J. Sci. Technol. Environ. Inform. 13(01): 850-863 | Nur et al. (2024)
EISSN: 2409-7632, Journal home: www.journalbinet.com
Crossref: https://doi.org/10.18801/jstei.130124.85

Analyzing the socio-economic impacts of salinity intrusion in a coastal union of Bangladesh

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Article received: 04.01.2024; Revised: 16.04.2024; First published online: 05 May, 2024

Article Information

Key Words:
Salinity intrusion, Coastal area, Socio-economic impact and Adaptation strategies.

Access by Smart Phone

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ABSTRACT

Salinity intrusion is a major issue in the South-east coastal region of Bangladesh. Around 53% of the coastal region is affected by different degrees of salinity. Increased salinity has several negative impacts on the livelihood of the people in this area. So, this research explores different socio-economic impacts of salinity on various aspects of livelihoods at Ratandi Taltali union of Galachipa Upazila in Patuakhali district and suggests some adaptation strategies for reducing the impacts. The study was conducted based on primary and secondary data sources. Informal interviews, a pre-determined questionnaire, and Focus Group Discussion (FGD) were adopted to collect primary data. Secondary data was collected from literature reviews, published journals, and documents. The study results show the impact of salinity on agriculture, fisheries, livestock, health and other social sectors and the economic losses that occur in those sectors due to increased salinity. Agriculture is the sector most susceptible to salinity intrusion, and paddy is the most affected crop in the study area. The existing local and institutional strategies for reducing salinity impacts are not sufficient. In this aspect, the study suggests some adaptation measures that can benefit the people in the area.

Citation: Nur, M. N. B., Aktar, S., Setu, S. H. and Rahim, M. A. (2024). Analyzing the socio-economic impacts of salinity intrusion in a coastal union of Bangladesh. Journal of Science, Technology and Environment Informatics, 13(01), 850-863. Crossref: https://doi.org/10.18801/jstei.130124.85

I. Introduction

Bangladesh is a low-lying deltaic country that is especially susceptible to the dangers of climate change (Agrawala et al., 2003). Due to its almost flat topography and location at the point of the "funnel-shaped" Bay of Bengal, Bangladesh's coastline is susceptible to several natural hazards, including cyclones and tidal surges, saline intrusion, riverbank erosion, and shoreline recession (Haider, 1992). Among these, salinity intrusion has become a global environmental issue in recent decades (Dasgupta et al., 2017; Peal et al., 2020). It has become an increasingly prevalent issue in coastal regions worldwide,

particularly in low-lying developing nations (Nicholls et al., 2007). So, as a developing and coastal nation, the adverse effects of saltwater intrusion are particularly severe (Mahmuduzzaman et al., 2014). In Bangladesh's coastal region, surface, ground and soil water salinity has emerged as one of the biggest threats (Rahman et al., 2011). In addition, salinity negatively affects surface water quality, sanitation, agriculture, fishing, aquaculture, and plant growth in coastal part for salt building in the soil's root zone (Yadav et al., 2009).

The agricultural production system, which raises economic awareness globally, is essential to development. However, growth in agriculture and the economy are hampered by salinity intrusion. Regular crop production is hindered by the hostile environment created by salinity, which persists throughout the year. Salinity is a serious issue that not only reduces agricultural potential but also impacts farmers' livelihood strategies and shortens the lifespan of boats, nets and houses (Rahim et al., 2018). The issue is made worse, especially during the dry season, when insufficient rainfall reduces the salinity of surface water and removes salt from the soil. Due to salt and tidal flooding, coastal agriculture suffers a yield drop or, in extreme cases, destruction (Nicholls et al., 2007). Hazards related to climate change, such as storm surges, cyclones and rising sea levels, have worsened the issue.

Most people in Bangladesh reside in rural areas where agriculture is the main source of income, contributing to the nation's GDP growth (Miah et al., 2020). Agriculture is also the primary land use in Bangladesh's coastal regions, even though the coastal zone of Bangladesh comprises 144,085 gross and 83,416 net-cropped hectares, respectively (Gowing et al., 2006). However, several variables have combined to cause the net-cropped area of the coastal zone to trend downward over time. According to the study, 830,000 million hectares of land in Bangladesh's coastal regions had varying degrees of soil salinity (Cell, 2007). Saline conditions can have a wide range of socio-economic effects that impact several facets of the nearby coastal towns. Therefore, the effects of saline intrusion on society and the economy are currently a significant issue as it is poorly characterized in all spatial scales.

The study aims to evaluate the socio-economic effects of salt intrusion in Ratandi Taltali union of Galachipa upazila in the Patuakhali district, one of the highest salinity-impacted areas (Hasan, 2019). Sedimentation, rising sea levels, cyclones, storm surges and tidal surges are all natural processes that contribute to the increased salinity in this coastal region. Simultaneously, the dominance of salt in the region is also influenced by human activities like shrimp farming, inadequate infrastructure and poor maintenance, increased greenhouse gas emissions and rising temperatures. A substantial yield loss, or an average of 20–40% in main crops, was seen in saline-prone coastal regions (Miah et al., 2020).

II. Materials and Methods

Study area

The location of the study area is between 22°9'24.001"N and 90°28'13.001"E. The total area of the Ratandi Taltali Union is about 7,396 acres (Figure 01).

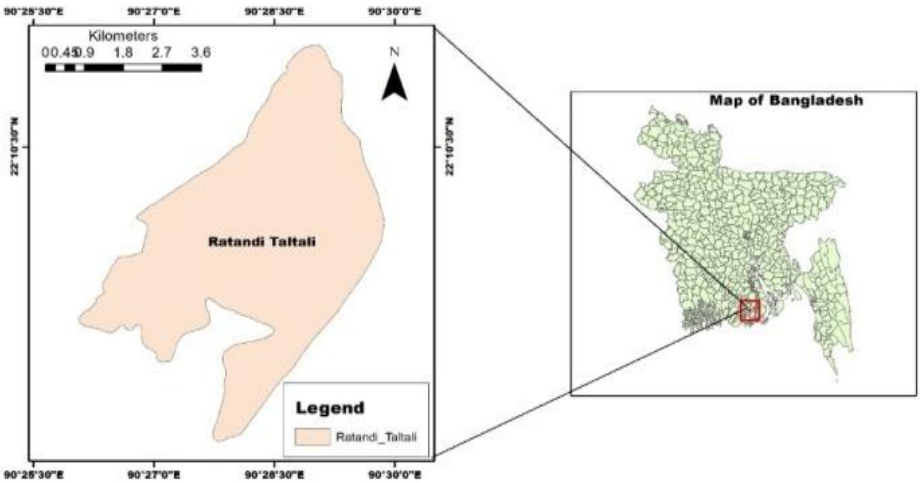

Figure 01. Location map of the study area

There are nine villages, and about 40% of the people live below the poverty line. Agriculture, fishing, rickshaw/auto pulling, and small business are the most common jobs. The principal crops are rice, mug bean, watermelon and khesari. There is only one cyclone shelter, six primary schools, three secondary schools, a madrasa, and two community clinics.

Applied Methodology

The study utilized both primary and secondary data from different sources. Primary data was collected through a questionnaire survey, community-level focus group discussion (FGD), individual interviews, and Key Informant Interviews (KII). It was collected from the local people - both victims and people who witnessed salinity intrusion- using formal and informal interviews with the households and key informants through the questionnaires. Informal discussions with various classes of people and direct field visits have also been done. The sample size was calculated using the following equation:

Sample Size, $n_0 = \frac{(z^2 * p * q)}{e^2}$

$= \frac{1.96^2 * 0.5 * 0.5}{0.1^2}$

$= 96$

Where,

Total targeted household, N=4557
Confidence level=95%
Margin of error, e= 10%
95% level of significance, Z=1.96
Estimated Proportion of successes, Standard Deviation, P=0.5
Estimated proportion of Failures, q=(1-p) =0.5

Adjusted, $n = \frac{n_0}{1+[\frac{n_0-1}{N}]}$

$= \frac{96}{1+\frac{96-1}{4557}}$

$= 94.0395$

$= 94$

Secondary data was also collected from a brief literature review, including data from different journals, articles, websites, statistical records, different reports, other published literary works and NGO offices on salinity intrusion and its socio-economic impacts. After the data collection procedure, computation and analysis were performed using the Microsoft Office Excel 2010 program.

III. Results and Discussion

Respondent's profile

There were five different age ranges in total respondents where 5% were (less than years of age) range, 15% were (18-25 years of age) range, almost 35% were (26-40 years of age) range, 30% were (26-40 years of age) range and only 15% were (above of 60 years of age) range. Among the total respondents about 62% are male and 38% are female. In this area, male person is the leading earning member for most families and females organize household activities but, sometimes accompany male person to earn and maintain their families. Most of the family consists of 5 members on average and depends on one single man's income. The literacy rate is about 49.5% and 4% of the respondent community is illiterate. Nearly 37% have completed primary school, 33% have completed high school, 15% have completed college-level education, 8% have graduated, and only 3% have completed post-graduate studies.

Income source of people

In the study area, most of the people engaged in fishing. Agricultural activities are the next livelihood option here. About 40% of families generate income from fishing and they are traditionally fishermen. About 18% of families earn from agriculture and have some cultivable land, while about 17% have income from day labor activities. They have little or no land. Almost 7% of families has small shops, 6% depend on business, about 5% engaged in different job sectors and 7% of people depend on rickshaw pulling for livelihood purposes (Figure 02).

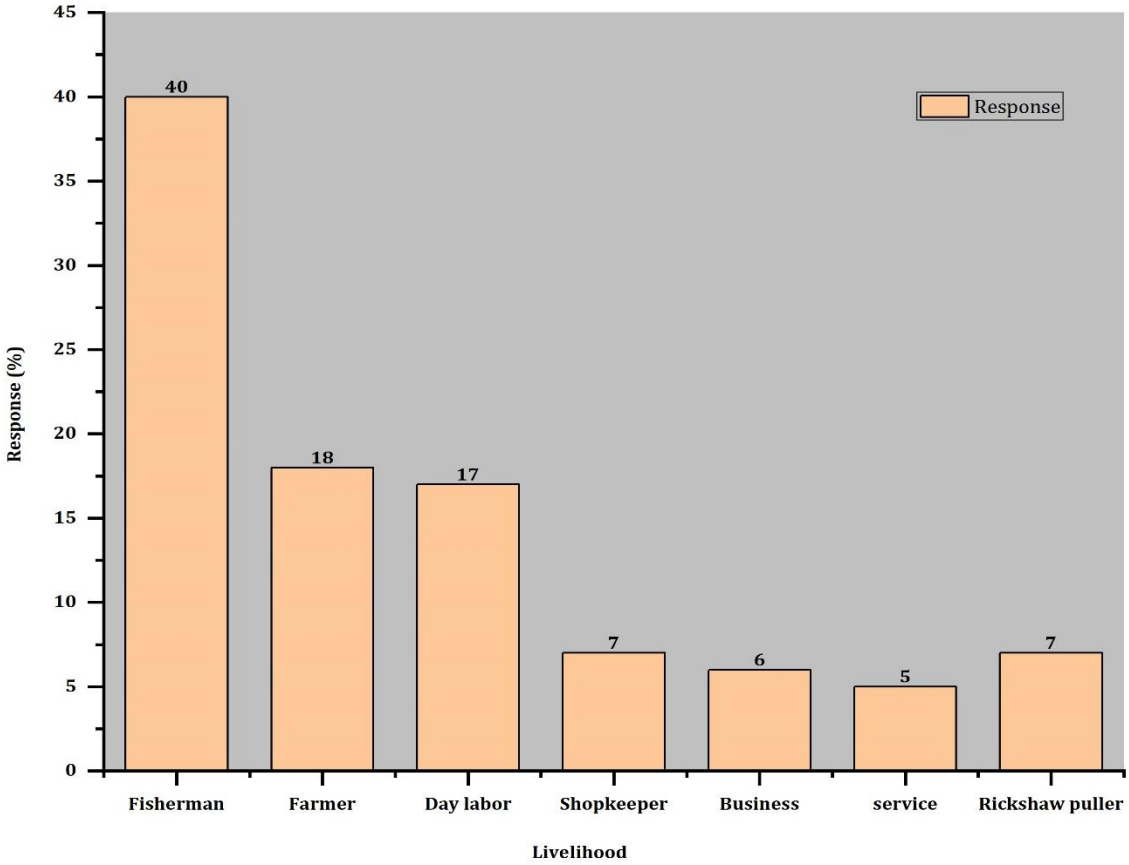

Figure 02. Income source of people (Source: field survey, 2023)

Intensity of salinity intrusion in this area

The intensity of saline water intrusion in this area was very high. Field survey indicates that 57% area is very highly edged by salinity, whereas 34% area was highly affected. Only 6% area was medium affected, while in only 3% area saltwater intrusion was low. So, this area indicated as a highly salinity-prone zone (Figure 03).

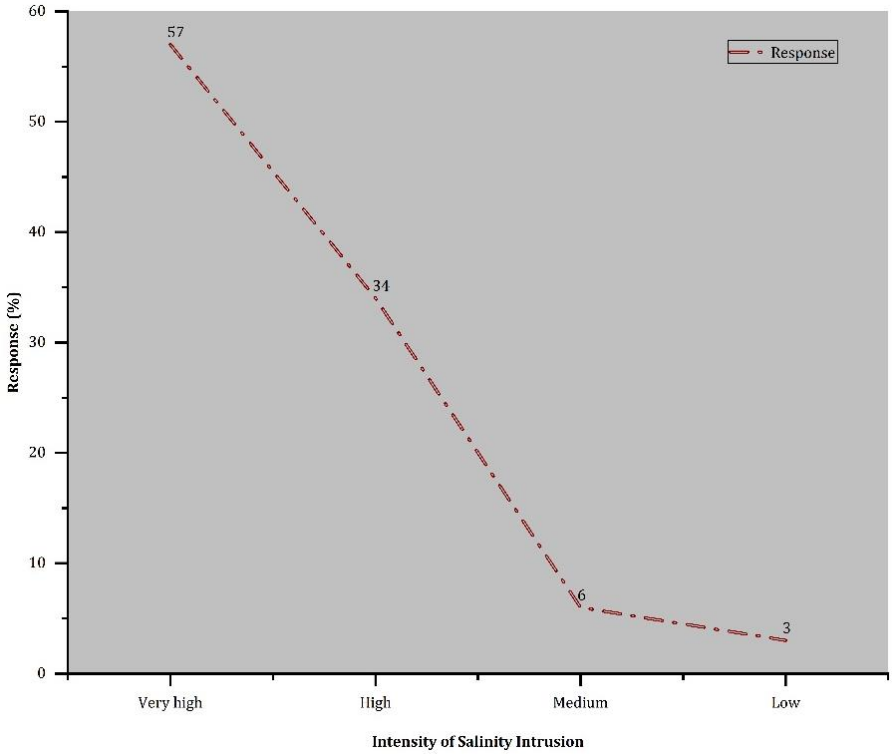

Figure 03. Intensity of salinity intrusion in study area (Source: Field survey, 2023)

Salinity influence in the area by times per year

The field survey also shows that the saline water intrudes into the ground area more than once a year. About 40% identified salinity intrusion as occurring within the area at all times, while 35% indicated that it happens 3-4 times yearly. In addition, salt water augmentation occurs 2-3 times per year, supported by 20% of people and only 5% admit that it happens 1-2 times yearly. However, this area has been rare in recent decades (Figure 04).

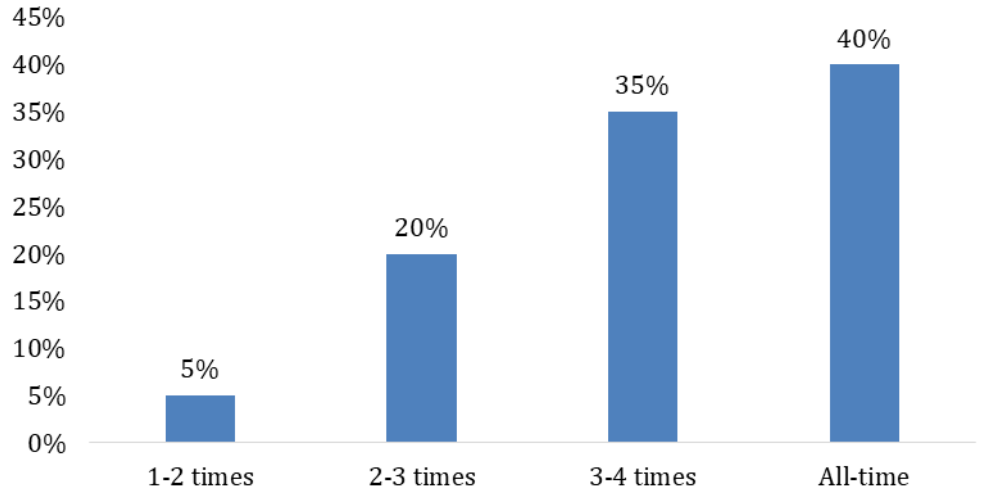

Figure 04. Salinity influence in the area by times per year (Source: field survey, 2023)

Analyzing the socio-economic impact of salinity intrusion

Sectors damaged due to salinity

Salinity intrusion in the coastal area has significant impacts on various sectors. The field survey shows that salinity is one of the most dominant disasters that cause much more damage. From the respondents' opinions, it can be concluded that salinity has a vast impact in almost every sector. Here, 45% of damage likely occurs in agriculture, 6% in livestock, 15% in fisheries, 5% in health, 9% in water and sanitation, 13% in drinking and 7% in infrastructure (Figure 05).

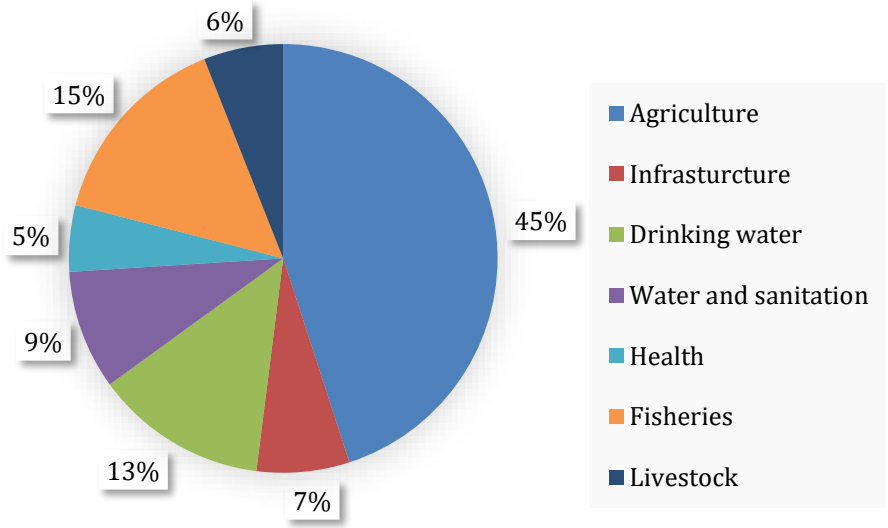

Figure 05. Sectors mainly damaged due to salinity (Source: field survey, 2023)

Salinity produces unfavorable hydrological and climate conditions that restrict year-round normal crop production (Haque, 2006). Crop growth is impeded and soil composition is altered when saltwater seeps into agricultural areas. In rain-fed and irrigated places, soil salinity is the main issue and a persistent danger to the sustainability of agricultural output (Hailu and Mehari, 2021). The strength of Bangladesh's storms is causing the coastal belt to become more salinized. Throughout the coastal belt, there are several linkages between this salty water and freshwater sources. It causes alterations to

shallow freshwater bodies' trophic structure and diversity. As a result, freshwater and saltwater fish are combined.

Nonetheless, the introduction of saltwater into various freshwater environments has been a significant factor in the extinction of certain fish species (Brucet et al., 2012). A shortage of grazing pasture and fodder crops for animal production results from the rising salinity (Barnhizer and Torre, 2003). When the salt concentration in the water is beyond the recommended limits, drinking high-salinity water can have adverse health effects.

Impact on Agriculture

The total cropping area is about 7,396 acres. As salinity intrusion is evident during the dry season (October-May) cultivation of crops during this period is highly susceptible to the effect of salinity (Clarke et al., 2015).

Most vulnerable crops due to salinity intrusion: Every year, salinity intrusion problems frequently occur in this area and harm crop production. The intensity of salinity has increasing effects on seasonal crop production. The (Figure 06) indicates that the most vulnerable crop is paddy (40%), watermelon (5%), mung (24%), khesari (10%), chili (12%), and potato (9%) respectively (Figure 06). IRRI is mainly affected by salinity in the dry season in this region, as there is a lack of fresh water for irrigation.

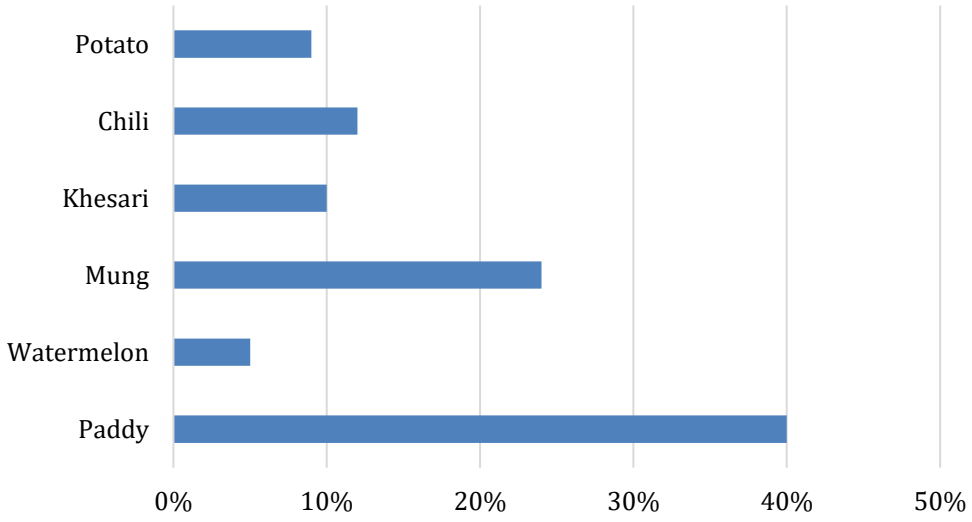

Figure 06. Most vulnerable crops due to salinity intrusion (Source: field survey, 2023)

According to Gregoria et al. (1997), rice (*Oryza sativa* L.) considered rather sensitive to salinity. Poor tilling, stunted growth, rolled leaves, white tips, drying of older leaves, grain sterility, and decreased grain volume are all signs of salt injury in rice (Redfern et al., 2012). River water and soil are impacted by salinity. It significantly affects the region's agricultural sector's revenue or the stability of the economy. According to the respondents' opinion, the economic losses are 15% in the range of <20000 TK, 28% in the range of 20000-35000 TK, 32% in the range of 35000-50000 TK and 25% in the range of >50000 TK. Most farmers face more economic loss as they cultivate paddy on all their lands.

Impacts on the fisheries sector

In the research area, raising fish is a regular habit; most of the respondents' homes have ponds in front of them. Local fish varieties are raised for personal consumption and commercial sale by those whose primary source of income is fishing. However, fish culture is not so good since saline water logging occurs in this area due to frequent disasters like storm surges and cyclones. The primary reason for the decline in fish species is this salinized water. All the fish in the pond were washed out by the salty storm surge accompanying the typhoon. Once more, the maximum pond's bank is not elevated to the point when salty water can readily reach freshwater sources.

Most vulnerable fisheries due to salinity intrusion: There is a 38% economic loss in freshwater fish annually. Carp farming, a common aquaculture practice in the Galachipa region, may face challenges

due to salinity intrusion. There is a 35% economic loss in carp farming per year. Rice-fish farming is a traditional integrated farming system in the region where fish are reared in rice fields. There is a 19% economic loss in rice-fish farming per year. Salinity intrusion can positively and negatively affect shrimp farming in the Galachipa region, with an 8% economic loss in shrimp cultivation per year (Figure 07).

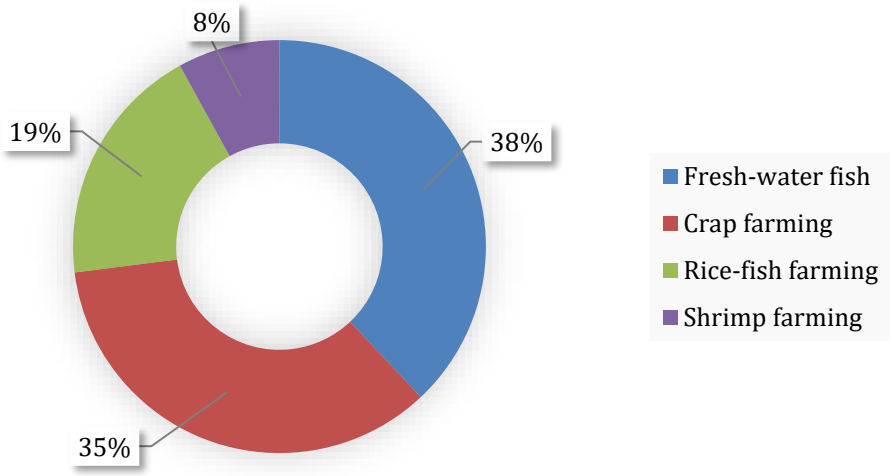

Figure 07. Impacts on fisheries sector (Source: field survey, 2023)

Increased salinity in Bangladesh's coastal region impacts spawning grounds, which results in significant declines in inland open-water fishing (Rabbi and Ahmed, 1997). Freshwater species that may find it difficult to thrive or procreate in higher salinity levels include koi (*Cyprinus rubrofuscus*), mrigal (Cirrhinuscirrhosus), rohu (Labeorohita), and catla (Catlacatla). The growth and physiology of *L. rohita* (rohu) can be significantly impacted by prolonged exposure to saline. Higher salinity levels negatively impacted oxygen consumption, lifespan, and tissue ascorbic acid levels (Sarma et al., 2020). Salinity can harm carp farms' ability to survive, flourish, and produce fish. By lowering the amount of acceptable water available for fish breeding, salinity intrusion can affect the practice of rice-fish farming. Certain shrimp species, including the tiger shrimp (Penaeus monodon), can withstand greater salinities. However, environmental factors such as salinity, rising sea levels, and coastal flooding can impact white shrimp (*Penaeus vannamei*) (Ahmed and Diana, 2015). Salinity causes enormous economic loss in the fisheries sector in the study area. The rate of loss is 17% for less than 20000 Tk, 29% within the range of 20000-35000, 32% within the range of 35000-50000 Tk, and 22% for greater than 50000 Tk. Because of its location on the coastal side, people in the study area depend highly on the fisheries sector. Economic losses mainly occur from saltwater intrusion into fish farms due to frequent saline waterlogging.

Impacts on the livestock sector

The scarcity rate of drinking water for livestock due to salinity is 35%. Almost 21% of livestock grazing options were reduced due to salinity. Salinity intrusion can affect the reproductive capabilities of livestock. The fertility reduction rate of livestock due to salinity is 14%. The susceptibility to diseases in livestock is 30% for saltwater intrusion (Figure 08).

Feed and fodder shortages are the main factors affecting dairy cattle production in the coastal region. Salinity in the soil and water harms plant growth and development, making these conditions unsuitable for crop production. Additionally, livestock feeds and fodder require extra irrigation from December to May. The lack of grazing and feed fields restricts the possibility of raising animals (Anwar, 2003). According to Alam et al. (2017), the dependence of livestock on salt has resulted in several adverse effects, including skin illnesses, liver fluke, diarrhoea, loss of body weight, and immune system breakdown, ultimately hindering productivity. This is especially true for fodder crops. Significant financial losses may occur for livestock farmers in the Galachipa region due to decreased fertility, decreased output, higher healthcare costs, and the possible loss of cattle. The rate of economic loss in

the livestock sector is 22% for the range of less than 10000 Tk, 41% for the range of 10000-20000 Tk, 21% for the range of 20000-30000 Tk and 16% for the range of more than 50000 Tk. Due to high-level salt water intake and foraging during saline water incursion and dry periods, many people lose their domestic animals. Increased death rates are also a result of disease epidemics brought on by salinity. However, decreased milk output, weight loss and other factors impact farmers' livelihood and income that depend on their animals.

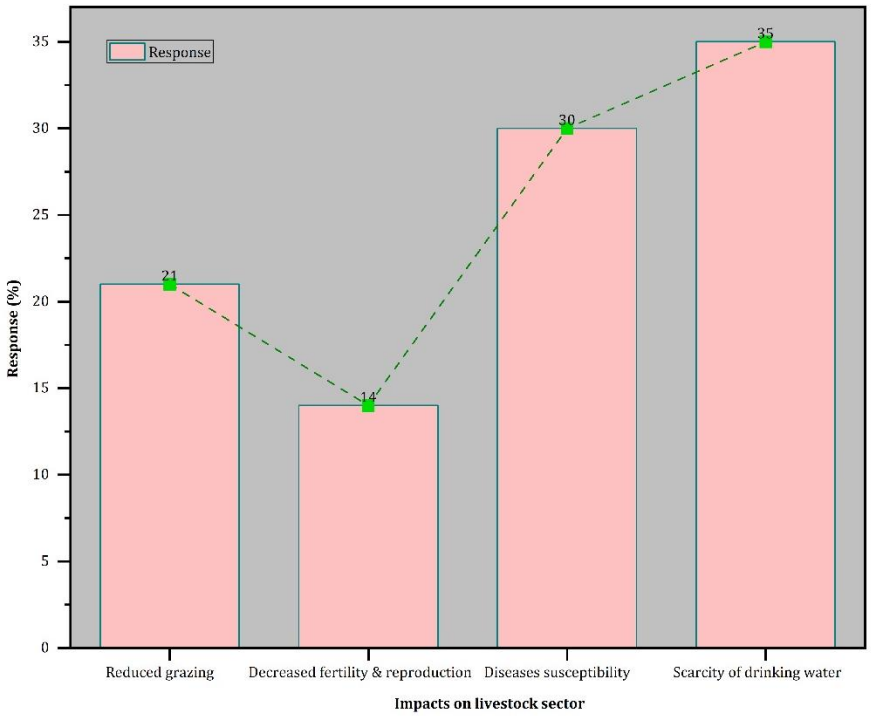

Figure 08. Impacts on livestock sector (Source: field survey, 2023)

Impacts on human health

Salinity intrusion causes drinking water contamination. Higher saltwater consumption causes waterborne diseases such as diarrhoea, dysentery, and cholera. The ratio of diseases in the study area is about 55%. Malnutrition occurs as salinity affects food security. The ratio is about 12%. Hence, salinity influences high blood pressure, skin diseases, and women's health hygiene, which is 18%, 13%, and 15%, respectively (Figure 09).

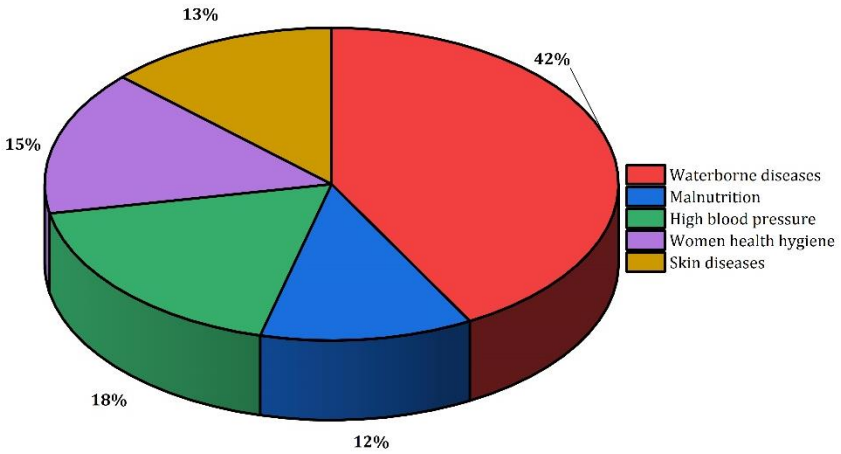

Figure 09. Impacts on human health (Source: field survey, 2023)

The region is prone to cholera and other water-borne illnesses including diarrhea and dysentery because of the greater salinity of the drinking water that people drink. Elevated salt in drinking water has been linked to higher hospitalization rates for diarrhoea, abdominal pain, and cardiovascular disease (Chakraborty et al., 2019). Due to the drinking of salty water, hypertension and high blood

pressure are also becoming more common in coastal areas daily. Because of the saline water intrusion brought on by climate change, almost 20 million individuals in Bangladesh are at high risk of developing hypertension (Rasheed et al., 2016). Saline water use has the potential to raise blood pressure, which could raise the risk of unfavorable pregnancy outcomes by pushing women's blood pressure into the (pre)hypertensive range (Scheelbeek et al., 2016). Using salt water during menstruation of a woman interferes with her menstrual cycle and her ability to reproduce. Salinity intrusion decreases food variety and availability, which may harm the community's nutritional balance. Skin issues such as rashes and itching are brought on by prolonged exposure to salty water. In the research area, the typical family size is five individuals. Some of them become ill all year round from salinity-related issues.

Regarding health purposes, the cost-to-income ratio is roughly 10% for TK ranges less than 5000, 24% for 6000–7000 TK ranges, 34% for 8000–10,000 TK and 32% for TK ranges greater than 10,000. An annual health crisis affects most families due to diseases caused by salinity. These illnesses result in financial loss, particularly high blood pressure and issues relating to women's health, which are more expensive.

Impact of salinity intrusion on infrastructure, drinking water and sanitation

Infrastructure parts, including pipelines, pumping stations and water treatment facilities, are susceptible to corrosion and salt intrusion degradation, shortening their lifespan and raising maintenance costs. Distilled water gets on a salt flat, adversely disrupting the soil's natural cementation process. As a result, there is a decrease in strength, increased permeability and settlement, and even collapse (Messad et al., 2019).

Freshwater sources become contaminated by saline water infiltration, rendering them unfit for human consumption. High amounts of dissolved salts, such as sodium chloride (NaCl), are present in saline water. Although salt is essential for human health, consuming too much can harm one's health (Farquhar et al., 2015).

Other Social Impacts

This area is normally free from migration induced by salinity intrusion. In the respondents' opinion, salinity has a minimal effect on the social aspect of living patterns in this region. Salinity intrusion sometimes may cause damage to social bondage in this region, leading to conflict for less saline-affected land, agriculture, and fisheries production. Salinity can hamper family ties in this region. The impact of salinity may often increase the rate of indebted people as they lose their production (Figure 10).

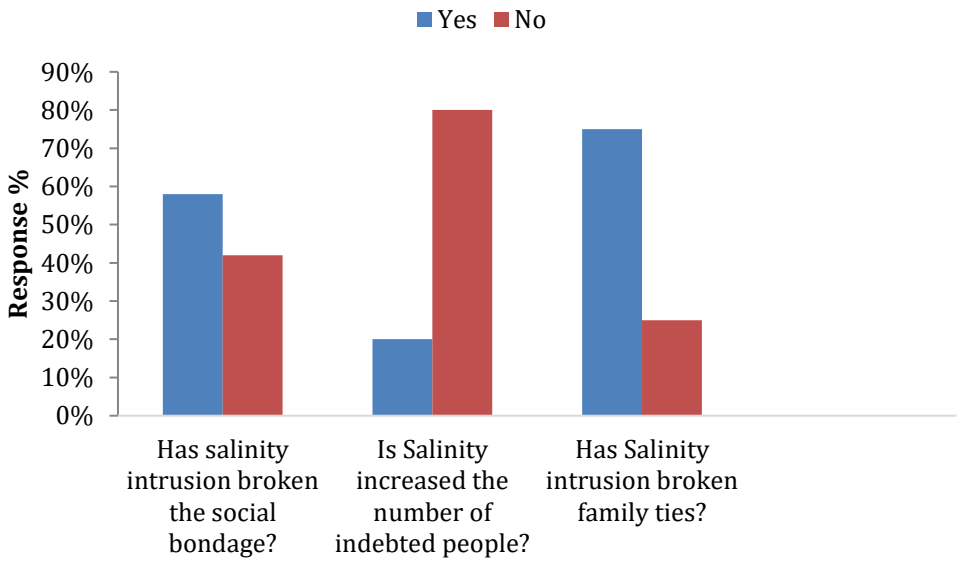

Figure 10. Other social impact of salinity intrusion (Source: field survey, 2023)

Some adaptation strategies to reduce the impact of salinity

Construction of embankment across the bank of sea

An array of rivers connects the inland body of water. An embankment between the river banks and the sea is supposed to have separated it. By building an appropriate-sized embankment, this land might be shielded from the flooding of salt water. Five to ten meters above the high tide line is the optimal size. According to Brammer, the Coastal Embankment Project is necessary to prevent saltwater from invading inland communities. Additionally, he suggested that maintenance be done on it more regularly than in the past (Brammer, 2014).

Provision of sluice gate on the embankment

Bangladesh's coastline region is connected to saltwater bodies using a sluice gate. This sluice gate, which is installed in the embankment systems, controls excess water. This protects the coastal belt from saline water intrusion during high tide. During high tide, this sluice gate over the embankment can drain extra saline water.

Leveling of land

Salt builds up in crop fields due to minor differences in the terrain. Land should be levelled appropriately to avoid water buildup in low-lying areas with shallow groundwater tables and enable a consistent drainage system for the removal of excess water. Additionally, it will aid in regularly applying irrigation water in the field from January to March during the Rabi season, promoting improved crop growth and uniform seed germination. Haque (2006) suggests that levelling the soil in crop fields plagued by salinity will ensure that nutrients are distributed evenly.

Harvesting of rainwater for irrigation

In general, tidal water is salty. Crops in the coastal belt cannot be produced with this water. Overflowing rainwater should be kept in ponds and canals throughout the rainy season. This rainwater harvesting will later irrigate crops during the dry season. Sea levels have risen along the coastal area due to climate change. Consequently, this has led to an increase in the region's salt intrusion. A consequence of this is the dearth of drinkable water in Bangladesh's southwest coastline region. Throughout Bangladesh's coastal region, this rainwater collection stem is a suggested way to supply fresh water for household and agricultural use throughout the rainy season.

Cultivation of saline tolerant variety

The coastline region is primarily flat, although there are specific locations where standing water can reach depths of up to 100 cm, and these areas vary in altitude. To maximize the production of the available area, cultivar varieties should be chosen based on their tolerance to standing water and the degree of salinity in the field. One of the most essential ways to address salinity is to use crops that can withstand salt. These salinized circumstances have changed how plants synthesize proteins quantitatively and qualitatively. Abiotic stress causes several genes to become active in plants, which raises the amounts of various metabolites and proteins. Some of these proteins may even partially protect the plant from the effects of salt stress.

Introduction of crop in rabi (winter) season

In slightly salinized locations, crop intensities should be adjusted by implementing appropriate soil and water management techniques and introducing crop types that can withstand salt. With careful drainage system management, salt-tolerant minor cereal crops, including lentils, mung beans and peas as well as several vegetables, may be grown during this dry season.

Application of potash fertilizer

Generally speaking, soils have little organic matter and are not very fertile. Therefore, applying suitable fertilizers is essential to raising crop yields. Potash fertilizer offers an extra benefit in saline soil. Plants absorb less sodium (Na) and more potassium (K). Fertilization with potassium (K) shield crops against the damaging effects of sodium (Na). This crop nutrient management is among the most effective ways to raise plant productivity in salty environments. To address this, applying potassium sulfate (K_2SO_4) to food crops in a saline climate can increase plant production and nutrient uptake. It was found that when plants are treated with K fertilizer in a saline environment, they absorb and accumulate more nutrients such as calcium, magnesium, potassium, and phosphorus.

Policy implications and gaps in this salinity-affected area

Fragile water governance systems at the local level

The factor that contributes to the rise in salinity is inadequate municipal water governance frameworks. In addition to being a natural occurrence, human activity contributes to salinity intrusion. A wide range of human activities can lead to saline water intrusion, including careless use of water, haphazard shrimp farming, inadequate infrastructure maintenance, and weak management practices.

Lack of capacity of local government

Bangladesh's local government reforms have changed significantly in response to the demands of the ruling class (Westergaard, 2000). The municipal government's policies have changed along with the changes in power. Because of mandates and funding constraints, the Local Government Institute (LGI) has not been able to effectively engage with any tiers of government, which has prevented them from fulfilling their roles and obligations. According to independent studies, Bangladesh has failed to build a decentralized system of accountability and governance. The unplanned shrimp culture and other infrastructure, such as roads, embankments, and coastal polders, cannot be protected by LGIS because of its limited capability. As a result, salinity has been rising throughout Bangladesh's coastal region.

Weak structure and poor maintenance

A 5,017 km embankment across Bangladesh's coast guards the Bay of Bengal polders. In Bangladesh, the main objectives of the polder were to increase agricultural productivity and shield coastal residents from frequent natural calamities (Shaw, 2006). The restoration of the polders is under the jurisdiction of the Bangladesh Water Development Board, which was formerly known as the Water and Power Development Authority (WAPDA) (Thomas, 2014). However, in many cases, coastal polders have not been shielded from saline incursion into the agricultural fields because of inadequate maintenance. About 51 polders have been classified as extremely vulnerable by the BWDB, and another 55 polders as moderately vulnerable. It is essential to repair the polders' damaged infrastructure to deal with vulnerability. Due to damage to most sluice gates, saltwater is allowed to flow inland unhindered. Additionally, the embankment is weakened because shrimp farmers cut it to allow saline water into their shrimp fields. Particularly during a full moon, this thin embankment is readily destroyed by tidal pressure, which allows salt water to infiltrate the polders.

Lack of coordination among different organizations

There is a communication gap between the federal and local governments. All staff members in the engineering section, water development boards, fisheries, livestock, extension and disasters may work together to implement government policies, but national and international organizations, scholars, and nongovernmental organizations (NGOs) have been working independently. However, the suggested actions for reducing salinity throughout the coastal belt have not been significantly implemented nationwide due to a lack of cooperation among the institutions.

IV. Conclusion

Ratandi Taltali union of Galachipa upazila is the region most susceptible to saltwater intrusion, where livestock, fish farming, and grain production are the main sources of income for the local population. Freshwater, drinking water, and soil salinity are increased due to augmentation of saline water, while agricultural sector is severely damaged with a significant impact on paddy production. Therefore, the direct impacts of this fall on people's means of subsistence and income. The diversity of species in the fishing industry is lost, and the integrated rice-fish farming system is threatened. Most livestock suffer from drinking water scarcity, disease susceptibility, fertility and grazing options reduction problems for salinity-related problems. Salinity-related health effects, including water-borne diarrhea, dysentery, cholera infections, malnourishment, hypertension, and issues with women's hygiene are prominent in the affected region. People are ignorant of how to improve their livelihoods and withstand the rising impacts of salt since many are disadvantaged and lack formal education in the subject of study. Some proposed adaptation methods can mitigate the negative impacts of saltwater intrusion. However, closing the policy gap and its consequences can be a long-term solution to alleviate the socioeconomic repercussions of salinity intrusion in Bangladesh's coastal regions.

Acknowledgment

The authors would like to express their gratitude to the Patuakhali Science and Technology University for facilitating this research. Acknowledgment also goes to the anonymous reviewers for their careful review and valuable suggestions, which helped us to improve the manuscript.

Conflicts of Interest

The authors declare that the above manuscript has no conflict of interest.

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HOW TO CITE THIS ARTICLE?

Crossref: https://doi.org/10.18801/jstei.130124.85

MLA

Nur, M. N. B. et al. "Analyzing the socio-economic impacts of salinity intrusion in a coastal union of Bangladesh". Journal of Science, Technology and Environment Informatics 13(01) (2024): 850-863.

APA

Nur, M. N. B., Aktar, S., Setu, S. H. and Rahim, M. A. (2024). Analyzing the socio-economic impacts of salinity intrusion in a coastal union of Bangladesh. *Journal of Science, Technology and Environment Informatics*, 13(01), 850-863.

Chicago

Nur, M. N. B., Aktar, S., Setu, S. H. and Rahim, M. A. "Analyzing the socio-economic impacts of salinity intrusion in a coastal union of Bangladesh" Journal of Science, Technology and Environment Informatics 13(01) (2024): 850-863.

Harvard

Nur, M. N. B., Aktar, S., Setu, S. H. and Rahim, M. A. 2024. Analyzing the socio-economic impacts of salinity intrusion in a coastal union of Bangladesh. Journal of Science, Technology and Environment Informatics, 13(01), pp. 850-863.

Vancouver

Nur, MNB, Aktar, S, Setu, SH and Rahim, MA. Analyzing the socio-economic impacts of salinity intrusion in a coastal union of Bangladesh. Journal of Science, Technology and Environment Informatics. 2024 May, 13(01): 850-863.