Journal of Science and Technology 14(June 2016):48-54

NATURE OF AGRICULTURAL PRODUCTION AT SALINITY PRONE AREA IN SOUTHWEST COASTAL REGION OF BANGLADESH

M.T. Khatun[*1], M. Rahman[2], S. Mostafiz[3] and H. Jamil[4]

[1]Sociology Discipline, Khulna University, Khulna, Bangladesh;[2]Department of Social Service, Bagherhat, Ministry of Social Welfare, Bangladesh;[3&4]Department of Sociology, Hajee Mohammad Danesh Science and Technology University, Bangladesh

ABSTRACT

Global climate change is a matter of deep concern for countries like Bangladesh, whose economy largely depends on agricultural production. Agriculture contributes a big portion of the total GDP and provides a large volume of work for the population. In the last couple of years, the country has experienced erratic rainfall, high temperature, drought, high humidity and excessive salinity etc. due to global warming. Agricultural production of coastal salinity prone areas of Bangladesh has interrupted due to climatic change and intensity in salinity. The present study is conducted to maximize our understanding of agricultural production at salinity prone areas in Betbunia, Vakotmari and Groikhali village of PaikgachaUpazila in Khulna district of Bangladesh. To do so, this study used a survey design to collect data from respondents. Simple random sampling was used to select the respondents. In addition, total 3 Focus Group Discussions (FGDs) were used on a subsample of 24 respondents. This study highlights people's knowledge of climate change, difference between agricultural production in the past and at present, visibility of seasons, rainfall pattern, difficulties regarding shrimp cultivation, agriculture production, and disappearance of local trees and fishesdue to climate change and salinity. The study found the decline trend of the density of some local tree species (e.g. Mango, Jackfruit, Palm, Guava tree, etc.) and fishes (e.gRuhi, Shing, Magur, Gojar etc.) which is not a good sign for the salinity prone areas of Bangladesh. To reduce the impact, the government should be given top most priority to agricultural development while maintaining a concern for climate change so that a sustainable development goal can be assured.

Key words: Agriculture, climate change, salinity, tress,shrimp cultivation

INTRODUCTION

Bangladesh is predominantly an agro-based country. The total cropped area is 15.085 million hectares with 190% cropping intensity and agricultural crop production is 37.266 million metric tons (DAE-AIS 2013).Agricultural production provides the primary source of livelihood for people's at any remote or coastal region of Bangladesh as an agro-based economic structure. In the heavily populated countries like Bangladesh highly depend on agricultural labor and the agricultural system highly depends on natural blessing. If agricultural production is adversely affected by climate change, the livelihoods of large numbers of the rural poor will be put at risk and their vulnerability to food insecurity will be increased. The ultimate impact of global climate change being observed day to day and researches shows that poor countries are the most vulnerable. Bangladesh is the most vulnerable in measure of the loss through climate change among all other countries, with the Intergovernmental Panel on Climate Change (IPCC) affirming that its effects have already been observed, and scientific findings indicating that precautionary and prompt actions are necessary to address its impending threats (IPCC 2001). A cropping pattern is the yearly sequence, temporal and partial arrangement of crops in a given land area. It is dependent on physical, historical, social, institutional and economic factors as well as government policies (Agrawal and Kassam 1976).Pressure for increased crop production is triggered by the rapid population growth and it is the most important challenge. Apart from food security, the sector alone contributes about 12% of the GDP and employ 44% workforce of the country. For these reasons, the government has put topmost priority to the agriculture sector. The agriculture sector is directly related to the rural poverty as the sector benefits livelihood of the rural poor people who account for the majority of the population. The agriculture sector is the contributor of income and employment generation in Bangladesh (Millennium Development Goals – Need Assessment and Costing 2009-2015 Bangladesh). Agriculture in Bangladesh has been already under pressure both from huge and increasing demands for food, and from problems of agricultural land and water

*Corresponding author: M.T. Khatun,Sociology Discipline, Khulna University, Khulna, Bangladesh,Cell: 01716067371

resource depletion. The prospect of global climate change makes the issue, particularly urgent for Bangladesh and its southern part which also affected by extreme soil salinity. Average rainfalls in drier and wetter regions are 1500mm and 5000mm per year respectively (Climate of Bangladesh, Banglapedia 2007). Despite technological advances such as improved crop varieties and irrigation system, weather and climate are still key factors in agricultural productivity. The rise of CO_2 level in the atmosphere and the concomitant climate change will have a direct impact on agriculture. It is generally well accepted that this increase will have beneficial effects on plant productivity. Thus, it is difficult to predict the combined impact on agricultural productivity. Crop simulation models can be used to predict the impact. These models can provide a way to estimate crop production at coastal region. Research on crop simulation has concentrated on determining the relationships between crop growth, yields and environmental variables through field experiments as well as simulated experiments. So it is crying need to illustrate the actual situation and whether how to overcome the problem and how to ensure sufficient solutions.How productivity reduces due to salinity, shrimp farming and raise of coastal level?How does it differ the food production in time determination?The answer to these questions would help to formulate an effective relationship to show the situation of food production and consumption of people in salinity prone southwestern coastal region of Bangladesh along with identifying the livelihood pattern of people that is changing with climatic change.

MATERIALS AND METHODS

A survey was designed to conduct the study at Betbunia, Vakotmariand Groikhali village of PaikgachaUpazila in Khulna district of Bangladesh.The study area was purposively selected based on the situation of climate change and food production in salinity prone southwest coastal region of Bangladesh, as indicated by the acuteness of salinity in the community, visibility of climate change impact on food production, the problems of local agricultural production due to salinity, patterns of alternative agricultural production. The respondents (head of household and 40 years or above) who formed the sample have a profound knowledge about the gradual change of local climate and involve directly or indirectly in food production and control the family food consumptions as household head in the selected villages. Considering the above mentioned unite of analysis criteria 217 households (calculated from voter list) were identified through census as a study population. Simple random sampling was used to select 120 (40 from each village) respondents at a 95 % confidence level and a 6 % margin of error by using the Creative Research Systems' Sample Size Calculator and The Research Advisors' Sample Size Table [http://www.surveysystem.com/sscalc.htm] (Creative Research Systems). Additionally, a sub-sample of 24 respondents was selected for Focus Group Discussion (FGD). Three FGDs (1 for each village, each group contained 8 participants) were organized. The aim of organizing FGD was to obtain an understanding of the underlying situations related to the impact of climate change, impact of salinity on soil and food production, existing social and organizational support to address food security issues related to climate change. The primary data were collected through face to face interview and the secondary data were collected from certain institutions, organizations, NGOs and other government agencies. A team of 5 interviewers collected the data. To do this, initially an interview schedule was prepared and a pre-test was conducted with a sample of 15 (5 for each village) respondents over a single week period. Eventually, an interview schedule was prepared. Finally, the raw data were compiled and cleaned to make it suitable for statistical analysis.

RESULTS AND DISCUSSION

The demographic composition and socio-economic information were furnished in the Table 1 where it was found that the significant numbers (28.3 %) of respondents belonged to the age group 44-47 years among 120 respondents. Besides this, 22.5 % of the respondents were from 52 to 55 years age group and mean age of the respondents was 50.6 years. Regarding educational attainment, the findings of the study showed that the greater part (64.1 %) of the respondents had completed their education up to class 5, followed by 10.8 % up to SSC level and only 4.2% of the respondents had completed their graduation. The data illustrated that the majority (47.5 %) of the respondent were primarily depend on agriculture, fisheries as their occupation, while 27.6 % of the respondent engaged to shrimp fry collection and followed by 11.7 % of the respondents were depended on agricultural crops as their occupation. In the study area, due to climate change and saline water intrusion, the respondents were under pressure and they were forced to change their occupation to sustain their livelihood. In the study, there were 93 respondents who changed their occupation mostly due to the adaptation of hazardous climatic situations among 120 respondents, where it was found that the majority (63.0 %) of the respondents had changed their previous occupation due to beginning of shrimp cultivation, followed by 51% of the respondents who were forced to change their livelihood due to loss of agricultural production and 47 % of the respondents altered their occupation for losing their agricultural land.

Table 2 explored that the majority (96.7 %) of the respondents had knowledge about climate change. Regarding the difference of agricultural production scenario between past and present, the greater part (40.8 %) of the respondents reported that the crop varieties reduced before 20 to 25 years ago due to excessive salinity on soil, while 30.8 % of the total respondents mentioned the reduction of agricultural production and at the same time another 28.3% of the respondents said that the agricultural production cost increased abruptly comparing with the past. It illustrates the explicit example of local climate change and its fur-reaching impact on the local agricultural productions. However, the study showed that 69.2 % of the total respondents had a partial understanding about presence of six seasons in their locality, while 14.2 % had medium understanding and only 10.8 % of the respondents had no understanding about the presence of six seasons.

Table 3 represented that the problem occurred by salinity and where 43.3 % of the respondents argued that salinity was responsible for the degradation of soil fertility, 27.5 % of the respondents told that salinity hindered the paddy production, whereas 11.7 % of the total respondents mentioned that it also hampered the production of other crops followed by 10.8 % of the total respondents argued that salinity also acted as a barrier of fresh water shrimp cultivation and only 6.7 % of the respondents told that due to salinity the average production was decreased.

The Table 4 also revealed about the effect of climatic change on agriculture and found the majority (75.83%) of the respondents condemn acute soil salinity whereas 72.5 % of the respondents argued that the lower level of precipitation while 73.33 % of the respondents told high temperature burn paddy and 39.17 % of respondents responded the tidal surge or inundate saline river water as rise its level.

Table 1. Demographic composition and socio-economic distribution of the respondents (N=120)

Age (in year)	Total	Percentage
40-43	12	10.0
44-47	34	28.3
48-51	23	19.2
52-55	27	22.5
56-59	12	10.0
Above 60	12	10.0
Mean Age = 50.6 and Standard Deviations (7.87)		
Educational Qualification		
Illiterate	5	4.2
Class 1-5	77	64.1
Class 6-8	17	14.2
SSC	13	10.8
HSC	5	4.2
Graduate	3	2.5
Standard Deviations (23.67)		
Type of Occupation		
Agriculture, Crops	14	11.7
Agriculture, Fisheries	57	47.5
Shrimp Fry Collection	23	27.6
Agro Business	13	10.8
Rent by Land	3	2.5
Day Labor in Agricultural Sector	10	8.3
Standard Deviations (16.66)		
Causes of Changing of Occupation (N=93) *		
Low or Loss of Agricultural Production	55	51.0
Beginning of Shrimp Cultivation	68	63.0
Loss of Agricultural Land	48	47.0
Loss of Local Livestock Production	41	38.0

*Multiple Responses

Table 2. Climate Change Perception and Respondents Understanding

Perceptions	Total	Percentage
Knowledge regarding Climate Change		
Yes	116	96.7
No	4	3.3
Differences in Agricultural Production in past 20-25 Years	Total	Percentage
Reduce Agricultural Production	37	30.8
Limited Crop Varieties	49	40.8
Increase Production Cost Roughly	34	28.3
	Standard Deviations (6.61)	
Understanding on the Presence of six seasons at the locality	Total	Percentage
Yes	7	5.8
Medium	17	14.2
Partial	83	69.2
Fully Absence	13	10.8
	Standard Deviations (29.66)	

Table 3. Kinds of Barrier Faced for Agricultural Production by Salinity

Kinds of Problem	Total	Percentage	Standard Deviations
Reducing Soil Fertility	52	43.3	15.24
Losing Average Production	8	6.7	
Hindering Production of Paddy	33	27.5	
Hampering Production of Other Crops	14	11.7	
Fresh Water's Shrimp Cultivation	13	10.8	

Table 4. Effect of Climatic Change on Agriculture*

Effect of Climatic Change	Total	Percentage	Standard Deviations
Lower Level of Precipitation	87	72.5	17.41
Acute Soil Salinity	91	75.83	
Tidal Surge / Inundate Saline River Water as Rise its Level	47	39.17	
High Temperature Burn Paddy	88	73.33	

*Multiple Responses

The Table 5 illustrated that the respondents of the study area had their agricultural land, but all of these were not suitable for cultivation. In the study the considerable number (66.7 %) of the respondents had land, but it was not cultivated due to heavy salinity on soil, whereas 11.7 % of the respondents argued that they had 7-11 *bigha* of rice cultivable land followed by 10 % of the respondents had 1 to 3 *bighas* of land followed by 9.2 % of the respondents said that they had 4 to 6 *bighas* of rice cultivable land and only 2.5 % of the total respondents argued that they had more than ten *bighas* rice production land (11-13 *bighas*). The table-6 also described that the majority (23.3 %) of the respondents got 11-15 kg of shrimp from per *bigha* land while 10.8 % collected 6 to 10 kg per *bigha* land, whereas 5 % of the respondents got 16 kg to 20 kg of shrimp from each land. But 5.8 % of the respondents collected shrimp per land ranging from 26 kg to 30 kg. The table exposed that 45 % of the respondents had land ranging from 4 *katha* to 6 *katha* whereas 23.3 % of the respondents owned 1-3 *katha* of land, followed by 16.7 % of the respondents had 7-10 *katha,* while only 3.3 % of the respondents were the owner of above 20 *katha* of land. The table-6 also expounded that the majority (36.7 %) of the respondents were landless, while 12.5 % of the respondents had only 1-2 *bighas* of land, Followed by 11.7 % of the respondents were the ownerof land ranging from 7 *bighas* to 8 *bigha*. And finally, only 4.2 % of the respondents had landed between 20 *bighas* or above.

Table 5. Relation of Production for Farming (*Amon* Cultivation, N= 120)

Variable with Category	Total	Percentage	Standard Deviations
Amount of Rice Farming Land in *Bigha*			
Not Cultivated	80	66.7	
1-3 *Bighas*	12	10.0	
4-6 *Bighas*	11	9.2	26.32
7-10 *Bighas*	14	11.7	
11-13*Bighas*	3	2.5	
Amount of Production of Shrimp per *Bigha* Land			
1-5*Bighas*	4	3.3	
6-10*Bighas*	13	10.8	
11-15 *Bighas*	28	23.3	
16-20 *Bighas*	6	5.0	16.58
21-25 *Bighas*	4	3.3	
26-30*Bighas*	7	5.8	
Not Cultivated	58	48.3	
Amount of Respondents' Ownership of Homestead Land in Katha			
1-3 *Bighas*	28	23.3	
4-6 *Bighas*	54	45.0	
7-10 *Bighas*	20	16.7	
11-13 *Bighas*	9	7.5	15.80
14-16 *Bighas*	4	3.3	
17-20	1	.8	
Above 20	4	3.3	
Amount of Ownership of Agricultural Land			
below 1	11	9.2	
1-2 *Bighas*	15	12.5	
3-4*Bighas*	14	11.7	
5-6*Bighas*	11	9.2	10.23
7-8*Bighas*	14	11.7	
9-10*Bighas*	6	5.0	
20*Bighas or Above*	5	4.2	
No Land	44	36.7	

Table 6. Major Problems in Agricultural Practice and Shrimp Cultivation (N= 120)

Variable with Category	Major Problems	Total	Percentage
Agricultural Practice	Flood and Drought	36	36.0
	Salinity in Soil	72	72.0
	Excess Fertilizer and Pesticides Use	7	7.0
	Excess Cropping	5	5.0
Shrimp Farming	Virus Attacking	96	96.0
	Shortage of Feed	12	12.0
	Marketing Problem	6	6.0
	Problem Preservation	6	6.0

Table 7. Reduction of the density of trees and fishes from the locality due to climate change and salinity intrusion

Species	Causes	Reduction Species	Adapted Species
Trees	Climate Change and Salinity Intrusion	Mango, Jackfruit, Berry, Date tree, Palm tree, Guava, and other salinity intolerable species as well as several varieties of rice also disappear	Gauoa, Orha, Kaoura, Shiris, Koroi, Babla , Nim
Fishes	Climate Change and Salinity Intrusion	Ruhi, Carp, Kaoi, Shing, Magur, Baien, Gojar	Shrimp, Tangra, Parisha, Chakha, Bele, Talapeia, Silver carp, Crab

The problems of agricultural practice and shrimp cultivation were furnished in the Table 6, where it was found that increase of salinity intrusion, flood, drought and excessive cropping were the main problems in agricultural field. Moreover, excessive use of pesticides and virus attack on shrimp cultivation area was also created problems in agricultural productions. These were mainly responsible for the reduction of agricultural practice in the study area. For these reasons, people have to produce two or three times more crops every year to meet the demand of a growing population. Besides these, shortage of feed, lack of marketing and preservation facilities were also other kinds of problems for shrimp cultivation and agricultural practice.

The Focus Group Discussion's (FGD) results were furnished in the Table 7 which depicted that due to rise of the coastal belt water level and salinity intrusion affect trees and fishes severely of the study area, especially the salinity intolerable species. The environment of this area was deteriorating abruptly due to rise of water level of the river and salinity intrusion for shrimp cultivation. The intensity of salinity increases in the river water than the past. The study identified some kinds of trees (e.g. Mango, Jackfruit, Palm, Guava tree, etc.) and fishes (e.gRuhi,Shing, Magur, Gojar etc.), which were disappearing day by day. As the water level of the river was increasing due to climate change, which also promote at the same time the intrusion of saline water as well. As a result, the number of gher was also increasing. So, the saline areas were increasing year after year. The river water was unsuitable for crop production and other household uses from many years. At that time, the situation was more severe. As a result, the crop land was decreasing continuously. The salinity situations of different places of homestead, open space, field, roads, Khal, Beeletc. create desertification. It was clear that several indigenous species and varieties of lives were disappearing.

CONCLUSION

Agriculture, a key sector for providing socio-economic development in Bangladesh, is facing the negative impacts of climate change. Coastal areas of Bangladesh are facing tremendous challenge of climate change and salinity. Climate change determines the exposure to disaster and requires immediate efforts to build resilience and adaptive capacity. The households involved in the study area are participating in non-agricultural activities and in shrimp cultivation. Salinity hinders both cultivation and rearing of livestock resulting in scarcity of household food availability. To tackle the situation, agricultural sector must be based on the principles of sustainable development and diversification. In addition, productivity has to be improved to meet the dual challenge of achieving food security and growing sufficient food to meet the increasing demand. Farmers utilize indigenous farming skills, and selected modern technologies to minimize the harmful impacts of climate change, but it is important to create awareness on crop varieties, introduce salt tolerant crops and alternative cropping system to boost up agriculture. Additionally, social-forestation, homestead gardening and pond fishing can be encouraged as a substitute for the dominant livelihood of the coastal community. Involvement of experts and further study can assist in finding alternatives to ensure food security and possible adaptation strategy.

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