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The effect of Rainfall, Temperature and Humidity on Saline in the Southern area of Bangladesh

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Abstract

A study was taken to measure the effect of rainfall, temperature and humidity on salinity area as well as to project the future trend of increasing saline area in the southern area of Bangladesh. Patuakhali district was selected as study area for the study. Secondary data such as temperature, saline area, relative humidity, rainfall, etc. were used in the experiment. The results showed that minimum temperature and relative humidity has the positive effect whereas rainfall and maximum temperature has the negative effect on decreasing the soil salinity. The study projects that the saline area would be increasing trend in future. Therefore mitigation measures could be taken to prevent the salinity in the coastal area.

Keywords: Forecasting, Southern area in Bangladesh, Saline water, Soil salinity.

1. Introduction

Salinity problem is worldwide. Bangladesh is also facing to the problem and the southern part of the country affected by salinity. The coastal region covers almost 29,000 km^2 or about 20% of the country. Again, the coastal areas of Bangladesh cover more than 30% of the cultivable lands of the country. About 53% of the coastal areas are affected by salinity (S. A. HAQUE 2006). In Bangladesh, salinization is one of the major natural hazards hampering crop production. Coastal area in Bangladesh constitutes 20% of the country of which about 53% are affected by different degrees of salinity (Islam 2004). The coastal saline are lies about 1.5 to 11.8 meters above mean sea level. The Ganges River meander flood plain systems are standing higher than the adjoining tidal lands. The tidal flood plain has a distinctive, almost level land scape crossed by innumerable interconnecting tidal rivers and creeks. The estuarine islands are constantly changing shape and position as result of river erosion and new alluvial deposition. Peat basins are located in some of the low lying areas between the Ganges river flood plains occurring in the western part of Khulna (Karim et al, 1982). These areas are subject to flooding in the monsoon season and water logging in parts of the basin areas in the dry season. Tidal flooding through a network of tidal creeks and drainage channels connected to the main river system inundates the soil and impregnates them with soluble salts thereby rendering both the top and sub soil saline. The coastal areas of Bangladesh have already been facing salinity problem which is expected to be exacerbated by climate change and sea level rise is causing unusual height of tidal water. In dry season, when the flows of upstream water reduce drastically, the saline water goes up to 240 kilometers inside the country and reaches to Magura district. Presently around 31 Upazilas of Jessore, Satkhira, Khulna, Narail, Bagerhat are facing severe salinity problem. Agricultural activities as well as cropping intensities in those Upazilas have been changing as a result farmer cannot grow multiple crop sin a year (Shamsuddoha and Chowdhury, 2007). More than 30% of the cultivatable land in Bangladesh is in the coastal area. About 1.0 million ha of arable lands are affected by varying degrees of salinity. Farmers' grow mostly low-yielding traditional rice varieties during the wet season. Most of the lands remain fallow in the dry season (January-May) because of soil salinity and lack of good quality irrigation water (Karim et al., 1990; Mondal, 1997). In soil salinity is believed to be mainly responsible for low land use as well as cropping intensity in the area (Rahman & Ahsan, 2001).

Salinity areas are increasing day by day. It is the measure of all the salts dissolved in the water and measured in parts per thousand (ppt or %). The average ocean salinity is 35ppt and average river water salinity is 0.5ppt or less. This means that in every kilogram (1000gm) of sea water 35 gram are salt. High salinity has an impact on

people and Industries reliant on water from the river murray. It can also negatively affect plant growth and yields. Soil salinity is measured in terms of g/l or electric conductivity (EC) in ds/m as the salt can concentrate in the soil solution. The relation between these two units is about 5/3: y g/l. sea water may have a salt concentration of 30 g/l (3%) and EC of 50 ds/m.

The severity of salinity problem in Bangladesh increases with the desiccation of the soil. It affects crops depending on degree of salinity at the critical stages of growth, which reduces yield and in severe cases total yield is lost. Soil reaction values (pH) in coastal regions range from 6.0-8.4(S. A. HAQUE 2006). The organic matter content of the soils is also pretty low (1.0-1.5%) (Karim *et al.*, 1982**).** Nutrient deficiencies of N and P are quite dominant in saline soils. Micro-nutrients, such as Cu and Zn are widespread. Climate change might have effects on salinity. During the wet monsoon the severity of salt injury is reduced due to dilution of the salt in the root-zone of the standing crop.

2. Objectives

i. To estimate the individual effect of rainfall, temperature and humidity on saline area

ii. To estimate the saline area in 2025 in the study area

3. MATERIAL AND METHODS

Patuakhali district was selected as study area for the study. Secondary data was used in the experiment. Data such as yearly average salinity area, temperature, rainfall and Humidity of the study area were collected from different government and other organization.

Table1: Average saline area, temperature, rainfall and Humidity of Potuakhali district

Year	Saline area(000'ha)	Max.T (^{0}c)	Min.T (^{0}c)	Humidity (%)	Rainfall (mm)
2000	139.35	30.85	21.89	83.79	177.50
2001	141.11	31.10	21.83	84.28	242.92
2002	142.87	31.00	21.76	85.18	225.33
2003	144.62	30.74	21.91	87.19	238.08
2004	146.38	30.67	21.88	86.06	220.58
2005	148.14	31.22	22.18	84.58	225.25
2006	149.89	31.43	22.33	84.16	190.58
2007	151.64	30.72	21.84	84.59	238.08
2008	153.39	30.82	21.90	84.24	209.50
2009	155.18	30.53	22.10	93.99	62.25
2010	156.43	30.67	22.58	93.74	70.60
2011	157.28	30.41	21.45	94.53	81.45
2012	158.08	31.32	22.80	92.30	86.99

Source of data: BMD and SRDI Note: (Salinity density range 2 to > 16 ds/m)

Then the individual effect of climatic parameter was determined on salinity area increase/decrease in the study area based on historical data. Then using the historical salinity data, area coverage of the study area was projected for the year 2025. This analysis was done by using multiple regression and least square method respectively. These equations are as follows:

A multiple linear regression equation was used to find out the effect of temperature, rainfall and humidity on soil salinity area.

$Y = a + b_1x_1+b_2x_2+b_3x_3+b_4x_4+e$ ---------- (1)

Where,

Y= Soil salinity area
a= Constant
b= Coefficient
e= error
X_1,X_2,X_3 and X_4= Parameter

The expected saline area in 2025 was estimated using the following least square method formula.

Where,

$Y = a+bx$ ---------- (2)
Y=Salinity area
a= Constant

b= Coefficient
x= Time

4.RESULTS & DISCUSSIONS

The combined effects of maximum temperature (X_1), minimum temperature (X_2), humidity(X_3) and rainfall (X_4) on saline area (Y) was measured by using multiple linear regression method.: The estimated multiple linear regression equation relating maximum temperature(X_1), minimum temperature (X_2),humidity(X_3) and rainfall(X_4) to salinity area (Y) was estimated as:

$Y = 27.375 – 0.05\ X_1 + 0.230\ X_2 + 0.154X3 - 0.518X_4$

Where,

$a = 27.375$, $b_1 = - 0.05$, $b_2 = 0.230$, $b_3 = 0.154$, $b_4 = - 0.518$, and $R^2 = 0.62$

$R^2 = 0.62$ means 62% of the total variation in the saline area can be accounted for by a linear function, involving maximum temperature, minimum temperature, humidity and rainfall.

Table 2:

ANOVA Table

SV	SS	df	MS	F-statistic	Significance level
Regression	393.603	4	98.400	4.07	0.041
Residual	193.406	8	24.176		
Total	587.009	12			

Compare the computed F value to the tabular F values with $f_1 = k$ and $f_2 = (n – k - 1)$ degrees of freedom. The coefficient of determination R^2 is said to be significant (significantly different from zero) if the computed F value is greater than the corresponding tabular F value at the prescribed level of significance.

Here the tabular F values with $f_1 = 4$ and $f_2 = 8$ degrees of freedom are 3.84 at the 5% level of significance. Because the computed F value is larger than the tabular F value at the 5% level of significance, but smaller than the tabular F value at the 1% level of significance. Hence the estimated multiple linear regression is significant at the 5% level of significance. Thus, the combined linear effects of rainfall, temperature and RH contribute significantly to the variation in saline area of the study area.

The expected saline area in 2025 was estimated using the least square method formula.

Again if the origin point year 2006, then x = 13 for the year 2025

The equation becomes Y = 149.57 + 1.63(13)

=180.54 (000'ha)

Where a =149.57 and b = 1.63

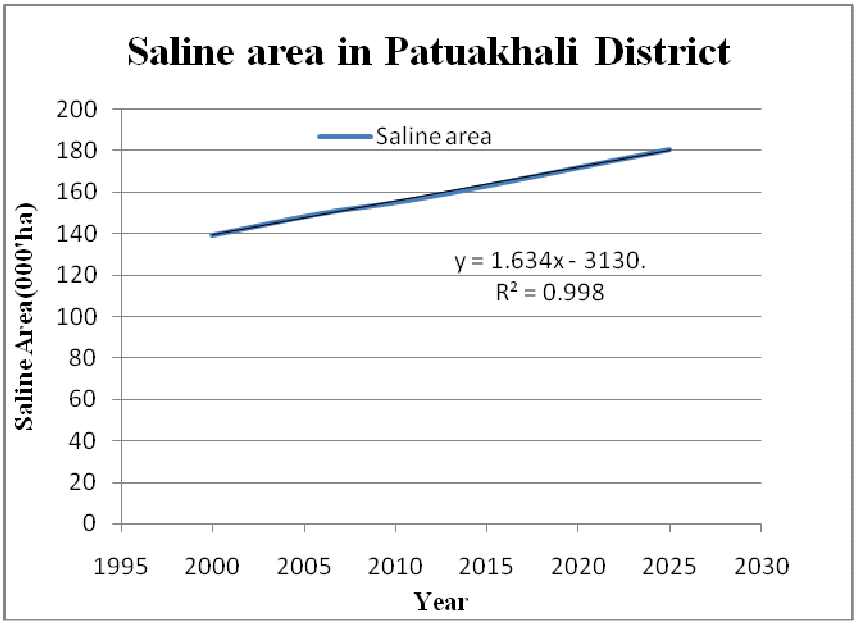

Fig 1 Future trend of saline area growth in Patuakhali district

Therefore, salinity area in Patuakhali district in 2025 might be 180.54 (000'ha). The salinity area in Patuakhali

district estimated as increasing trend.

5.CONCLUSION

The climate has an effect on soil salinity area. Minimum temperature and relative humidity has the positive effect whereas rainfall and maximum temperature has the negative effect on decreasing the soil salinity area. The study projects that the saline area would be increasing trend in future. Therefore mitigation measures could be taken to prevent the salinity in the coastal area.

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