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SALINITY ASSESSMENT FROM SURFACE WATER SOURCES AT COASTAL DACOPE UPAZILA OF BANGLADESH

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ABSTRACT

The salinity is considered an important limitation for the production of food grains in coastal areas of the country. It causes adverse environment and hydrological situation that limit normal crop production throughout the year. The effects of salinity are considered also to be one of the most serious threats to the environment possible negative effects on food security, agriculture, fisheries, human health, biodiversity, water, and other natural resources. The aim of the present research study was therefore to know the salinity levels in surface water for irrigation purposes. The study was conducted with the five water samples from adjacent surface water sources at Polder 33. Water samples collected from adjacent khals (cannels) were analyzed against National/International permissible limits for irrigation water quality. The analytical results showed that in 2007 the salinity varied 1.07-1.61 ms/cm, while 1.57-2.01 ms/cm in 2008. Here the highest salt content was measured from Borobaker khal during 2007 and on the other hand in Dhopar khal during 2008. The findings also showed that the salt content was always increased except Borobaeker khal. The variations were measured in the range of 16.30-62.10%. The results for salinity in different khal water of Polder 33 also explored that the salinity levels were within the permissible limit accordingly the different existing national as well as international standards for irrigation water. Hence the water can be used to grow crops safely in the coastal Dacope Upazila of Bangladesh.
Key words: Salinity, surface water, coastal, polder.

Introduction

The coastal area covers about 20% of the country and over 30% of the net cultivable area. It extends inside up to 150 km from the coast. Out of 2.85 million hectares of the coastal and offshore areas about 0.83 million hectares are arable lands, which cover over 30% of the total cultivable lands of Bangladesh. Most of the coastal areas of Bangladesh are used in agriculture. The cultivable lands in these coastal areas are affected with varying degrees of soil salinity and other natural hazards (SRDI, 2013). In the south-west coastal zone of Bangladesh, frequent natural disasters like- flood, cyclone, and associated storm surge, water logging, river erosion etc are familiar phenomena. Super cyclones like- SIDR (2007), and AILA (2009) increased soil salinity that hampered agriculture, the major livelihood of this area. The farmers of the coastal belts mostly cultivate rice and at the same time they grow some indigenous vegetables like cucumber, tomato, cantaloupe/rock melon, spinach, cabbage, broad bean, potato, sweet potato, capsicum, beans, carrot, radish, sweet gourd, bottle gourd, red amaranth, aroids etc. In this area, crop performance may be adversely affected by salinity-induced nutritional disorders. Salinity influence the nutrient availability, competitive uptake, transport or partitioning within the plant or may be caused by physiological inactivation of a given nutrient resulting in an increase in the plant's internal requirement for that essential element. Two or more of these processes may occur at the same time, but whether they ultimately affect crop yield or quality depends upon the salinity level, composition of salts, the crop species, the nutrient in question and a number of environmental factors (Grattan and Grieve, 1999). In some cases, salinity also has a toxic effect on plants because of the high concentration of certain salts in the soil. Salinity prevents the plants from taking up the proper balance of nutrients they require for healthy growth. Land use of south-west coastal Dacop of Khulna is diverse, is competitive and conflicting. Agriculture, shrimp farming, salt production, forestry, ship breaking yards, ports, industry, settlements, and wet lands are some of the uses. Due to climate change the adaptation strategies of costal agriculture also have been changed now a day. There are different adaptation options introduced for agricultural activities which enhancing agricultural production, improve soil health. As soil salinity in coastal zone particularly Dacop upazila of Khulna District increasing day by day, so the farmers of this area use saline tolerant verities of rice and vegetables to minimize yield gap, harvest rain water for irrigation as well as drinking purpose, cultivate various cucurbit vegetables like- cucumber, sweet gourd, bitter gourd, sponge gourd, bottle gourd etc. in the dyke of pond, canal, etc.. Winter vegetable production of Dacop upazila can meet the local demand and play a vital role in national agricultural economy. Still all those agricultural activities depend on surface water availability, where salinity level is a crucial factor. Here, continuing monitoring of surface water salinity may be regarded as one of the important criteria for coastal agriculture. So, the present study regarding assessment of surface water salinity will ensure the agricultural sustainability in coastal Dacop upazila of Khulna district.

Materials and Methods

The study was carried out taking water samples from five specific locations during the year of 2017-2018 at Polder 33 under Dacope upazila of Khulna district. Total length of embankment in the polder is 52.50 km and the design crest level is 4.2 m PWD. It has 13 drainage sluices and 19 flushing inlets serving through 100.00 km drainage channel inside the polder. Gross protected area is 8,600 ha and net benefited area is 7,600 ha. The embankment and water control structures as well as the drainage channels have got performance restrictions due to low cress height of embankment, damages happened to the structures and silt deposition in the drainage channels. Hence, the samples were collected from those channels/khals following the rules outlined by APHA (1995) and Hunt and Wilson (1986). To provide necessary information for each sample such as date of collection, location, source of water, were recorded in note book and each sample collected in a plastic bottle, was labeled separately with a unique identification number. After collection we covered the bottles with black polythene to protect the sunlight, because sunlight can change the chemical properties of drinking water. Then the water samples sent to the Consultancy Research & Testing Services (CRTS), Khulna University of Engineering & Technology (KUET), Khulna-9203 for measurement of surface water salinity (EC). It is widely used to indicate the total ionized constituents of water. It is directly related to the sum of the actions (or anions), as determined chemically and is closely correlated, in general, with the total salt concentration. EC of the water was measured by taking 100 ml samples in a beaker. The cell of conductivity meter was rinsed with distilled water and then placed in the collected water sample. The electrical conductance of samples was determined electrometrically using Water Quality Monitoring Meter in the form of ms/cm. Finally, the analyzed data were combined, presented as a table, and included in the manuscript.

Results and Discussion

The five different water samples were analyzed to know the salinity with respect to EC values and the findings were shown in Table 1. The analytical results for EC showed that in 2007 the salinity varied 1.07-1.61 ms/cm, while 1.57-2.01 ms/cm in 2008, respectively. Here the highest salt content was measured from Borobaker khal during 2007 and on the other hand in Dhopar khal during 2008. The findings also showed that the salt content was always increased except Borobaeker khal. The variations were also shown in Table 1, where values are measured in the range of 16.30-62.10%. When the values of EC were compared with different national and international standards, the salt levels were observed to be within the allowable limit according to the Wilcox standard (1955), whereas accordingly the standard of Bhumbla and Abrol (1972) the measured salinity levels in different khal water were good for irrigation purposes at Polder 33. The salt contents were also compared to the standard values of Richard (1954); UCCC (1974) and ECR (1997), where the investigation showed that in all cases the salinity was found within the allowed limits (Tables 1-2). The above result was supported by the findings of SRDI (2014). Though the salinity levels were found within the permissible limits accordingly different existing standards, the situations were forwarded to alarming as the increasing trend of salinity reached upto 62.10%. The salinity levels were measured in the month of March, where there were possibilities for lower salinity due to dilution of salinity in the coastal river. After that the salinity of the adjacent rivers are increased, so protections needs to be adopted to remain fresh water in khals avoiding the mixing of saline water from rivers. Here the functions of existing sluices at Polder 33 will be greatly controlled. Otherwise the saline water will entire in to the khal and consequently the khal water will become saline, which may not be safely used to grow crops within the Polder area. The most important characteristics that determine the quality of irrigation water are pH, EC, B and concentration toxic elements, concentration of CO_3^{2-} and HCO_3^{2-} as well as content of anions such as Cl^-, SO_4^{2-} and NO_3^-. The analytical data on the above parameters are used to describe the quality of irrigation water taking standards fixed for each aspect as an index (FAO, 2008). Irrigation water that has high sodium (Na^+) content can bring about a displacement of exchangeable cations Ca^{2+} and Mg^{2+} from the clay minerals of the soil, followed by the replacement of the cations by Na^+. Sodium-saturated soil peptizes and loses their permeability, so that their fertility and suitability for cultivation decrease (Matthess, 1982). However, the chemical constituents of irrigation water can affect plant growth directly through toxicity or deficiency, or indirectly by altering plant availability of nutrients (Ayers and Westcot, 1985; Rowe and Magid, 1995). Bad irrigation water not only can affect crop production, but also soil fertility that influences soil physical condition (Al-Omran *et al*., 2010). A number of water quality parameters are included in a mathematical equation to rate water quality, determining the suitability of water for drinking (Ochuko *et al*., 2014). Water quality is influenced both by natural and anthropogenic intervention where the former includes local climate, geology etc. and the latter covers the construction of dams and embankments, agricultural practices (Pierzynski *et al*., 2000).

Table 1. Salinity status in different surface water sources at Polder 33 in the month of March during 2017 and 2018

Sl no.	Source of surface water	EC values (ms/cm)		Variations
		2017	2018	
1	Bojan khal	1.35	1.57	16.30%
2	Borabag khal	1.21	1.67	38.02%
3	Borobaker khal	1.61	1.20	-25.47%
4	Dhopar khal	1.24	2.01	62.10%
5	Dacope khal	1.07	1.71	59.81%
	Range	1.07-1.61	1.57-2.01	16.30-62.10%

Table 2. Comparison of observed salinity (ms/cm) with different national as well as international standard

Quality	Richard (1954)	Wilcox (1955)	Bhumbla and Abrol (1972)	UCCC (1974)	ECR (1997)	Observed values	
						2017	2018
Very good/Excellent		0.25	<1.0				
Good		0.25–0.75	1.0–2.0				
Marginal/Permissible	0-3.0	0.75–2.0	2.0–4.0	0.7-3.0	2.25	1.07-1.61	1.57-2.01
Poor/Doubtful		2.0–3.0	4.0–6.0				
Harmful/unsuitable		>3.0	>6.0				

Furthermore, the cropping pattern at Polder 33 is being forwarded to the profitable agricultural enterprises, where the use of fresh water is highly demanding to the farmers especially for water melon cultivation. Hence there is the requirement of community for fresh water in the existing khal at Polder 33. Here the function of community especially the participations of the community in the water management functions will be greatly considered as per water related rules and regulations of Bangladesh.

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References

Al-Omran, A. M., Al-Harbi, A. R., Wahb-Allah, M. A., Nadeem, M. and Al-Eter, A. 2010. Impact of irrigation water quality, irrigation systems, irrigation rates and soil amendments on tomato production in sandy calcareous soil. *Turkish J. Agric. For*., 34:59-73.

APHA. 1995. Standard methods for the examinations of water and waste water. 17^{th} Edn, Washington DC, USA.

Ayers, R. S. and Westcot, D. W. 1985. Water quality for agriculture, irrigation and drainage (Paper No. 29). FAO, Rome.

Bhumbla, D. R. and Abrol I. P. 1972. Is your water suitable for irrigation. Indian Farming, Vol. 22: 15–17.

ECR (The Environment Conservation Rules), 1997. Government of the People's Republic of Bangladesh. Ministry of Environment and Forest. P. 208.

FAO (Food and Agriculture Organization). 2008. Guide for laboratory establishment for plant nutrient analysis. FAO, paggeno.

Grattan, S. R. and Grieve, C. M. 1999. Salinity and mineral nutrient relations in horticultural crops. *Scientia Hort.*, 78: 127-157.

Matthess, G. 1982. The Properties of Ground Water, John Wiley and Sons, New York, USA.

Ochuko, U., Thaddeus, O., Oghenero, O. A. and John, E.E. 2014. A comparative assessment of water quality index (WQI) and suitability of river Ase for domestic water supply in urban and rural communities in Southern Nigeria. *Int. J. Human Soc. Sci.*, 4(1):234–45.Google Scholar.

Pierzyn'ski, G.M., Sims, J.T. and Vance, G.F. 2000. Soil and Environmental Quality. CPR press. LLC. NY. USA, pp. 40-53.

Richards, L.954. Diagnosis and Improvement of saline and Alkali soils, U.S. Department of Agriculture Handbook, Vol. 60, Washington D. C., USA. p.160.

Rowe, D. R. and Magid, I. M. A. 1995. Handbook of wastewater reclamation and reuse. CRC Press, Florida.

SRDI (Soil Resource Development Institute). 2014. Annual report report, Krishi Khamar sarak, Dhaka. p. 111.

UCCC (University of California Committee of Consultants). 1974. Guidelines for Interpretations of water Quality for Irrigation. Technical Bulletin, University of California Committee of Consultants, California, USA pp. 20-28.

Wilcox, L. V. 1955. Classification and use of irrigation water. USDA, Circular 969, Washington, DC, p. 19.