AGRICULTURAL ADAPTATION MEASURES TO COMBAT SALINITY PROBLEM IN SOUTHWESTERN BANGLADESH

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ABSTRACT

Agricultural practices in coastal Bangladesh are under threat due to the effects of salinity intrusion into the soil layers and fresh water scarcity. This study aims to investigate the extent of usage of adaptation measures to combat the salinity intrusion and fresh water scarcity problem from the perceptions of farmers through a questionnaire survey, targeting farmers (N=300) from 15 random locations of Tala and Shyamnagar Upazilas. Measures such as applying gypsum (77% in Tala and 80% in Shyamnagar) and shifting to shrimp culture (74% in Tala and 83% in Shyamnagar) got a high response. On the other hand, use of low water consuming crops got the least popularity among the farmers. There is still a significant scope of implementing agricultural adaptation measures in both the study areas. Independent t-test and Mann-Whitney 'U' test were carried out on the perceptions and it has been observed that the opinions of the respondents of the two areas had no significant statistical differences.

Introduction

Salinity intrusion in coastal regions causes severe land degradation and abandonment of agricultural lands (Li et al., 2011). Both natural (flood and storm surge) and anthropogenic (excessive use if fertilizer and shrimp culture) causes trigger salinity intrusion in coastal Bangladesh and Satkhira, Khulna, Bagerhat, Borguna, Patuakhali, and Barisal districts are the worst victims (Disaster Management Bureau, 2010; Islam et al., 2012; Wu et al., 2008). The well-being of the coastal people must need to be considered for the development of Bangladesh, as the coastal region is the home to a population of 36.8 million people and over 30% of the net cultivable land is in the coastal area (Akanda and Howlader, 2015; Islam et al., 2012). The primary occupation of coastal people is agriculture, which is one of the most disaster-affected sectors. Salinity is the most prominent controlling factors of crop production and 36.8% of arable lands in the coastal and off-shore area are affected by varying degrees of salinity (Asib, 2011). Coastal farmers extract groundwater for irrigation at the beginning of winter period and exaggerate salinity intrusion into the aquifers (Haider and Hossain, 2013; Murshid, 2012). Agricultural lands have lost their productivity, which eventually declines net food production, due to this salinity intrusion and irrigation with saline groundwater (Islam et al., 2012; SRDI, 2010). Researches have reflected that salinity intrusion has significant negative impacts on the livelihood strategy of the local farmers and on crop production and yield (Baten et al., 2015; Haider and Hossain, 2013). To cope with this adverse situation, farmers have to adapt some effective measures.

Haider and Hossain (2013) tried to trace out the impact of salinity on livelihood strategies of farmers and responses of farmers to solve the salinity problem, studying four villages from two unions in Assasuni Upazila of Satkhira district, Bangladesh. The study found that though salinity intrusion negatively influences income, expenditure and employment opportunity for the farmers, it positively influences shrimp culture-led land-use activity and farmers try to handle the salinity problem at their own levels through applying lime, gypsum etc. The impacts of salinity on crop agriculture in the south-central coastal zone of Bangladesh have been studied by testing irrigation water collected from the lower Meghna at Gosairhat Upazila in Shariatpur district and interviewing experts and local farmers. Salinity concentration has already put a threat to crop production, crop yield, farmers' livelihood, income generation and food security (Baten et al., 2015). Effect of salinity intrusion on rice production in Satkhira district has been explored and saline-tolerant rice cultivars have been identified as the most important adaptation measure, though this has not been enough to deal with the sudden increase in salinity after cyclone AILA in 2009 (Rabbani et al., 2013). Islam et al. (2012) have attempted to know the present extent of salinity and how much agricultural land has reduced gradually during last decade studying Satkhira district and also tried to identified suitable land use practices and available adaptation measures to adapt to a certain level of salinity. Very few researches have been made in Tala and Shyamnagar Upazilas of Satkhira district, which appear to be severely affected by salinity. This study aims to identify the

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risk reduction strategies in practice and other potential methods to reduce the risks associated with salinity intrusion in the farmlands from the perceptions of farmers. Therefore, the objective of this study is to explore the extent of usage of the agricultural adaptation measures to combat the effect of salinity intrusion in Tala and Shyamnagar Upazilas of Satkhira district.

Study Area

Atulia, Nurnagar, Kaikhali, Shyamnagar, Padmapukur, Ishwaripur, Gabura and Harinagar of Syhamnagar Upazila and Nagarghata, Kumira, Patkelghata, Tala, Islamkati, Khalishkhali, and Khosra of Tala Upazila were selected as study locations from Satkhira district of southwestern Bangladesh (Figure 1). The majority of the people in Shyamnagar Upazila earn their living through shrimp farming, as agriculture is seemingly getting difficult due to the degradation of land through salinity intrusion and sustaining agriculture has become costlier than shrimp farming. Therefore, the shift in the land use pattern has been a major issue for Shyamnagar Upazila (Alauddin and Rahman, 2013). On the other hand, during field visit, it was observed that Tala has a better balance between shrimp farming and agriculture but persistent waterlogging in some locations has made the lives difficult for the local people.

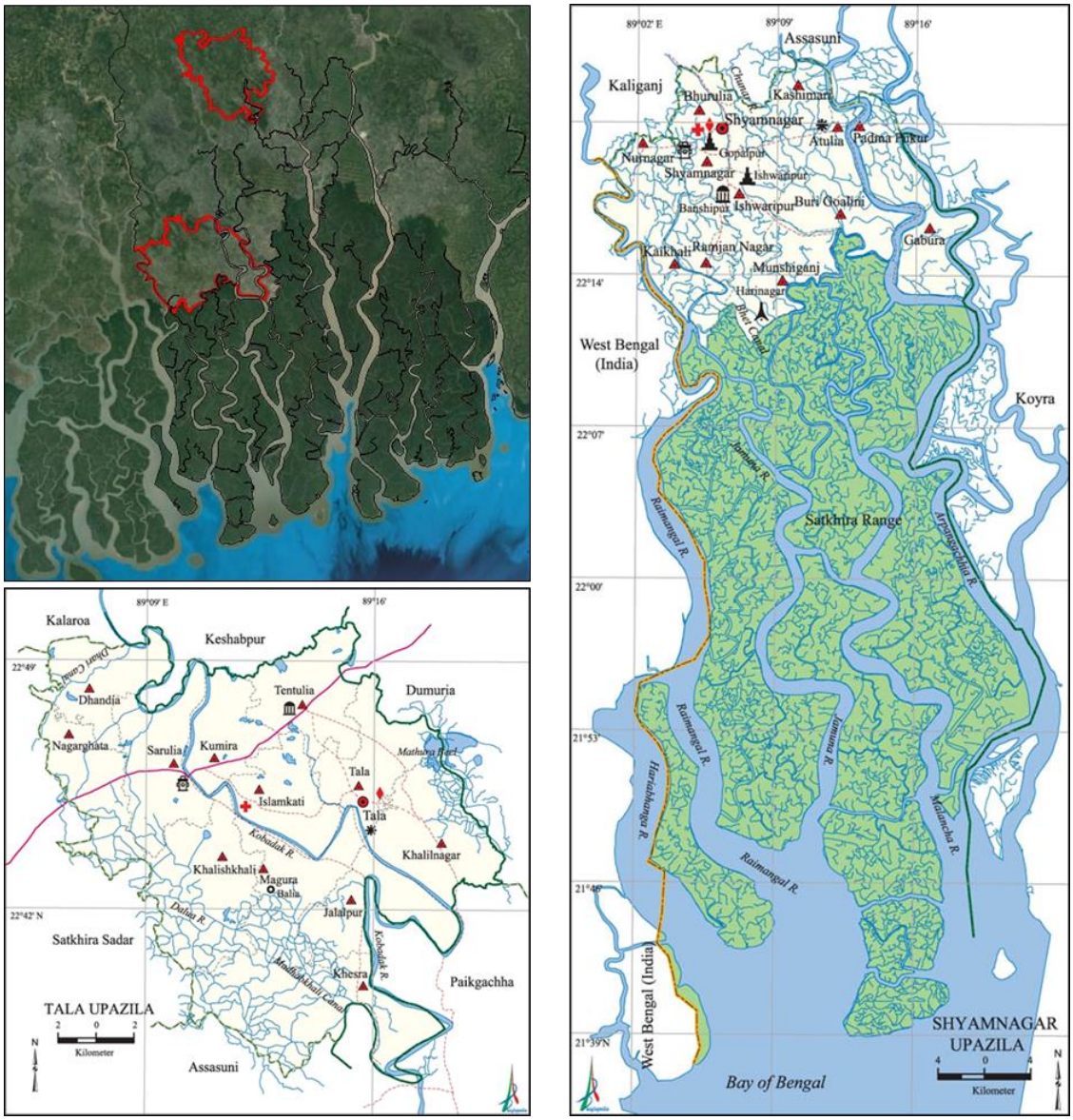

Figure 1. Location of study area (Tala and Shyamnagar Upazila)

The study area forms a part of the southwest coastal region of Bangladesh, where the rapid conversion of rice

fields to shrimp 'ghers' (the local name given to shrimp farming lands) has been termed as the 'Blue Revolution'. The amount of rice production seems to have therefore decreased over the years as the rice fields have been modified into 'ghers' (shrimp farm) in the southwest coastal region (Ahmed et al., 2010). As a result, there may be a shortage of food production in the area and in the near future food might be needed to be brought in from other areas of the country to meet the demands of the southwest coastal region (Islam et al., 2015). The significance of this area being chosen for the study is the rate at which agricultural lands are slowly being converted to other land use categories. Sustainable agricultural methods need to be in practice to bring in a balance in the land use category. So, risk reduction in agricultural practices can be a sustainable way of practicing agriculture and the perception of the farmers need to be known before implementing risk reduction strategies.

Methodology

To collect the primary data regarding the farmers' perception of agricultural adaptation measures, a field trip was organized during Mach 2016. Perceptions of the farmers to what extent do they applied agricultural adaptation practices were collected by a semi-structured questionnaire. The adaptation practices included in the questionnaire were more focused on reducing water usage in agricultural activities, as in-field observation concluded the presence of water scarcity in the study area. The questionnaire format was kept as simple as possible for better and quick understanding of the farmers keeping their literacy level in concern. General information on the type of farmers was collected prior to the questionnaire survey to finalize the samples for the questionnaire survey. It was ensured that all types of farmer participated in the questionnaire survey. 95% confidence interval and ±5% level of precision was used for calculating the sample size of the study area and the approximate sample size was 300. Among the respondents, there were 105 owners, 27 owner-cum tenants and 18 tenants in Shyamnagar and 100 owners, 35 Owner-cum tenants and 15 tenants in Tala Upazila. With the semi-structured questionnaire, 300 farmers of different categories had been interviewed. For an effective and participatory collection of perceptions from the farmers, the local government representatives from Shyamnagar and Tala enlightened the research team and helped with his knowledge of the local communities and agricultural lands.

Four focus group discussions have been arranged in four Unions of two Upazilas, Nagarghata, and Tala of Tala Upazila and Gabura and Shyamnagar of Shyamnagar Upazila. Around 10-12 members were present in each FGD. Chairmen and some of the members of Union Parishads and some representatives from local NGOs were present in the discussion. The overall salinity condition and its consequences on the agricultural practice of the area were the key topics of the discussions. The Upazila Nirbahi Officers (chief executive of an Upazila) of the two Upazilas have been interviewed also.

Independent t-test was carried out using IBM SPSS 20.0 software on the perceptions. This was to observe whether the opinions of the respondents of the two areas had any significant statistical differences or not. Mann-Whitney 'U' test was also carried out to further bolster the fact of statistical differences. If the 'p-value' of the equal variance independent 't' test is larger than the value of 0.05, then it can be said that the perceptions of the respondents in the two Upazilas did not differ significantly. On the other hand, the critical value for the Mann-Whitney 'U' test is dependent on the number of options (N). The critical value is 13 when N is 8 and 17 when N is 9. If the obtained value is greater than the critical value, then it means that the response of the farmers in the two Upazilas does not vary significantly. If the statistical differences are not significant then the risk reduction measures can be applied commonly to both the locations due to the fact that both the areas are exposed to or are suffering from the same type of hazards.

Results and Discussions

Researchers have identified 9 agricultural adaptation measures for the study area from literature review and own knowledge. Selected adaptation measures are applying Gypsum, shifting to Shrimp/Crab culture, manuring and composting, reuse of sullage water, mulching technique, multi-cropping/intercropping, retention irrigation, changing irrigation techniques for conserving water and low water consuming cropping pattern. Farmers were asked which agricultural risk reduction measures they use and Figure 2a and 2b show their responses on different agricultural risk reduction measures in Tala and Shyamnagar respectively. Almost all the risk reduction measures gathered less to very less response. The use of low water consuming crops got the least popularity (up to 81% respondents putting "very less" response) in Tala.

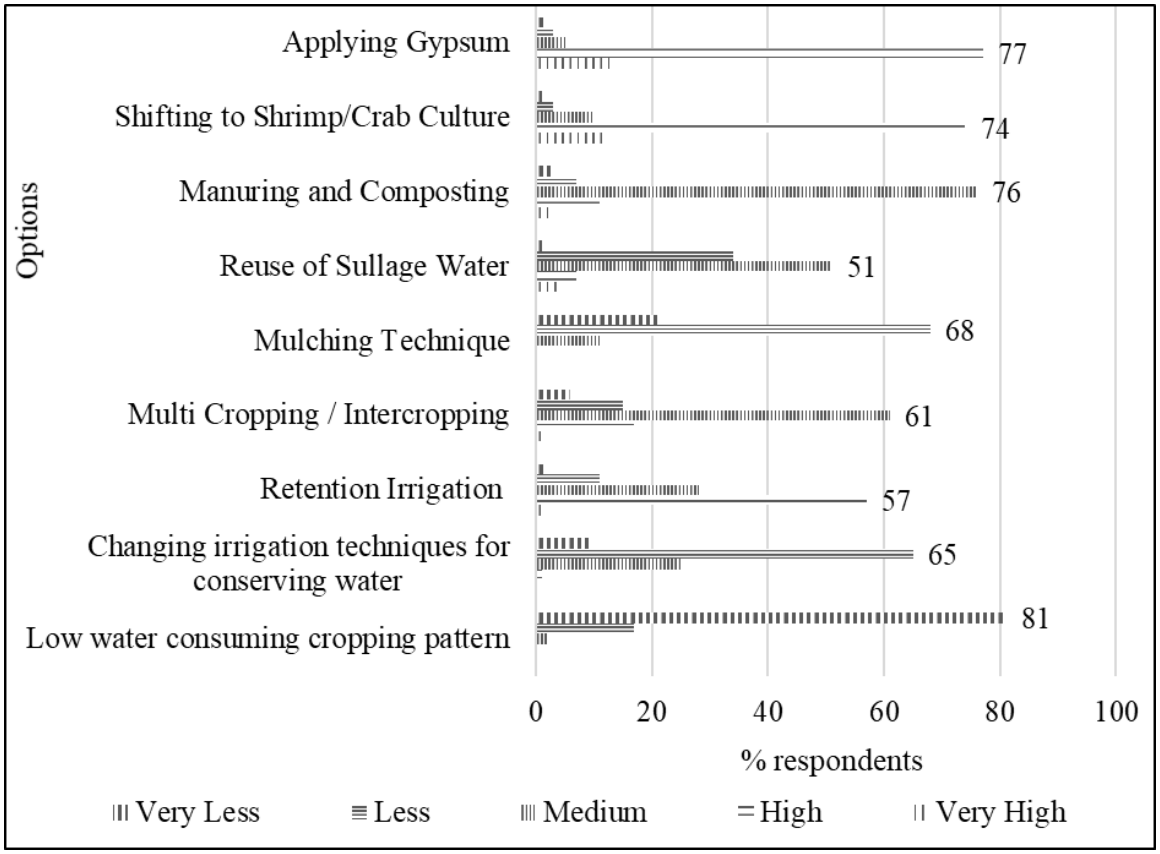

Figure 2a. Perceptions of the farmers about agricultural risk reduction measures in Tala

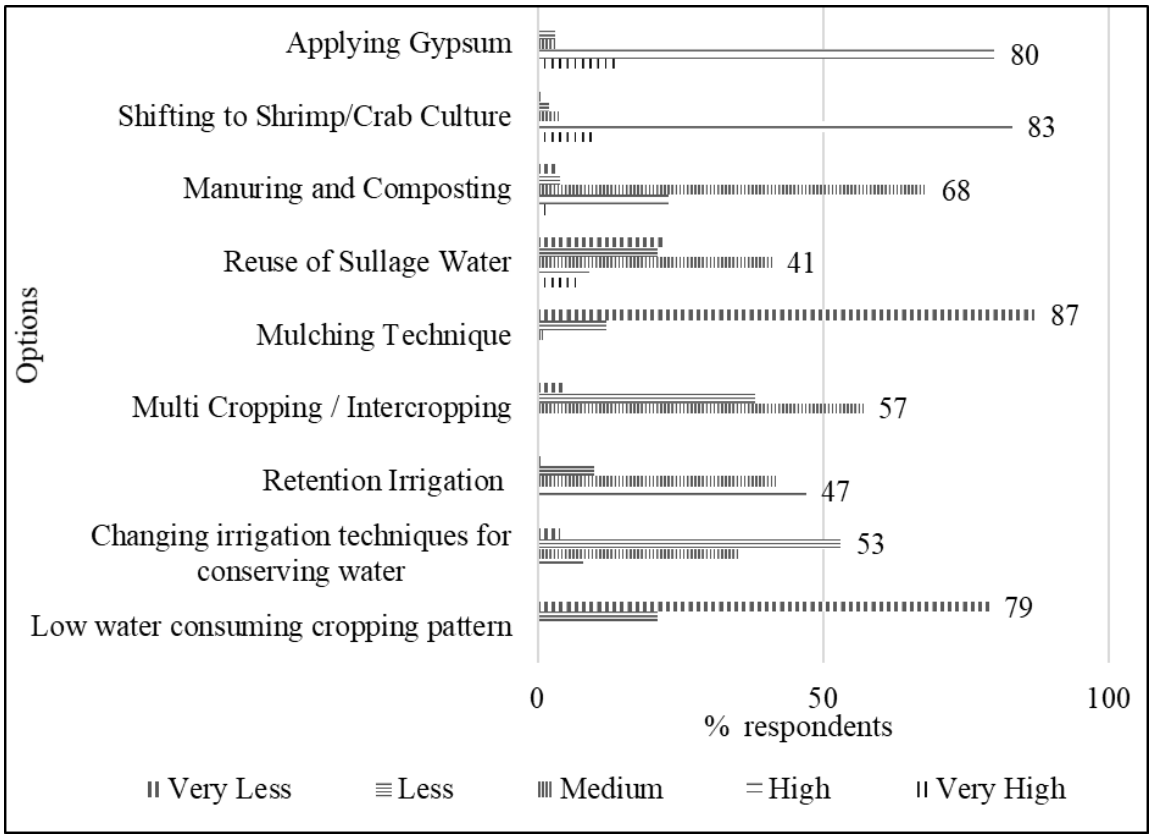

Figure 2b. Perceptions of the farmers about agricultural risk reduction measures in Shyamnagar

Retention of irrigation water gathered "high" response and other techniques such as manuring and composting got a medium category of response. Shrimp culturing and applying gypsum were in high practice according to the respondents with 74% and 77% respondents putting "high" response to these risk reduction methods respectively in Tala. The mulching technique seemed to be the least practiced and known risk reduction measure in Shyamnagar, with 87% respondents revealing that it is the least practiced and known risk reduction measure. Searching for low water consuming crops or planting them also appeared to be a very less known practice in Shyamnagar. 79% respondents put their opinion in this category. The highest practiced risk reduction practice in Shyamnagar was found to be switching to shrimp cultivation (83%) and applying gypsum (80%) to the croplands to reduce the effects of salinity. Retention irrigation through rainwater harvesting was pretty popular with 47% respondents putting "high" response to this method (Fig. 2b). The 'p-value' was calculated to be 0.967 and that the sample size was big enough for the Mann-Whitney test to be conducted, the U value came out to be 40. Both the statistical tests suggest that the perception reactions did not significantly vary statistically.

Adaptation measures are the modern way out to tackle the impact of hazards and some of them have already been practiced in the study area. Owner of the lands are better suited to switch to appropriate adaptation at a fast rate than others, as they have the control on the choice. Over 50 % farmers of the study area own agricultural lands, which is a positive indication. Researchers have found the advisory board regarding various agricultural adaptation measures in Shyamnagar. The advisory board tells about practicing retention irrigation, allay cropping, multi-cropping/intercropping, reusing of sullage water and mulching technique for reducing the effects of soil salinity as adaptation measures (Figure 3).

Figure 3. A colorful advisory board about agricultural adaptation measure, written in the local language of Bengali in study area

The current level of administrative support to combat the risks associated with agriculture is not satisfactory. The farmers are receiving support in small monetary terms for agriculture but there is yet lack of infrastructure support to provide irrigation water. Crop insurance may be an effective method to combat the immediate negative effects of crop failures. Farmers suffer a significant amount of financial setback in the event of crop failures. But crop insurance facilities are almost absent in the study area. The arrangement of water supply tankers for monthly irrigation support was found to be almost negligible with a few water purification plants being operated by the Non-Governmental Organizations (NGOs) but was only limited to drinking water purposes. The water purification plants established by private entrepreneurs appeared to deliver water at increased costs and that also for only drinking purposes.

Community-based rainwater harvesting tanks and solar power based salinity removal plant can be pioneered by the administrative bodies by providing long-term loan facilities to the farmers. In this way, the poor farmers can have the opportunity to sustain agricultural activities. The local respondents insisted on the national

authorities disbursing short term loans so that they may set up rainwater harvesting plants at the community levels.

Conclusions

Agricultural practices in the southwestern coastal Bangladesh have been affected significantly due to scarcity of irrigation water free of salinity. To sustain agriculture in these crisis prone areas, farmers' perception is a useful tool in designing adaptation measures. The farmers' perceptions reflected their concern regarding salinity intrusion and contamination and unavailability of fresh irrigation water. Measures such as retention irrigation, composting and manuring and reuse of sullage water are some of the self-driven adaptation measures that the farmers are practicing in the study area, but certainly not in large numbers. Rather adaptation techniques such as switching to shrimp farming and applying gypsum to soil layers were found more popular in the study areas. Vigorous practice of shrimp farming may in turn affect the overall ecological diversity of the study area and might result in monoculture. So, an integrated and well-coordinated agricultural adaptation measures should be immediately taken into concern for this area.

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