

Assessing Loss and Damage of Low Exposed Sudden Onset Disasters: Evidence from the Marginal Salt Cultivators of Kutubdia Island, Bangladesh

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ABSTRACT: In recent years in Bangladesh, there has been regular cyclonic event, flooding and erratic pre-monsoons precipitation that has hampered production greatly and forced Bangladesh to import salt from abroad to manage market deficiency. There is much uncertainty about the effects of climate change on the frequency and intensity of small-scale, sudden onset weather phenomena such as heavy rainfall and subsequent loss and damage (L&D). But, several studies indicate that an obvious strong relationship exists between irregular rainfall and associated L&D. Nowadays, severe changing rainfall patterns are observed in Bangladesh, which is rapid-onset in nature, but low exposed in terms of response. The current study explored a 'double-exposed' burden combined of both climatic (e.g., uneven rainfall) and non-climatic governance factors (e.g., imperfect trade policy, the absence of risk transfer mechanisms) which are hindering salt production and pushing the country from the aspiration of salt exporting to the net buyer. This chapter mainly assesses the impacts of L&D due to climatic events that are causing overwhelming effects on the well-being of marginal salt farmers at Kutubdia Upazila of Bangladesh. Data were mainly collected through Participatory Vulnerability Analysis (PVA), Key informant interviews (KII), and Sample Surveys (SS). This study would provide insights for improved disaster management policy and an appropriate adaptive measure to address such extreme events as well as to initiate a further study for understanding the nexus of 'nature and market' in building resilience among the marginal salt farmers.

Keywords: Climate change, loss and damage, human well-being, marginal salt farmers, adaptation, vulnerability, Bangladesh

1. Introduction

The coastline of Chittagong and Cox's Bazar is the central hub of crude salt production in Bangladesh (National Salt Policy, 2011). Typically, these areas are very 'exposed' to sea and hugely 'sensible' to various Hydro meteorological hazards such as cyclone, heavy rainfall, tidal surge, and sea-level rise (SLR). Climate change poses an existential threat, and the salt-producing areas in Bangladesh recognized as the most vulnerable areas to potential losses of livelihood (Toufique and Yunus, 2013).

Favorable weather conditions (low rainfall and available daylight) are the apparent preconditions for salt production. Thus, winter and the pre-monsoon season between November and May are the most suitable periods for the production of salt. In recent years, the salt-producing areas have experienced a frequent cyclonic surge, tidal inundation, and uneven rainfall in the salt cultivation period. Such incidents hugely hampered the salt production and forced the country to import about one million tons of salt in repeated three year period (from 2015 to 2017) to manage the market shortfall (BSCIC, 2018).

Several reports and studies identified unfavorable weather conditions that had reduced the number of salt beds (Hossain et al., 2006; Hossain et al., 2003), low market price (Hossain et al., 2006) and also the import of salt from foreign countries. These are the main causes of failure to achieve production targets. The field investigation explores a 'double-exposed' burden combined of both climatic (e.g., uneven rainfall, cyclonic surge) and non-climatic governance factors (e.g., unfavorable trade policy, lack of risk transfer mechanisms) are hindering salt production and pushing the country from the aspiration of salt exporting to a net buyer. Given the complex scenario, this study mainly attempts to assess the loss and damage due to climatic events increasing overwhelming effects on the wellbeing of 'marginal salt cultivators'¹ at Kutubdia Upazila of Bangladesh.

There is significant suspicion regarding the impacts of climate change on the frequency and severity of small-scale, sudden onset weather phenomenon (e.g., heavy rainfall, storm, hailstorms, etc.) and subsequent loss and damage. However, several studies indicate that an obvious strong relationship exists between uneven rainfall events, high tide, and associated loss and damage (IPCC, 2014; Putnam and Broecker, 2017). Therefore, from a climate change point of view, this study is an attempt to texture the feature of loss and damage of 'double-exposed' less adaptive (in terms of financial instruments or physical measures) salt cultivation. This chapter explores a 'double-exposed' burden combined with climatic (e.g., uneven rainfall, cyclonic surge, etc.) and non-climatic factors (e.g., unfavorable trade policy, lack of risk transfer mechanisms) that are hindering salt production. As a result, the country had pushed from the aspiration of salt exporting to the net buyer. Therefore, the study mainly seeks to assess how the impacts of climate change (weather anomalies) affect salt production

¹ The definition 'Marginal Farmer' refers to a farmer cultivating (as the owner, tenant, or shareholder) inland less than 0.049 acres, as stated by the Bangladesh Bureau for Statistics (BBS).

and to what extent the livelihoods and well-being of marginal salt farmers are affected by increased loss and loss of salt yield.

First, this chapter began with a summary of the concept of loss and damage (L&D) and described its relationship to climate change. Later, we discussed the background of salt cultivation in Bangladesh as well as its situation in the context of the changing nature of the global climate change. After that, we presented the methodology that we followed in this study and discussed the findings and results accordingly. Lastly, the chapter ended with summary and concluding remarks.

1.2 Understanding Local Level ‘Loss and Damage’

In the global negotiation, ‘loss and damage (L&D)’ is commonly conceptualized as the impacts of climate change that are ‘beyond adaptation’ limits and unavoidable through adaptation as usual mitigation efforts (Roberts et al., 2015; Verheyen et al., 2012). But at the local level, ‘L&D’ has been specified as the impacts of climate change that households and communities cannot adapt within their existing capacity (Warner et al., 2012; 2013). Correspondingly, this argument has reinforced calls for increased mitigation ambition and incremental financing for adaptation (Huq et al., 2013; Kreft et al., 2013; Roberts and Huq, 2013; Roberts and Pelling, 2018). L&D also presents a range of ethical and global political issues as it narrates the questions of liability and compensation for climate change-induced losses and damages (James et al., 2019). Despite growing scientific advancements, the debate is currently more extensive and prolonged, while the strong policy direction and norms of compensatory justice remain unclear and disputed (Mechler et al., 2019). It is essential to develop a separate definition to assess the local level loss and damage incurred from a particular climatic event by considering the diverse global and local context (Van der Geest, 2018). In this regard, Lopez et al. (2019) and Van der Geest (2018) focused on the convergence among climate change adaptation (CCA) and disaster risk reduction (DRR). They emphasized the need to assess coping capacity and adaptation measures for conducting local empirical work.

Analyzing available literature (O'Brien and Leichenko, 2000; O'Brien et al., 2004; Warner and Van der Geest, 2013; Van der Geest, 2018) this pilot study focused on the climate impacts that affect the vulnerable people and community in particular; tried to identify traditional practices to deal with such consequences within their limit (coping) and explore the possible options (technical, financial, social and policy support) to avert harmful impacts (adaptation). This study is also an attempt to assess the particular role of extreme events and volatile market price (the ‘double stress’) threatening the small salt farmers from ‘both ends’ (nature and the market).

1.3 Climate Change Attribution

Nowadays it has become a debatable issue among the international climate scientists (e.g., Huggel et al., 2015; Hulme, 2014; James et al., 2014) whether the loss and damage (L&D) is attributable to climate change or more generally to any climate-related impacts (Warner and van der Geest, 2013). However, this attribution matter is debatable as it is linked with blame and liability (James et al., 2014). Nevertheless, biophysical and social determinants influencing L&D, including climate change, need to be recognized to address the associated risks (Huggel et al., 2013). The consideration of attribution evidence may help inform and facilitate policy discussions (Huggel et al., 2015). To what extent can particular, extreme events, such as landslides, erratic or heavy rainfall, etc. be attributed to anthropogenic climate change is a crucial question in international climate change negotiations (Parker et al., 2017; Van der Geest, 2018) though solid evidence exists correlating to slow-onset events, such as the sea-level rise and glacial retreat, to climate change (Bindoff et al., 2013). But, links between climate change and specific extreme weather events, such as heatwaves, and particularly floods and droughts, were found more uncertain due to the larger role of natural variability. It is not likely to prove whether an event would have appeared in a stable climate (Parker et al., 2017). However, all the previous IPCC's Assessment Reports (AR) (e.g., AR3, AR4, AR5, etc.) mentioned that due to increased global greenhouse gas emissions (GHG), the global temperature would be increased which will influence the intensity and distribution of several extreme weather events. For example, the IPCC (2018) special report on the impacts of global warming of 1.5 °C above pre-industrial level shows that trends in intensity and frequency of several climate and weather extremes will be influenced to a large extent. The report pointed that several regional changes in climate are predicted to occur with global warming up to 1.5°C compared to pre-industrial (1850-1900) (average warmth in between 12-15°C) levels, including warming of extreme temperatures in many regions (high confidence), increases in frequency, intensity, and amount of heavy precipitation in many areas (high confidence), and an increase in intensity or frequency of droughts in some regions (medium confidence) (IPCC, 2018).

2. State of Salt Cultivation in Bangladesh

Salt producing areas in Bangladesh are very exposed to open sky, adjacent to the sea, thus faces all the hazards approaching from the sea. Sometimes the whole production is washed away by heavy rain and tidal surge because of lack of protection and storage facility. Despite being seasonal goods, salt farming generates many employment opportunities in Cox's Bazar and Chittagong districts of the country. About five hundred thousand people are directly or indirectly engaged in salt production, refining, preservation, storing and marketing, etc. (National Salt Policy, 2011). This sector contributes about 35.5

to 41.5 million USD each year in the national economy. In Cox's Bazar district, around 15 percent of total rural households within the community are involved in salt farming. This area meets the bulk of the demand for raw salt in the country (Al Mamun et al., 2014). Nevertheless, the Government has also taken the initiative to bring alternative areas under salt production in the Khulna-Satkhira region. The salt cultivation program has already started in Shyamnagar Upazila of the Satkhira district.

3. Salt Cultivation under a Changing Climate

The global demand for salt is increasing, especially in developing countries, due to the large chemical manufacturing market. Climate and weather conditions are affecting salt production, particularly in developing countries, and are likely to be hard hit by climate change over the coming decades (Bhat et al., 2015). A study (Roland et al., 2018) on the Songor salt project in Ghana finds a correlation between climate change and yield of salt production by running a linear multiple regression model. Therefore, soon, the climate shocks may directly decline the salt productivity in the developing countries and shall increase dependency on importing salt from the industrially developed and growing economies, such as the leading greenhouse gas emitters China, USA, and India.

In case of Bangladesh, a significant increasing trend of annual and pre-monsoon rainfall (March-April-May) has been observed with a growing trend in heavy precipitation days and decreasing trends in consecutive dry days (Shahid, 2011) which may lead to reduce the salt-producing season, hamper production, may influence to change livelihood, increase loss and damage. The IPCC's Report (2013) anticipated that the Indian summer monsoon circulation will be weakening, but leading to more rainfall within the small period. Though the monsoon is the most important climatic phenomenon which is directly related to crop production and livelihood of billions, flood and landslide due to heavy monsoonal rain is also a common catastrophe in the South Asian countries has been reported to increase the loss of lives, assets and lead to displacing million in recent years.

Not only change in monsoonal rain, but also the frequency and intensity of tropical cyclones have also been reported to increase in recent decades. Several studies (Girishkumar and Ravichandran, 2012; Dasgupta et al., 2014; Balaguru et al., 2014; Chowdhury and Ndiaye, 2017) anticipated that the El Nino/La Nina events will further intensify the threat of cyclonic activities in Bangladesh and could double in the future due to global warming. Considering the increasing risk of weather extremes, insurance as a risk transfer mechanism could be supportive of reducing the chances of loss and damage from extreme weather events. However, in Bangladesh, the insurance sector is rather on an initial stage to think about a new package for transferring the risks of the natural catastrophe like cyclones, rainfall variability, drought, etc. Therefore, the study's overall goal is to assess the impact of sudden onset but low exposure (in terms of response from government and non-government agencies and media attention) disasters on the climate-sensitive economic activities of the poor and marginalized people living in Kutubdia Island.

4. Methods

4.1 Study Area

Cox's Bazar in the southeastern coastal district of Bangladesh, is a hub for salt farming activities, consisting of production activities in the fields and refining and marketing activities of the industries. The different parts of Cox's Bazar and the adjacent offshore islands, including the islands of Kutubdia, Ramu, Ukhia, Teknaf, Chokoria, Pekua, Moheshkhali, and Kutubdia, produce seawater salts mainly from the solar process. In this study, salt production data for the whole district of Cox's Bazar and the precipitation data for the three separate rainfall stations Cox's Bazar Sadar, Teknaf and Kutubdia Island have analyzed to explore interconnection with salt production and precipitation. Besides, as the case, we have taken Kutubdia Island to investigate the loss and damage of salt cultivation at a local level due to various weather anomalies (Al Mamun et al., 2014).

Kutubdia Island is located in between $21^{\circ}43'$ and $21^{\circ}56'$ northern latitudes and in between $91^{\circ}50'$ and $91^{\circ}54'$ east longitudes. This small island is surrounded by the Bay of Bengal on the north, west, and south and Kutubdia channel on the east (Fig. 1). With an average width of about three kilometers, the channel divides the island from the mainland. The elevation of the island differs between 0.1 m and 7.6 m above sea level. Kutubdia is threatened by sea erosion, which compressed the island with an area of 433 km² in 1880 to at present 151 km². At the current rate of decay, Kutubdia Island will cease to exist within the next thirty years (Vidal, 2013; Rahman et al., 2015). According to the trend analysis (CCC, 2016), the range of sea-level rise (SLR) on the Bangladesh coast over the 30 years is between 6-21 mm/year. The study also identified higher trends of SLR in the Chittagong and Cox's Bazar coast compared to the previous study findings of SMRC (2003), which could also reduce the salt cultivable land in this region. Moreover, this area is also under increasing cyclonic risk. Chowdhury (2018) identified the southeastern coastal (Southern Chittagong, Cox's Bazar and Teknaf) belt as the most impacted and more exposed to cyclonic events during the pre-monsoon season; further threatened the salt farming in this area.

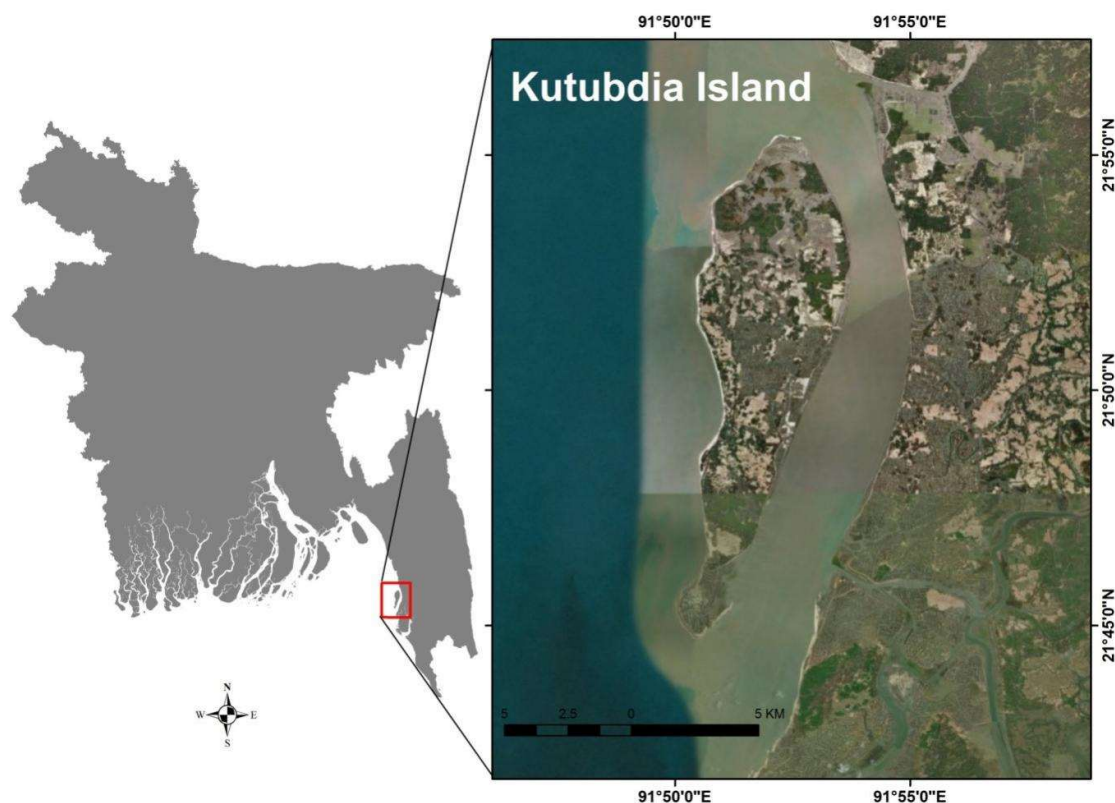


Figure 1. Study Area (Kutubdia Upazila).

4.2 Data Collection

This study also attempted to collect data on the pricing of raw salts at producers and refined salts at the consumer's standard. This approach intended to assess the particular role of extreme events and volatile market price (the 'double stress') threatening the small salt farmers from 'both ends' (nature and the market). Thus, the study made use of both qualitative and quantitative techniques. The qualitative part was anchored in Participatory Vulnerability Analysis (PVA), Key Informant Interview (KII)'s, and case study method. At the same time, quantitative data were collected by conducting the sample questionnaire survey. A set of questions and checklists were developed based on literature review, analysis of the study proposal, field test, and frequent consultation with relevant experts. This study used data from a questionnaire administered to inhabitants of six unions² (Ali Akbar Deil, Uttar Dhurung, Kaiyabil, Dakshin Dhurung, Baraghop, and Lemsikhali) of Kutubdia Upazila. The Unions were selected based on their location and proximity to rivers, their vulnerability to natural disasters, and the number of households involved in salt cultivation. However, the secondary information was collected through direct communication with Bangladesh Small, Cottage Industries Corporation (BSCIC). Historical data were analyzed from the available evidence obtained from the Bangladesh Meteorological Department (BMD), published and unpublished scientific journals and media reports, etc.

² Unions (Also known as Union Parishads or Union Councils) are the oldest and smallest administrative units in Bangladesh. There are nine Wards in each Union. Normally, one village is named as the ward.

4.3 Data Analysis

A simple random sampling (also referred to as a random sampling) method was applied to investigate the targeted population. This method is used when the whole community is accessible, and the investigators have a list of all subjects in this target population (Elfil and Negida, 2017). A total of 52 respondents were randomly selected from a list of 248 salt farmers in Kutubdia, provided by the Bangladesh Small and Cottage Industries Corporation (BSCIC). If the chosen randomly farmer was unavailable at the time of the survey, the next available farmer within the list was interviewed. The study consisted of both open- and close-ended questions. The survey was conducted in October 2018. This survey would be considered as a pilot survey for a detailed study in the future. Questionnaire survey data included respondent's household, livelihood and vulnerability information, information on loss and damage from climate-related events, and existing adaptation and coping measures against those extreme events. The data was analyzed using Microsoft Excel (2010). The analysis was carried out in two stages: the information was first tabulated in a Microsoft Excel sheet, and then frequency distribution and percentage were calculated. Finally, descriptive analysis, including both textual and tabular formats, described the study results. Respondents were asked about their age, ownership of house and salt farming land, access to electricity, income source, experience on natural hazards, loss and damage, available adaptation and coping options, etc. The overall goal was to explore the impact of various rapid onset extreme climatic events on the livelihood of marginalized salt farmers.

5. Results and Discussion

5.1 Respondents Profile

The selected demographic and socioeconomic characteristics of the respondent are presented in Table 1. The age of the respondents ranged between 18 and 85 years. The age distribution pattern shows that the salt farming activities in the study area are highly involved with the people aged between 41–50 years (36.5%). All of the survey participants were male, which reveals that males are mostly engaged in this profession. The farmers also play the role of household head, and they take major decisions on family issues. The respondents stayed at their own house, a mostly mud-built house (*Kacha*) (36.5%). Most of the people have access to electricity (90.4%). The survey results revealed that the highest number of respondents (86.5%) used solar as a primary source of electricity. Only a few people had access to the national power grid (3.8%). Salt farming is the primary occupation of all the respondents. The other supporting income-generating activities (IGA) are paddy cultivation (30.8%), livestock (26.9%), small business (7.7%), fisheries (3.8%), vegetable gardening (3.8%), day labor (3.8%), fishermen (3.8%), remittance (1.9%) and boat rent (1.9%). Salt (100%) and paddy (57.7%) are the major cultivable crops in that area. The people, mostly cultivate salts in a lease (30.8%) taken and borrowed (25%) land, and at the same time a good portion of the respondents cultivated in the mixed type of lands (e.g., own and borrowed (25%), and own and lease taken (19.2%) land).

Table 1. Respondents certain characteristics.

Characteristic	Number	Percentage
Age (In Years)		
18-30	14	26.9
31-40	14	26.9
41-50	19	36.5
51-60	4	7.7
> 60	1	1.9
Gender		
Male	52	100
Female	0	0
Is the respondent Household-Head?		
Yes	52	100
No	0	0
Do you own the house you live in?		
Yes	52	100
No	0	0
Type of the living house		
<i>Jhupri</i> (Hut)	13	25
<i>Kacha</i> (Mud-built house)	35	36.5
<i>Semi-Paka</i> (Semi building)	2	3.8
Tin Shade	0	0
<i>Paka</i> (Building)	2	3.8
Access to electricity		
Yes	47	90.4
No	5	9.6
Source of electricity		
Power Grid	2	3.8
Solar	45	86.5
Both	0	0
No electricity	5	9.6
Major income source		
Salt Farming	52	100.0
Others		
Paddy	16	30.8
Livestock	14	26.9
Fisheries	2	3.8
Vegetable garden	2	3.8
Remittance	1	1.9
Small grocery / medicine shop	4	7.7
Day labor	2	3.8
Boat rent	1	1.9
Fishermen	2	3.8
None	8	15.4
Major crops		
Salt	52	100
Others		

Paddy	30	57.7
Vegetable	3	5.8
None	19	36.5
Type of salt cultivated land		
<i>Borga</i> (Borrowing)	13	25.0
<i>Ijara</i> (Lease)	16	30.8
<i>Own + Borga</i> (Borrowing)	13	25.0
<i>Own + Ijara</i> (Lease)	10	19.2

5.2 Trend of Rainfall in Kutubdia, Cox's Bazar and Teknaf

The linear trend analysis of the monthly rainfall for April in three coastal locations, including Kutubdia, Cox's Bazar, and Teknaf, is the key hub for salt farming and salt production in Bangladesh shows an increasing trend for the last sixteen (from 2003 to 2018) years. The highest rainfall for Kutubdia, Cox's Bazar and Teknaf was found in 2017 (270 mm, 361 mm and 163 mm, respectively) and the lowest rainfall was found in the year 2008 (0.5 mm, 0.4 mm and 0 mm respectively (Fig. 2)

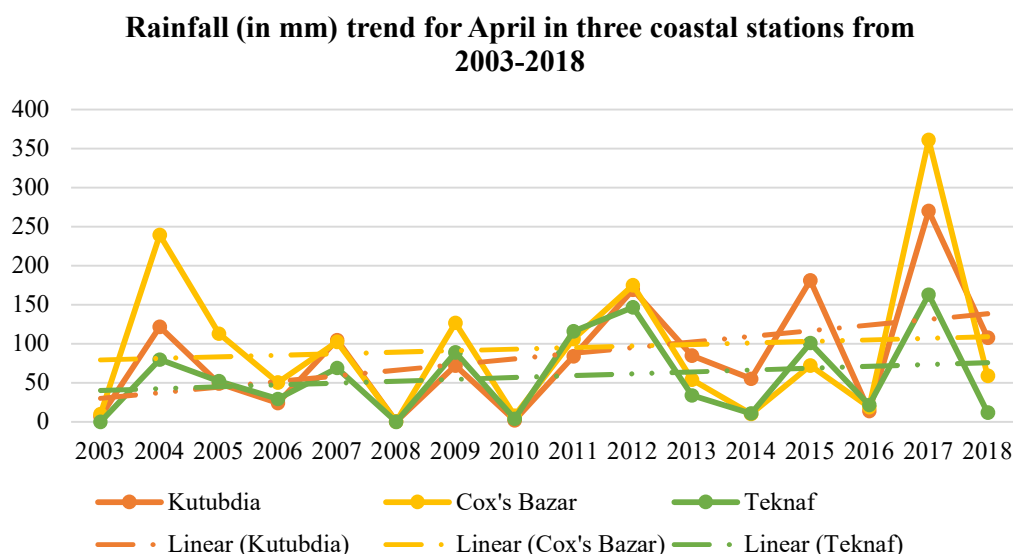


Figure 2. Rainfall (in mm) trend for the month of April in Kutubdia, Cox's Bazar and Teknaf from 2003 to 2018.

Figure 3 show that the total rainfall during March, April, and May also shows an erratic pattern in these locations. At the same time, total rainfall in April is rising, especially (Fig. 2). The highest total rainfall for the pre-monsoon season (Mar-Apr-May) was found in the year 2013 for Kutubdia (1222 mm) and Teknaf (792 mm), in 2006 for Cox's Bazar (860.6 mm). However, the lowest was found in the year 2003 for Kutubdia (232 mm) and in the year 2014 for Cox's Bazar (146 mm) and Teknaf (78.7 mm).

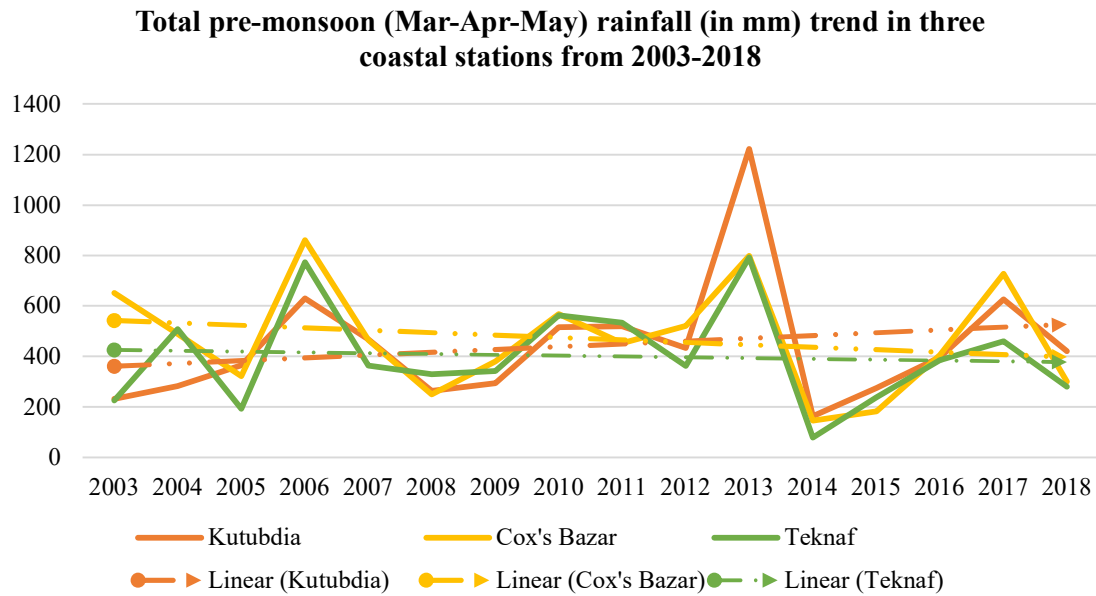


Figure 3. Total pre-monsoon rainfall (in mm) trend in Kutubdia, Cox's Bazar and Teknaf from 2003 to 2018.

5.3 Trend of Salt Production in Cox's Bazar

Availability of raw material (seawater), squeezing scope for cropping (paddy) due to salinity and better-earning opportunity are the main factors that encouraged coastal people to engage in salt production. In the season 2017-2018, nearly 27,528 salt cultivators operated on 59,563 acres of land in the Cox's Bazar district (Table 2). Salt is both an agricultural as well as manufacturing product. Production of crude salt from seawater is a traditional practice involving land, labor, and weather, while the refinement and crushing is a manufacturing activity involving men, machines, and money (Quaiyum, 2019). It should be noted that the favorable weather condition for salt production prevails when there are low rainfall and high daylight. In Bangladesh, such weather condition prevails only during winter and pre-monsoon season (between November and May). While over the last few years, uneven pre-monsoon rainfall, cyclonic surge, and tidal inundation have reduced salt-producing area and hindered production. As a result, the country has failed to reach the production target and bound to import nearly one million metric tons of salt during the 2015-2017 periods worth 120 million USD roughly (Table 2).

Table 2. Scenario of salt production in Cox's Bazar from 2014 to 2018. (Source: BSCIC, 2018)

Salt cultivation season	Total number of salt cultivators	Area (In acres)	Demand (Lakhs M.T.)	Production target (Lakhs M.T.)	Net production (Lakhs M.T.)	Import (Lakhs M.T.)
2005-2006	44,574	70,050	11.70	11.70	15.74	-
2006-2007	45,000	70,754	12.20	13.00	10.54	-
2007-2008	43,000	67,743	12.20	13.00	12.02	-
2008-2009	44,000	69,415	13.00	13.20	13.58	-
2009-2010	43,353	67,751	13.33	13.45	17.04	-
2010-2011	38,582	55,637	13.70	13.90	9.56	-
2011-2012	43,390	62,718	14.36	14.50	11.68	-
2012-2013	44,761	64,151	15.06	15.20	16.34	-
2013-2014	42,484	59,960	15.80	16.00	17.53	--
2014-2015	29,508	51,970	16.58	18.00	12.82	2.00
2015-2016	40,380	60,130	16.58	18.00	15.55	2.50
2016-2017	43,102	64,140	15.76	18.00	13.64	5.00
2017-2018	27,528	59,563	16.21	18.00	14.93	-

Table 2 shows a decreasing trend in salt production, especially from the 2014-15 periods. The number of salt farmers and land indicates a huge fluctuation, influenced by unstable market price and inappropriate import policy of the government. In 2017-18, the number of salt farmers had decreased by nearly 38 percent compared to 2005-06. Salt productive areas also reduced significantly in this period, almost 15 percent reduction compared to 2005-06 (Table 2). Bumper production in early 2016, the country envisaged it as a salt exporting nation (Dhaka Tribune, 2016). But, soon after the shock of cyclone 'Roanu' in the same year (2016) and cyclone 'Mora' in the following year (2017), the government had decided to import 5 lakh and 2.5 lakh metric tons of crude salt from abroad (Kallol, 2017).

It should be noted that in the previous year (2014-2015), Bangladesh was also bound to import two *lac*³ metric tons of salt from exporting countries (57 % from India and 35% from China) after the shortfall in production (Table 2). Though the National Salt Policy (2011) emphasized on various actions to protect local industries and farmers, the salt farmers have been deprived of many agricultural subsidies as salt recognized as industrial goods, rather than a farming crop. Therefore, the smallholder salt producers are exposing double burden, reducing their yield due to unpredictable weather events, and then unable to sell the product in the market when 'low cost imported salt' is available in the market.

³ A *lac* (also written as *Lakh*) is one hundred thousand (100,000) in the Bangladeshi numbering system.

5.4 Critical Stress Moment

Though, the normal monthly rainfall for Cox’s Bazar for April was estimated as 99.3 millimeters (Khatun et al., 2016). For several years, the rain in April was found much higher than the normal monthly range. For example, the monthly precipitation of April was 102.4 millimeters, 127 millimeters, 106 millimeters, 175 millimeters, and 361 millimeters for 2007, 2009, 2011, 2012, and 2017 respectively (Fig. 4). However, it is observed that in the years in which the monthly rainfall for April exceeded the average monthly normal rain resulted in a shortfall of production target, except 2008, 2015, 2016 and 2018 when tidal surge and inundation associated with cyclones such as Nargis (in 2008), Komen (in 2015), Roanu (in 2016), and Titli (in 2018) washed the salt fields (Fig. 4).

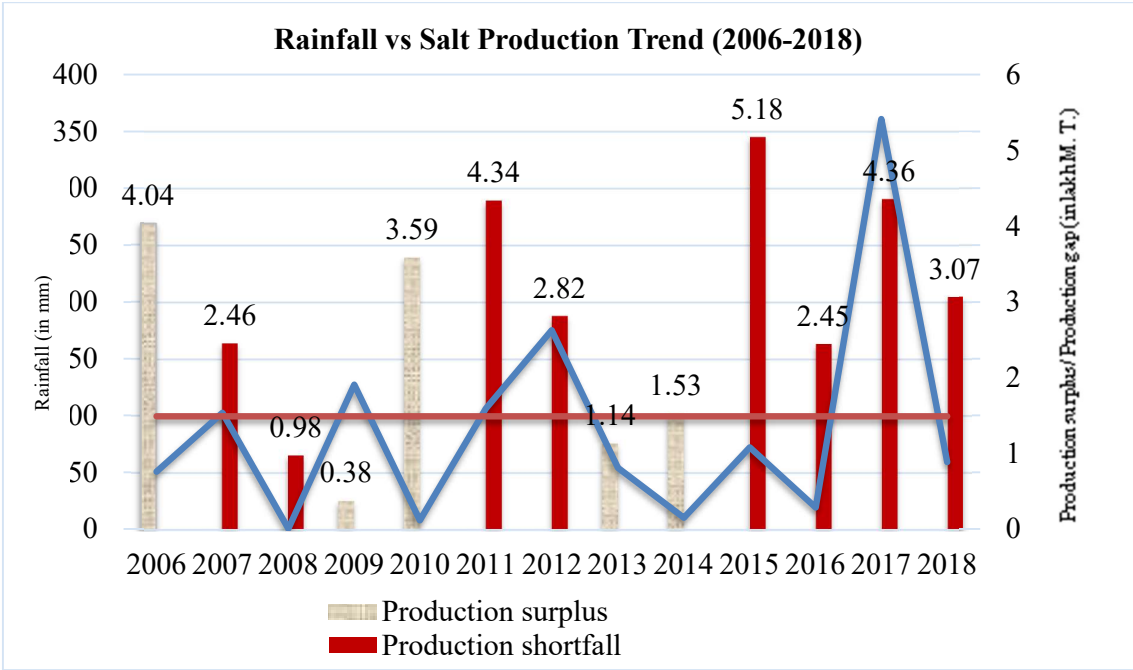


Figure 4. April rainfall vs. production surplus or shortfall in Cox’s Bazar.

5.5 Major Climatic and Non-Climatic Stressors for Salt Cultivators in Kutubdia

It is observed from the field survey that heavy rainfall (33%), cyclone (22%), flood/inundation (17%), and storm (16%) are the most devastating hazards in the entire Kutubdia Upazila (Fig. 5). Among the other natural hazards, thunderstorm/lightning (8%), continuous rainfall (2%), hailstorm (1%), and irregular rainfall (1%) pattern have found comparatively less destructive (Fig. 5). All of the respondents (100%) said that they had experienced the impact of erratic or heavy rainfall in their community. It is also found that in the last ten years and five years number of erratic and heavy rainfall incidents increased significantly; e.g., increased a lot (17.3%), increased a bit (73.1%). People (59.6%) also noted that rainfall has occurred during April, which is a peak season for salt farming. Also, Kutubdia is threatened by continuous erosion. Moreover, the dense foggy weather is another threat to the salt cultivators. In addition to climatic stress, non-climatic factors such as fluctuation of salt price, lack of financial capital, changing government regulation, lack of

support (e.g., insurance), and weak implementation of policy also affect the ‘marginal salt farmers’ of Kutubdia island.

Major natural hazards in Kutubdia

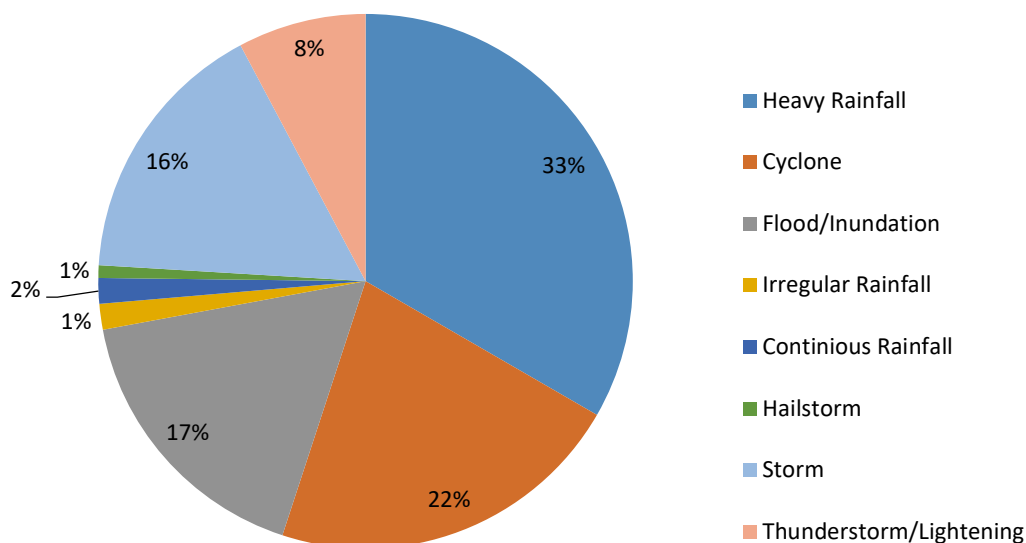


Figure 5. Major natural hazards in Kutubdia Upazila.

5.6 Outcomes of Hazards on Salt Cultivators in Kutubdia

Several natural hazards, including erratic and heavy rainfall patterns, caused both economic and non-economic loss and damage of life and belongings of the salt cultivators of Kutubdia Island. In case of economic loss, reduced salt production, reduced income, damaged properties, and reduced livelihood opportunity are the key concerns. Besides, key non-economic concerns are children drop out of school, breaking social cohesion, psychological stress, and displacement. The respondents said that they had experienced long term impacts of the erratic and heavy rainfall events. Such events have affected salt production (100%), livestock (e.g., cow, hen, duck) (9.6%), trees (7.7%), housing (11.5%), and health and wellbeing (5.8%). Moreover, salt cultivators informed that a significant portion of their produced salt was damaged in their land in 2018. However, the amount of loss varied from farmers to farmers, e.g., 1 to 15 metric tons (69.2%), 16 to 30 metric tons (21.2%), 31 to 45 metric tons (5.8%), and 46 to 60 metric tons (3.8%). In terms of money, the loss was also found noticeable among the respondents, such as 40001-60000 BDT (21.2%), 80001-100000 BDT (19.2%), and 20001-40000 BDT (13.5%) in the year 2018.

5.7 Salt Cultivation in Kutubdia is in Peril!

Repeated embankment breaching, tidal inundation, and unusual rainfall patterns hamper salt production, reducing salt production area and season. Cyclone Roanu that struck on 21st May 2016 killed four and made nearly 20,000 people homeless. The cost of damage was around BDT 200 crores (25 million USD) only in Kutubdia (DDM, 2016). Approximately 18 km of embankment in Kutubdia was reported to be damaged (BWDB, 2016), and tidal wave

overflowed the earthen barrier washed shrimp *gher*⁴, crop and salt fields in association with heavy rain. Financial and technical support was very limited from both government and non-government agencies or, in some cases, absent to reduce and manage unexpected losses (Field Survey, 2018).

Internal displacement and changing traditional occupation have also been reported by the local authorities (e.g., local government representatives), which also increases, particularly after any sudden disaster events or frequent crop failures. While low exposed, but both the slow (e.g., salinity intrusions, degradation in soil quality, etc.) and sudden-onset events (e.g., low scale cyclone, embankment bleaching) is also forcing people to become displaced over time (Field Survey, 2018). These types of events are reasonably covered by news and reports in the national and local news media. The heightened degree of media coverage reveals that the frequency and severity of this rapid or sudden onset, but low-exposed disasters have increased at an alarming rate in this area in the last few years. However, the issues come to the surface just after the event, and follow up investigation and assessment on the long-term impacts were not noted. Also, loss and damage due to heavy rainfall are less discussed. These unusual weather events cause loss and damage to the lives and properties of millions of people in Bangladesh. But, no support was visible from both the government and non-government agencies in response to such localized, small-scale disasters. Besides, these types of disasters are not covered by government safety net programs (Field Survey, 2018). With the growing concerns over supporting the smallholders with risk transfer and recovery facilities, very few insurance companies are developing such products (Rahman, 2018).

Nevertheless, some initiatives are practiced to a limited scale to support smallholders to recover crop loss caused only by sudden-onset disasters. For instance, in Bangladesh, crop insurance was introduced in 1977 through the state-owned insurance company Sadharan Bima Corporation (SBC) as a pilot project. Due to a shortage of policy support and partnership, expertise, and monitoring and methodological problem, this project was not sustained, and the scheme was closed in 1996 (Habiba and Shaw, 2013). Later on, Pragati Insurance Company Ltd, a privately-owned venture established in 2000, introduced a crop insurance scheme in Sirajganj district in 2013 to support loss recovery caused by monsoon floods. However, that initiative was a periodic attempt, not eventually conceptualized as a 'business product' and didn't consider its operational sustainability; therefore, it didn't sustain. This project was led by several national and international organizations with differentiated roles and responsibilities. For example, Oxfam Bangladesh was involved in planning, Swiss Development Agency and Corporation (SDC) in the financing, and Manob Mukti Songstha, a local NGO in implementation (Rahman, 2018).

Moreover, CRM India was involved in providing technical support, the Institute of Water and Flood Management (IWFM), respectively, in data collection and Swiss Re- as the reinsurer. Unfortunately, this initiative also didn't last long (Rahman, 2018). But, still, risk transfer and

⁴ A pond commonly dug into a rice field to use for fish farming.

insurance mechanisms could be an effective strategy to deal with such loss and damage due to rapid onset extreme events if properly implemented.

5.8 Coping and Adaptation Measures

Field survey (2018) and Hussain et al. (2017) identified that the salt farmers are smallholders who use manually operated local equipment and lease the land from landowners or the government every year. Community-focused land leasing systems, sufficient credit facilities, mechanical equipment (water pump, leveler, etc.), and reliable weather forecasting can enhance salt production. Moreover, the formation of salt farmer's cooperatives can ensure bargaining power and maximize economic return (i.e., salt price) for their living (Hussain et al., 2017).

Though there are very limited opportunities for initiating adaptive measures to save the yield from cyclone surge, tidal inundation, or heavy rainfall, the salt cultivators are mainly using polythene or plastic sheets to cover stacked salts to protect from the fog in winter and rain during the pre-monsoon season. But it is very temporary and not even enough to protect salts from unpredicted rain, which may arise quickly from the Bay and will not allow the necessary time to cover the field (Field Survey, 2018). At the same time, as a traditional technique, salt farmers used to store salts under the salt fields by digging a deep hole or well, deposit salts in the well and finally intensely filled the top few feet with soil (Fig. 6). Using polythene or plastic sheet to cover the top of the dug well before filling it with the earth is traditionally very popular. This technic allows the water to flow over the tight hole easily during the rainy season and left the salt in useable condition. After the rainy season or in the late monsoon, the holders, remove the earthen few feet from the top of the well and collect their salt from the deposit. But, sudden cyclone, unexpected tidal inundation, or heavy rainfall during the productive period remains a subject of 'key risks' for achieving production targets (Field Survey, 2018).



Figure 6. The traditional method for storing the salt by digging a deep hole or well in the cultivation field.

The salt cultivators have not received any support from the government organizations (GOs) or non-government organizations (NGOs) to reduce the loss of salt farming caused by any natural hazards like heavy rainfall or tidal inundation. However, people had taken loans with a higher interest rate from the local money lenders, landlords, or land lease providers immediately after the loss. Even many were bound to sell their bonds and withdrawn savings from the bank or cooperatives. Few smallholders had taken loans from government programs such as 'Ektee Bari Ektee Khamar'⁵ Project'. Unfortunately, there were no visible supports from the government or the aid agencies, particularly for the salt cultivators, to address their loss (PVA, 2018).

Moreover, dams are not built properly. Thus silts enter into the salt fields, and salt quality and price decrease. As heavy rainfall or inundation is natural events, so those are unavoidable, and farmers can't do much by working under an open sky without observing the stored salts being washed out. More importantly, a week-long rain can easily overflow the embankments. Hence, it is mandatory to increase the dam's height and repair the damaged embankments in due time. Due to the domination of the third parties in the salt industry from the field levels to mill owners, the farmers don't get a reasonable price. For that reason, they had to keep the salts in the fields without selling in some cases. Moreover, local government representatives, such as the Union Parishad members and chairmen, are often corrupted (PVA, 2018). Nonetheless, people faced various types of difficulties such as having no alternative options (11.5%), lack of skills or knowledge (38.5%), and absence of government or private support (5.8%), etc. to adopt effective measures to prevent the impacts of extreme events on salt farming and reduce the loss (Fig. 7).

⁵ A project runs by the government of Bangladesh to reduce poverty in rural areas.

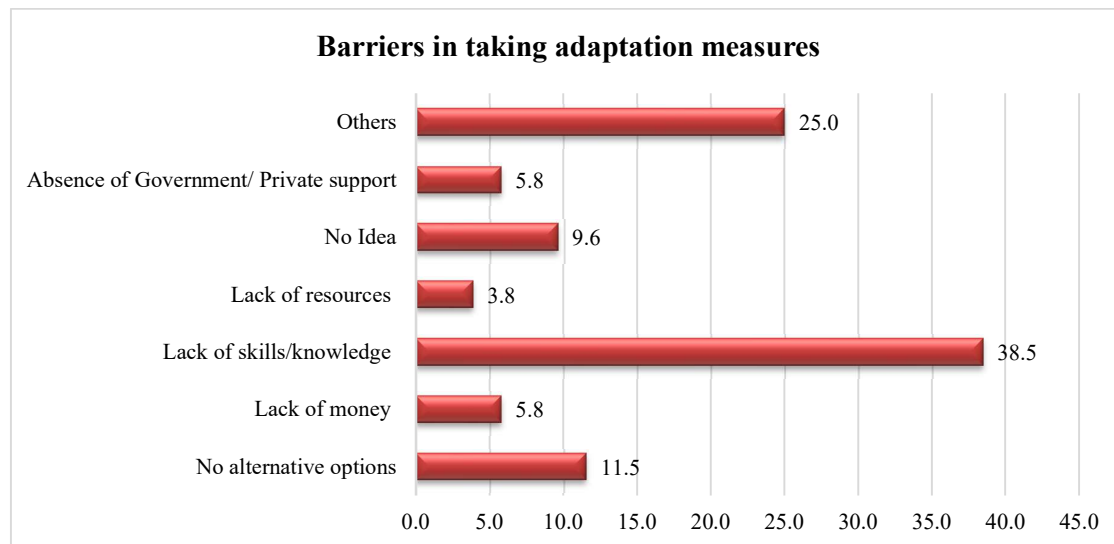


Figure 7. Key hindrance in taking effective adaptation measures.

To cope with the adverse situation, people took different measures, including taking support from people (21.9%), getting loans (46.6%), selling properties (12.3%), using buffers (e.g., stored foods, savings) and receiving support from local organizations (6.8%), etc. (Fig. 8).

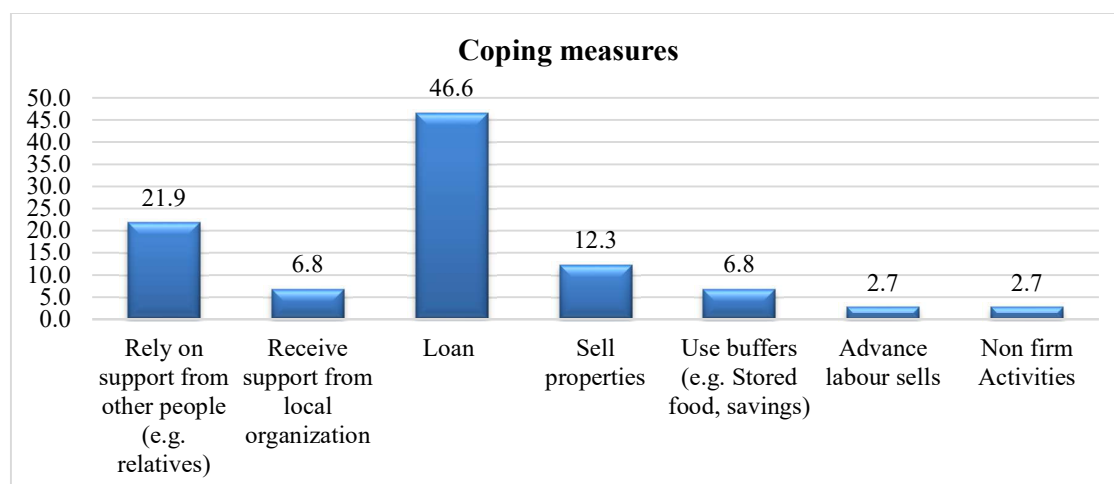


Figure 8. Coping measures taken by the marginal salt cultivators.

It is very much unlikely that none of the local or national level organizations (including the government institutions, NGOs, cooperatives, etc.) have not initiated any research or piloted technical support (such as using solar energy for drying up the salt or indorsed local weather forecasting system) which may contribute to support the salt farmers in adapting with adverse weather events. Additionally, there are no insurance or compensation programs that exist for the marginal salt farmers (Field Survey, 2018).

5.9. Additional Burden on Smallholders due to Low Market Price!

It is perceived from the field survey (2018) that along with loss and damage due to the frequent visit of different natural catastrophes, the smallholder salt producers are also facing a massive loss due to low market price of crude salts. The average production cost for the per

hectare of land is approximately 1,399 USD which includes expenses such as land lease, water supply, polythene and labour charge (Table 3).

Table 3. Salt production cost per hectare (Source: Field Survey, 2018)

Type of Cost	Amount (In BDT)	Amount (In USD) *
Land Lease (For 6 months)	83,333	981
Water Supply Cost	10,417	123
Polythene use cost	12,500	147
Labour Cost	12,500	147
Total Cost	118,750	1,399

Note: In Bangladesh, the local salt cultivators use the land measurement unit named 'Kani.' The author has collected data on the local unit and converted it into the international unit. 1 Kani= 120 decimals =0.48 hectares

On the other hand, the current selling price of crude salts at the field level is around 920.1 USD only. Therefore, the farmers undergo a loss of approximately 478.4 USD per hectares of cultivated land. And per metric ton of production, the financial loss is around 23 USD (Figure 9).

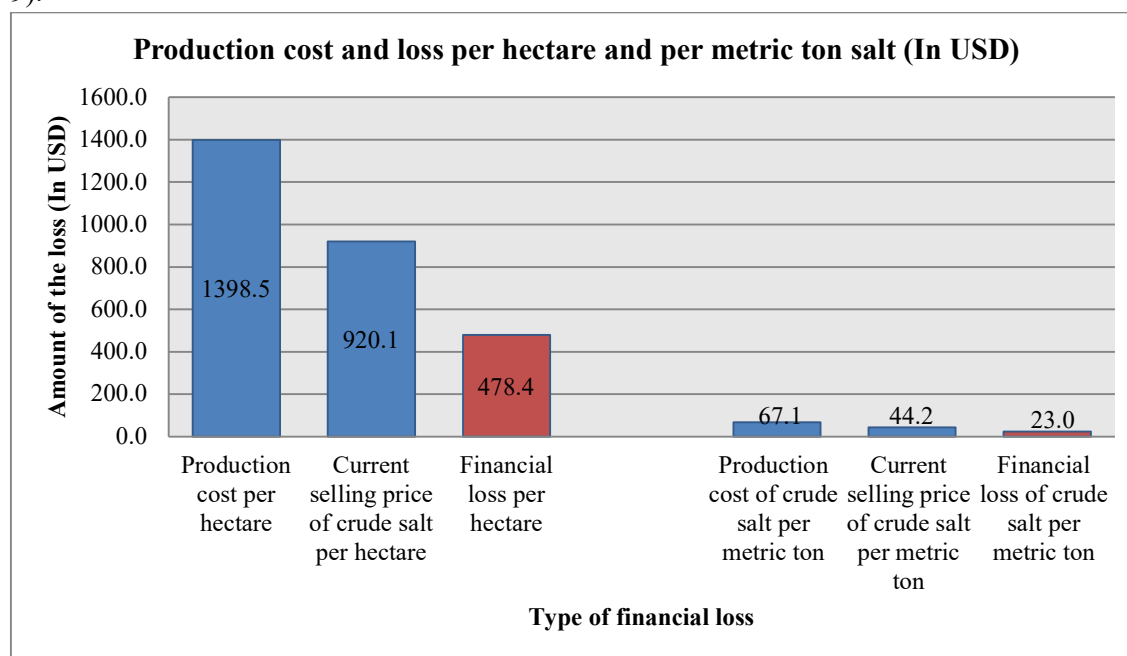


Figure 9. Production cost of salt and financial loss (Source: Survey, 2018).

Imports of ordinary refined, bouldering or other salts are restricted in line with the government's import policy order (2015-2018). However, salt can only be imported as the primary raw material for the industry and the recognized industrial, pharmaceutical company by its recognized industrial unit producing chemical products, approved by the Directorate of Drug Administration (GoB, 2016). By abusing this Act, crude salts are being illegally smuggled and imported by some salt mills at a low price in Dhaka, Chittagong, Cox's Bazar, Khulna and Jhalokati, as opposed to a local market (Al Mamun et al., 2014). Such activity

creates an added burden and damages from natural disasters on marginal salt farmers. In addition, the raw salt price is comparatively low in comparison to the retail price of the refined salt sold in the local market. Hence, the salt producers are facing injustice in the pricing of salts.

6. Conclusion

In the last four fiscal years, the country has failed to reach the salt production target due to adverse weather conditions such as unexpected heavy rainfall and tidal inundation. Consequently, Bangladesh had to import nearly one million metric tons worth of 120 million USD, and therefore, this country could claim equivalent compensation from the international loss and damage fund! While in the absence of such financing authority, governments in vulnerable countries have started developing their mechanisms for loss and damage. For example, Bangladesh is already setting aside contingency funds for climate-related disasters and is now considering the development of a dedicated loss and damage mechanism. Other countries have developed regional risk pooling solutions – such as the Caribbean Catastrophe Risk Insurance Facility (CCRIF) – or national insurance mechanisms.

Most importantly, these mechanisms need to reach those most in need of support: poor households with a high dependency on natural resources for their livelihoods (Kreienkamp and Vanhala, 2017). However, in Bangladesh, there is still an absence of such risk insurance mechanisms or policies that would be useful for addressing the loss and damage of marginal salt farmers due to the low exposed sudden-onset events, including erratic or heavy rainfall events. Hence, this study urges to the policymakers and other relevant stakeholders to come forward to take necessary steps in developing essential policies and introducing adequate adaptive measures (such as using the removable cover, community storage facilities, enhancement of early warning system and dissemination through mobile technology) and efficient response measures (such as well-targeted safety net program, a soft loan or insurance facilities). At the same time, the researchers and academicians should initiate a comprehensive study for exploring solutions to save the marginal farmer from the unfavorable nexus of ‘Nature and Market.’

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