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Impact of Salinity: A Case Study in Saline Affected Satkhira District

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Abstract

Geographical location turns Bangladesh to the most disaster-prone country. People of the coastal areas of Bangladesh are fighting with different disaster like flood, cyclone, landslides, earthquake and thunderstorm. The aim of the study is to explore the impact of salinity on different sectors specially on livelihood and examine the changing patterns of livelihood and effectiveness of current adaptation measures in Satkhira district. The study found that salinity intrusion has severely affected traditional livelihood options. It has seen that 62.3% people of the study area has changed their livelihood as their previous and traditional livelihood options were affected by salinity which has led to the emergence of alternative livelihood options, such as shrimp farming, crab fattening, and day labor. However, even these alternatives are also facing challenges due to excess salinity and virus attacks. The study highlights the need for collaboration between NGOs and the government to ensure secure livelihoods for the community. The findings of this study have important implications for policymakers and practitioners working on disaster risk reduction and livelihood development in the coastal areas of Bangladesh.

Keywords

Salinity, Livelihood, Agriculture, Shrimp Culture, Satkhira

1. Introduction

Almost half of the world population, which is currently 3 billion, live within 200 km coastline and it is estimated that it will double within 2025 (Creel, 2003). In Bangladesh, coastal area totally grabs a huge area. About 29% of people in Bangladesh lives in the coastal areas (Ahmad, 2019). The coastal area of our country

is very prone to different natural and man-made disaster which is affecting every year. Now water and sea level rise, cyclone and tornado have become a serious threat for coastal region. In the last 50 years, the coastal area was seriously affected by at least nine devastating cyclones (Rabbani et al., 2013). The southern region of our country lies two meters above the sea level. Climate change due to natural and human induced activities is supposed to be one of the major regions of sea level rise, which is contributing to salinity intrusion. According to World Bank Report 2000, Sea level rise, which is caused by climate change will submerge most of the low-lying land by 2050. Every year salinity is increasing an average of 0.74% (Shaheedur Rashid Md Anowar Hossain Md Nazrul Islam et al., 2010). The main occupation of the coastal people is agriculture. Rice is the main crop and staple food for the people of Bangladesh. The coastal zone of our country is extremely vulnerable to different devastating events which affect rice production, the main livelihood option. The agricultural lands in southern part are decreasing every year. Farmers are unable to produce Aman rice due to excessive soil salinity in the crop land. After cyclone Sidr and Aila hit the southern part, salinity at that area increased radically and farmers were unable to produce Aman rice because of losing their potential yield in following five years (Rabbani et al., 2013). Salinity is affecting new area day by day and also the non-coastal zone. People of salinity prone area are suffering from the problem of irrigation, agricultural production and also scarcity of safe drinking water. At least 70% agricultural land of the south coast is affected by different degrees of soil salinity (Ziaul & Zaber, 2013). Salinity intrusion is minimum during the rainy season due to extreme flow of fresh water, it is very high during the dry season, because of lack of water flow to wash away saline water and result in salinity absorption by soil (Habiba, et al., 2014).

There are mainly two major dimensions of salinity intrusion for the coastal people 1) Food insecurity and affect livelihood 2) Lack of safe drinking water and health impact (Habiba et.al., 2014). Different area is affected by different amount of salinity. Low saline prone area people are trying to cope with in various ways. They are trying to cultivate crop, white fish where the high saline prone area has no choice except shrimp (Ziaul & Zaber, 2013). In some area the profit of shrimp cultivation influence farmer to allow the saline water in agricultural land and do shrimp cultivation which is rapidly decreasing the crop production in the land. Salinity has engulfed many new areas and crop production at that area has stopped permanently. Politically powered and rich farmers take the control over shrimp farming process and they compelled the farmer to give their lands for shrimp cultivations and the number of landless people increased.

In the recent time, coastal crop land has not been used for agriculture and crop cultivation due to both soil and water salinity. Due to soil salinity other crop production is not possible. Whole coastal areas are grasped by salinity. Shyamnagar upazilla of Satkhira district is fully saline induced. Gabura union parishad is fully destructed union by Aila. After Aila in 2009 salinity of this area increased

in a high rate from the past time. After Aila duration of saline water stay in crop land increased. Now saline water stays almost all the year in the crop land (Rabbani et al., 2013).

Though shrimp culture is one of the probable livelihoods as it helps instant money earning, it is facing some problems. Shrimp farmers are now familiar with the virus attack of gher. Virus attack in shrimp gher is affecting income. Different government and non-government organizations are giving people different alternative livelihood training on non-farm activities. But that is not working much as the initiative is not matched with the community need. Like community need water treatment plant, Water tank but this organization is unable to give to people. There needs combination indigenous and scientific knowledge to cope with salinity intrusion. This study aims to identify the changes and impacts of salinity intrusion on crop land and households in Gabura, Padmapukur and Burigoalini union parishad of Shyamnagar upazila in Satkhira district. The study will also investigate the adaptation strategies taken by the community and the shortcomings of government intervention.

2. Materials and Methods

It has been estimated that 53% area of coastal region is affected by serious salinity in both soil and water (Haque, 2006). Among the 19 coastal district almost all area is affected by moderate to severe salinity which has increased in last 5 years due to the hit of differernt cycone in very short distance (Kabir et al., 2016). Farmers have taken agricultural and non-agricultural adaptation measures but the agricultural measures are not scientific and non-agricultural measures are difficult to fulfill, because of experience and financial constraints. The study area was targeted to conduct in the saline affected coastal region of Bangladesh. Satkhira district was one of the severe salines affected region of Bangladesh, so this was selected as study area. Satkhira district is bounded by by jessore district to the north, Bay of Bengal to the south, Khulna district to the east, 24 pargana district of India to the west.

The annual minimum and maximum temperature of the district is 12.5 degree Celsius and 35.5 degree Celsius. The annual average rainfall of the district is 1710 mm. Total population of the area is 2,079,884. The district is divided by seven upazilas (Satkhira, Kaliganj, Shyamnagar) (Satkhira District-Banglapedia, n.d.). Due to mostly affected by salinity Satkhira district was selected. Shyamnagar upazila is adjacent to sundarban and the three union (Gabura, Burigoalini and padmapur) are mostly affected by salinity. The survey was taken in west Durgamati, Kholishabunia and Padmapukur village of Gabura, Burigoalini and padmapukur union. among this Gabura is mostly affected by cyclone Aila in 2009. Salinity problem is very severe in those areas for more than 25 years. People of this area are facing livelihood insecurity, as well as food insecurity. Shyamnagar is bounded on kaliganj andAssasuni upazila by north. The main rivers of this area are kalindi, Raymangal, kobadak, Arpangacchia, Haribhanga and chuna.

2.1. Theoretical and Conceptual Framework

To understand the complexities of coastal livelihood pattern and salinity impact in coastal area, a holistic understanding of livelihood is necessary. Livelihood approach will help to tie together the issue of poverty, vulnerability and food insecurity and provide link between people centered view of poverty. When a disaster occurs in any community it disrupts the life and livelihood of the community people. Salinity has severe impact on the livelihood of coastal people. The study focus is on livelihood. The economic theory, social vulnerability theory and poverty theory has relevance with the study topic. Wisners PAR model describes the root causes of disaster which creates the dynamic pressure on the community and creates unsafe conditions for the community (Wisner & Nivaran, n.d.).

The present study will focus on the fact that how the severity of salinity in shyamnagar upazila increased, its impacts on agriculture and other livelihood option. Salinity can be of both water and soil. All form of livelihood and lifestyle like fisheries, biodiversity, agriculture, tree pattern changed. Create vulnerability in social, economic, livelihood and cultural vulnerability. This framework also describes about adaptation measures and the gaps in different sectors.

2.2. Research Methodology

A Semi structured questionnaire was used for this study in order to assess the impact of salinity on agriculture and other livelihood options. This study was supported by various primary and secondary data sources. The study was conducted using mix method. quantitative and qualitative both techniques were applied to find out the impact of salinity intrusion on agriculture, fisheries, livestock. The quantitative data include household questionnaire survey and qualitative data were conducted through different tools and techniques including focus group discussion (FGD), case study, key informants' interview (KII), observation etc.

3. Results and Discussions

3.1. Salinity and Livelihood

3.1.1. Primary Occupation of the Household Head

During study it was seen that the study area people are engaged in two types of livelihood options. One is primary occupation and another is secondary occupation. Following **Figure 1** shows the percentage of primary occupation of the household head of satkhira district. Because of instability occupation due to salinity, people of this area have to do two or more livelihood options for living. They work as seasonal labor in brick field. This percentage is 22.0%. the second highest is shrimp farming where people lease land from others called land owner for cultivation of shrimp. This person is the rich and land owner. The person with low land sometime gave lease or cultivate shrimp by own.

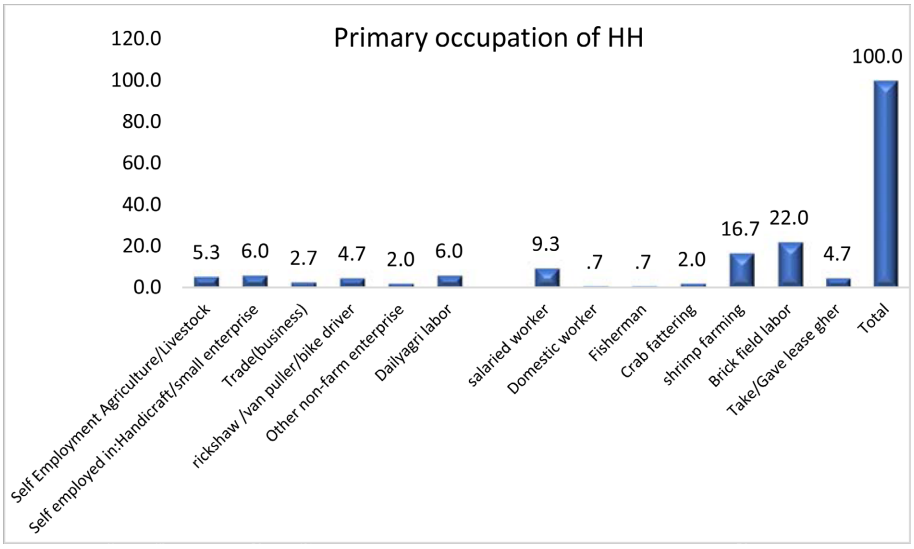
3.1.2. Main Disaster of Shyamnagar Upazilla

Coastal areas of Bangladesh are prone to various natural and man-made hazard.

Among that Cyclone, Flood, water logging is the severe problem of that area. Here salinity, which is considered as the most severe problem of that area and a slow onset disaster. Figure 2 shows that the main disaster of this area is salinity. Among 150 respondent 48% believe that salinity is the main disaster.24.0% and 19.3% people mention about cyclone and flood, where flood is the common problem. It was observed during the research that a large number of people do not think salinity a disaster because of its slow onset and they are used to it. Moreover, people of study area are now thinking that salinity is a part of their life and they lose hope to get rid from this disaster.

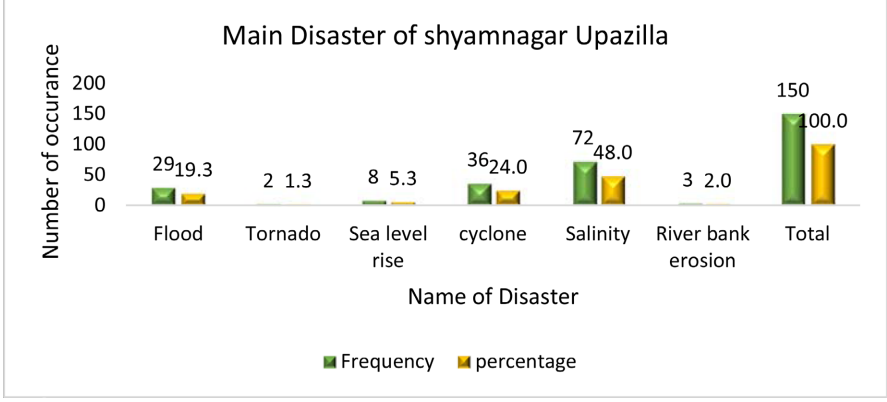
3.2. Salinity Impact on Livelihood

Due to sea level rise, intentional and forcefully allowance of saline water in the agricultural land for shrimp culture by the politically powerful and other people, Salinity intrusion started in the coastal area during the course of 20 years. But



Source: Field survey, 2018.

Figure 1. Primary occupation of the household head.



Source: Field survey, 2018.

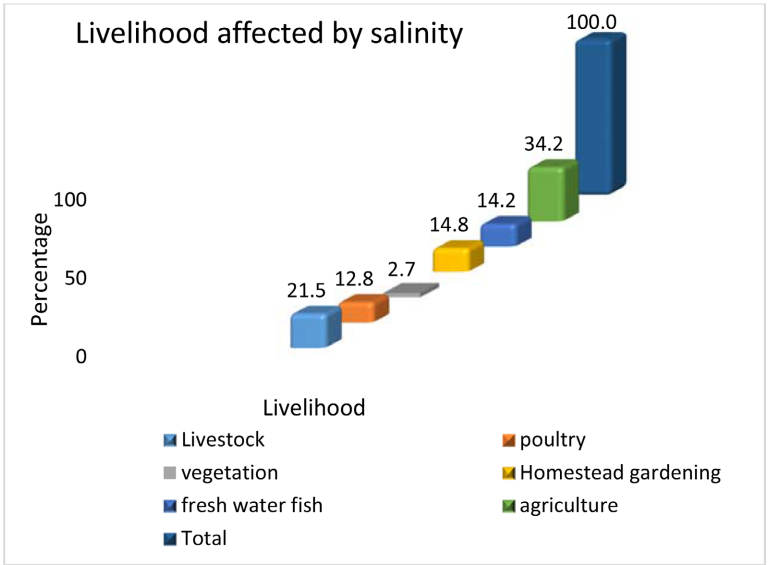
Figure 2. Main Disaster of shyamnagar Upazilla.

the protest from the farmer, the saline water picking recently stopped at that area. After cyclone Aila of 2009, salinity intrusion increased in this land and till now it is flowing. With that illegal water channel, creating more channels within shorter distance, shrimp farming, embankment breaching is responsible for increasing the salinity in the agricultural land. Salinity affected mostly the agriculture-based livelihood. In Gabura, Padmapukur and Burigoalini union most of the agricultural land are being used for shrimp culture, rest are unusable for agricultural production. Other livelihood like bike riding, daily agri-labor, daily non agri-labor is reducing due to salinity impact. By creating food crisis, unemployment, social crisis, illegal activities, salinity reduces the capacity of people to do anything. It creates severe water crisis for drinking, cooking and bathing. During dry season the fresh water source like river, pond, canal die off and the solidity of salinity increases. Due to lack of irrigational water agricultural production is becoming impossible.

Study shows that livelihood of 62.7% people has been changed due to salinity This people left their previous occupation and shift to another. Main reason for this occupation change is lack of feasible environment in the previous occupation, 44% people talked about this. Indirectly they mean that lack of labor demand decreased in cultivation where 19.3% respondent directly indicates salinity as responsible for change in livelihood. Figure 3 shows the livelihood options affecting by salinity. Here respondent agreed that 14.2% of fresh water fish, 21.5% of livestock rearing and 34.2% of agricultural sector are affected by salinity problem.

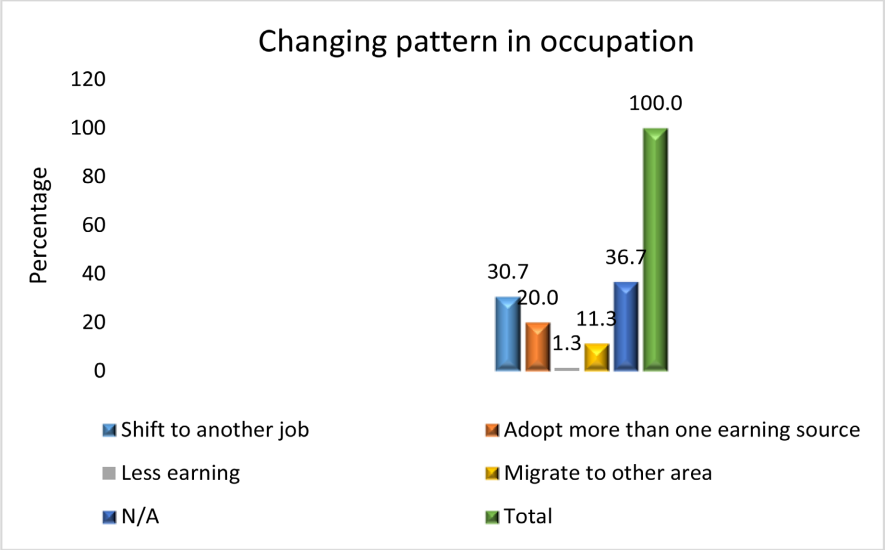
Change in Livelihood

From Figure 4, it is shown that 36.7% people have to change their livelihood by shifting to another job. About 20.0% respondent adopted more than one earning



Source: Field survey, 2018.

Figure 3. Livelihood affecting by salinity.



Source: Field survey, 2018.

Figure 4. Changing pattern in occupation.

source, because the previous job gave less earning scope. Here another important thing they focused on the interview was that a large number of people migrate to urban area (11.3%) Internal migration is also part of the percentage which means the shifting to another job. Salinity of this area has highly increased after cyclone SIDR.

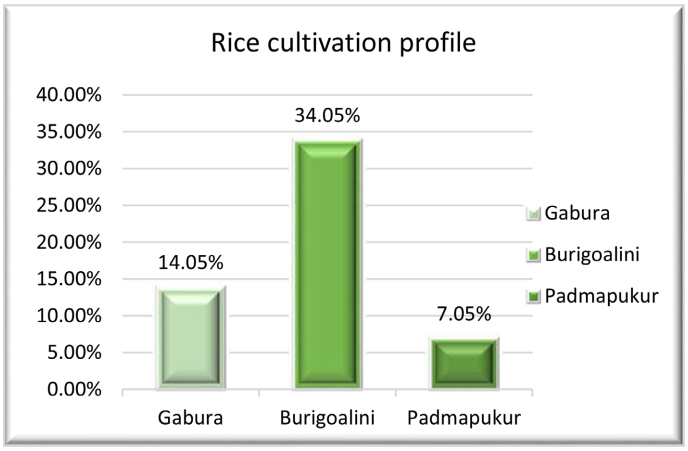
Study shows that 62% respondent changed their occupation from previous one. A large number of people changed livelihood 2 - 3 times in the last 10 years. Most focusing thing here is that a large number of populations migrate to urban area for searching job. Lack of job opportunities in the area is forcing people to leave the area for work. Respondent who worked as agricultural labor or do rice cultivation are now work outside the area as day labor, rickshaw puller and garments worker etc.

3.3. Agricultural Profile of the Study Area

Agriculture was the main occupation of the people of these unions once but agricultural production come to the level of less than 10%. More over rice can be cultivated once in a year. No crop other than rice can be cultivated here.

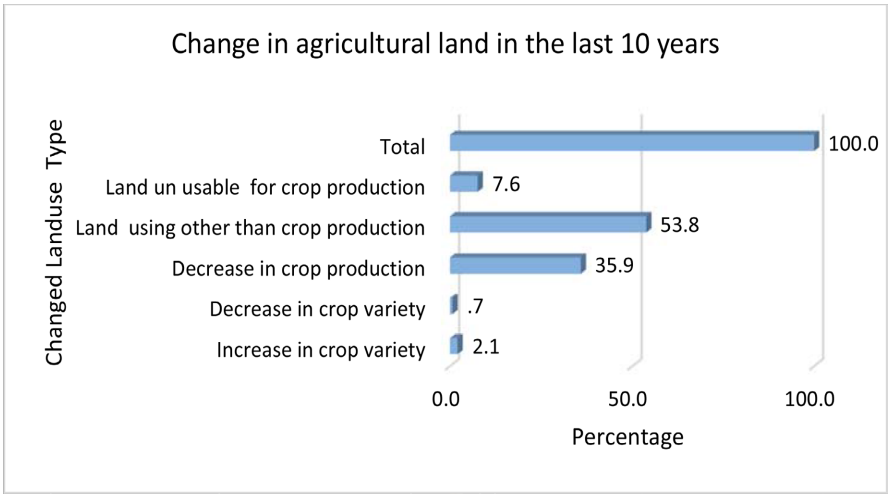
People who try heart and soul to do agricultural production cannot do this because the shrimp culture of one land affect the adjacent one. If data of agriculture can be seen it will show that total cultivable land of shyamnogor upazila is 30,764 hectre. Nit cultivable land where agriculture is done once is 13,700 (upazila agriculture statistics, Shyamnogor). However, it is the statistics of total area but the study area is mostly affected by salinity and less agriculture happen.

Figure 5 shows the rice cultivation in three union of Shyamnagar upazilla. Rice cultivation in Burigoalini is 34.05%. Inspite of most affected area by Aila, Gabura possess rice production of 14.05%, where rice production in padmapukur is (7.05%).



Source: Field Survey, 2018.

Figure 5. Rice cultivation profile in three union.



Source: Field survey, 2018.

Figure 6. Change in agricultural land in the last 10 years.

Change in Agricultural Land

Figure 6 below is showing the condition of agricultural land in the last 10 years. The data is showing that 53.8% agricultural land are using for other (shrimp culture, crab fattening), 35.9% of land suffer decreased Crop production due to salinity intrusion. The 53.8% are unusable for rice cultivation for next 10 years. If salinity of a land has to prevent, this has to keep without cultivating. It will take 10 - 12 years for the land to come back in the normal situation.

Study finds out that agricultural land is now using as shrimp gher. Irrigation crisis has become a severe problem. Water source are saline induced. 99% respondent talked about either water source salinity or water crisis in rive is responsible for this problem. Study mainly found that lack of irrigation of fresh water is responsible for crisis in agriculture. Here the study also identifies a very alarming thing that government intervention for agriculture is very low and government seems not to paying any heed to this problem.

3.4. Livestock and Poultry

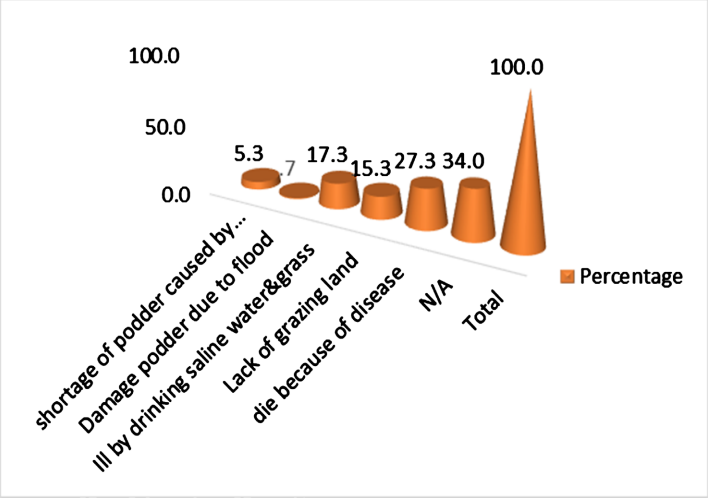
Livestock and poultry is another sub income source of the community people of the village. During survey, it has been seen that the rate of livestock rearing in the saline affected study area decreased from the previous year. There is a change in the three union of the same upazilla which is based on the adaptation pattern, feeding and other issue.

Figure 7 shows the problem faced in rearing livestock and poultry in the saline affected area. 27.3% respondent mentioned about the death of animal due to disease for drinking saline water and saline induced grass. 17.3% mentioned about lack of grazing land and grass. 5.3% mentioned about shortage of podder due to less agricultural production. Livestock and poultry mainly affected during severe salinity at the time of hot weather.

Another objective of the study was to see the salinity impact in different sector of livelihood. Livestock and fisheries sector are passing severe problem. Respondent are not getting profit from livestock and poultry sector. Almost all respondent who rear livestock told that livestock suffer from disease and die of because of drinking saline water and saline induced grass. Shortage of fodder, lack of grass and saline water are responsible for this. Fresh water fish variety of study area decreases. The native species are not found now.

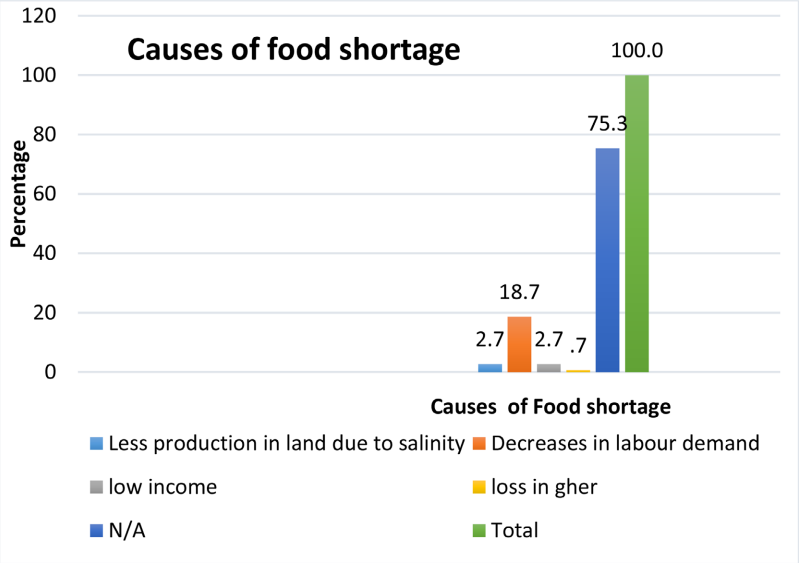
3.5. Salinity and Food Insecurity

Deep relation exists between salinity, livelihood and food insecurity. Due to the profit of shrimp culture, some people are more benefited and some people who are labor and have no land are deprived and suffer from food crisis. Less agriculture turns the price hike of rice. Respondent among three union talked about the high price of essential good due to weak communication, distance. Before salinity, they had rice in their home but now, they have to consume rice in small proportion. Figure 8 shows that 75.3% respondent said that the reason of food



Source: Field survey, 2018.

Figure 7. Problem faced in rearing livestock and poultry.



Source: Field survey, 2018.

Figure 8. Causes of food shortage.

insecurity is Less or no production in agricultural land.18.7% respondent said that lack of agricultural cultivation requires less labor and people became unemployed. Unemployed people are unable to meet the basic need of their family.

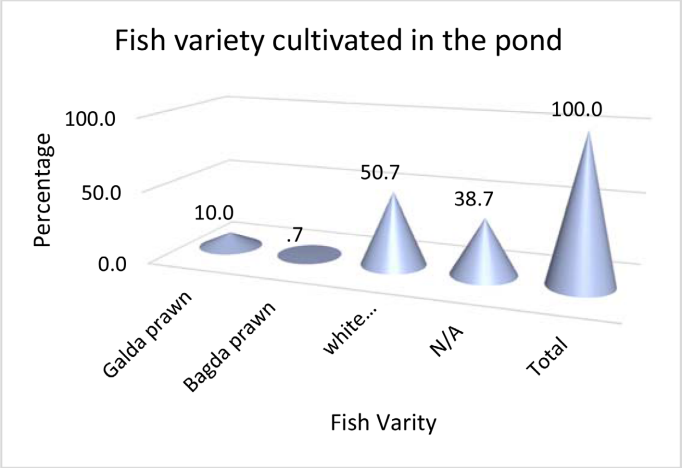
Agricultural production in the study area has decreased very radically in the last 10 years very radically. Among three union rice production in Burigoalini is higher than other union. Rice grows once in a year where it was twice in the past. Homestead gardening is reducing due to higher salinity in soil. Livestock rearing is reduced from the previous time.76% people face food shortage in different time of the year.

3.6. Salinity Impact on Fresh Water Fisheries

Another livelihood options of the people of coastal area were fresh water fish cultivation for both subsistence and sale. It was tradition that have agricultural land or not but almost all household hold a pond in front of their house. The pond was primary source of fresh water during salinity intrusion. But after cyclone AILA most of the pond became saline prone. After AILA fresh water fish cultivation stopped because of saline water intrusion. In **Figure 9**, we can see that respondent of the three-union opined that, 43% pond water are mix of both fresh water and saline water. Respondent determined 19% pond as fresh water source, 28% as saline water pond.

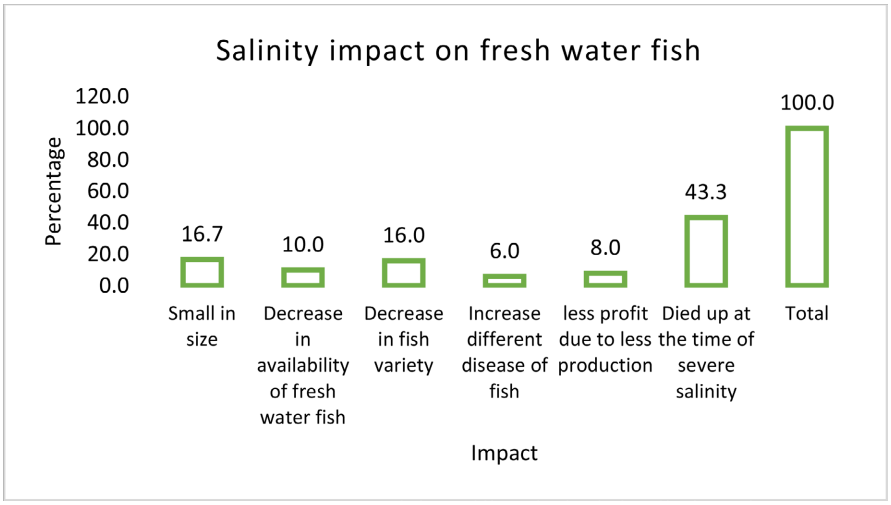
Figure 8 indicate the fish varieties cultivated in the pond.50.7% respondent opined of cultivating white fish which are carp, Rui, tilapia, fissa.10% talked of cultivating galda prawn. But at the time of severe hot season, water density reduced and salinity of pond water increased. Saline water cause damage to fish cultivation. The fish cannot cope up with the severity of salinity.

Salinity impact on fresh water fish can be detect from **Figure 10**, where 43.3%



Source: Field survey, 2018.

Figure 9. Fish variety cultivated in the pond.



Source: Field survey, 2018.

Figure 10. Salinity impact on fresh water fish.

respondent mentioned about died up of fish at the time of severe salinity.16% indicate decrease of variety, 16% indicate decrease of fish size.

3.7. Impact on Shrimp Farming

Among the various cause of salinity, shrimp farming is one of the main causes. salinity in the coastal area initiated by shrimp cultivator. During 1980 some rich and terror type people initiated saline water from river for cultivating shrimp, because they wanted to be benefited. Shrimp farming was an instant money earning source that time. With the saline water initiation agricultural production started to decrease. Now the area turns to shrimp gher. No cultivation happens here.

Though at present it is one of the main occupations and earning source for a large number of people. It is facing loss due to decrease in market price for the rumor of adding jelly, virus attack, water solidity increase. Shrimp cultivator are

now in the problem. Now it is two side problem, if they leave shrimp, agriculture is not possible for several years. Land is initiated with saline water and soil are also saline contaminated.

Table 1 is showing the percentage of respondent who has shrimp gher or lease gher for shrimp farming. So, among the respondent 41.8% are involved in shrimp farming in Gabura union, 45.5% in Burigoalini, 42.5% in padmapukur. Here the percentage is combined of both shrimp farmer and respondent who gave hari.

After the initiation of saline water people started shrimp farming. Except the rich and powerful, all people were against shrimp gher. As agriculture is not possible people started shrimp farming. But shrimp farming also getting less benefit due to virus attack. Now 79% people who are engaged with shrimp farming want to go back to agriculture and the rest want shrimp farming due to profit. Respondent who wants shrimp farming are the owner of huge amount of land. So, the Marginalized farmer are mostly affected. Due to shrimp farming occupational variety is creating in the study area. For secure livelihood and earning they are doing different kind of job at different time of the year to cope with the changing environment.

3.8. Ecosystem and Salinity Impact

Coastal area especially shyamnagar upazilla is covered by sundarban the biggest mangrove forest of the world. But due to excess salinity, biodiversity of sundarban is destroying. Sundori, keora, hogla grow in saline water but excess saline and logging of saline water prevent the tree to breath. The tree number are decreasing. different trees are dying due to excess salinity. Native fish species are vanishing. Tree integral part and important source of oxygen to breadth. Except some specific species other cannot grow. Problem in the Biodiversity will be the greatest threat for the coastal Bangladesh. Sundarban is protecting the southern part of our country from different natural disaster. Destruction of sundarban is the indication of destruction of the coastal belt.

Tree variety in the study area decreases. It has been seen that only saline tolerant some varieties of tree grow here. Fruit trees like Sapodilla palm grow here. People here are trying to grow different fruit tree by using organic fertilizer. Sundarban is affecting by over salinity. Different tree species are dying due to excess salinity. Lack of work forcing people to go to sundarban for Crab fattening, collecting honey, collecting golpata, which are destroying the ecosystem of sundarban.

Table 1. Shrimp Gher initiation.

Shrimp Gher	Gabura		Burigoalini		Padmapukur	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Yes	23	41.8	25	45.5	17	42.5
No	32	58.2	30	54.5	23	57.5
Total	55	100.0	55	100.0	40	100.0

3.9. Salinity and Health Problem

Salinity in coastal area creating various health problem of the people. Respondent talked about suffering from different health defect due to salinity. 34.0% mentioned suffering from diarrhea, 28.0% talked about skin diseases. They also mentioned about high blood pressure, eye irritation, cholera etc. Children, elderly and women are more vulnerable. This disease is also affecting the earning by making people unable to work, people have to spend money for treatment which is related to livelihood.

3.10. Salinity and Gender Issue

Another thing come from the study is gender issue. Women in our country are deprived. Their rights are not fulfilled. Respondent ensure that carrying drinking water from distance source is the main responsibility of women. About 87.3% adult women carry water where men are only 8.0%. 4.7% girl child carry water. Though we know women are weak then men by born, carrying water is affecting their health. Sometime women have to face harassment. Saline water is also harmful for pregnant women.32% women told about suffering from problem with uterus, 30% women suffered from pregnancy related complication, 28% suffered from high blood pressure by drinking saline water. Carrying water vase of high weight cause pain in waist, hand and leg. Authority and government is not involving women in development activities.

3.11. Adaptation Measures Taken by Community

Adaptation capacity means the ability of system or community to cope with the adverse effect of disaster or climate change (Levina & Tirpak, 2006). Adaptation measures are a core to cope with salinity. The community people adopted different adaptation options in their household and land to cope up with the salinity impact. In community adaptation measures they mainly use their indigenous knowledge to cope. Among the 150 respondent, almost 85% talked about their different adaptation measures for their livelihood. As salinity impacted the livelihood options, respondents took alternative adaption mechanisms at that issue to cope with that problem. It is about the livelihood sector affected and the adaptation measures to cope with that problem. Basically community have to adapt to the adverse effect of salinity in different sector, so they took adaptation mechanism in different sector which are affected by salinity.

3.12. Adaptation and Livelihood

Different adaptation measures have been taken in the different livelihood options to secure it from the adverse effect of salinity. Agriculture, Fisheries, Livestock, Poultry, Homestead gardening are affected by salinity, so community taken some measure to adopt to the adverse effects. So, the adaptation measures in different sectors are given below:

1) Adaptation in Agriculture

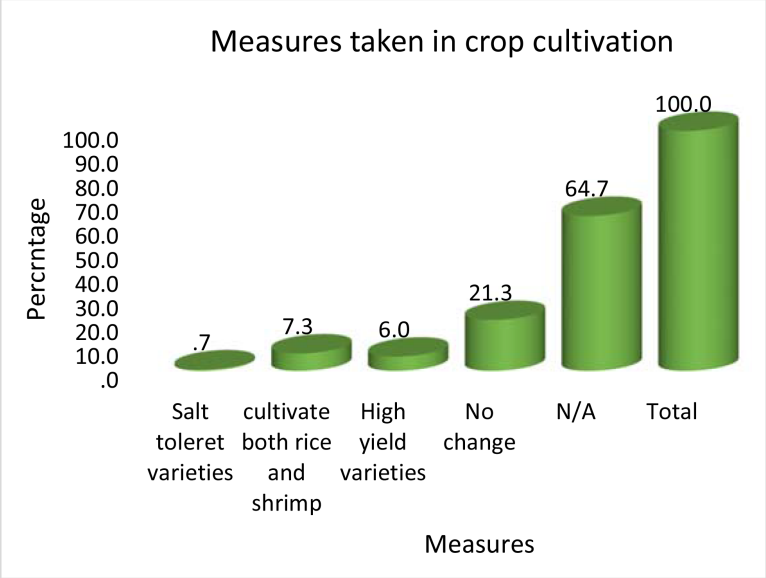
Once agriculture was the main livelihood options of the study area. Now agricultural production decreases and come to the state that the ratio of agriculture and shrimp cultivation in agricultural land are 80:20. Still farmer who cannot give up rice cultivation are trying their best to make their land cultivable.

Among the 150 respondent who cultivate rice take some measures for land. 15.3% use fertilizer like potash, zypsum, zinc to reduce soil salinity. Farmer raise the land high so that saline water did not enter. Some respondant (0.7%) mentioned about using lime to wash their land. For irrigation they use Shallow machine which give saline free water, they mainly rely on water, use water of canal which are saline free.

Figure 11 is showing that 21.3% do not make any change in the crop variety. 6.0% use high yield varieties.0.7% use salt tolerant varieties. They are taking different measures but the crop production is not increasing in a satisfactory rate. If shrimp farming or saline water initiation is reduced, salinity in field would reduce.

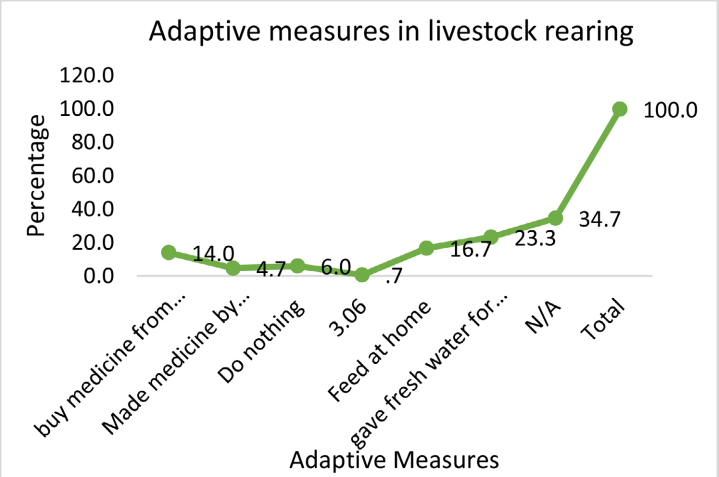
2) Adaptation in livestock rearing

Livestock rearing was one of the important income generating activities in the study area. Due to saline water intrusion livestock died up. Now the rate of livestock rearing is very low. Respondent report salinity as responsible for low rate of livestock rearing. Respondent told that as one of the main earning source and source of milk they cannot give up. Now they are taking some adaptation measures for livestock rearing. From Figure 12, it can be concluded that 23.3% respondent said that they use saline free water for drinking of the livestock. As the grass are saline induce, during severe salinity 16.7% respondent feed the livestock at home with rice husk. To prevent disease, they made medicine by own for



Source: Field Survey, 2018.

Figure 11. Measures taken in crop cultivation.



Source: Field Survey, 2018.

Figure 12. Adaptive measures in livestock rearing.

the livestock.

3) Adaptation in fresh water fish cultivation

Due to salinity fresh water fish variety of respondent frittering away. Respondent took different adaptation measures to protect the fresh water fish cultivation in pond. To protect the pond water from salinity or the pond which already get saline prone respondent took measures. From the survey result, it is seen that 41.3% respondent say that they only use lime which is the best remedy from salinity. 8.7% talked about rising the fringe of the pond. 5.3% respondent use different chemical. Some use both of the lime and chemical. They said that they are trying to cope with. Some are cultivating white fish which grow in the mix water easily.

4) Adaptive measures for drinking water

Drinking water crisis is one of the severe problems created by salinity. Other problem can be solved by alternative measures but the water crisis and lack of water in water source (pond, Canal) is a severe problem. People have to buy drinking water or collect from long distance source and who cannot buy or collect have to drink saline water and became ill. Sometimes the water source (pond, tube well) is the ownership of a person who is not relative and they veto to collect water. Among 150 respondent 41.3% told that they collect water from long distance source.56.0% buy water from van or water plant.

Except the adaptation measures community have taken some alternative coping mechanism for secure livelihood which are listed in Table 2.

Respondent knows that salinity is causing harm to their life and livelihood but now they thought that there is no remedy from this problem and they are trying for alternative livelihood where they can abolish the salinity. Respondent are now used to this situation as no proper remedy is taken for this. They think remedy from salinity is not possible as it was initiated by the locally powerful persons. At the same time, they are saying that lack of working opportunity in their

Table 2. Different coping Mechanism by community.

Types of Adaptive Measures	Explanation	Findings
Migrate to urban area for work	Some respondent work in urban area as labor for Livelihood	Day labor, Rickshaw puller, Brick field labor, garments worker is common occupation
Business	Some started different business, who used to work as agricultural labor	Fish seller, selling crab, vegetable shop, grocery shop
Handicrafts	Most of the women are involved in this activity for earning with the help of different Ngo	Tailoring, preparing mat, bag, sweets box, Chutneys
Income generating activities	AIGA are done by men and women. Some respondent talked about this.	Preparing net, preparing box for collecting crab is very popular business, collect larvae
Work in shrimp gher	Women mainly work in shrimp gher for sorting grass	Sort grass, men clean water, gave medicine in the gher
Rearing pig	In the coastal area it is getting popular	People rear pig for selling. Specially the Hindu community rear this.
Crab collection, Gol tree	Some go to Sundarban for collecting and cultivating crab and collect golpata	Specially the young men go to the deep area of sundarban though it is restricted

area is making them economically vulnerable and working outside the area is not possible for all. Adaptation measures taken by community are effective but they do not use scientific process, so it shows a long-term impact on the community land. Farmer adjust time in cultivating crop, use lime to reduce salinity from soil and irrigate fresh water during rainy season.

5) Measures by Government

Government measures for salinity reduction is not satisfactory because government has taken very few measures. The measures government taken are for shrimp farming. Government measures for agriculture and other livelihood are not that amount to discuss.

6) Measures by NGO

NGO activities in saline prone area is very effectively working than government. Different NGO is working though they all focus on same issue. Main activities of NGO at coastal area are Alternative Livelihood basis.

Gonomukhini is a local NGO which give training to the farmer, provide deep tube well for agriculture and give loan in low interest rate.

ADDIN set up water plant in different village of Shyamnogor upazila. They provide safe drinking water in low rate. They provide water tank in installment.

63.3% respondent told the activities done by most NGO are alternative income generating activities.

Shusilon provide the policy help to the local people.

Codec mainly focus on three main issues of livelihood. Codec mainly focusses on agriculture. They provide AIGA which means alternative income generating activities. They had divided the community people divided in three categories:

a) Ultra poor—Household does not have anything.

b) poor—who have below 10 decimal lands.

c) Medium—More than 10 decimal.

For vegetable cultivation, they work for the producer who produce different types of vegetables at their homestead and focus so that they can make a market link up. They gave training hen, duck, livestock by agriculture and fisheries officer. They gave money, seeds to AIGA level. Gave training on Bamboo product, Tailor, Car duster, rearing Rattan, Goat, duck etc. They mainly work with women. CODEC gave selected beneficiary training by locally experienced personnel at different AIGA. CODEC gave those 1000 per month and tell them to start a business plan. The study shows the respondents view about the government and NGO. Salinity situation is common in all southern part. If it can be compared to Khulna, salinity situation of Satkhira does not improve much. Ngo activities is very low here. Study has found an interesting thing about NGO activities. There is no coordination among NGOS. Like in one area same person is getting help from two or three NGO. NGO worker does not survey to find out the actual need. They use the list of other NGOs and gave the same person same benefit. All NGO are focusing in one thing. But different NGO can focus on different sector of livelihood.

About 98% respondents are not satisfied with the activities of government. They explain the cause is that 36.7% talked about no involvement of community, where 42.9% talked about the measures given by government do not match the community perspective. Government intervention for agriculture is not level of mentioning. Respondent think that government failed to ensure the pure drinking water for people.

4. Conclusion

The study highlights the alarming situation of increasing salinity intrusion in the coastal areas of Bangladesh over the past 20 years. The impact of salinity on the livelihood of the coastal people is significant, and it is affecting almost all agricultural land, leaving limited working opportunities and creating food insecurity. The respondents' knowledge about salinity impact on livelihoods is clear, but their knowledge of adopting mechanisms to reduce salinity impact is inadequate. This study also reveals that there is a lack of sufficient adaptation measures, and traditional mechanisms need to be combined with scientific mechanisms to combat this issue. Developing country like Bangladesh mainly depends on agriculture, and the decreasing agricultural production is creating severe threats to

the people of the coastal area. Therefore, it is crucial to develop a specific policy model that addresses the gaps and finds solutions that meet the community's requirements. Additionally, measures should be taken to carry out shrimp farming using scientific experiments, which is profitable without hampering other livelihood options. Overall, implementing better policies and finding sustainable solutions will ensure all types of livelihoods in the coastal areas of Bangladesh.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Ahmad, H. (2019). Coastal Zone Management Bangladesh Coastal Zone Management Status and Future Trends. *Journal of Coastal Zone Management, 22,* Article No. 466.

Creel, L. (2003). *Ripple Effects: Population and Coastal Regions*.

Habiba, U., Abedin, M. A., Shaw, R., & Hassan, A. W. R. (2014). Salinity-Induced Livelihood Stress in Coastal Region of Bangladesh. In *Water Insecurity: A Social Dilemma* (pp. 139-165). Emerald Group Publishing Limited. https://doi.org/10.1108/S2040-7262(2013)0000013013

Haque, S. A. (2006). Salinity Problems and Crop Production in Coastal Regions of Bangladesh. *Pakistan Journal of Botany, 38,* 1359-1365. https://www.researchgate.net/publication/228724784_Salinity_problems_and_crop_production_in_coastal_regions_of_Bangladesh

Kabir, R., Khan, H. T. A., Ball, E., & Caldwell, K. (2016). Climate Change Impact: The Experience of the Coastal Areas of Bangladesh Affected by Cyclones Sidr and Aila. *Journal of Environmental and Public Health, 2016,* Article ID: 9654753. https://doi.org/10.1155/2016/9654753

Levina, E., & Tirpak, D. (2006). *Adaptation to Climate Change: Key Terms*. https://www.oecd.org/env/cc

Rabbani, G., Rahman, A., & Mainuddin, K. (2013). Salinity-Induced Loss and Damage to Farming Households in Coastal Bangladesh. *International Journal of Global Warming, 5,* 400-415. https://doi.org/10.1504/IJGW.2013.057284

Satkhira District-Banglapedia (n.d.). https://en.banglapedia.org/index.php/Satkhira_District

Shaheedur Rashid Md Anowar Hossain Md Nazrul Islam, M., Ahsan Director, M., Bhaban, M., Sarak, K. et al. (2010). *Saline Soils of Bangladesh Surveyed and Data Compiled by Report Prepared by: Soil Resource Development Institute Soil Resource Development Institute SRMAF Project Ministry of Agriculture*.

Wisner, C., & Nivaran, D. (n.d.). *At Risk: Natural Hazards, People's Vulnerability and Disasters Second Edition 2003*.

Ziaul, H. M., & Zaber, H. M. (2013). Impact of Salinity on Livelihood Strategies of Farmers. *Journal of Soil Science and Plant Nutrition, 13,* 417-431.