SALINITY IMPACT ON COASTAL FARMERS' LIVELIHOOD IN BANGLADESH

A Thesis
BY

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CERTIFICATE

*This is to certify that thesis entitled, "**SALINITY IMPACT ON COASTAL FARMERS' LIVELIHOOD IN BANGLADESH"** submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of Master of Science (MS) in Agricultural Extension, embodies the result of a piece of bona fide research work carried out by **MOUSUMI AFROZ, Registration No. 19-10026** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

Dated: JUNE, 2021
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Dedicated To

My Beloved Parents

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The Author

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX

ABBREVIATION AND ACRONYMS

AEO	Agricultural Extension Officer
BBS	Bangladesh Bureau of Statisrics
BDT	Bangladesh Taka
DAE	Department of Agriculture Extension
et al.	All others
etc.	et cetera, and the other
GHG	Greenhouse Gas Emissions
IPCC	Intergovernmental Panel on Climate Change
OCED	Organization for Economic Cooperation and Development
RSLR	Relative Sea Level Rise
SPSS	Statistical Package for Social Science

ABSTRACT

Bangladesh, especially in the coastal zone, are struggling with the adverse impacts of climate change. Among the impacts of climate change salinity is the serious concern for coastal area of Bangladesh. The present study is concerned with the impact of salinity on affected coastal farmers' livelihood in Bangladesh. The study carried out in Mongla upazila under Bagerhat district. The objectives of the research were to describe the selected characteristics of the farmers to assess the impact of salinity among them and the contribution of salinity related factors on farmers' livelihood in study group. The impact was measured by various dimension with different categories and also t-test value taking both study and control group with the minimizing spill-over effects. Data were collected from the 80 test respondents selected from the intervention area (4 study villages) considering those who were affected to salinity. On the other hand, data were also collected from 80 control respondents selected from the four control villages in purposive random sampling method considering those who were not affected to the impact of salinity. The basic right as nutrition consumption, clothe habit, housing condition, sources of drinking water, treatment and quality of life as changes in poverty level by the respondents were observed in both study and control group to measure the impact. It indicated housing condition, drinking water source, health care facilities showed significant difference between study and control group. It may be enlightened that salinity has commencing role in changing different dimension of livelihood

CHAPTER I
INTRODUCTION

1.1 General Background

Bangladesh is a part of the Bengal Basin, one of the largest sedimentation in the world. Comprising an area of 147,570 km^2, the country has world's largest coastline of 710 km, which lies along the Bay of Bengal. About 80% of the country's land is low-lying floodplains, half of which are subjected to tidal influence, formed through the sedimentation of three large rivers, the Ganges, the Brahmaputra and the Meghna. The Himalayan range is located to the North and The Bay of Bengal to the South; where the southern coast converges at the northern tip of the Bay of Bengal, like a funnel towards the Meghna estuary. Such geo-physical settings along with abject poverty make the country vulnerable to climate change among which salinity intrusion is the most serious concern for coastal crop agriculture (Baten et al., 2015). Coastal zone of Bangladesh is geo-morphologically and hydrologically dominated by the Ganges Brahmaputra Meghna (GBM) river system and Bay of Bengal. The coastal zone of Bangladesh covers an area of 47,201 km^2, 32% of the country, being the landmass of 19 districts. Coastal zone of Bangladesh consists of 19 coastal districts that are Jessore, Narail, Gopalganj, Shariatpur, Chandpur, Satkhira, Khulna, Bagerhat, Pirozpur, Jhalakati, Barguna, Barisal, Patuakhali, Bhola, Lakshmipur, Noakhali, Feni, Chittagong, and Cox's Bazar. Depending on geographic features, coastal zone of Bangladesh consists of three parts, (a) The eastern zone, (b) The central zone, (c) The western zone. The western region known as Ganges tidal plain, comprises the semi-active delta and is crisscrossed by numerous channels and creeks. The central region is the most active and continuous processes of accretion and erosion. Meghna river estuary lies here in this zone. The eastern region is covered by hilly area that is more stable. The coastline is 710 km long which is composed of the interface of various ecological and economic systems, including mangroves (world largest mangrove forest covers 6,017 km^2), tidal flat. Estuaries, sea grass, about 70 islands, accreted land, beaches, a peninsula, rural settlements, urban and industrial areas, and ports. Coastal areas are one of the most productive regions in the world where millions of people live and produce agricultural goods. Maintaining the quality of surface water as well as groundwater is a major challenge in such areas as they are vulnerable to coastal environmental changes

(Rahman et al., 2018). Many of the coastal inhabitants are poor, and the population is exposed to both natural disasters and man-made hazards. Climate change driven events like sea level rise, cyclone, storm surge, coastal inundation, salinity intrusion and land erosion are main the natural disasters (Ahmed, 2019). Although all hazards are detrimental to agriculture, however sea level rise is likely to put the gravest threat by land submersion and salinity intrusion (Baten et al., 2015). The people of Bangladesh, especially in the coastal zone, are struggling with the adverse impacts of climate change (Rabbani et al., 2013). Among the impacts of climate change as predicted by the Intergovernmental Panel on Climate Change (IPCC), the serious concern for Bangladesh is the relative sea level rise (RSLR). Sea level rise is projected for Bangladesh, although there is disagreement on what the degree of sea level will be-the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment gives a global average sea-level rise over the second half of the 20th century was 1.8 ± 0.3 mm/yr, and the order of 2 to 3 mm/yr is considered likely during the early 21st century. It has also been predicted that the RSLR is expected to displace 20 million environmental refugees; 32 percent and 8 percent loss of rice and wheat production respectively. Certainly these are a matter of serious concern to the people and government of country as well as the world community. A 45-centimeter sea level rise in Bangladesh may dislocate about 35 million million people from 20 coastal districts by 2050. Organization for Economic Cooperation and Development (OECD, 2003) study suggested that 1 (one) meter rise in sea level would inundate 18% of Bangladesh's total land mass which will ultimately turns the whole southern region into a sea. In a worst-case scenario, Bangladesh could lose nearly 25 percent of its 1989 land area by around 2100 .Projected sea-level rise could flood the residence of millions of people living in the low lying areas of South, South-East and East Asia such as in Vietnam, Bangladesh, India and China. (Alam and Uddin, 2013).

1.2 Salinity

Salinity as defined herein is the concentration of dissolved mineral salts present in soils (soil solution) and waters (Tanji, 2002). Salinity intrusion is a severe environmental problem all around the world. Bangladesh is a rising and growing nation. This progress is reliant on an agricultural production system, which, in turn, provides global economic visibility. Both agricultural and economic development are hampered by salinity challenges. In Bangladesh's coastal zone, salinity creates an unfavorable climate for

normal crop production throughout the year (Alam et al., 2017). Salinity creates an unfavorable climate and hydrological state, limiting normal crop output all year. As the newly deposited alluviums from upstream in Bangladesh's coastal areas come into touch with sea water, they become saline and continue to be inundated during high tides and ingress of sea water through creeks. Tidal flooding during the wet season (June-October), direct inundation by saline or brackish water, and upward or lateral flow of saline ground water during the dry season are all elements that contribute considerably to the establishment of saline soils (November-May). According to recent observations, normal crop production is becoming increasingly restricted as a result of increased salinity in some regions and the growth of salt affected areas as a result of additional infiltration of salty water. In general, soil salinity is thought to be the primary cause of poor land usage and agricultural intensity in the area (Rahman & Ahsan, 2001).

In the past, the country's salinity received virtually little attention. Increased population pressure necessitates more food. As a result, it's become increasingly vital to look for ways to boost the potential of these (saline) lands for increased crop production. It necessitates an assessment of the current state of salinity-affected land areas (Hague, 2006). Drinking water obtained from various natural sources has varying degrees of salinity, which affects those living along the coast. This is due to the fact that Bangladesh's coastal population relies largely on rivers, tube wells (groundwater), and ponds for washing, bathing, and drinking water. Salinity intrusion has two important dimensions for Bangladeshi coastal residents: (a) the food security and livelihood of saline-affected people's production (b) salinity intrusion, which causes severe problems with clean drinking water and has an impact on people's health, particularly women's. (Habiba et al., 2013) Soil salinity not only reduces agricultural output, but it also has far-reaching implications for farmers' livelihood strategies. Salinity in both the soil and the water has a negative impact on people's living standards, daily activities, and socioeconomic conditions (Haider and Hossain, 2013).

1.3 Livelihood

A livelihood is made up of the skills, assets (both material and social), and activities that are required to make a living. It includes people's abilities, assets, money, and activities that are required to meet basic needs. A livelihood is sustainable if it allows people to cope with and recover from shocks and pressures (such as natural catastrophes

and economic or social upheavals) while also improving their own and future generations' well-being without compromising the natural environment or resource base. Salinity poses serious threats to the livelihoods of the people living in the affected areas, particularly to those who are still into farming. In the southern region, farming and agricultural labour supply are the major livelihood options available. Because of salinity and water logging, 15 per cent of the total cultivable land in the region is either left fallow or out of any productive use. Farming alone is insufficient to support the livelihoods of the rural households, and such households are increasingly forced to explore opportunities within the non-farm sector (Anik et al., 2018). In addition coastal areas are also prone to land-use changes such as transformation from rice cultivation to shrimp culture. Such changes may result in loss of livelihoods of local people, thereby causing impoverishment, debt and the associated lack of access to healthcare (Rahman and Ahmed, 2018)

1.4 Statement of the Problem

In Bangladesh, one of the world's freshwater reservoirs, salinity has become a severe problem. Salinity is a long-standing issue in the southern region of the country. As a result of climate change, this issue has become increasingly visible. As a result, millions of people in the region's health are at risk, land production is dropping, and many people are losing their jobs. Food production falls short of the needs of 160 million people around the world every year because to salinity. Salt is required by the human body and is obtained through food and water. However, the amount of salt in coastal water is many times larger. The health danger grows when this water enters the body. In the context of the above circumstances the researcher intended to find out the answers of the following research questions

1. What are the impact of salinity on coastal farmers' livelihood?
2. What are the selected socio economic characteristics (predictors) of the farmers?
3. What are the contribution of selected predictors of the farmers to their livelihood?

1.5 Specific Objectives

In order to answer the above the questions the following specific objectives were formulated that supposed provide proper direction and to the study:

- To describe the selected predictors of the farmers
- To ascertain the impact of salinity on coastal farmers' livelihood
- To explore the contribution of the selected predictors of the farmers to their livelihood

1.6 Justification of the Study

Bangladesh is an unwitting victim of global warming. Rural people who live in marginalized areas and are reliant on nature. These people's livelihoods are being hampered by restrictions and constraints as the climate changes. Soil salinity is one of the most serious consequences of climate change in Bangladesh's coastal areas. The study's major goal is to figure out how salinity affects coastal farmers' livelihoods. Bangladeshi rural farmers' livelihoods are based on food, clothing, housing, education, and medical care. Bangladeshi coastal farmers are constantly fighting the effects of salinity on their livelihood. Persuasion is limited by soil salinity. The results of this study will be acceptable in the chosen field. The socioeconomic status of coastal farmers will be revealed as a result of soil salinity in this study. As a result, the study's findings will have a significant impact on the livelihoods of Bangladesh's coastal residents.

1.7 Assumption of the Study

An assumption is the supposition that an apparent fact or principle is true in the light of the available evidence (Goode and Hatt, 1952). The researcher had taken the following assumptions into consideration during carrying out the study:

1. The respondents had enough capability to provide proper response of the question furnished in the interview schedule.
2. The respondents were provided views and opinions included in the sample representative of the whole population of the study area.
3. The items, questions and scale of measurement of the variables were reasonably authentic to present the actual condition of the respondents.
4. The findings of the study would give clear concept of the impact of salinity.
5. The data furnished by the respondents were free from bias.
6. The researcher was capable to adjust with the social and cultural environment of the study area. So, the respondents could provide their information correctly.

1.8 Limitations of the Study

It is necessary to impose certain limitations to make the research manageable and meaningful. Thus, during the entire research the most challenging limitations were:

1. The research was confined to the 4 villages of Mongla upazila under Bagerhat under district and Shalikha upazila of Magura district.
2. Data were collected from a small group of respondents taken as the sample of the study because of time and resource constrains.
3. The researcher had to face many difficulties during data collection. All the data were recall data. So, the researcher had to depend on the data as given by the respondents.
4. Only eight socio-economic characteristics of the farmers were selected as independent variables.
5. The researcher had to face many difficulties in conducting the research as ascertainment of impact is very complex.

1.9 Definition of important terms

Variable: The variable is a characteristic, which can assume varying, or different values in successive individual cases.

Independent variable: An independent variable is that factor which is manipulated by the researcher in his attempt to ascertain its relationship to an observed phenomenon.

Dependent variable: A dependent variable is that factor which appears, disappears or varies as the researcher introduces, removes or varies the independent variable.

Age: Age refers to the terms of actual years from their birth to the time of the interview, which was found on the basis of the verbal response of the farmers.

Education: Education was measured by assigning score against successful years of schooling by a person.

Family size: Family size refers to the total number of members in the family including him/her, children and other dependents.

Effective farm size: Effective farm size of a farmer refers to the total area of land on which carried out the farming operation, the area being in terms of full benefit to the family.

Annual family income: Annual income refers to the annual gross income from different sources.

Extension media contact: Extension media contact defines as one's extent of exposure to different communication media related to farming activities

Salinity: The term "salinity" refers to the concentrations of salts in water or soils. Salinity can take three forms, classified by their causes: primary salinity (also called natural salinity); secondary salinity (also called dryland salinity), and tertiary salinity (also called irrigation salinity).

Impact: Impact referred to a term which refers to sustained changes as a result of any intervention which have lasting effect.

Treatment group or study group: Organizations (or individuals) who receive the treatment or intervention.

Control group: The Organizations (or individuals) who do not receive the treatment or intervention.

Livelihood: livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term while not undermining the natural resource base

CHAPTER II

REVIEW OF LITERATURE

Bangladesh is a deltaic country with total area of 147,570 km2. The major part (80%) of the country consists of alluvial sediments deposited by the river Ganges, Brahmaputra, Tista, Jamuna, Meghna and their tributaries. The coastal region covers almost 29,000 sq. km or about 20% of the country. Moreover, the coastal areas of Bangladesh cover more than 30% of the cultivable lands of the country. About 53% of the coastal areas are affected by salinity. Agricultural land use in these areas is very poor, which is much lower than a country's average cropping intensity. Salinity creates an unfavorable climate and hydrological state, limiting normal crop production year-round. Tidal flooding during the wet season (June to October), direct inundation by saline water, and upward or lateral flow of saline ground water during the dry season are all elements that lead to the development of saline soil (November to May). The severity of the salt problem in Bangladesh worsens as the land dries out. It affects crops depending on the degree of salinity at critical growth phases, reducing production and, in severe situations, resulting in total yield loss. Every year, the salinity level climbed in April to May and fell in October to November. Due to the elevated saline level, it has an influence on agricultural productivity during the dry season. If the Ganges water supply is increased during the dry season, the salinity effect on crop output in Khulna is reduced. Rainfall also reduces the saltiness of the soil's surface (Rasel et al., 2013). Bangladesh is one of the world's most salinity-vulnerable and exposed countries (Salinity and Bangladesh Department of Environment, Government of People' Republic of Bangladesh, Salinity Cell, Dhaka, 2007).

In Bangladesh, there is evidence of significant increases in the intensity or frequency of many extreme events such as floods, land erosion, heat waves, tropical cyclones, intense rainfall, tornadoes, drought, storm surges, salinity intrusion, and other events that cause livestock loss, pastureland damage, increased fodder scarcity, destroyed shelters, decreased production, increased management costs, and disease incidence, among other things. Salinity's negative effects are expected to impair the availability and quality of water for home usage. Furthermore, salinity is likely to enhance the prevalence and infection of vector-borne and water-borne diseases like malaria, dengue fever, cholera, and dysentery, among others. Degradation of biodiversity will diminish the supply of many traditional medicines, which may have an impact on the poor and

rural populations that rely on natural resources for medicine, income, and food. The poor population living in Bangladesh's coastal and floodplain zones would be severely impacted by sea level rise (SLR). Many of the interventions performed in Bangladesh to reduce baseline or contextual risks are, however, also synergistic with the so-called adaptations that may be necessary if salinity impacts appear (Hossain et al., 2012). Bangladesh is one of the countries most exposed to the effects of salt, with its coastline region being particularly sensitive. The effects of salinity have major ramifications for the affected population's livelihood patterns and overall health (kabir et al., 2016). Bangladesh is a heavily populated coastal country with smooth terrain consisting of broad and narrow ridges and depressions, making it particularly vulnerable to sea level rise. The Sundarbans, which are likewise vulnerable to sea level rise, are located in Bangladesh's southwest area and are the world's largest single track of mangrove forest. It is situated at the mouth of the Ganges River Delta, on the Bay of Bengal's southern shore. By 2050, a 45-centimeter rise in sea level could engulf 75 percent of the Sundarbans (Nishat and Mukherjee, 2013).

Bangladesh's coastline region accounts for roughly 20% of the country's total land area and more than 30% of its cultivable land. It contains a wide range of ecosystems, including the Sundarbans, the world's largest single tract of mangroves, beaches, coral reefs, dunes, and marshes. Bangladesh's population benefit from its diverse natural settings, which provide a variety of goods and services. Bangladesh, as a deltaic coastal country, is widely acknowledged as one of the world's most vulnerable countries to salinity. Climate change in coastal zones could add to the load on systems that are already under a lot of stress. About 53% of the coastal region is affected by different degrees of salinity. Salinity intrusion in this area is mainly derived through salinity as well as anthropogenic factors that make this region more vulnerable. Hence, salinity intrusion has adverse effects on water, soils, agriculture, fisheries, ecosystem, and livelihoods of this region (Habiba et al., 2014).

2.1 Salinity impact on nature

The coastal areas of Bangladesh, with near flat topography and location at the tip of “funnel shaped” Bay of Bengal, are susceptible to a number of natural hazards such as cyclones, tidal surges, salinity intrusion, riverbank erosion, and shoreline recession. The coastal zone of Bangladesh, especially exposed coast has come into focus in a number

of policy and academic studies for salinity intrusion, but with the accelerated impacts of salinity salinity extends from the exposed to the interior coast hampering crop production. Estimated salinity concentration has a threat to the crop production and a significant yield loss has noticed in dry season. In the changing scenario of sea level rise the increasing concentration of salinity create more pressure to the farmer by reducing yield on one hand and threatening livelihood, income generation and food security on the other hand (Baten et al., 2015). Salinity intrusion has a detrimental impact on farmers' income, spending, and employment opportunities, while it has a beneficial impact on shrimp culture-led land-use activity. Farmers try to solve the salinity problem on their own by using lime, gypsum, and other materials (Haider and Hossain 2013). Land and water in coastal locations are most affected by salinity. It eventually expands towards inland water and soil as a result of salt. The primary agricultural system, coastal biodiversity, and human health are all threatened by this scenario of creeping saline intrusion in Bangladesh's coastal territory. The critical geographical location of Bangladesh, low river flow caused by a barrage in an upstream neighboring country, faulty management of coastal polders, sea level rise, cyclone and storm surge, backwater effect, precipitation, and shrimp culture are all factors that contribute to salinity intrusion in the country's coastal belt (Mahmuduzzaman et al., 2014).

The impacts of salinity on agricultural production have been significant. The focus of this study is on the effects of soil and water salinity on crop, fish, and livestock output in Bangladesh's coastal region. Salinity affects about 200 hectares of fodder crops each year. In the 36 present cropping patterns, 92% of the regions were found to be salt affected. Salinity has caused the extinction of 12% of marine fish species and 25% of shrimp species. In this coastal area, the harmful impact of soil and water salinity on crops, fish, and cattle has been growing (Alam et al., 2017). The main issue in the south-western zone is saline water incursion. During the dry season, salinity affects around 60 and 15 percent of arable land (total 1.0 mha croplands) in the southwestern and southeastern regions, respectively. In the world, it is estimated that 884 million people do not have access to safe drinking water. Increased salinity of natural drinking water sources has been mentioned as one of the numerous issues plaguing low-income countries, although it has yet to be completely investigated.

Rising sea levels due to salt, as well as other contributory causes such as changes in fresh water flow from rivers and increased shrimp aquaculture along the coast, exacerbate the problem. Desalination plants are used in certain nations to partially remove salt and other minerals from water sources, although this is unlikely to be a long-term solution for low-income countries with significant salinity. Using Bangladesh as an example, the problem of salinity can have major consequences in terms of increased rates of hypertension and other public health issues among huge segments of the global population (Vineis et al., 2011). Cyclone and storm surges, high spring tidal inundation, and capillary action all contribute to the salinity. It has an effect on the soil surface and root zones, lowering crop productivity by 0.13 M.T. each year. Due to the salinity effect and the reduction of flood plain, a rise in salt intrusion and a decrease in arability will be prevalent, and it may spread throughout the country. In this context, Bangladesh's control of salinity intrusion is critical. With the mission of saline water proofing through structural management such as coastal embankment projects, dams, and sluices, as well as non-structural management such as coastal area zoning to change land use and other activities, Bangladesh can achieve its vision of sustainable livelihood and environment (Rahman and Bhattacharya 2014).

On heavily salinized soil, salinity intrusion not only destroys crop yield but also results in a loss of total crop production. As a result, the saline-prone coastal region had a significant output loss, with typical yield losses of 20-40 percent in main crops (cereals, potato, pulses, oil seeds, vegetables, species and fruit crops). Local transplanted Aman is the most common crop in saline-prone areas of southwest Bangladesh, followed by HYV Boro rice. Further rice based farming systems are being 17 converted into prawn/shrimp/crab based farming due to salinity accompanied with the disappearance of native fish species both in open and fresh water bodies encompassing decrease livestock production leading to food insecurity. So key impacts of salinization on extent, land feature and crop production along with its credible causes and pathways in south-west Bangladesh are discussed with the recommendations needed (Miah et al., 2020). Gradual increases in soil salinity correspond to increased aquaculture diversification and internal household mobility. Even after accounting for income losses, salinity has a direct impact on internal and international migration, with mobility restricted to specific areas inside Bangladesh (Chen and Mueller, 2018).

2.2 Salinity impact on coastal farmers' livelihood

The Ganges–Brahmaputra–Meghna delta of Bangladesh is one of the most populous deltas in the world, supporting as many as 140 million people. The delta is threatened by diverse environmental stressors including salinity intrusion, with adverse consequences for livelihood and health. Shrimp farming is one of the few economically viable responses to the delta's quickly salinizing effects. While varied levels of salinization are strongly associated with growing poverty, neither saline nor freshwater shrimp farming had a significant association with poverty. Salinization, water logging, wetland/mudflats, employment, education, and road access, to name a few, are all geographically observable drivers of poverty in the delta, indicating that poverty alleviation programs in the delta need to be strengthened with area-specific targeted interventions (Johnson et al., 2016). High blood pressure (prehypertension and hypertension) was found significantly associated with drinking water salinity. People 18 exposed to slightly saline (1000–2000 mg/l) and moderately saline (≥2000 mg/l) concentration drinking water had respectively 17% ($p < 0.1$) and 42% ($p < 0.05$) higher chance of being hypertensive than those who consumed water ((< 1000 mg/l). Hypertension was found to be 31 percent more common in women than in men. The salinity of the drinking water varied just slightly from season to season. During the dry season, blood pressure tended to rise and peaked (Nahian et al., 2018). In comparison to arsenic and drought hazards, salinity is the leading cause of unsafe drinking water. Despite a number of socioeconomic conditions and a geographic location that exacerbates the vulnerability of coastal towns, some communities have developed their own adaptation mechanisms to deal with the issue. Government and nongovernmental organizations have aided community efforts to address the issue (Abedin et al., 2014).

The vast majority of people consume saline water on a daily basis, with an average of four liters drunk per day. Many of the participants had gastrointestinal difficulties and were sick once every few months (Razu et al., 2018). In Bangladesh's south-west area, salt intrusion has modified land use activities. People have been urged or coerced to use their property for shrimp farming as a result of the salinity. Because to the development in shrimp farming, the area's unemployment and underemployment rates have risen. Salinity has caused permanent or temporary migration, as well as increasing reliance on the Sundarban. As a result, social harmony, peaceful family life, and the Sundarban's preservation are all at risk. The spread of income inequality, changes in food habit and

shortage of drinking water are some other negative consequences of salinity in the area. The people of the area initially welcome the salinity intrusion for the hope of getting speedy returns through shrimp farming. However, most of them currently treat salinity as a curse instead of blessings.

The deterioration of soil quality, water logging, deforestation, river 19 bank erosion and ecological imbalance as the long run consequences of the increase in salinity level. All of these factors have an adverse impact on livelihood patterns (Haider et al., 2009). Household food production is a multidimensional cornerstone of rural livelihood in the southwest coastal region, and salt has a severe impact on nearly every aspect of it, from rice plantations and homestead gardening to animal farming and aquaculture. Households have tried a variety of ways to modify food production, but successful adaptation has eluded them. Improved irrigation and floodplain management, as well as restrictions on saltwater aquaculture to reduce salinity, are seen as promising treatments at the community level (Lam et al., 2021). Although yield loss has increased every year, salinity in both soil and water is good for rice agriculture. To enhance productivity and cope with soil salinity, the community switched from native to high yield rice cultivars, which resulted in increased fertilizer and pesticide use. In addition, due to the inability to cope with the current salinity level, soybean, sugarcane, and jute agriculture has been halted for the past twelve years. Other explanations for saltwater intrusion have been proposed, such as a lack of fresh water during the dry season and saline encroachment from the sea through downstream rivers (Khanom 2016). By the end of the twenty-first century, dry-season irrigation water is anticipated to become increasingly saline. Once the dry season irrigation water quality goes above 5 ppt, the monsoon rainfall is no longer able to leach the dry season salt deposits so salt accumulation becomes significant and farm productivity will reduce by as a much as 50%, threatening the livelihoods of farmers in this region (Clarke et al., 2015).

The Sundarbans mangrove forest protects the southwest coastal region from tidal surges as part of an inactive delta of big Himalayan rivers, cyclones, tidal surges, floods, drought, saline incursions, recurring waterlogging, and land subsidence are all common occurrences in this area. In this region, silent and unseen calamities such rising salinity, arsenic poisoning, and drought have an impact on local livelihoods, people, and habitats. The southwest region's vulnerability to rising salinity, arsenic contamination,

and drought is the result of a complex interplay between the country's biophysical, social, economic, and technological aspects. Furthermore, the country is anticipated to be harmed by the country's biggest, most long-lasting, and global-scale yet quiet disaster: rising salinity, natural arsenic poisoning, and drought in the near future (Abedin et al., 2012). In a rural coastal area of south-western Bangladesh, there is a lack of water. Arsenic and specific conductivity (SpC) concentrations in groundwater were higher than those in surface water (ponds); there was no statistically significant seasonal change in mean concentrations in groundwater, but there was for ponds, with arsenic higher in the dry season. Arsenic levels in local drinking water were 2–4 times higher than the national average. Although the majority of individuals polled did not consider their water as having a 'bad' or'salty' taste, all of the local groundwater tests above the Bangladesh guidance for SpC. (Benneyworth et al., 2016).

Due to salt intrusion, arsenic-contaminated groundwater, and frequent droughts, the southwestern region of Bangladesh has a scarcity of safe drinking water. Five upazilas (sub-districts) in Khulna and Satkhira districts have medium adaptation, ten upazilas have low adaptability, and one upazila has very low adaptability among 16 upazilas in Khulna and Satkhira districts (Abedin et al., 2014). In Bangladesh's coastal regions, saline intrusion into fresh groundwater is a severe problem. It affects people's well-being in both direct and indirect ways. Salinity levels differed depending on tube-well depth and distance from the sea. Due to the use of saline water, villagers suffered from several diseases including skin diseases, hair loss, diarrhea, gastric and high blood pressure. In 21 one village high salinity restricted villagers to practice agriculture on limited agricultural land. Increasing salinity due to adverse climatic conditions in coastal areas would pose a serious threat on household water supplies. In salt-affected areas, suggestions are made to improve the management of fresh surface water and groundwater resources, as well as to investigate rainwater collection as a long-term solution (Jabed et al., 2018). Elevated water salinity makes coastal areas in South Asian countries more vulnerable.

Salinity in drinking water has been linked to cardiovascular disease (CVD), diarrhea, and abdominal pain. Our goal was to see if high salt in drinking water was linked to more hospital visits and a variety of health problems in Bangladesh's coastal sub-districts. CVD, diarrhea, and abdominal pain related hospital visits were found to be

significantly associated with high water salinity and TDS. Households exposed to high salinity demonstrated a higher frequency of hospital visits than the low salinity-exposed households. People exposed to high salinity seemed to lack awareness regarding salinity-inducing health effects (Chakraborty et al., 2019). Salinity induced salinity and seasonal (October to May) intrusion of saline water in addition to the severe cyclone that originated from the Bay of Bengal has penetrated to the people, livelihoods, flood plains of the south and south-western part of Bangladesh (Waheduzzaman and Mizanuzzaman 2021).

In Bangladesh's coastal regions, salinity has reduced agro-biodiversity. Vegetables, seasonal fruits, animal species, eggs, and milk production all decreased as salinity rose. Broilers, exotic and marine fish species, and exotic oils were introduced when the price of the aforementioned animal commodities climbed. Non-residents transforming the farmers' property into shrimp ponds, increasing the salinity in the area, and killing the farmers' ducks influenced the decision on what to plant. These agro-biodiversity changes caused reduced frequency of 22 consumption of beef, goat, native chicken, egg, local freshwater fish, seasonal fruits, vegetables and milk, while broilers, exotic fish, exotic oils and marine fish species were increasingly consumed. Despite this, total fish consumption has decreased. These new eating patterns could have serious health effects for people living in rural and coastal areas (Rahman et al., 2011). Fisheries provide a large amount of protein for millions of people in Bangladesh's southwest coastal region, and they are an essential source of livelihood for tens of thousands of poor people. One of the most significant issues that fisheries in the southwest coastal region would encounter as a result of salinity will be unfavorable effects from increased aquatic salinity caused by sea level rise. Aquatic salinization have an especially negative impact on poor households in the region.Poorly populated areas that lose species are six times more common than those that gain species (Dasgupta et al., 2017).

Excess soil salinity may increase current food insecurity risks in densely populated tropical deltas, posing a threat to the human and ecological sustainability of these areas and beyond. Soil salinization has a major detrimental impact on food security in the home (Hossain et al., 2016). Maternal hypertension, preeclampsia, and postpartum infant morbidity and death are all linked to the salinity of drinking water drank during pregnancy. The adverse effect of salinity on grade advancement does not vary

significantly across the gender of the child while poverty, as expected, exacerbates the effect. Impaired cognitive development due to early childhood exposure appears to be the most plausible channel through which the negative effects of excessive sodium consumption permeate to young children's educational deficit. Additionally, poor health of the adults and elevated medical expenditure play a small yet significant mediating role (Akter, 2019).

2.3 Research Gap of the Study

There have been many studies on salinity indicators, but there have been few studies on the effects of salinity on rural farmers' livelihoods. Furthermore, just a few researchers have attempted to examine the effects of salinity on rural farmers' livelihoods by comparing study and control groups. Despite this, no research has been done in Bangladesh to reduce the impact of salinity on livelihood. To determine the effect of salinity, only a few researchers used a systematic technique of effect analysis. This was a study's research gap. As a result, the researcher conducted the current study to determine the influence of salinity on the livelihood of farmers in the Mongla upazila of Bagerhat district**.**

2.4 The Conceptual Framework of the Study

The contribution between the experimental variables and the main focus of the study can be clearly delineated with the help of conceptual framework of the study. The researcher was made an attempt to ascertain the impact of salinity on coastal farmers` livelihood of Mongla upazila under Bagerhat dristrict as the main focus of the study. It was conceptualized in the research that the impact of salinity on coastal farmers may be influenced and affected by the interacting forces of many socio-economic and others characteristics of the farmers. To make the process conspicuously interpretable a conceptual framework has been presented in a schematic diagram (Fig 2.1).

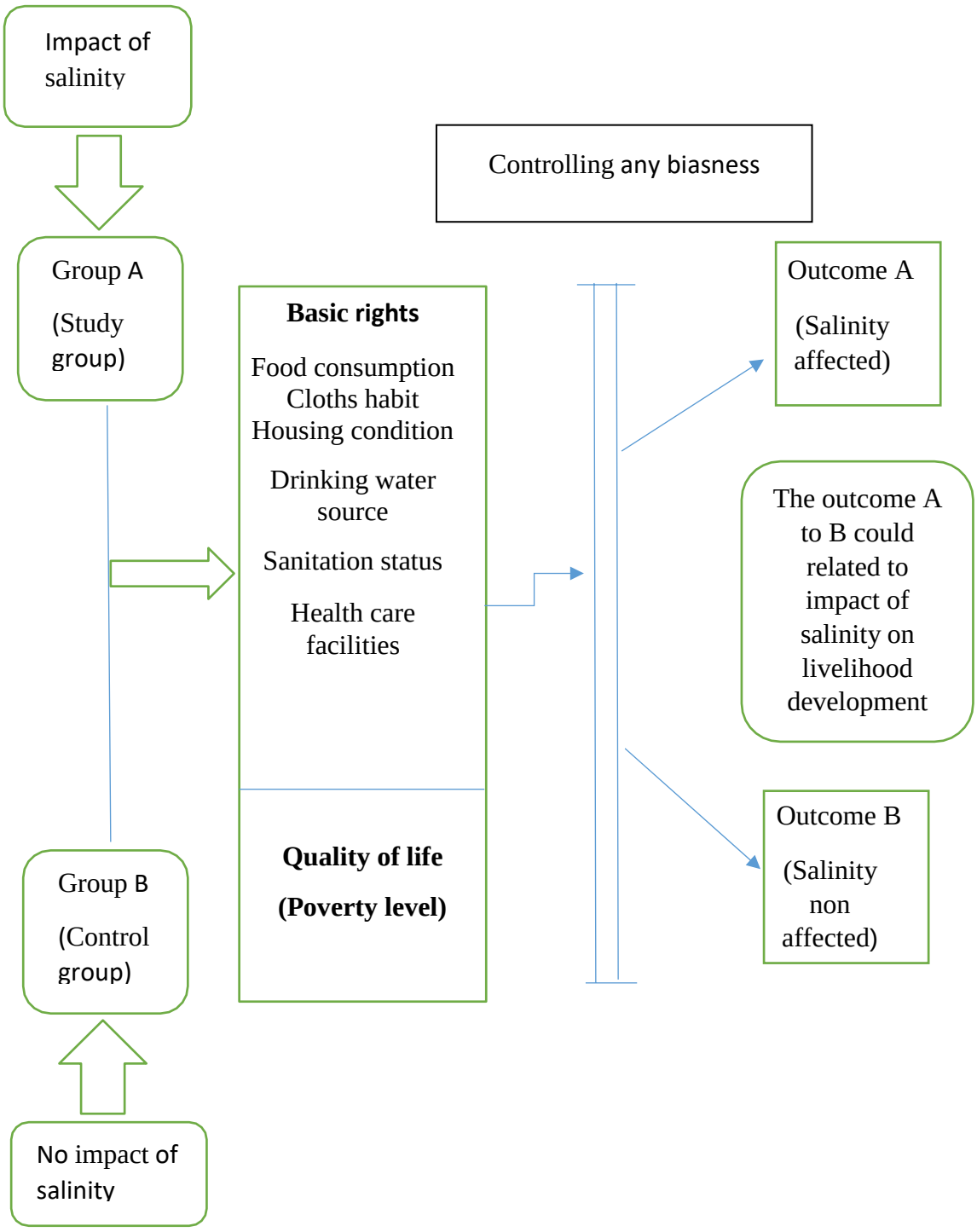

Figure 2.1: Conceptual framework of the study

CHAPTER III

MATERIALS AND METHODS

A researcher should do work very carefully in formulating methods and procedures. Methodology gives clear direction to a researcher about his works and activities during the whole period of the study. Appropriate procedures for collecting data were taken by the researcher to collect valid and reliable information. Methods of analysis were appropriate to arrive at correct conclusion. Various methods, tools and techniques were used during different stages of this research work and compilation of data. The purpose of this chapter was to describe the setting, methods and procedures used in conducting this study.

3.1 Locale of the Study

The study was conducted at Mongla upazila under Bagerhat district of Bangladesh where people were affected by salinity. Two unions from Mongla upazila namely Chadpai and Chila were selected for study group and Dhaneswargati and Talkhari unions of Shalikha upazila under Magura district were selected for control group. Eight villages were finally selected from the selected four unions by taking two from each union for the study. Salinity affected people were considered as study group and salinity non affected people were considered as control group. A purpose sampling procedure was followed to selected one district from all over the Bangladesh. A map of Mongla upazilla and a map of Shalikha upazila showing the union of the study area are presented in Fig. 3.1 & Fig. 3.2.

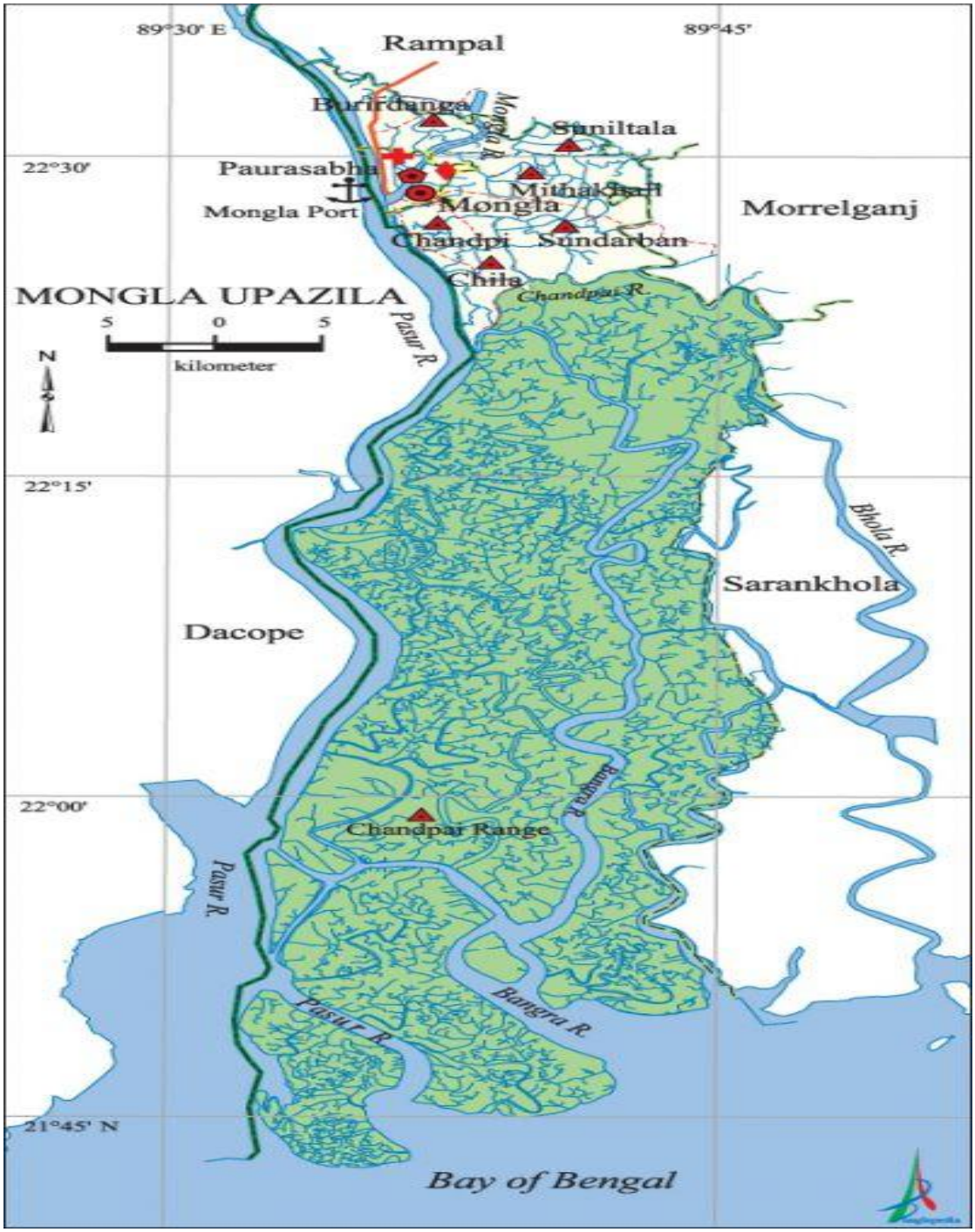

Figure 3.1: Map of Mongla upazila

Figure 3.2: Map of Shalikha upazila

3.2 Population and sampling procedure

A random sampling method was used to select two upazila under salinity affected area. Random sampling procedure was also used to select 8 villages from three selected unions. The total number of individuals under study was estimated to be 509 in selected areas. To determine the sample size, Yamane (1967) formula was used.

The formula is $(n) = \frac{Z^2P\ (1\text{-}P)\ N}{Z^2P\ (1\text{-}P)\ N+N\ (e)^2}$

Where,

n = sample size,

N = population size,

e = the level of precision (10%)

z = the value of the standard normal variable given the chosen confidence level (e.g. z= 1.96 with a CL = 95%),

p = the proportion or degree of variability = 50%

Thus, 80 respondents constituted the sample size of the study from the study respondents. The test respondents were selected by using purposive random sampling procedure. Thus the sample size for Kanainagar, Kainmari, Holdibonia and Boirjomari were 24, 17, 20 and 19 respectfully. And for control group data were collected from Thaipara, Dhaneswargati, Pathorghata and Sablat villages. A reserved list was maintained to fill in the gaps if any respondent in the original list was found missing as the same respondent in the interview period. Ten percent of the population was selected through proportionate random sampling procedure to include in the reserved list for study group and control group of the respondents. Researcher used 1:1 method for selecting control respondents.

Table 3.1 Distribution of population, sample and reserve list for the study group

Name of the upazila	Name of the selected union	Name of the selected villages	Number of the population	Number of the sample	Reserved list
Mongla	Chadpai	Kanaingar	150	24	2
		Kainmari	110	17	2
	Chilla	Holdibonia	125	20	2
		Boirjomari	120	19	2
		Total	505	80	8

Minimizing spill-over effects

The study used a quasi-experimental survey approach to address endogeneity issues at both the participant and geographic levels. Endogeneity (program placement and participation) is a severe issue, according to a previous study by Pit and Khandaker (1998). If endogeneity is not taken into account during estimation, the results can be deceptive. To prevent the problem of information transfer from salinity afflicted farmers to non-affected farmers, researchers chose separate villages as study areas, such as Kanainagar, Kainmari, Holdibonia, and Boirjomari. Reduce the spill-over impact, i.e. prevent knowledge from being transmitted/contaminated from salinity-affected farmers to non-affected farmers.,i.e. diffusion of treatment and to avoid downward bias, all control respondents were chosen from communities where salinity had not been introduced at all, i.e. diffusion of treatment. The villages in the research and control groups were kept at a significant distance apart (Mazumder, 2015 and Hulme, 2000). The poll includes one farmer from each farming family to prevent information misinterpretation. The two-way stratified random sampling approach was used to

determine homogenous / comparable categories of control and testing group respondents. Furthermore, to ensure similar socio-economic conditions for both the control and test groups, a two way stratified random sampling technique was used, in which education and farm size were considered as two individual strata. 80 control respondents (not affected by salinity) were selected in 1:1 ratio of the test respondents. Education was categorized into three groups: group 1 (denoted E_1), respondents are illiterate or can sign only; group 2 (denoted E_2), respondents have primary education, and group 3 (denoted E_3), respondents have secondary or higher education. After that, Farm size was also categorized into three groups: group 1(denoted as F_1), small farm group (farm size up to 0.5 hectors); group 2 (denoted as F_2), medium-farm group (farm size 0.51–1.0 hector, and group 3 (denoted as F_3), large farm group (farm size above 1.0 hector). The two-way stratified random table is given as Table 3.3.

Table 3.2: Two ways stratified random data of the study and control group respondents

Category	% respondents	Study	Control
E_1 X F_1	8.53	4	4
E_1 X F_2	18.56	15	15
E_1 X F_3	8.93	8	8
E_2 X F_3	20.72	20	20
E_2 X F_1	8.26	4	4
E_2 X F_2	14 .02	12	12
E_3 X F_2	8.00	6	6
E_1 X F_1	4.50	4	4
E_3 X F_3	8.48	7	7
Total	100	80	80

3.3 Data Collection Instrument

An interview schedule was prepared keeping in mind the objectives of the study. Direct questions and different scales were kept in the questionnaire to get the desired information. After preparation of data collection instrument pre-test was conducted on salinity affected farmers and non-affected farmers from the population but excluded from the sample. Necessary correction, addition and alternation were made in the

interview schedule based on the pre-test. After correction, the interview schedule was finalized for the data collection.

3.4 Data Collection

Data were collected personally by the researcher herself through personal interview schedule from the sampled farm families of the selected areas. Before starting collection of data, the researcher met the respective Upazila Agriculture Officer (UAO), Agriculture Extension Officer (AEO) and the concerned SAAOs. The researcher also discussed the objectives of the present study with the respondents and Officers and requested them to provide actual information. Rapport was established with the farmers, so that they feel easy to answer the questions. The researchers took all possible care to establish rapport with the respondents so that they feel any indecision while starting the interview. A very good cooperation was obtained from the field extension workers. No serious difficulty was faced by the researchers during collection of data. The interviews were made individually in the houses of the respondents. Questions were asked in different way so that the respondents could easily understand the questions. Whenever a respondent faced difficulties in understanding any questions, care was taken to explain the same clearly with a view to enabling him to answer it properly. Before going to the respondents' home for interviewing they were informed verbally to ensure their availability at home as per schedule date and time. In case of failure to collect information from the repondents due to their other business, a revist was made with prior to appointments. If any respondent failed to understand could not clear about what was wanted to know then supplementary questions were asked for further clarification.

3.5 Variables of the Study

In a descriptive research, the selection and measurement of variables an important task. The hypothesis of a research, constructed properly, contains at least two important variables viz., independent and dependent variables. A dependent variable is that factor which appears, disappears or varies as the researcher institute introduces, removes or varies the independent variable. An independent variable is that factor which is manipulated by the researcher in his attempt to ascertain its relationship to an observed phenomenon. To determine the condition of farmers' livelihood was the main focus of this study. Reasonably, it constituted the dependent variable. A variety of factors might have influence to the effect of

salinity. It is very difficult to deal with all the factors in a single study. It was therefore, necessary to limit the independent variables. As the study was conducted to farmers' benefit. so the characteristics of rural people in some cases were different for the selection of independent variables, the researcher went through the past studies as far as available and also discussed with teachers, experts, supervisor. The researcher carefully considered the various characteristics of the coastal farmers as independent variables. These were: age, education, family size, effective farm size, annual family income, agricultural extension media contact, knowledge on salinity and knowledge on livelihood also as independent variable. The dependent variable was treated as salinity impact on coastal farmers' livelihood of this study.

3.6 Measurement of Independent Variables

For conducting the study in accordance with the objectives it was necessary to measure the independent variables. The independent variables were age, education, family size, effective farm size, annual family income, agricultural extension media contact, knowledge on salinity and knowledge on livelihood. Procedures for measuring these variables are described below:

3.6.1. Age

The age of respondent farmers was measured by counting the actual years from his/her birth to the time of interview on the basis of his/her statement. It was measured in terms of complete years on the basis of his response. This variable appears in item number (1.1) in the interview schedule as presented in Appendix-I.

No fractional year was considered for the study. A score of one (1) was assigned for each year of age. Based on their age the farmers were classified into three categories (MoYS, 2012).

Categories	Years
Young	≤ 35
Middle	36-50
Old	≥ 50

3.6.2 Education

Education was measured by assigning score against successful years of schooling by a farmer. One score was given for passing each level in an educational institution (Rashid,

2014). For example, if a farmer passed the final examination of class five or equivalent examination, his/her education score has given as five (5). A score of zero (0) were assigned for never schooling or illiterate, A person not knowing reading or writing but being able to sign only was given a score of 0.5. If a farmer did not go to school but took non- formal education, his educational status was determined as the equivalent to a formal school student. Non-formal Education equivalent score was calculated as stated by the respondent. This variable appears in item number (1.2) in the interview schedule as presented in Appendix-I.

According to Reza (2007) the level of education of a respondent were classified as follows:

Categories	Score
Illiterate	0
Can sign only	.5
Primary Education	1-5
Secondary Education	6-10
Above Secondary Education	≥11

3.6.3 Family size

The family size of the respondents was measured by the total number of members in the family of a respondent. The family members included the respondent himself/herself, his/her spouse, children and other dependents who jointly live and eat together during interview time. It was measured by computing total number of member in the family. One score was given for each family member. This variable appears in item number (1.3) in the interview schedule as presented in Appendix-I.

According to Haque (2002) based on their total farm size, the respondents were classified into three categories as follows:

Categories	Family members
Small	1-3
Medium	4-6
Large	Above 6

3.6.4 Effective farm size

Farm size of a farmer referred to the total area of land on which his/her family carried out the farming operation, the area being terms of full benefit to the family. The term refers to the cultivated area either owned by the farmer or cultivated on sharecropping, lease or taking from other including homestead area and measured using the following formula; (Rashid, 2014)

Farm Size= {A+B+1/2(C+D)+E}

Where, A= Homestead area

B= Own cultivation area

C= land given from others as borga

D=land taken to others as borga

E= land taken from others on lease

The data was first recorded in terms of local measurement unit i.e., bigha or decimal and then converted into hectre. The total area, thus, obtained is considered as his farm size score (assigning a score of one for each hectre of land). This variable appears in item number (1.4) in the interview schedule as presented in Appendix-1.

3.6.5 Annual family income

Annual family income refers to the total financial return from different financial activities in one year. Annual family income of a respondent was measured by taking sum of income amount in taka earned by a respondent and others member of the family in a year from sources such as: main crop, secondary crop, business, labor, service etc. It was expressed in Taka. One score was given for 1000 taka. For an amount less than Tk 1000 a fraction was computed and added with the main score. Based on their total amount family income, farmers were classified into three categories; small, medium and large income. This variable appears in item number (1.5) in the interview schedule as presented in Appendix-I

3.6.6 Agricultural extension media contact

The agricultural extension media contact of a respondent was measured on the basis of the response of the media contact user farmers against the extent of his

contact with selected ten media by putting tick mark against any responses one of the four regularly, occasionally, rarely, not at all. The agricultural extension media contact score of the respondents ranged from 0 to 40 where 0 for not at all, 1 for rarely, 2 for occasionally, 3 for frequently contact and 4 for regularly contact. Based on their extension media contact (Akther, 2020) classified the respondents into four categories as no contact, low contact, medium contact, high contact. This variable appears in item number (1.6) in the interview schedule as presented in Appendix-I

3.6.7 Knowledge on salinity

Knowledge of the farmers towards salinity was measured on 10 basic open ended questions. Each question contains 2 marks. Knowledge of coastal farmers on salinity was determined by summing up the weights for their responses to all the ten question. Thus knowledge of the farmers on salinity score of the respondents could range from 0 to 20, where zero (0) indicating low knowledge and 20 indicate very high knowledge. Based on their knowledge on salinity, the respondents were classified into three categories as poor, moderate and good knowledge. This variable appears in item number (1. 7) in the interview schedule as presented in Appendix-I.

3.6.8 Knowledge on livelihood

Knowledge of the farmers` livelihood was measured on 9 basic open ended question. Each question contains 2 marks. Knowledge of livelihood was determined by summing up the weights for their responses to all the 9 statements. Thus knowledge of the farmers towards livelihood score of the respondents ranged from 0 to 18, where zero (0) indicating no knowledge and 18 indicate sound knowledge. Based on their livelihood knowledge respondents were classified into three categories as poor knowledge, moderate knowledge and good knowledge. This variable appears in item number (1.7) in the interview schedule as presented in Appendix-I

3.7 Measurement of the Dependent Variables (Selected Livelihood parameters)

Sanitation and food security were used as indicators to measure livelihood by Malak et al., (2020). Housing condition, sources of drinking water, treatment and cloth value indicator were used to measure the livelihood indicator by Podder (2015). Nahian et al., (2018) and Abedin et al., (2014) also used safe drinking water source as an indicator to

measure livelihood. Livelihood status of farmers in areas of Sylhet Division were observed by using housing and sanitation facilities by Mamun et al., (2019). Kamaruddin and Samsuddin (2014) were used sanitation facilities, food consumption, wearing better clothes indicator in their study. Family income and land use pattern were used as indicator to measure livelihood status by Haider and Hossain (2013). Yet, any researcher have not been conducted a complete paper with following above all livelihood subcomponents. Therefore, this is the research gap of researcher study paper. In this paper researcher summarized livelihood subcomponents such as food consumption (Nutrition uptake), clothing habit, housing condition, drinking water source, sanitation status, health care facilities and quality of life to measure the impact of salinity on livelihood of the farmers.

1. Food consumption

It was measured under the mentioned amount kcl for each time breakfast, lunch and dinner and other. The total daily average food intake per person per day was measured calorie following a standard chart. Scores 1, 2 and 3 were assigned for up to 1300 cal, 1301-1600 cal, above 1600 cal respectively nutrient consumption ability per head per day. This variable appears in item number (2.1) in the interview schedule as presented in Appendix-I. Based on their food consumption the respondents were categories into low, medium and high intake.

2. Clothing habit

Respondents were asked how many sets of cloth they use. Based on respondents answers scores were assigned as 2 sets of cloths (1), 3 sets of cloths (2), 4 sets of cloths (3). This variable appears in item number (2.2) in the interview schedule as presented in Appendix-I.

3. Housing status

Scores 1, 2 and 3 were assigned as Tin shed with tin wall, Tin shed with brick wall (Semi-pucca), Tin shed high-rise house respectively.). This variable appears in item number (2.3) in the interview schedule as presented in Appendix-I.

4. Drinking water source

Score was assigned as pond/ rain with simple treatment (1), arsenic free tube well (2), Own tube well normal base (3). This variable appears in item number (2.4) in the interview schedule as presented in Appendix- I.

5. Sanitation status

Respondent's having latrine in bush (1), sanitary ring slab latrine (2), pucca latrine upon normal base (3). This variable appears in item number (2.5) in the interview schedule as presented in Appendix- I.

6. Health care facilities

The respondents were directly asked to mention the healthcare facilities that their family numbers availed in after intervention periods. There were 3 types of physician in taking treatment as allopathic medicine seller, MBBS doctor, specialist doctor and assigned score were given as 1, 2 and 3 respectively. The respondents were categorized into such three categories as low treatment, medium treatment and high treatment and then comparing with control group. This variable appears in item number (2.6) in the interview schedule as presented in Appendix- I.

2. Quality of life: Poverty level

The poverty level was measured in score. There were two types of poverty as moderate poverty and extreme poverty (ultra -poor, poorest of the poor). Score 1 was assigned for moderate poor, 2 for ultra -poor, 3 for poorest of the poor. The respondents were categorized as low poverty level, medium poverty level and high poverty level of the study group and then comparing with control group. This variable appears in item number 2 (b) in the interview schedule as presented in Appendix- I.

3.8 statistical analysis

Data were coded, tabulated, compiled, and analyzed according to the objectives of the study. SPSS were used for data analysis. Descriptive statistical measures, including number, percentage distribution, average, and standard deviation were used. The sample sizes in the two groups (study group and control group) were not equal and were therefore, estimated separately. Paired t test were used to assess differences between means. Five percent (0.05) and one percent (0.001) level of significance was used as the basis for rejecting any null hypothesis.

3.9 Statement of Hypothesis

According to Kerlinger (1973), a hypothesis is a conjectural statement of the relation between 2 or more variables. Hypothesis are always in declarative sentence form and they relate either generally of specifically variables to sentence

form and they relate either generally or specifically variables to variables. Hypothesis may be broadly divided into two categories, namely, research hypothesis and null hypothesis.

3.10 Research hypothesis

"Each of the eight (8) selected characteristics (age, education, family size, effective farm size, family annual income, agricultural extension media contact, knowledge on salinity and knowledge on livelihood) of the respondents has significant contribution to the change in different indicators of dependent variable in study group." However, when a researcher tries to perform statistical tests, then it becomes necessary to formulate null hypothesis.

3.11 Null hypothesis

A null hypothesis states that there was no contribution to the concerned variables. The following null hypothesis was undertaken for the present study "There was no contribution of the selected predictors of the farmers to their livelihood." The selected characteristics were age, education, effective farm size, family size, annual family income, agricultural extension media contact, knowledge on salinity and knowledge on livelihood.

CHAPTER IV

RESULTS AND DISCUSSION

The findings of the research have been presented in this chapter in the following three sections: a) Selected characteristics of the respondents b) The impact of salinity on coastal farmers' livelihood c) Contribution of the selected characteristics of the respondents on the salinity impact on their livelihood.

4.1 Selected Characteristics of the Farmers

Table 4.1: The salient features of the selected characteristics of the farmers (study group)

Categories	Measuring Unit	Range		Mean	S D
		Possible	Observed		
Age	Years	-	22-89	51.77	12.47
Education	Year of schooling	-	00-18.00	4.91	4.52
Family size	Number		2-8	4.51	1.15
Effective farm size	Hectare	-	.01-3.67	.77	.60
Annual family income	'000'Tk.		11-230	68.33	37.78
Agricultural extension media contact	Score	0-40	4-35	10.13	5.93
Knowledge on Salinity	Score	0-20	10-20	15.68	3.32
Knowledge on Livelihood	Score	0-18	8-18	13.30	2.89

4.1.1 Age

Age score of the farmers ranged from 22-89 years with a mean of 51.77 and standard deviation of 12.47. Based on their age score, the farmers were classified into three categories namely 'young', 'middle' and 'old' aged (Rashid, 2014). Data furnished in the Table 4.1.1 shows that the old aged respondents group was higher than middle aged and young aged group. Different results were observed by Nasreen et al., (2013) in different study area where young aged respondents group was higher than the middle and old aged respondents groups.

Table 4.2: Distribution of the farmers according to their age

Categories	Farmers		Mean	SD
	Number	Percent		
Young aged (up to 35)	8	10	51.77	12.47
Middle-aged (36-50)	27	33.75		
Old (>50)	**45**	**56.25**		
Total	**80**	**100**		

It was found that 56.25 percent of the respondents were old-aged, 33.75percent of the respondents were middle aged and rest 10 percent were young (Table 4.2). Islam (2017) found that the middle and old aged farmers were higher than young aged. Afrin et.al (2017) found that old aged person (51.01%) was higher than that of middle aged (13.7%). From the above discussion, researcher might be concluded that old aged respondents were increased in a study areas because they have sound knowledge on salinity impact.

4.1.2 Education

The level of educational scores of the farmers ranged from 00-18.00 with a mean and standard deviation of 4.91 and 4.52 respectively. Based on the educational scores, the farmers were classified into five categories. The distributions of farmers according to their level of education were presented in Table 4.3. Results presented shows that highest number of the respondents were in secondary education level where lowest number of the respondents were above secondary level. It seems that due to lack of available support from family they were unable to continue their higher study. Middle aged group respondents' education was in secondary level. It might be due to their consciousness about education. Similar result were observed by Reza (2007) where the highest number of respondents were educated up to secondary level education.

Table 4.3: Distribution of the farmers according to their education

Categories	Farmers		Mean	SD
	Number	Percent		
Illiterate(0-0.5)	29	36.25	4.91	4.52
Primary level(1-5)	17	21.25		
Secondary level(6-10)	**30**	**37.5**		
Above secondary level(>10)	4	5		
Total	**80**	**100**		

Islam (2017) observed that highest number of the respondents were at secondary level. But contradictory result was observed by Nasreen et al. (2013) where the highest number of respondents were at primary education level. According to the national standard of classification, among the respondents of rural farmer, 29 percent had no education, 21.25 percent had education at primary level, 37.5 percent had education at secondary level and 5 percent had education at higher level. It can be concluded that education broadens farmers' horizons of vision and increases their ability to understand any salinity-related problem. Because the respondents in the study areas were unaware of the importance of education, the education sector was not highlighted.

4.1.3 Family size

Family size score of the farmers' ranged from 2-8 with the mean and standard deviation of 4.51 and 1.15 respectively. Based on the family size score the respondents were classified into three categories namely 'small family', 'medium family', and 'large family' by Kisar (2018). The distribution of the farmers according to their family size is presented in Table 4.4.

Table 4.4: Distribution of the farmers according to their family size

Categories	Farmers		Mean	S D
	Number	Percent		
Small family (up to 3)	13	16.25	4.51	1.15
Medium family (4-5)	**55**	**68.75**		
Large family (above 5)	12	15		
Total	**80**	**100**		

Table 4.4 indicates that the medium size family constitute the highest proportion (68.75 percent) followed by the small size family (16.25 percent). Only 15 percent farmers had large family size. Such finding is quite normal as per the situation of Bangladesh. The findings indicated that average family size of the study area was smaller than the national average which is 4.85 (BBS, 2014). The trend of nuclear family has been rising in the study area and subsequently the family member becoming smaller than the extended family. This could be attributable to the research area's high prevalence of joint family systems. According to the findings, the study area was in a remote village where family bonding was frequent and people sought to live together to increase their family size. Based on the foregoing discussion, the researcher may conclude that

medium family size families exist in the study areas due to laggardness of size control progress and lack of enjoyment facilities in their daily life.

4.1.4 Farm size

The farm size of the farmers ranged from 0.01-3.67 ha with a mean and standard deviation of .77 and .60 respectively. Based on their farm size, the farmers were classified into five categories following the categorization of DAE (1999). The distribution of the farmers according to their farm size is presented in Table 4.5.

Table 4.5 Distribution of the farmers according to their farm size

Categories	Farmers		Mean	SD
	Number	Percent		
Marginal farm (up to 0.2 ha)	16	20	0.77	0.60
Small farm (0.21-1.0 ha)	6	7.5		
Medium farm (1.01-3.0 ha)	**55**	**68.75**		
Large farm (>3.01 ha)	3	3.75		
Total	**80**	**100**		

Data in the Table 4.5 reveals that the majority of the respondents (68.75%) had medium farm size, while (20.0%) have marginal farm and (7.5%) have small farm size and (3.75%) have large farm size. It showed that the respondents might face resource constraints in managing their farms. The average farm size of the farmers of the study area (.77 ha) was higher than that of national average (0.60 ha) of Bangladesh (BBS, 2015).

4.1.5 Annual family income

The score of annual family income of the coastal farmers ranged from 11-230 with a mean and standard deviation of 68.33 and 37.78 respectively

Data presented in the Figure 4.1 shows that the respondent having medium annual family income were higher than the respondents of low and high annual family income respectively. Researcher followed the Mean ± SD for categorizng the farmers' annual income. On the basis of observed range, the respondents were classified into three categories namely "low income", "medium income", and "high income" as shown on the table 4.6

Table 4.6 Distribution of the farmers according to their income

Categories	Farmers		Mean	SD
	Number	Percent		
Low (up to 31)	3	3.75	68.33	37.78
Medium (32-105)	**69**	**86.25**		
High (above 105)	8	68.33		
Total	**80**	**100**		

Reza (2007) found the similar result where highest number of respondents were medium annul income. Podder (2015) found that the respondent having medium family income were higher than the respondents of low family income and high annual family income respectively. According to the previous discussion, the majority of respondents were from the middle income category. They were also active in numerous activities such as dairy farming, labor, service, and business, according to the researcher.

4.1.6 Extension media contact

The observed score of agricultural extension contact of the farmers ranged from 4-35 against a possible range of 0 to 36. The average score of the farmers was 10.13 with a standard deviation 5.93 (Table 4.6). Researcher followed the Mean ± SD for categorizing farmers' extension media contact. The farmers were classified into three categories on the basis of their exposure to farming information through extension media contact scores and distribution of the three categories namely 'low', 'medium' and 'high' extension contact of the farmers.

Table 4.7: Distribution of the farmers according to their extension contact

Categories (Scores)	Farmers		Mean	SD
	Number	Percent		
Low (up to 5)	13	16.25	10.13	5.93
Medium (6-15)	**59**	**73.75**		
High (above 15)	8	10		
Total	**80**	**100**		

Data shows that the highest proportion (73.75 %) of the farmers had medium extension contact as compared to 16.75 percent of them having low extension contact and 10 percent were felt in high extension media contact (Table 4.7). From this table, it might be said that majority (73.75 percent) of the farmers had medium extension media contact. It could be sated that extension agent or media of the study area were available

to the farmers. The finding was interesting but logical because in general the farmers in the rural areas of Bangladesh are less cosmopolite in nature and less exposed to different information sources. Finding reveals that 16.25 percent of the farmers had low extension contact which demands for strengthening and improving the communication strategy. Low extension contact might be the reason that some respondents may think that they have enough knowledge about farming activities. They receive information from their neighbors, relatives and workmates etc. Peal (2015) reveals that medium contact (48.1%) was higher than that of low contact.

4.1.7 Knowledge on livelihood

Knowledge on livelihood scores of the farmers ranged from 8-18 against the possible range of 0-18. The average score and standard deviation were 13.30 and 2.89 respectively.

Table 4.8: Distribution of the farmers according to their knowledge on livelihood

Categories (Scores)	Farmers		Mean	SD
	Number	Percent		
Poor knowledge (up to 11)	15	18.75	13.30	2.89
Moderate knowledge (12-15)	**48**	**60**		
Good knowledge (above 15)	17	21.25		
Total	**80**	**100**		

Information presented in the Table 4.8 indicates that 60 percent respondents having moderate knowledge which were higher where 21.25 percent and 18.75 percent respondents had good knowledge and poor knowledge respectively. It seemed that livelihood knowledge was moderate due to most of their educational background were secondary level. Podder (2015) also revealed that knowledge of livelihood was moderate (79.3%).

4.1.8 Knowledge on Salinity

Knowledge on salinity scores of the farmers ranged from 10-20 against the possible range of 0-20. The average score and standard deviation were 15.64 and 3.32 respectively.

Table 4.9: Distribution of farmers according to their knowledge on salinity

Categories	Farmers		Mean	SD
	Number	Percent		
Poor knowledge (up to 12)	19	23.75	15.68	3.32
Moderate knowledge (13-18)	**41**	**51.25**		
Good knowledge (>18)	20	25		
Total	**80**	**100**		

Table 4.9 reveals that 51.25 percent of the farmers had moderate knowledge on salinity, 25 percent had good knowledge and 23.75 percent had poor knowledge on salinity. Podder (2015) indicates that 82.6 percent of the respondents had moderate knowledge which were higher where 7.6 percent and 9.8 percent respondents had poor knowledge and good knowledge respectively. From the above discussion, researcher could concluded that it might be indicated that most of the rural farmers had secondary level of education and that's why they had moderate knowledge on salinity.

4.2 Salinity impact on coastal farmers' livelihood

Salinity impact on coastal farmers' livelihood had one selected dimension as livelihood development indicators of life. The Livelihood impact score was summated by making of all the indicator value unit free.

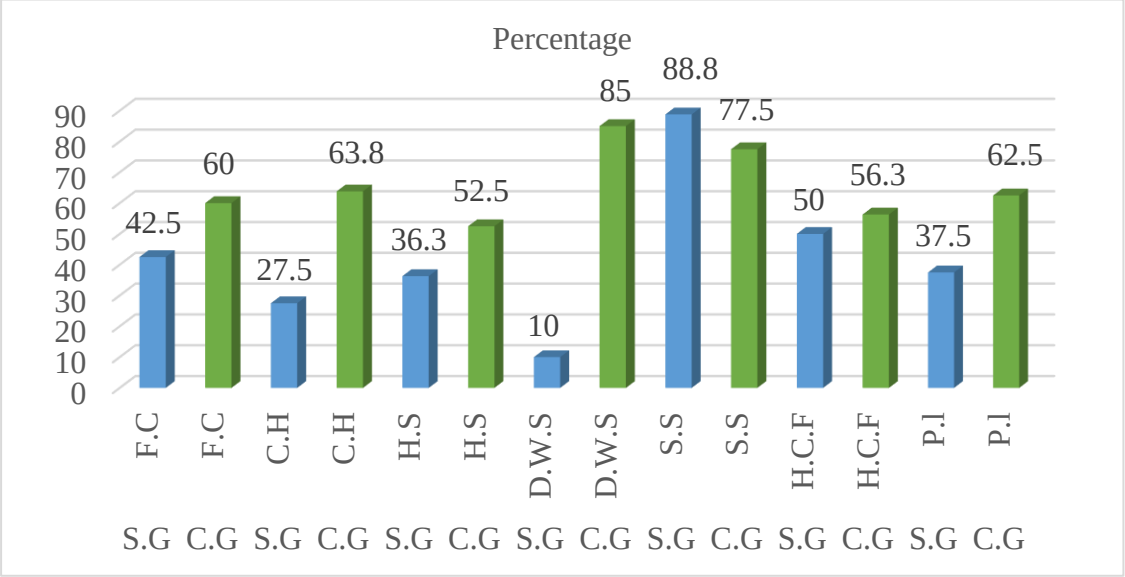

Figure 4.1: Distribution of farmers' livelihood in study and control area

F.C=Food Consumption, C. B=Clothing Habit, H. C=Housing Condition, D.W.S =Drinking Water Source, S. S=Sanitation Status, H.C F =Healthcare Facilities and P.L= Poverty Level, S.G= Study Group and C.G= Control Group

From the figure, researcher can concluded that medium intake percentage (60%) of the coastal farmers in control group was higher than that of study areas farmers (42.5%). 3 sets of cloths use farmers percent (63.8%) was higher in control group farmers than study groups (27.5%). Housing condition of the study groups' farmers was lower than that of control group farmers. The percent of the tin shed with brick wall status of housing condition was 36.3% in a study group farmers. Normal base own tube well use farmers (85%) was higher in control groups than that of study areas. (10%). Sanitary ring slab latrine using farmers' percent (88%) was higher than that of control group farmers' percent (77.5%). Allopathic medicine seller percent (50.0%) was lower than that of control (56.3%) farmers. Quality of life was good (62.5%) in control groups than that of study group (37.5%).

From the above discussion, researcher concluded that farmers livelihood in control groups was comparatively better than study areas due to impact of salinity.

Coastal farmers' livelihood condition

Results contained in the Table 4.9 show that majority (67.5%) of the respondents were medium in their livelihood condition. Podder (2015) showed that majority of the respondents (49.5+43.0) lead either low changes or medium changes in their livelihood condition.

Table 4.10: Distribution of farmers according to their study group impact

Categories	Farmers		Mean	SD
	Number	Percent		
Low (up to 10)	10	12.5	12.81	1.87
Medium (11-14)	**54**	**67.5**		
High (>14)	16	20		
Total	**80**	**100**		

Table 4.11: Distribution of farmers according to their control group impact

Categories	Farmers		Mean	SD
	Number	Percent		
Low (up to 13)	20	25	14.91	1.70
Medium (14-17)	**57**	**71.25**		
High (>17)	3	3.75		
Total	**80**	**100**		

Researcher followed the Mean ± SD for categorization of farmers. From the above

Table, researcher may conclude that medium livelihood condition were observed between two groups But contradictory in a study groups medium changes was lower (57.5%) than (71.25 %) in control group. Overall, this Table shows that medium livelihood was observed among two groups. This may be occurred among the respondents in a control group because there has no impact of salinity on their livelihood condition.

Comparative test (t- test) with salinity affected farmers between non – affected farmers

The comparative salinity affected and non-affected farmers in Bangladesh was tested by using the following null hypothesis. The calculated "t" value was 7.17 which were significant at 1% levels. The result of t' value supported to reject the null hypothesis and clearly indicated that improvement of non-affected farmers more than that of affected farmers.

Table 4.12: Results of t-test showing the mean of present salinity affected and non-affected farmers in Bangladesh

Items	N	Mean	SD	t- value
Salinity affected	80	12.81	1.8	7.176**
Non-affected	80	14.91	1.7	

Hence, it was concluded that significant impact of study group as well as the salinity impact on farmers' livelihood at 1% significance value from t-test compared with control group who were not affected by salinity.

4.3 The Contribution of the selected characteristics of the respondents to their livelihood development

This section deals with the findings exploring the contributing relationship between the selected characteristics of farmers to their livelihood development. The contributing factors were age, education, family size, effective farm size, annual family income, agricultural extension media contact, knowledge on livelihood and knowledge on salinity.

For this study eight characteristics of the respondents were selected and each of the characteristics was treated as independent variable. The final null hypothesis: There is

no contribution of the selected characteristics (age, Education, family size, effective farm size, annual family income, agricultural extension media contact, knowledge on livelihood and knowledge on salinity. It was observed that out of 8 variables only 3 independent variables namely agricultural extension media contact, knowledge on salinity and knowledge on livelihood were entered into the regression equation which contribute the farmers livelihood development. The regression model shows that agricultural extension media contact (.031) knowledge on livelihood (0.037) was the second contributing factors which was significant at 5% level. Knowledge on salinity was the third contributing factor which was significant at 1% level. The multiple adjusted R^2 values and R^2 value were found 0.448 and0.504 and the corresponding F value was 9.013 which were significant at 0.000 levels. In order to estimate the farmers livelihood development the multiple regression analysis was used which is shown in a Table 4.13.

Table 4.13: Multiple regression coefficients of the contributing variables related to their livelihood development.

Dependent variable	Independent variable	B	β	SE	t-value	ρ	R^2	Adj. R^2	F
Salinity impact on coastal farmers livelihood	Age	0.015	.098	0.014	1.075	0.286	0.50	0.44	9.013
	Education	0.022	.106	0.018	1.250	0.215			
	Family size	1.088	.093	1.044	1.042	0.300			
	Effective farm size	0.307	0.125	0.295	1.040	0.302			
	Annual family income	0.038	0.019	0.245	0.155	0.877			
	Agricultural extension media contact	2.023	0.217	0.928	2.181	0.031			
	Knowledge on Salinity	0.210	0.374	0.058	3.633	0.001			
	Knowledge on Livelihood	0.102	0.209	0.048	2.120	0.037			

** Significant at p<0.01; *Significant at p<0.05

Podder (2015) revealed that there was a significant contribution of respondent's education, family size, media contact, training experience and knowledge on climate change in changing their livelihood of the respondents. Among these, education and knowledge on climate change was the most important contributing factor (significant

at the 1% level of significance) and family size and training experience were the second most contributing factor (significant at the 5% level of significance). Media contact related to change in rural livelihood due to the climate change effects (significant at the 1% level of significance).

There was a significant contribution of the farmers' level of education, farmers' perception of climate change and knowledge on climate change their food stock ability 61 status through which was 51.6% and significant contribution of the farmers age, family size, agricultural extension contact and knowledge on food security to change in nutritional security status through which was 35.9%. According to Hossain (2016), the most important contributing factors were age, service term, and extension media interaction (significant at the 1 percent level of significance). The farmer's awareness of the problem was also a significant contributing factor (significant at the 5 percent level of significance).

Based on correlation coefficient analysis, Salim (2006) discovered that the age and duration of service of SAAOs had a significant association with their work performance at the 5% level. The researcher applied multiple regression analysis that showed that job performance had significant relationship with level of education, academic achievement and job satisfaction. From the above review, researcher may be concluded that multiple regression is a general and flexible statistical method for analyzing associations between two or more independent variables and a single independent variable. The process of performing a regression allows us to confidently determine which factors matter most, which factors can be ignored, and how these factors influence each other. To improve food security, the government should take additional steps, such as raising farmer understanding of the benefits of food security, so that they can live their lives without fear of bad future consequences Kisar (2018).

Farm size may have a significant impact on both investment capacities and risk orientation issues (Arun et. al., 2017). DAE should focus on launching new that have a positive impact on farmers' livelihoods. Farmers with small farms should be eligible for low-interest loans from the government bank. The agriculture extension office should organize need-based training sessions to bridge the gap projects between farmers and SAAOS. Raising awareness about the health risks of water salinity is essential for the government to frame policies and mitigation strategies to control this emerging threat.

Local and central government, NGOs and community people should work in a well-coordinated manner to develop the livelihood condition of farmers. If these rules are maintained, the farmer's livelihood situation in a Bangladeshi neighborhood appears to be altered, according to the study.

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This Chapter presents summary of major findings, conclusion and recommendation of the study.

5.1 Summary of Findings

5.1.1 Selected characteristics of the farmers

The major findings of the study are summarized below:

Age

Age of the farmers ranged from 22-89 years with the average of 51.77 years and the standard deviation was 12.47. Highest proportion (56.25 percent) of the farmers was under old aged category.

Education

Education score of the respondents ranged from 00-18.00 with the average of 4.91 and the standard deviation was 4.52. Highest proportion (37.5 percent) of the farmers was under secondary education.

Family size

The majority (68.75%) of the respondent had medium family size compare to 16.25 % and 15% had small and large family size respectively.

Effective farm size

The medium farm size constituted the highest proportion (68.75%), whereas the only 3.75% of the farm holder was large farm size.

Annual family income

The highest proportion (86.25 %) of the respondents had medium annual income, while 3.75% percent had low income and 10 percent had high income.

Agricultural extension contacts

The highest proportion (73.75%) of the respondents had medium extension media contact as compared to (13%) and (8%) having low and high extension media contact respectively.

Knowledge on livelihood:

The respondents having moderate knowledge on livelihood (60%) were higher than the respondents having good (21.25 %) and poor knowledge on livelihood (18.75%) respectively.

Knowledge on salinity:

The respondents having moderate knowledge on salinity (51.25%) were higher than the respondents having poor (23.75%) and good knowledge on climate change (25%) respectively.

5.1.2 Salinity impact on coastal farmers' livelihood

Food consumption

Medium intake percentage (60%) of the farmers in control group was higher than that of study areas farmers (42.5%).

Clothing habit

3 cloths use farmers percent (63.8%) was higher in control group farmers than study groups (27.5%).

Housing condition

Housing status of the study groups' farmers was lower than that of control group farmers. The percent of the tin shed with brick wall status of housing condition was 36.3% in a study group farmers.

Drinking water source

Normal base own tube well use farmers (85%) was higher in control groups than that of study areas. (10%).

Sanitation status

Sanitary ring slab latrine using farmers' percent (88%) was higher than that of control group farmers' percent (77.5%).

Healthcare facilities

Allopathic medicine seller percent (50.0%) was lower than that of control (56.3%) farmers.

Quality of life (poverty level)

The respondents having medium poverty level in quality of life of the respondents were higher in study group (62.5%) than control group (37.5%)**.**

Farmers' livelihood condition

Medium livelihood was observed between the study and control two groups. This may be occurred among the respondents in a control group because there has no impact of salinity on their livelihood condition.

5.1.3 Contribution of the selected characteristics of the respondents

There was a significant contribution of the knowledge on salinity, agricultural extension media contact (.031) knowledge on livelihood (0.037) where knowledge on salinity was significant at 1% level and agricultural extension media contact (.031) knowledge on livelihood (0.037) was significant at 5% level to their livelihood development.

5.2 Conclusions

Findings of the study enabled the researcher to formulate the following conclusions:

- Findings reveals that the percentage of food consumption, clothing habit, housing condition, drinking water source, health care facilities, quality of life were good enough in control group than that of study group. Because the control group respondents were not affected by salinity. It can be concluded that salinity had highly impact on study group respondents.
- Findings shows that the respondents` extension media contact, knowledge on salinity and knowledge on livelihood had significant contribution to the basic rights and quality of life of the respondents in the study group. It may be concluded that farmers` livelihood condition due to salinity is likely to be influenced by the respondents` extension media contact, knowledge on salinity and knowledge on livelihood.

5.3 Recommendations

5.3.1 Recommendations for policy implications

On the basis of the findings and conclusion of the research some recommendations have been formulated. These are following-

- Government should take combined efforts to mitigate salinity.
- DAE should give attention for conducting new project which might influences the farmers livelihood development.
- The government bank should give loan in an easy term to those farmers who have lowed small farm size.
- Agriculture extension office should develop technology that could be long –term effective mitigation measures for tackling the salinity intrusion issue.

5.3.2 Recommendations for further study

On the basis of scope and limitations of the present study and observation made by the researcher

The present research was undertaken in the mongla upazila of Bagerhat district. The findings of the study are needed to be tested in the other areas of the country

- The present research was undertaken to measure the impact of salinity were considered as the coastal farmers` livelihood in this study. Further research should be conducted to assess the specific impact of salinity.
- The present study was conducted on the basis of the recall data furnished by the respondents. Further research should be carried out without using recall data.
- Contribution of only seven selected characteristics of the respondents to the impact of salinity was examined. It may be recommended for further research to examine the contribution of other socio-economic characteristics of the farmers to the impact of salinity.
- The present research was carried out seven indicators to measure the impact of salinity. Further research undertaking should be carried out to measure the impact of salinity with different indicators.

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APPENDIX-I

English Version of Interview Schedule (for study group respondents)

Department of Agricultural Extension and Information System

Sher-E-Bangla Agricultural University Dhaka-1207.

An Interview Schedule for a Research Study Entitle

SALINITY IMPACT ON COASTAL FARMERS` LIVELIHOOD IN BANGLADESH

Serial No……

Respondent Name:

Village:

Union:

Upazila:

District:

Mobile No:

Please answer the following question:

1.1 Age

What is your present age? .....Years

1.2 Education

What is your level of education?

a) Illiterate……
b) Can sign only ……
c) Have passed class……..
d) I took non-formal education……which is equivalent to class

1.3 Family size

Please mention the number of your family member

a) Male……...
b) Female…….

Total…….

1.4 Effective farm size

Please mention the area of your land possession

SL No.	Use of land	Land possession	
		Local unit	Hectre
1.	Homestead area (A)		
2.	Own cultivation area (B)		
3.	land taken to others as borga (C)		
4.	land given from others as borga (D)		
5.	Land taken from others on lease (E)		
Total = {A+B+1/2(C+D)+E}			

1.5 Annual family income

Please mention your yearly family income from each of the following

SL No.	Sources of income	Total price (Taka)
1.	Main crop (Rice, wheat, potato)	
2.	Secondary crop (Pulse, water melon, coconut, vegetables)	
3.	Labor wage	
4.	Service	
5.	Buisness	
6.	Others (Specify) …….	

1.6 Agricultural extension media contact

Please indicate the extent of contact in following sources

SL No.	Name of information sources	Extent of contact				
		Regularly (4)	**Frequently (3)**	**Occasionally (2)**	**Rarely (1)**	**Not at all (0)**
1	Upazilla level agricultural Officer (AEO/AO/AAO)					
2	Meet with $SAAO_s$					
3	Contact/ Model Farmers					
4	Agricultural input(seed / fertilizer / pesticide / equipment) dealers					
5	Participation in FINA/FGD					
6	Participation in agricultural result demonstration program					
7	Field Day					
8	Agricultural program through mass media (radio/TV)					
9	Agricultural features in printing media (daily newspaper, leaflet, booklet, magazine etc)					
10	Agro based NGO Worker					

1.7 Knowledge on Salinity

Please answer the following questions

SL No.	Questions	Full Marks	Marks obtained
1	Have you ever heard salinity?	2	
2	What are the causes of salinity?	2	
3	What are the features of salinity?	2	
4	Which season salinity occurs most?	2	
5	How salinity degrades the soil properties?	2	
6	What are the impact of salinity?	2	
7	How salinity hampered agricultural production?	2	
8	How salinity deteriorates the water quality?	2	
9	Does salinity affect the livelihood of the communities?	2	
10	What are the mitigation procedure of salinity problem?	2	

1.8 Knowledge on Livelihood

Please answer the following questions

SL No.	Questions	Full Marks	Marks obtained
1	What do you know about livelihood?	2	
2	What are the components of livelihood?	2	
3	What amount (kcal) of nutrition is essential for an adult per day?	2	
4	Can you cite an example of a balance diet?	2	
5	What are the sources of pure drinking water?	2	
6	What is hygienic sanitation system?	2	
7	What do you know about different types of doctor?	2	
8	How many clothes are sufficient for a person per year?	2	
9	What do you think how much money is needed to maintain good life per person per day?	2	

2. Salinity impact on farmers' livelihood:

a) Basic rights

2.1 Food consumption (in terms of nutrition):

Please mention your daily food consumption/ person among your family members

SL No.	Name of meal	Menu and amount (g)	Nutrition value (calorie)
1	Breakfast		
2	Lunch		
3	Supper/ Dinner		
4	Others (if any)		
Total			

2.2 Clothing habit

Please state your used number of sets of clothes and its value

SL No.	Cloths	Score
1	2 sets cloths (1)	
2	3 sets cloths (2)	
3	4 sets cloths (3)	
Total		

2.3 Housing condition

Please state your status of your shelter

SL No.	Types of houses	Score
1	Tin shed with tin wall (1)	
2	Tin shed with brick wall (semi-pucca) (2)	
3	Tin shed high rise house (3)	
Total		

2.4 Drinking water source

Please state your present sources of drinking water

SL No.	Drinking water source	Score
1	Pond/rain with simple treatment (1)	
2	Arsenic free tube well (2)	
3	Own tube well normal base (3)	
	Total	

2.5 Saniation status

Please mention your sanitation status

SL No.	Types of sanitation status	Score
1	Latrine with bush (1)	
2	Sanitary ring slab latrine (2)	
3	Pucca latrine upon normal base (3)	
Total		

2.6 Health care facilities

Please mention your health care facilities

SL No.	Medicare	Score
1	Allopathic Medicine Seller (1)	
2	MBBS doctor (2)	
3	Specialist doctor (3)	
Total		

b) Quality of life

Please indicate your present poverty position

Category of poverty	Score
a. Moderate poverty (income per person per day) income more than 160 tk.	
b. Extreme poverty (income less than 160 tk. per person per day)	
i. Ultra -poor (food and assets poverty)	
ii. Poorest of the poor (most extreme hardship, people with limited rights and capabilities)	

Score 1 assign for moderate poor, 2 for ultra-poor 3 for poorest of the poor.

Thank you very much for your cooperation.....

Signature of the interviewer

Date:

APPENDIX-II

English Version of Interview Schedule (for control group respondents)

Department of Agricultural Extension and Information System

Sher-E-Bangla Agricultural University Dhaka-1207.

An Interview Schedule for a Research Study Entitle

SALINITY IMPACT ON COASTAL FARMERS` LIVELIHOOD IN BANGLADESH

Serial No……

Respondent Name:

Village:

Union:

Upazila:

District:

Mobile No:

Please answer the following question:

1.4 Age
What is your present age?.....Years

1.5 Education
What is your level of education?

e) Illiterate……
f) Can sign only ……
g) Have passed class……..
h) I took non-formal education……which is equivalent to class

1.6 Family size
Please mention the number of your family member

c) Male……....
d) Female…….

Total…….

1.4 Effective farm size

Please mention the area of your land possession

SL No.	Use of land	Land possession	
		Local unit	Hectre
1.	Homestead area (A)		
2.	Own cultivation area (B)		
3.	land taken from others as borga(C)		
4.	land given to others as borga (D)		
5.	Land taken from others on lease (E)		
Total = {A+B+1/2(C+D)+E}			

1.5 Annual family income

Please mention your yearly family income from each of the following

SL No.	Sources of income	Total price (Taka)
1.	Main crop (Rice, wheat, potato)	
2.	Secondary crop (Pulse, water melon, coconut, vegetables)	
3.	Labor wage	
4.	Service	
5.	Buisness	
6.	Others (Specify) …….	

1.6 Agricultural extension media contact

Please indicate the extent of contact in following sources

SL No.	Name of information sources	Extent of contact				
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2	Meet with $SAAO_s$					
3	Contact/ Model Farmers					
4	Agricultural input (seed / fertilizer / pesticide / equipment) dealers					
5	Participation in FINA/FGD					
6	Participation in agricultural result demonstration program					
7	Field Day					
8	Agricultural program through mass media (radio/TV)					
9	Agricultural features in printing media (daily newspaper, leaflet, booklet, magazine etc)					
10	Agro based NGO Worker					

1.9 Knowledge on Livelihood

Please answer the following questions

SL No.	Questions	Full Marks	Marks obtained
1	What do you know about livelihood?	2	
2	What are the components of livelihood?	2	
3	What amount (kcal) of nutrition is essential for an adult per day?	2	
4	Can you cite an example of a balance diet?	2	
5	What are the sources of pure drinking water?	2	
6	What is hygienic sanitation system?	2	
7	What do you know about different types of doctor?	2	
8	How many clothes are sufficient for a person per year?	2	
9	What do you think how much money is needed to maintain good life per person per day?	2	

2. Impact on farmers' livelihood:

a) Basic rights

2.1 Food consumption (in terms of nutrition):

Please mention your daily food consumption/ person among your family members

SL No.	Name of meal	Menu and amount (g)	Nutrition value (calorie)
1	Breakfast		
2	Lunch		
3	Supper/ Dinner		
4	Others(if any)		
Total			

2.2 Clothing habit

Please state your used number of sets of clothes and its value

SL No.	Cloths	Score
1	2 sets cloths(1)	
2	3 sets cloths(2)	
3	4 sets cloths(3)	
Total		

2.3 Housing condition

Please state your status of your shelter

SL No.	Types of houses	Score
1	Tin shed with tin wall(1)	
2	Tin shed with brick wall (semi-pucca) (2)	
3	Tin shed high rise house (3)	
Total		

2.4 Drinking water source

Please state your present sources of drinking water

SL No.	Drinking water source	Score
1	Pond/rain with simple treatment (1)	
2	Arsenic free tube well(2)	
3	Own tube well normal base (3)	
Total		

2.5 Sanitation status

Please mention your sanitation status

SL No.	Types of sanitation status	Score
1	Latrine with bush (1)	
2	Sanitary ring slab latrine (2)	
3	Pucca latrine upon normal base (3)	
Total		

2.6 Health care facilities

Please mention your health care facilities

SL No.	Medicare	Score
1	Allopathic Medicine Seller (1)	
2	MBBS doctor (2)	
3	Specialist doctor (3)	
Total		

b) Quality of life

Please indicate your present poverty position

Category of poverty	Score
a. Moderate poverty (income per person per day) more than 160 tk	
b. Extreme poverty (income less than 160tk per person per day)	
i. Ultra- poor (food and assets poverty)	
ii. Poorest of the poor (most extreme hardship, people with limited rights and capabilities)	

Score 1 assign for moderate poor, 2 for ultra- poor and 3 for poorest of the poor.

Thank you very much for your cooperation.....

Signature of the interviewer

Date:

APENDIX-III

Food Consumption (Calorie Intake in Lunch and Supper items)

Name of food item	Calorie contents (Kcal/kg)
Rice	3490
Vegetables	430
Fish	1360
Meat	1090
Milk	670
Pulse	3430
Fruit	200
Edible oil	9000

Source: Dr. Shin Imai (2003), Livelihood Survey Forms, SPFS, FAO

Food Consumption (Calorie Intake in Breakfast items)

Name of food item	Amount (Per 100 gm)	Calorie (Kcal/Kg)
Muri	1 cup	50
Chanachur	28 gm	144
Mixed vegetables	1 cup	27
Parata	1 piece (79 gm)	238
Tea with sugar and milk	1 cup	37
Biscuit	1 piece	116

Source: National food and nutrition institute, Dhaka, Bangladesh