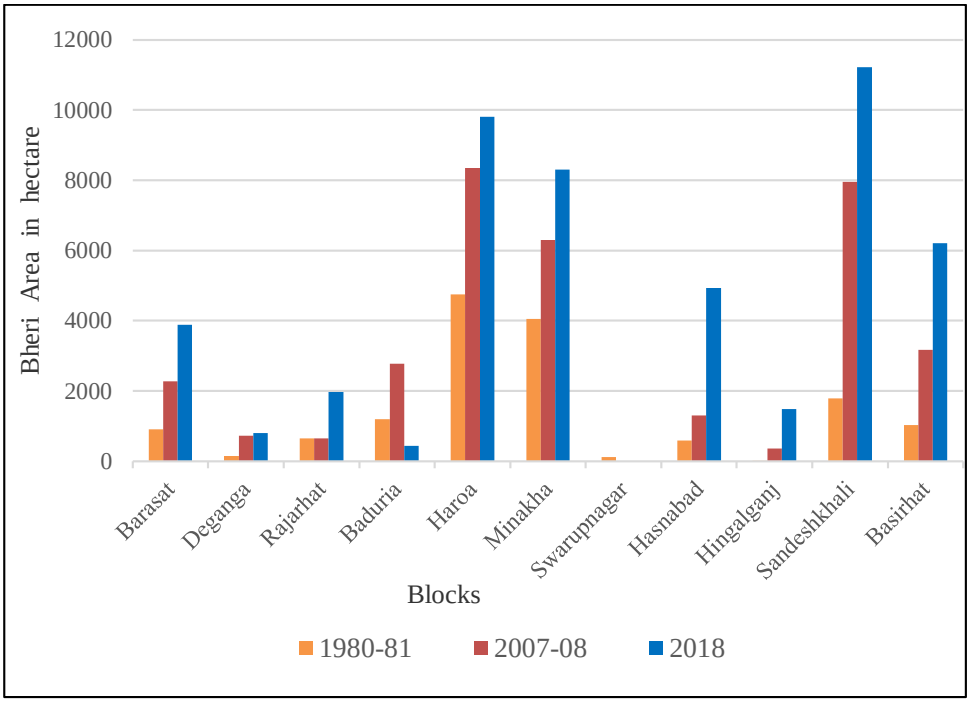
Figure: 4 – Percentage of Bheri Area in 2018 to Total Block Area



Source: Extracted Bheri Area based on Satellite image of 2018.

However, bheri is not evenly distributed over all the 13 blocks (Figure: 4) in the district. Since productive operation of this typical inland aquaculture is solely dependent on tidal sea-water, the bheries in the district have developed in and around the Bidyadhari River and its associated distributaries and tributaries. A considerable amount of Kolkata City-sewage also falls into the river, which indirectly helps in embellishing the bheri-culture. Fig: 4 shows percentage of present bheri-area with respect to total block-area in each of the 13 blocks. Haroa block rests on the top both in absolute as well as share in total geographical area since 1980-81- 4758ha (31%) in 1980-81, 8344ha (55%) in 2007-08 and 9813ha (64%) in 2018. In the like way Minakhan represents the second position since 1980-81- 4047ha (25%) in 1980-81, 6294ha (40%) in 2007-08 and 8310ha (52%) in 2018 and Sandeshkhali-I places the 3rd- 8923ha in 2018. Similarly, Basirhat-II occupies the 4th and Hasnabad 5th in position in 2018 representing 39% and 32% bheri respectively as compared to their total geographical areas. But if percentage-increase is taken into account, Hasnabad Block remains in the top (24 percentage-point) from 2007-08 to 2018 and Haroa remains in the highest position (23 percentage-point) from 1980-81 to 2007-08. Interestingly, Baduria Block has declined (-)13 percentage-point during the period from 2007-08 to 2018 and Swarupnagar traces no bheri in the year 2018.

Figure: 5 – Changing Trend of Bheri Area from 1980-81 to 2018



Source: Data of 1980-81 & 2007-08 are collected from Meen Bhavan, Barasat, North 24 Pgs and data of 2018 is calculated from extracted Bheri Area based on Satellite image of 2018.

Conclusion:

Bheri-culture has emerged centering the Bidyadhari River majorly, in the south and eastern skirts of North 24 Parganas District. Salinity of bheri-water gradually increases from south-east to north-west direction in general, though not uniformly. Bheri-area has increased in the district more than 230% over last 38 years and such growth has taken place gulping the agricultural lands to a great extent. Such transformation of lands calls for addressing and determining the environmental as well as various socio-economic aspects that have already cropped up and that would be, as well. The management and manipulation of brackish water is urgently required for valuable ecosystem functions which is now under degradation (Naskar et al. 2016).

References:

1. Biswas C. R. et. al., 1991: "Prospects and Retrospects of Paddy-cum-fish Farming in Coastal Low Land Rice Fields", J. Indian Soc. Coastal Agri. Res. 9(1/2), Page 93-97.

2. Biswas S., 2014, "Spatio-Seasonal Variation of Salinity in Bheri (Water Bodies) in North 24 Parganas District, West Bengal, India", Vol. 4, No. 2.

3. Census of India 2011

4. Ghosh A., 1990: "Culture Prospects of Brackishwater Finfish and Shellfish and Their Economics " published in the book "Technologies for Inland Fisheries Development" Edited by VV Sugunan and Utpal Bhowmik, Central Inland Fishery Research Institute (CIFRI), Barrackpur and Department of Fisheries, Government of WB.
5. Ghosh A., 2002: "Ecology and Fisheries of Estuarine Wetlands of West Bengal", Central Inland Fishery Research Institute (CIFRI) Bulletin No. 111, page 1-2.

6. Hunter W.W., 1998: "A Statistical Account of Bengal, Vol I, Part II, Statistical Account of the Sundarbans", the State Editor, WB District Gazettier, Education Department, Govt. of WB, originally published by Trubner & Co., London, 1876, Page 21, 37, 47-48, 54.

7. NABARD's Initiatives, 2007.

8. Naskar K. R., 1985: "A short history and present trends of Brackishwater Fish Culture in Paddy Fields at the Kulti-Minakhan Areas of Sundarbans in West Bengal", Indian Soc. Coastal agric. Res., 3(2), page 117.

9. Naskar K. R., et. al., 1987: "Mangroves Swamps of the Sunderbans", Naya Prokash, 206, Bidhan Sarani, Kol-06, Page 27, 212-213, 216, 218, 220, 221.

10. Naskar N., et. al., 2016: "Algal Dynamics of Brackish Water Environment in Sundarban", Book Chapter published in "*Environmental Degradation and Disaster: A Vision Plan for Sustainable Development"* Avenel Pressr, 206, Bidhan Sarani, Kol-06, Page 27, 212-213, 216, 218, 220, 221.

11. Sugunan V. V., 2003: "Inland Aquatic Resources of India and Their Relevance to Fisheries Development" CIFRI, Bulletin No 115, Page 2.