The Agriculturists 16(2):123-130(2018) **ISSN 2304-7321 (Online), ISSN 1729-5211 (Print)**
A Scientific Journal of Krishi Foundation ***Indexed Journal***
DOI: http://dx.doi.org/ 10.3329/agric.v16i02.40350 Impact Factor: 0.568 (GIF, 2015)

Short Communication

Water Pollution in Chandpai Range of the Sundarbans Mangrove Forest of Bangladesh

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Received: 16 October 2018 Accepted: 25 December 2018

Abstract

The present study was conducted to assess the water quality at Chandpai range in Bagerhat district of the Sundarbans Mangrove Forest of Bangladesh. Seven water samples were collected during July to December 2014. The water were analyzed for pH, EC, P, K, S, Ca, Mg, Cu, Mn, Zn, Fe and B. The EC values of rivers and canals water were found higher than that of the ponds. River waters of Chandpai range were detected as neutral to slightly alkaline. Waters from Karamjalkhal (Lake), Pasur river, Nandabala canal and Ismails Chila were found strongly saline (EC, 8-12 dSm^{-1}), Bholakhal (lake) was moderately saline (EC, 4-8 dSm^{-1}) and Boiddomari and Dashervarani ponds were poorly saline (EC<4 dSm^{-1}) in nature. The concentrations of K, Ca, Mg, S, Zn and B were found higher and P, Cu and Mn were lower at higher EC levels. The concentrations of K, S, Cu and B in most of the rivers exceeded the permissible level for aquaculture.

Keywords: Water pollution, mangrove forest.

1. Introduction

The Sundarbans region in Bangladesh has the largest productive mangrove in the world. It is rapidly disappearing as a result of the shrimp farming and wood harvesting industries. Extensive uses of the forest resources and indiscriminate felling have resulted in near extinction of some species (Mahmood, 1999). The mangrove ecosystem provides living support to nearly 1.2 million coastal people who are involved in fishing, hunting, collecting honey, wax and timber. The mangrove forest also has a buffer function, protecting the densely settled agricultural areas to the north from the full force of cyclonic storms and tidal waves (Mepham and Petr, 1987). About a fifth of the 20 million people who live in the coastal region of Bangladesh directly depend on the coastal and marine resources for their livelihood.

Sundarbans in both India and Bangladesh have been declared world heritage sites. However, its biodiversity continues to be threatened by a growing human population that not only exerts pressure on its biological resources, but also on the fresh water inflows from upstream area. The coastal environment faces pollution from domestic sewage and toxic pollutant from industrial effluents leading to serious impacts on water and sediment quality as well as on biodiversity. Oil exploration in coastal areas is also emerging as a new threat. This important ecosystem has started losing biodiversity because of over exploitation and habitat destruction. Both the Bangladesh government and UNESCO have emphasized the importance of conservation of biodiversity in the Sundarbans (Sattar and Faizuddin, 1998).

Mangrove ecosystems are specific in numerous aspects (e.g. carbon and nutrients cycles, sediment characteristics, tidal conditions) which are expected to affect the speciation, and therefore the bioavailability of contaminants (Bayen, 2012). It not only acts as a sink or transfers the pollutants but also oxidizes the metals present in the sediment by exuding oxygen into the anoxic soil through aerial roots (Scholander *et al.*, 1968). It can also arrest and bioremediation of certain pollutants (like fluoride) in local environment (Akhand *et al*., 2012). Mangrove wetlands are used for low cost waste disposal site.

Mangroves like other halophytes also decrease their water and osmotic potentials to maintain turgor at higher salinity (Khan *et al*., 2000). Detailed hydro-chemical research is needed to evaluate the different processes and mechanisms involved in polluting water. The balance between freshwater and salt water in this wetland has been suffering modifications from the tilting of the G-B delta toward the east and rising sea level. Increased anthropogenic influences like withdrawal of river water from the upstream region and increase in organic and inorganic pollutants have further led to deterioration of health of the wetland (Bhattacharya, 2008).

Very few or no study was conducted in Bangladesh on ionic pollution of water in the Sundarbans mangrove forest. Therefore, the study was carried out to assess the water pollution in Chandpai Range of the Sundarbans mangrove forest of Bangladesh.

2. Materials and Methods

Three water samples at 1 km distance from each other were collected from each of the seven rivers at Chandpai range in Bagerhat area of the Sundarbans such as Karamjolkhal (lake), Pasur river (Karamjol), Pond (Boiddomari), Nandabala canal, Bholakhal (Kalomteji), Ismails chila and Pond (Dasher varani).

The water samples were collected in half liter sterilized PET bottles. These bottles were cleaned with dilute hydrochloric acid and then washed with tap water followed by distilled water. Before water sampling, containers were again rinsed 3-4 times with river water to be sampled. The water samples were collected far from the bank of the water source to avoid the turbidity of water. Then 2-3 drops of nitric acid was added to each bottle to inhibit the precipitation, adsorption by container wall and microbial degradation. The collected samples were filtered through (Whatman, No. 42) filter paper. Then the samples were kept in refrigerator to prevent the growth and development of algae. Thus the samples were made ready for analyses. For the collection of samples method outlined by APHA (2005) was followed.

The pH and EC were determined following the methods mentioned by Tandon (1995). Calcium and Mg were determined by complexometric method of titration as mentioned by Chopra and Kanwar (1986). Potassium was determined flame photometrically (APHA, 2005). Spectrophotometric method was followed for the determination of P, S and B (Page *et al.*, 1982). Zinc, Cu, Fe and Mn were determined with the help of AAS following method outlined by APHA (2005). The mean values of 3 replications of samples were used for statistical analyses for each parameter and the statistical analyses were done following methods outlined by Gomez and Gomez (1984).

3. Results and Discussion

3.1 The pH, EC and ionic constituents of waters at Chandpai area of the Sundarbans in Bagerhat district

3.1.1 The pH and EC values in water

The values of pH and EC varied from 7.0 to 7.9 and 0.59 to 9.93 dSm^{-1}, respectively (Figure 1). The highest pH was found in the water of the pond at Dashervarani and the lowest was in the water of the rivers at Nandobala, Karamjal and Pasur. The highest EC value was found in Nandobala canal and the lowest was in Dashervarani pond. River waters of this area were detected as slightly acidic to alkaline. All the river waters in this area of the Sundarbans contained EC at strongly saline level (EC>8.0 dSm^{-1}) and this might be due to the evaporation of river water in the sampling period. Liss *et al*. (2004) reported that pH and SO42- concentration increase during dry season and decrease during wet season. In summer season, S and P status were increased might be due to fertigation of agricultural fields.

3.1.2 The status of K and Ca in water

The concentrations of K and Ca varied from traces to 23.46 to 96.96 and 19.41 to 36.29 mgL^{-1}, respectively (Figure 2). The highest K was detected in Karamjalkhal at Chandpai and the lowest level was detected in the pond of Biddomari. The highest Ca was found in Nandobala Canal and the lowest was in the Pond of Dashervarani. Higher concentrations of K and Ca were found at lower EC and lower K and Ca were detected at higher EC levels. The K concentrations in most of the rivers exceeded the permissible level (Meade, 1989) for aquaculture.

3.1.3 The status of Mg and S in water

The concentrations of Mg and S varied from 1.66 to 1.95 and 10.01 to 33.71 mgL^{-1}, respectively (Figure 3). The highest level of Mg was found in Karamjolkhal at 9.2 dSm^{-1} EC level and the lowest was found in Dashervarani pond at 0.59 dSm^{-1} EC level. The highest S was observed in Ismails Chila at Vola camp and the lowest was in Bholakhal at Kalomteji. The observations suggested an elevated level of S at lower EC levels. Similar observations were recorded by Taniguchi and Tase (1999).

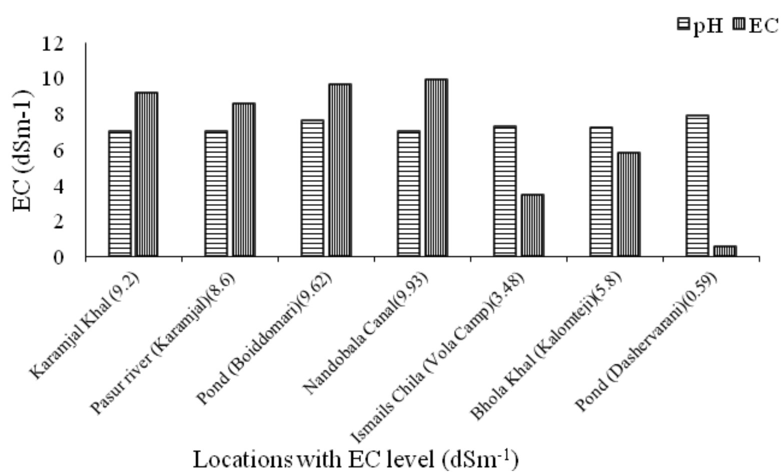

Fig. 1. The values of pH and EC at Chandpai area.

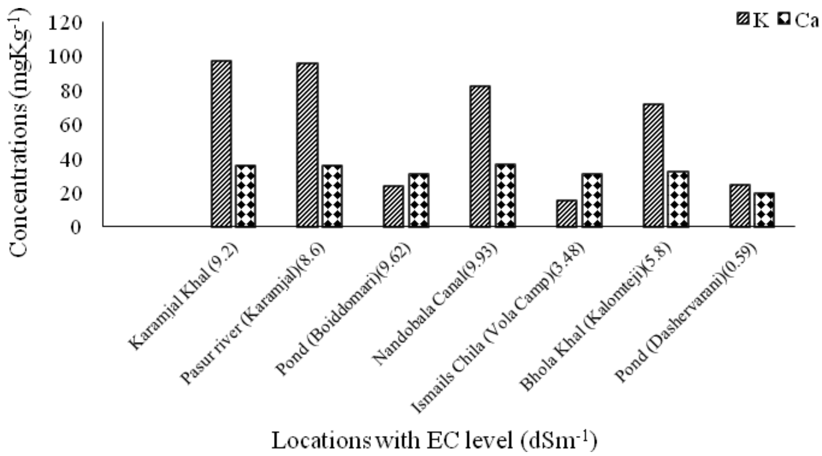

Fig. 2. The concentrations of K and Ca at Chandpai area.

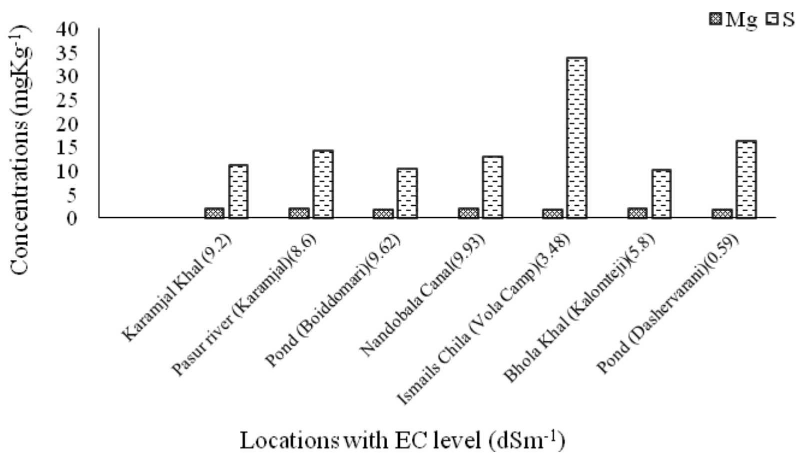

Fig. 3. The concentrations of Mg and S at Chandpai area.

3.1.4 The status of Cu and Mn in water

The concentrations of Cu and Mn in water varied from 0.02 to 0.024 and traces to 0.003 mgL^{-1}, respectively (Figure 4). The highest amount of both Cu was found in Ismails Chila and Dashervarani pond at 24.95 dSm^{-1} EC level and the lowest was at Barokeyakhali at 3.48 and 0.59 dSm^{-1} EC level, respectively. The lowest level Mn was found in Karamjalkhal and Vola camp. The concentrations of Cu and Mn were found higher at lower EC levels. The concentration of Cu was detected at above the permissible level (Meade, 1989) for aquaculture. Similar finding was also reported by Azam *et al*. (2010). Undisturbed sediments currently situated in the riverbanks contaminates with heavy metals such as Mn, Cu, Pb into the river system during flooding. This release could be markedly enhanced by increased nutrient levels into the river system.

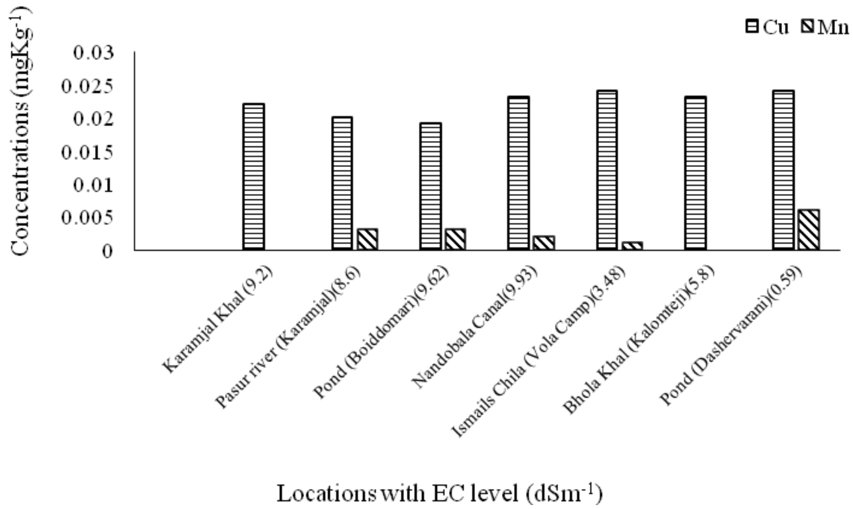

Fig. 4. The concentrations of Cu and Mn at Chandpai area.

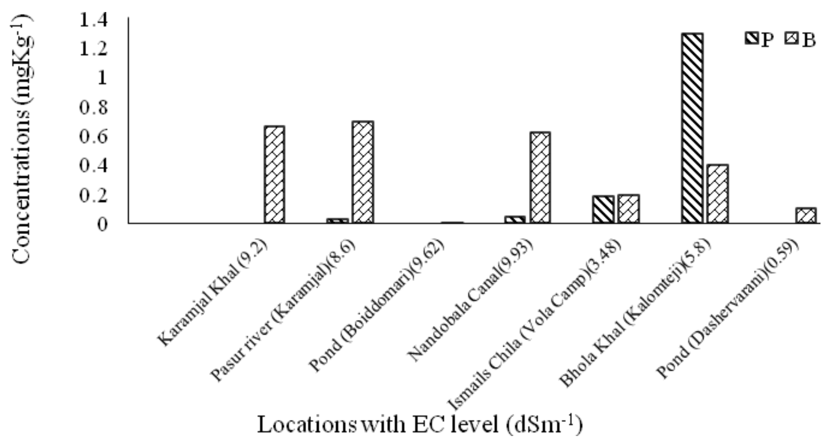

Fig. 5. The concentrations of P and B at Chandpai area.

3.1.5 The status of P and B in Chandpai area

The concentrations of P and B in water varied from traces to 1.289 and 0.1-0.69 mgL^{-1}, respectively (Figure 5). The highest P was detected in BholaKhal at Kalomteji and the lowest level was detected at different locations like Dashervarani pond, Boiddomari pond and Karamjalkhal. The highest level of B was found in Pasur river (Karamjal) at 8.6 dSm^{-1} EC and lowest was present in Boiddomari Pond at 9.62 dSm^{-1} EC level. The concentration B was detected at above the permissible level for aquaculture (Meade, 1989). Similar study was conducted by Cheung (2003) who found strongrelation between high P and S levels and the discharge of industrial effluents along the river.

Table 1. pH, EC and ionic constituents of water at different locations at Chandpai range of the Sundarbans in Bagerhat district.

SL. No	Location	pH	EC	P	K	Ca	Mg	S	Cu	Mn	Zn	Fe	B
			dSm^{-1}	$mgKg^{-1}$									
1	Karamjal Khal	7	9.2	0	96.968	35.46	1.95	11.17	0.022	0	0.043	0	0.66
2	Pasur river (Karamjal)	7	8.6	0.027	95.013	35.35	1.85	14.18	0.02	0.003	0.043	0.001	0.69
3	Pond (Boiddomari)	7.3	3.48	0	23.46	30.39	1.75	10.25	0.019	0.003	0.04	0.007	0.01
4	Nandobala Canal	7	9.93	0.043	82.248	36.29	1.85	12.9	0.023	0.002	0.041	0.009	0.62
5	Ismails Chila (Vola Camp)	7.6	9.62	0.186	14.858	30.33	1.758	33.71	0.024	0.001	0.045	0	0.19
6	Bhola Khal (Kalomteji)	7.2	5.8	1.289	71.553	31.67	1.8	10.01	0.023	0	0.04	0	0.4
7	Pond (Dashervarani)	7.9	0.59	0	23.851	19.41	1.66	16.2	0.024	0.006	0.039	0.003	0.1
	Range			0-1.289	23.46-96.96	19.41-36.29	1.66-1.95	10.01-33.71	0.02-0.024	0-0.003	0.039-0.045	0-0.009	0.01-0.69
	Mean			0.220714	58.27871	31.27143	1.802571	15.48857	0.022143	0.002143	0.041571	0.002857	0.381429
	SD			0.475691	36.23987	5.800582	0.092482	8.337137	0.001952	0.002116	0.002149	0.003716	0.283985
	CV%			46.39867	160.8138	539.1085	1949.102	185.7781	1134.484	101.2836	1934.277	76.88517	134.3128

***The value of each parameter indicates the mean value of three replications.

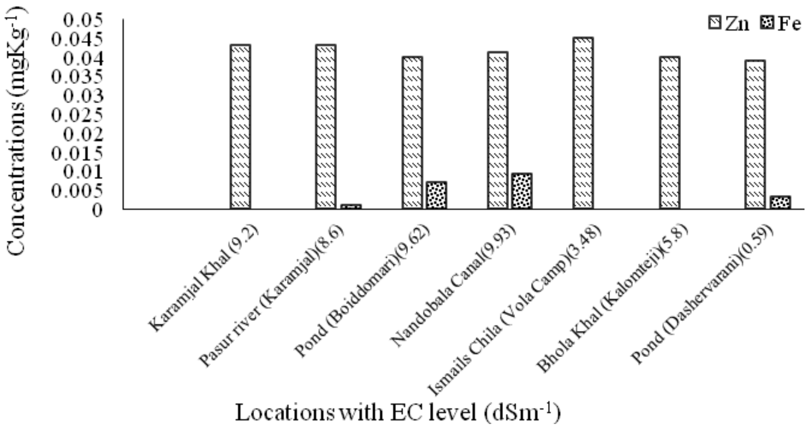

Fig. 6. The concentrations of Zn and Fe in Chandpai area.

3.1.6 The status of Zn and Fe in Chandpai area

The concentrations of Zn and Fe in water varied from 0.03 to 0.045 and traces to 0.009 mgL^{-1}, respectively (Figure 6). The highest level of Zn was found in Ismailschila and the lowest was at Dashervarani pond. The highest level of Fe was found in Nandobala and lowest was present in Volakhal, Ismailschila and Karamjalkhal. The concentrations of Zn and Fe were found higher at increased EC levels. Force *et al.* (1998) also conducted a similar study and found that the heavy metal loading of waters in the river system occurs not only as a result of the resuspension of particulate matter. Undisturbed sediments currently situated in the riverbanks contaminate with heavy metals such as Zn, Fe, Mn, Cu, Pb into the river system.

4. Conclusions

A research was conducted to assess the water quality at selected locations of Chandpai range in Satkhira district of the Sundarbans Mangrove Forest in Bangladesh. Ionic pollution is a great problem in the southern region of Bangladesh and one of the major causes of forest destructions. The water samples were analyzed for pH, EC, P, K, Ca, Mg, S, Cu, Mn, Zn, Fe and B. All the river waters in this area of the Sundarbans contained EC at strongly saline level (EC>8.0 dSm^{-1}).The concentrations of K, Cu and B in most of the rivers detected at above the permissible level for aquaculture.

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