

**SPATIO-SEASONAL VARIATION OF SALINITY IN BHERI (WATER BODIES) IN  
NORTH 24 PARGANAS DISTRICT, WEST BENGAL, INDIA**

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**Abstract**

Salinity in bheri-water is sourced from saline sea-water entered through rivers and canals. Production of different types of aqua-crops in bheri is conditioned with different degree of salinity. An attempt has been made to show spatio-seasonal variation in bheri in North 24 Parganas district through field investigation during 2012-13. For the present study, 46 sites were selected in the sample survey over 12 blocks in the district. Variation of salinity in bheri took place from one location to another and season to season. Assessment of such spatio-seasonal variation would help in maintaining proper water management in bheri for the sake of extracting optimum outcome from bheri-culture in North 24 Parganas.

**Key words:** *saline water, tiger shrimp, employment generation, nutritional security*

**Introduction**

Bheri (local name in West Bengal, India) is a unique and typical type of culture-fishery. This type of fishery is generally practiced in low land in which the water depth seldom exceeds 1.00 metre (Ghosh, 2002) impounded with earthen embankments all round. Water is ingressed into the impounded area through typically built channel at convenient time-interval. In India, it is found to be farmed all over the coastal states spreading over 3,00,000 ha estuaries (Sugunan, 2003) along the 5,600 KM coast line and even all over the globe though with different local names maintaining particular procedures during operation.

In India, different agency and organization like Central Marine Fishery Research Institute (CMFRI), National Commission on Agriculture (NCA), Indian Institute of Management (IIM) etc had estimated the resource in India time to time and they found varied figures. However, India has an estimated potential area of 12,40,000 hectares for brackishwater aquaculture, of which only 1, 57,000 hectares (13%) was utilized for the purpose in 2001-02 (Central Pollution Control Board, Govt. of India). This culture-based water impoundment is locally known as bhasabadha, gheri, jalkar or bheri in West Bengal (30,000 ha), pokkali in Kerala (6,400 ha), gazanis in Karnataka (4,800 ha), Kazanas in Goa (1,200 ha) and Salt pans or kharland in Maharastra (1,800 ha) (Biswas et. al., 1991 and Ghosh, 1990).

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In West Bengal, bheri-fishery is in existence from time immemorial in the Hooghly-Matlah estuarine systems though beginning of scientific culture is a recent phenomena (mid 80's and by mid 90's) (NABARD's Initiatives, 2007) and the dominant product is *Peneaus mondon* or tiger shrimp i.e, bagda chingri . In West Bengal brackishwater resource is estimated to be in the tune of 2,10,000 ha of which approximately a total of 50,000 ha (i.e. 23.81%) has presently been brought under culture-fishery. This type of aquaculture mostly exists in North 24 Pargana and then in South 24 Parganas (10,000 ha) and Purba Medinipur district (4,000 ha) in terms of area.

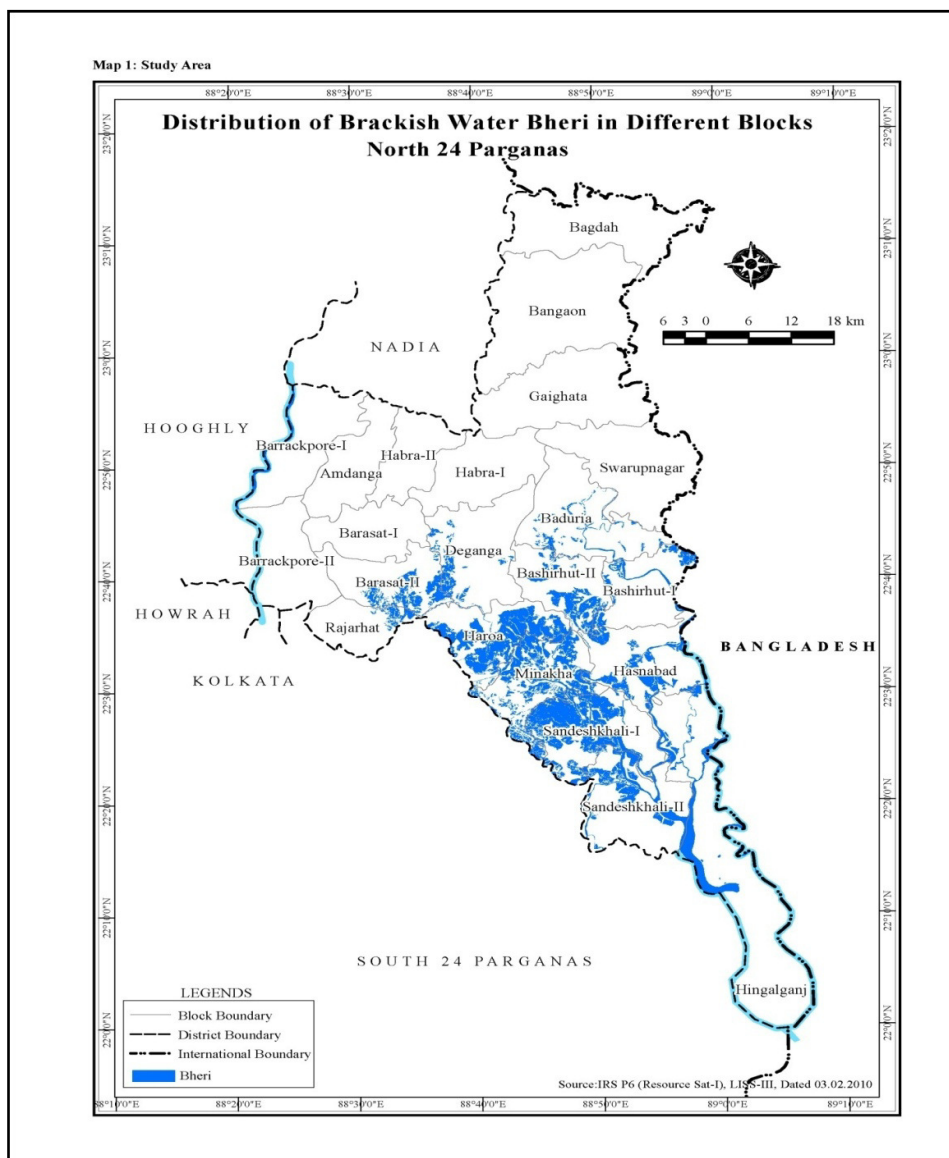
However, the bheri-fishery takes a significant part in food and nutritional security particularly in rural Bengal and broadly in rural India. They also help in earning considerable foreign currency by exporting shrimps, ample employment generation, environmental reclamation, flood control etc.

The bheries may be fed either with saline or non-saline water depending on the accessibility and/or availability and of course based on the type of farming procedure. However, almost all the bheries in India are of saline water type.

Salinity is a general term for water containing dissolved salts expressed usually in parts per million (ppm) or parts per thousand (ppt). Types of aqua-crops cultured in saline water bheries in all estuarine zones depend on the degree of salinity since a particular degree of salinity is suitable for proper sustenance and growth of a particular specie of fishes and prawns. Operational procedure and productivity also, to some extent, vary depending on the intensity of salinity. However, bheri-culture has a considerable effect on the people's way of life vis-a-vis agricultural activities. Hence, it is felt imperative to make an overview of such spatio-seasonal variation of salinity in bheri water.

### Study Area

Bheri-culture is practiced almost all over the coastal states in India, though with different local names and in different procedures. However, for easy and convenient approach the present study is limited to the saline water bheries in North Twenty 24 Parganas, West Bengal, India. The district 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 covering an area of 4,094 sq Km and a population of 89,30,295 (2001 Census). In North 24 Parganas district, brackishwater bheries cover an area of about 34,000 ha in the twelve blocks vide Barasat-II, Deganga, Rajarhat, Baduria, Haroa, Minakhan, Hasnabad, Hingalgunj, Sandeshkhali-I, Sandeshkhali-II, Bashirhat-I and Bashirhat-II as has been depicted in map 1. However, all the bheries in the district are of saline water type with varying degree of salinity-concentration except in Rajarhat and Barrackpur-I blocks where a very small area of sewage-fed bheri exists. Saline water bheries are cultured in low lands of the district's south and eastern parts. The areas are criss-crossed by innumerable tidal rivers and tributaries and literally characterized by delta formation. In some bheries, paddy is cultivated during monsoon seasons.



### **Contributors to Spatio-seasonal Variation of Salinity in Bheri in North 24 Parganas**

All the bheries in North 24 Pargana district (except some sewage-fed bheries in Rajarhat and Barrackpur-I blocks) are recognized in the tidally flooded stretches over the estuarine low lands. Hence, they are saline or brackish in nature. Such brackish water bheries constitute the largest area in bheri-farming in North 24 Pargana and in West Bengal as a whole. The tidal brackish water from the nearest and feasible sources is ingressed into the bheries as per requirement and necessary operation is carried out. Once, the water is stocked within the impoundments, it gets evaporated naturally with varying rates depending on various factors and the depth of bheri-water falls down. Consequently, brackishness of the impounded water goes up. When tidal water is let into the bheries salinity of bheri-water goes down as nearer to the ingressed tidal water. That is, in general salinity-concentration of bheri-water remains high before letting into tidal water and less after letting into.

Again bheri stretches a long areas right from the southern-most corner of the district (Hingalgunj block) to the middle of the district (Baduria block). Along the east-west direction, bheri stretches from Barasat-II block to Hingalgunj block. Along this vast stretches, the tidal water cannot reach with equal magnitudes. As the tidal water goes to the north, its influencing-strength falls down due to north-south slopping of the land-form, narrowness of the rivers in the north etc. At the same time, local sweet water floods the rivers. Hence, in the areas where tidal action is weak, the river water and hence the bheri-water remains less brackish round the year in general as compared to the areas where tidal action is strong.

Further, there occurs round the year seasonal variation of salinity-concentration in each and every bheri of the district. Salinity remains minimum during monsoons due to its characteristic precipitation, gets maximum in hot summer for resultant maximum evaporation and moderate in winter or post monsoon in all the bheries irrespective of geographical locations.

The above mentioned factors can mainly be attributed for spatio-seasonal variation of salinity of brackish water bheries in the district.

### **Data Source**

The saline water bheries have been identified in the district from IRS P6 (Resource Sat-I), LISS-III dated 03.02.10. The map has been taken from National Atlas and Thematic Mapping Organisation (NATMO), India. The data related to degree of salinity has been found from the primary survey made by the author during 2012-13 over different seasons.

### **Locations of the Sample Sites**

The tidal bheries in the district are situated besides the rivers or canals cut off from the convenient river. Their spreadization is generally cluster in physical existence and not scattered. Due to such cluster-nature of bheries the sites were selected on cluster-basis i.e. usually one site against one cluster assuming that the salinity-concentration remains almost same in all the bheries over a particular cluster. Number of clusters varies from block to block; hence varies the number of

sample-site. In case of bigger cluster, more than one site were taken for, as the researcher deemed suitable. A distant factor was considered in that case. Some clusters were taken divided into sub-clusters which means that they are in some way separated from the other and may be with the boundary of block, canal, sluice gates, villages, roads or something like that and one site was chosen against one sub-cluster. Block has been considered as the lowest administrative unit. All total 46 numbers of sites have been considered in this work to get an overview of salinity concentration of bheri-water all over the district and they have been mentioned in the table 1 showing latitudes and longitudes, salinity-concentration etc.

**Table 1: Location-wise and Season-wise Distribution of Salinity in Bheri Water in North 24 Parganas**

Sample Site No.	LONGITUDE	LATITUDE	SALINITY in ppt			Degree of Salinity
			Pre Monsoon	Monsoon	Post monsoon	
1	88.8428°E	22.6798°N	10.67	3.03	6.88	<b>M</b>
2	88.8378°E	22.5773°N	9.10	3.53	5.69	<b>L</b>
3	88.7322°E	22.5064°N	11.58	2.81	4.40	<b>M</b>
4	88.7962°E	22.5254°N	12.41	3.21	5.23	<b>M</b>
5	88.8823°E	22.3951°N	15.17	5.79	8.20	<b>M</b>
6	88.7549°E	22.7309°N	8.61	2.1	4.13	<b>L</b>
7	88.7681°E	22.6865°N	8.65	2.26	4.38	<b>L</b>
8	88.8084°E	22.7348°N	10.51	5.3	6.68	<b>M</b>
9	88.8695°E	22.4875°N	15.48	5.3	8.22	<b>M</b>
10	88.8477°E	22.4751°N	16.15	5.57	8.67	<b>M</b>
11	88.919°E	22.5319°N	13.92	4	6.77	<b>M</b>
12	88.8111°E	22.6473°N	10.98	1.88	1.79	<b>M</b>
13	88.7089°E	22.5513°N	8.92	3.21	3.04	<b>L</b>
14	88.8382°E	22.5184°N	14.93	5.58	6.39	<b>M</b>
15	88.612°E	22.6°N	8.84	1.8	2.31	<b>L</b>
16	88.5573°E	22.6197°N	8.05	1.74	1.87	<b>L</b>
17	88.6619°E	22.57°N	8.70	2.1	2.97	<b>L</b>
18	88.6928°E	22.4697°N	11.85	2.96	4.42	<b>M</b>
19	88.6834°E	22.5295°N	10.20	3.44	4.86	<b>M</b>
20	88.6584°E	22.6059°N	5.07	1.46	2.28	<b>L</b>
21	88.575°E	22.6766°N	7.00	1.17	1.51	<b>L</b>
22	88.7695°E	22.648°N	12.45	3.27	4.76	<b>M</b>

23	88.5908°E	22.6442°N	3.99	<b>1.15</b>	1.42	<b>L</b>
24	88.7391°E	22.6261°N	9.03	2.18	3.84	<b>L</b>
25	88.6999°E	22.5753°N	7.84	3.21	3.75	<b>L</b>
26	88.702°E	22.6917°N	8.42	2.2	4.13	<b>L</b>
27	88.6314°E	22.6956°N	8.23	2.32	4.30	<b>L</b>
28	88.6522°E	22.6507°N	3.92	1.19	1.38	<b>L</b>
29	88.6242°E	22.6536°N	4.02	1.18	1.43	<b>L</b>
30	88.7752°E	22.5858°N	9.10	3.55	5.06	<b>L</b>
31	88.7377°E	22.5704°N	9.58	3.49	5.60	<b>L</b>
32	88.7882°E	22.564°N	9.10	3.48	5.67	<b>L</b>
33	88.9701°E	22.2437°N	15.19	5.27	8.20	<b>M</b>
34	89.0006°E	22.2105°N	15.41	5.86	8.53	<b>M</b>
35	89.0179°E	22.2971°N	15.70	5.92	8.10	<b>M</b>
36	88.9355°E	22.411°N	14.83	4.63	7.26	<b>M</b>
37	88.8336°E	22.4217°N	15.19	5.67	9.12	<b>M</b>
38	88.7695°E	22.4707°N	15.46	6.19	8.59	<b>M</b>
39	88.7701°E	22.3925°N	16.08	6.79	8.81	<b>M</b>
40	88.7679°E	22.4385°N	14.60	5.61	9.17	<b>M</b>
41	88.9234°E	22.3034°N	<b>16.17</b>	6.39	7.16	<b>M</b>
42	88.8296°E	22.3806°N	15.15	5.51	8.62	<b>M</b>
43	88.8225°E	22.3101°N	15.41	5.49	8.15	<b>M</b>
44	88.9539°E	22.6946°N	11.36	3.25	7.21	<b>M</b>
45	88.8163°E	22.6126°N	9.46	3.26	6.16	<b>L</b>
46	88.5243°E	22.6457°N	8.20	1.61	1.98	<b>L</b>
<b>L</b>	Low Salinity					
<b>M</b>	Medium Salinity					
<b>H</b>	High Salinity					

Source: Primary survey, 2012-13

### Sample Collection and Testing

Water-samples were collected from a depth of about 0.5m measured from the surface of the water and approximately 10m away from the bheri-bank so as to avoid any contaminations. Again sufficient distance from the 'goipath' (i.e., entry point of water into the bheri) has been maintained during collection of sample to avoid salinity-contribution of recently ingressed water, if any. That is, the samples have been kept free from any contamination in respect of the parameter to be

measured and with a view to represent it as the whole bheri-water in terms of salinity. Samples were collected from 2 to 5 numbers of nearby bheries against a particular site and the average value of salinity-concentration of all those bheries has been taken for representing concentration of that site. And almost the middle position of all those sample-locations was considered for representing latitude and longitude of that particular site. This method had been adopted pre-assuming that salinity may vary from one bheri to another depending on the degree of evaporation, frequency and quantum of water ingressed just earlier to collection of samples etc, even though they are situated in the same cluster or sub-cluster. The samples were collected from the same bheries during each of the three seasons viz. pre-monsoon, monsoon and post-monsoon over the year 2012-13 and the values of salinity-concentration in those three seasons have been considered for analyzing and showing spatio-seasonal variation of salinity against each site individually. In the survey, latitudes and longitudes were measured by the GPS machine of model German eTrex-H and salinity was measured with the help of digital salinity meter, model 671E in the laboratory, department of Geography, University of Calcutta.

### **Classification**

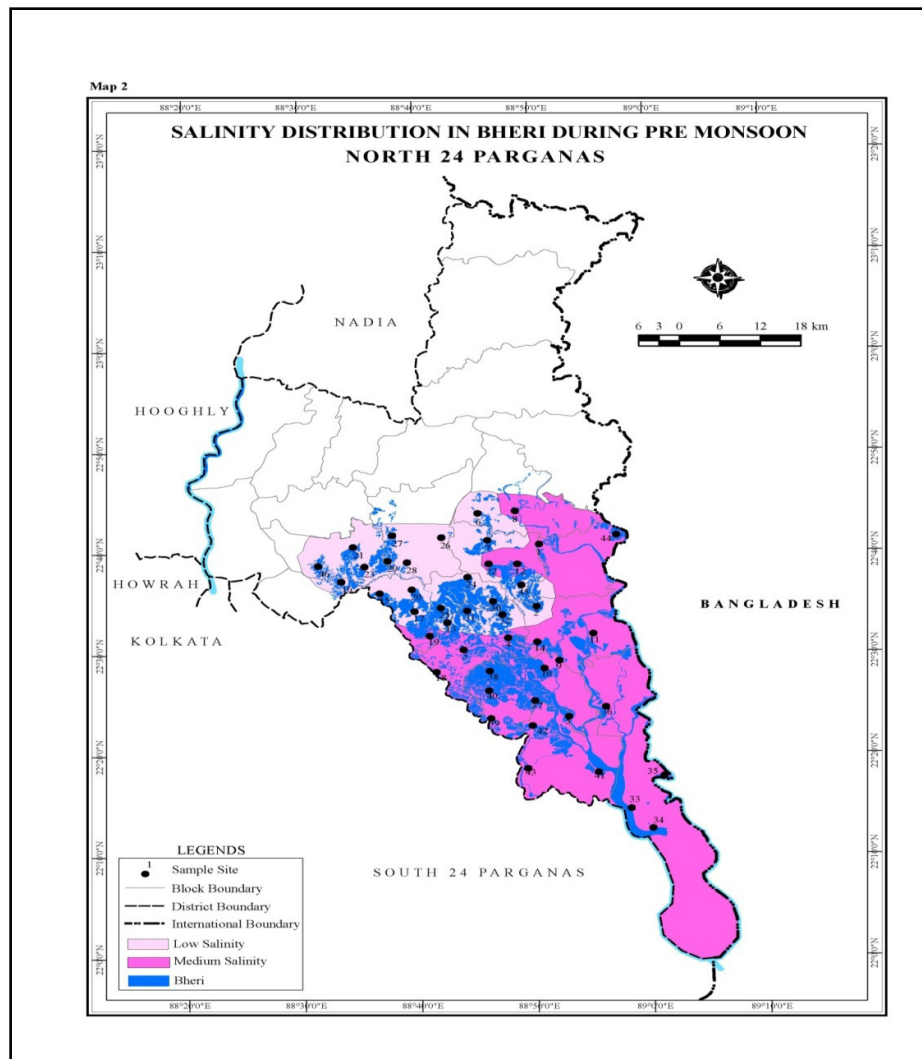
The salinity-concentrations of bheri-water of 46 sites over the district show that salinity ranges from 1.15 ppt (sample site no. 23, monsoon season) to 16.17 ppt (sample site no. 41, pre-monsoon season). This range of salinity has been classified in following three groups as per Saha et. al., (1986).

- i) Low saline bheries: where salinity remains below 10 ppt and
- ii) Medium saline bheries: where salinity does not generally exceeds 20 ppt
- iii) High Saline Bheries: where salinity rises above 20 ppt.

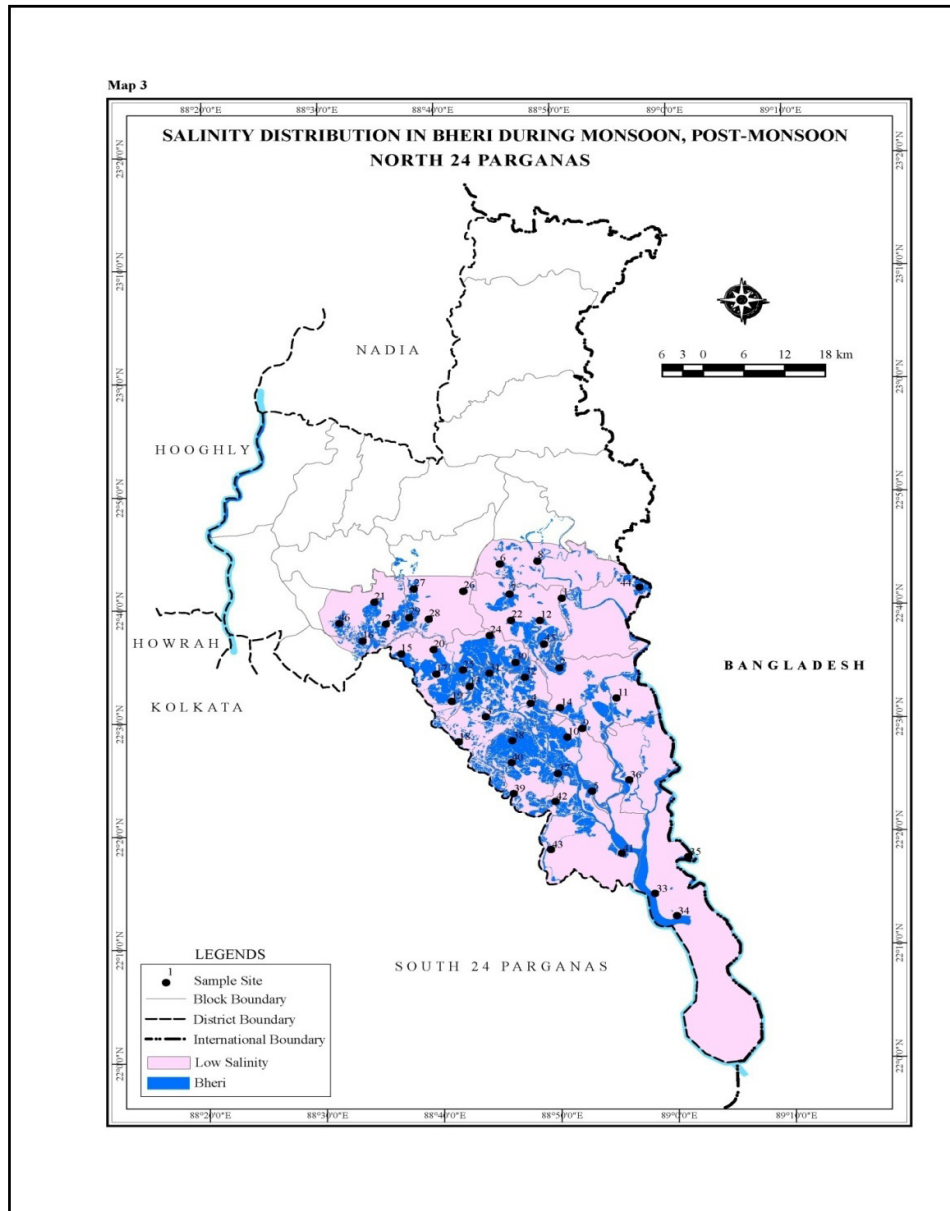
### **Results and Discussion**

Salinity distribution in respect of all the 46 sites based on those three categories has been depicted in the maps 2 and 3 showing locations of bheries as per satellite image. The data of table 1 shows that against sample sites 2, 6-7, 13, 15, 16-17, 20, 21, 23-32, 45 and 46, salinity did not rise above 10 ppt during pre-monsoon period, whereas against sample sites 3-5, 8-12, 14, 18-19, 22 and 33-44 salinity rose above 10 ppt (but remained below 20 ppt). Map 2 shows that the first series of sites are situated in Barasat-II, Deganga, part of Haroa, Minakhan, Hasnabad, Basirhat-I and Basirhat-II blocks and are farthest from the sea face, and hence are less influenced by tidal actions. This is the low saline bheri zone during pre-monsoon. The second series are 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 are comparatively more influenced by tidal amplitudes. This is designated as medium saline zone during pre-monsoon. During monsoon period salinity fell down substantially against all the 46 sites and salinity did not

cross the 10 ppt limit. The map 3 shows that the entire district fell in low saline zone during monsoon period. The same characteristic is observed during post-monsoon also.







Now, if the three seasons are considered together, the salinity distribution looks like that during pre-monsoon season i.e., like map 2 where north-western track is low saline zone and the south-eastern track is medium saline zone. Within the low saline zone, both fresh and brackish water fishes and prawns are cultivated simultaneously or separately. Here bagda chingri i.e., tiger shrimp (*P. monodon*) and Parse (*L. parsia*) are most extensively cultured. Besides these, other prawns like galda chingri (*P. indicus*), hanne chingri, chhati chingri etc, Indian major carps (*L. rohita*, *C. catla*, *C. mrigala* etc), Indian minor carps (*T. mossambica*), bata (*L. bata*), telapia etc are cultured. In some pockets of this zone, paddy is grown along with the prawn and fishes in synchronized or sequential manner over monsoon-postmonsoon periods i.e. from July to November while salinity drops down to almost freshwater level. In the south-eastern parts salinity rose above 10 ppt during summer season (but never rose above 20 ppt) while fell down considerably during monsoon period and this is categorized as medium saline zone. The concerned blocks vide Hingalgunj, Sandeshkhali-I, Sandeshkhali-II, part of Haroa, Minakhan, Hasnabad, Basirhat-I and Basirhat-II are situated nearer to the sea face and Ichhamati River, and hence are comparatively more influenced by tidal amplitudes. The sample sites as depicted in the map 2 and table 1 are 1, 3-5, 8-12, 14, 18-19, 22 and 33-44. Here also tiger shrimp (*P. monodon*) is the most favourable crop though parse (*L. parsia*), *L. tade*, *L. calcarifer*, *Mystus* sp., *E. tetradactylum* etc and other prawns like galda chingri (*P. indicus*), *M. monoceros* etc are cultured. Here carps are less cultured. Some bheries located on both sides of the Bidyadhari River after Kulti Lock Gate near Machhibhanga, Haroa, Minakhan, Malancha etc, which fall in this class, are fed with sewages disposed off by Kolkata city. However, no bheri in the district fell under high saline category during the study period.

### **Conclusion**

Salinity of bheri-water in the district gradually increases from south-east to north-west direction in general, though not uniformly. Weakening of tidal influences to such direction as moving far from the Bay of Bengal is mainly responsible for the same. In both low and medium salinity zones Bagda chingri (*P. monodon*) is the most costly and hence preferred product irrespective of degree of salinity-concentration, geographical location and season, though other varieties of prawns are reared up. Also various sweet water fishes like Indian major and minor carps, tilapia, bata etc are grown up particularly where salinity is comparatively less. The share of low salinity area is less than that of medium salinity. Of course, the salinity regime in spatio-seasonal perspective is not constant and may vary from year to year.

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