SOIL SALINITY HAZARD ASSESSMENT IN BANGLADESH COASTAL ZONE

M. H. Hasan¹, M. R. Rahman², A. Haque³, T. Hossain⁴

ABSTRACT

The coastal zone of Bangladesh covers about 20% of total land in the country and over 30% of the cultivable lands. According to the National Adaptation Program of Action (NAPA), water-related hazards due to climate change are likely to become a critical issue for Bangladesh. Salinity in surface water, groundwater, and soil have become a dominant hazard in Bangladesh coastal zone. There is a number of studies in the region that address surface water and groundwater salinity. But very few studies deal with soil salinity. There is no study in the region that particularly deals with the soil salinity hazard assessment. This study is aimed to fill this research gap. In this study, soil salinity hazard is assessed by using historical secondary data related to the area affected by soil salinity. By using the normalization method, soil salinity hazard map is prepared in a GIS environment. The results show that the western region is very high saline zone and eastern region is a low saline zone in terms of soil salinity. This study tries to find out the saline affected area from 1973 to 2009 and also tries to give a salinity risk map in the southern part of Bangladesh. Amount of saline affected area is considered as the parameter and by normalizing the number of affected areas the salinity risk maps are prepared. About 0.223 million ha (26.7%) new land is affected by various degrees of salinity during the last four decades. The maximum saline affected area is found at Galachipara Upazila in Patuakhali District while the minimum saline affected area is found at Maladi Upazila in Barisal district. The saline affected areas are increased in Khulna, Bagerhat, Satkhira, Patuakhali districts. From the risk map, it is identified that the lower middle and the corner of the southern part of Bangladesh fall at the zone of high and very high risk.

Introduction

Salinity in surface, ground, and soil in the coastal zone has become a very crucial matter in southern coast in Bangladesh (Mondal, Bhiuyian, & Franco, 2001) (Institute (SRDI), 2010) (Rahman, Majumder, Rahman, & Halim, 2011). When the soil salinity exceeds a plant’s tolerance, growth reductions occur. Salinity intrusion in river water may cause economic loss in terms of crop yield reduction, hampering industrial production, increasing health hazard and reducing the productivity of the forest species (Haque, 2006). Agriculture production is likely to decrease as saline containing water and soil reduce plant growth through concentrating salt in the root zone of plant and resulting in nutrients imbalance and yield loss (Pitman & Läuchli, 2002) (Haque, 2006). Average soil salinity concentrations at the coast are higher in the low flow season than the high flow season because of less freshwater flow from the upstream. Waterlogging is another problem that likely to increase soil salinity in the coastal zone (Awal, 2014). According to Karim and Mimura (2008), Sluice gates of different polders were blocked in the coastal areas for sediment deposition from rivers. As a result, saline water from high tide or storm surge interred into the polders but could not drain out properly, resulting in waterlogging and causes soil salinity. The salinity generally increases from October to the late May (Karim, 2008). In this condition, soil salinity maps are very useful to identify vulnerable area addressing salinity and help to create saline-induced risk map in the southern part of Bangladesh that might be helpful for decision makers and planners. As salinized soil has a negative impact on agricultural production in this region especially during the pre-monsoon season, so, identification of soil salinity area through risk mapping is now very essential for developing proper management strategies (Çullu et al., 2002).

Objective

The objective of this study is to identify the vulnerable area through salinity hazard map of the southern part of Bangladesh.

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Methodology

The study was conducted on the southwest coast of Bangladesh. Secondary data of soil salinity was collected from SDRI report of Bangladesh. Also, other data needed for the study were collected from different journal papers, reports, articles related to salinity. To show the soil salinity hazard, risk mapping was used. Salinity maps are prepared based on the soil salinity data determined in two different years 1973 and 2009 using GIS. There are 116 Upazilas situated in the study area. Amount of saline affected area was considered as the parameter to prepare the salinity risk map where the saline affected area was normalized by using the equation:

\[
\frac{(F - F_{\text{min}})}{(F_{\text{max}} - F_{\text{min}})}
\]

(1)

Where, \( F \) = Value of saline affected area of any location, \( F_{\text{max}} \) = Maximum value of the saline affected area of any location and \( F_{\text{min}} \) = Minimum value of the saline affected area of any location. The maximum value was found at Galachipara Upazila (\( F_{\text{max}} = 53390 \) ha) and the minimum value is found at Maladi Upazila (\( F_{\text{min}} = 110 \) ha). Five categories were considered to prepare risk mapping for salinity affected area (Table 1).

<table>
<thead>
<tr>
<th>Risk category</th>
<th>Range</th>
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<tbody>
<tr>
<td>Very low</td>
<td>0.00-0.009</td>
</tr>
<tr>
<td>Low</td>
<td>0.01-0.05</td>
</tr>
<tr>
<td>Medium</td>
<td>0.051-0.30</td>
</tr>
<tr>
<td>High</td>
<td>0.31-0.50</td>
</tr>
<tr>
<td>Very high</td>
<td>0.51-1.00</td>
</tr>
</tbody>
</table>

Table 1. Risk category of saline affected zone for risk mapping.

Discussions

The total area of Bangladesh is 147,570 sq. km and it extends inside up to 150 km from the coast (Petersen & Shireen, 2001). The coastal area of Bangladesh is divided into three categories. South-west, the mid-central and south-east coastal area of Bangladesh includes 16 districts. A comparative study of the salt-affected area of 1973 and 2009 showed that about 0.223 million ha (26.7%) new land was affected by various degrees of salinity during the last four decades. Figure 01 shows that about 22% to 47% of soil was found as soil saline in Shatkhira, Khulna, and Patuakhali while Borguna was found as the most vulnerable because of saline soil (about 48 to 76%).
From figure 1 it has been seen that in 1973, Jessore, Narail, Ikalakhati Barishal, Gopalganj, and Madaripur had a little salinity effect. In 2009, salinity in Khulna, Bagerhat, Satkira, Patuakhali, and Bhola did not change while Jessore, Narail, Ikalakhati Barishal, Gopalganj, and Madaripur has been affected a lot by salinity (figure 3).

According to the range, a risk map is prepared (shown in figure 4). From the risk map, it can be said that the lower middle and the corner of the southern part fall at the zone of high and very high risk. Those high and very high-risk zones have a lot of saline affected area. Due to a large amount of saline area people cannot grow a significant amount of agricultural product. People also face scarcity of fresh water in those areas.

Conclusions

The lower middle and the corner of the southern part fall at the zone of high and very high risk. Those high and very high-risk zones have a lot of saline affected area. Due to a large amount of saline area people cannot
grow a significant amount of agricultural product. People also face scarcity of fresh water in those areas. From 1974 to 2009 the salinity affected area was increased. As a result, in future, the southern part of Bangladesh will face a great problem due to salinity. In this situation management of salinity intrusion is the vital issue for Bangladesh. With the mission of saline waterproofing by structural management: like coastal embankment projects, dam, sluices, and coastal area zoning as well as non-structural management: to change the land use and research, training, awareness raising etc. can be the vision of sustainable livelihood and environment of the coastal zone of Bangladesh.

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References


