Analyzing the Socio-Economic Impacts of Cyclone at Pangasia Union in Dumki Upazila Under Patuakhali District, Bangladesh

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ABSTRACT

Bangladesh is among the most cyclone-prone countries worldwide. The geographical location and climatic conditions of the country have been identified as contributing factors to the occurrence of cyclones and other natural disasters. Over the past century, Bangladesh has been impacted by 53 major cyclones. Cyclones have a significant impact on coastal Bangladesh, but the intensity and frequency of these storms poses a considerable threat to the Pangasia Union of Dumki Upazila. This Union is more vulnerable to cyclones than other regions of the upazila. The research explores the various socio-economic impacts of cyclones on livelihoods in this area and examines some adaptation strategies for reducing the impacts of cyclones. The study was conducted based on both primary and secondary data sources. Primary data sources included a household questionnaire survey, a focal group discussion (FGD), and key informant interviews. Secondary data sources included books, journals, and documents. The study's findings illuminate the repercussions on agriculture, fisheries, livestock, health, and other social sectors. The findings of the study indicate that economic losses in these sectors are attributable to the impact of the cyclone. Agriculture is the sector most vulnerable to cyclones in the study area. Cultivated crop paddy is predominantly impacted by the cyclone. The maximum household or infrastructure present in this region is of a very poor quality. These infrastructures are particularly vulnerable to the effects of cyclones. A pervasive issue in this region is the substandard and deficient infrastructure. The efficacy of existing local and institutional strategies for mitigating the impacts of cyclones is questionable. The objective of the research is to investigate the socio-economic impact of cyclones and the scope of reducing the impact on lives and properties. In this regard, this study provides insight into adaptation strategies that can be employed to mitigate the socio-economic ramifications of cyclones.

Keywords: Adaptation strategies, Cyclone, Socio-economic impact.

INTRODUCTION

Bangladesh is a low-lying country located near the northernmost point of the Bay of Bengal (Khatun et al., 2017). Bangladesh is a country that is susceptible to natural hazards (Quader et al., 2017). Cyclones are the most significant type of natural disaster in this region, causing the most harm to the human population (Ahmed et al., 2012). Cyclones and the associated tidal surges have caused significant destruction to human life and property in Bangladesh's coastal and island regions (Alam, 2010).

The distinctive topography and geography of Bangladesh render the nation susceptible to a variety of natural hazards, particularly those stemming from extreme climate phenomena (Mallick et al., 2017). The tropical cyclone is among the most prevalent hazardous events in coastal regions worldwide in recent decades (Mallik et al., 2011). It is evident that all hazards are detrimental to the development of a nation like Bangladesh, particularly in the context of cyclones. This phenomenon has emerged as a pressing concern in the coastal regions

of numerous countries worldwide, particularly those experiencing rapid development and low-lying topography (Nicholls et al., 2007). As with all hazards, the adverse impact of cyclones is especially deleterious for a developing country like Bangladesh due to its low-lying geography (Alam, 2015). While cyclones affect much of the country, their most severe impacts are primarily felt in the coastal regions. The predominant livelihood activities in the coastal region of Bangladesh include agriculture, domestic work, fishing, and temporary employment. Cyclones have been shown to disrupt livelihoods (Solayman, 2017). Bangladesh is a developing country. The development is chiefly focused on the enhancement of agricultural production systems, a strategy that has the potential to generate economic prosperity on a global scale. Cyclones have been shown to impede economic and agricultural growth. The economy of Bangladesh is predominantly agricultural, with agricultural activities constituting a significant proportion of the overall economy. Agriculture constitutes approximately 12% of the national GDP and accounts for 44% of the country's workforce. It plays a pivotal role in generating income and employment opportunities for generations in Bangladesh. (Hossain et al., 2015). However, the agricultural sector is subject to significant annual impact from cyclones. The Pangasia Union is located in proximity to the coastline of the Bay of Bengal. The repercussions of this phenomenon are twofold: first, it directly hinders their economic well-being; second, it negatively impacts their status in the labor market.

The problem is particularly exacerbated during the rainy season. The agricultural sector is subject to a reduction in yield or, in certain instances, complete devastation due to tidal inundation and heavy rainfall (Nicholls et al., 2007). Climate change-related hazards, such as rising sea levels and storm surges, have been identified as exacerbating factors contributing to the severity of the problem. Bangladesh, a predominantly agrarian nation, is characterized by a population that is directly or indirectly dependent on agriculture for sustenance (Islam et al., 2004). A multitude of studies have predicted the deleterious impact that cyclones have on global agriculture (Alam et al., 2018). Therefore, cyclones have the potential to exert a wide range of socioeconomic effects on different parts of nearby coastal areas. At present, the socioeconomic effects of cyclones are a major concern. Accordingly, the objective of the present study is to assess the socio-economic impacts of the cyclone that struck Pangasia Union in Dhumki Upazila. Furthermore, the study will identify adaptation strategies that may be employed to mitigate the impacts of future cyclones.

According to Rasheduzzaman et al. (2020), the maximum cyclone-affected area is located in Dhumki Upazila, Patuakhali District. The Pangasius Union is particularly susceptible to the impact of cyclones. The elevated incidence of cyclones in coastal regions is attributable to a confluence of geophysical factors, including the unique geographical location, sedimentation, sea level rise, cyclones, storm surges, and tidal surges (Islam et al., 2011). Furthermore, socio-economic factors, including but not limited to human activities such as inadequate infrastructure, increased greenhouse gas emissions, and a lack of awareness, also impact the strength of cyclones in this region. Tajrin (2017) posits that this research contributes to an understanding of the socioeconomic impacts of cyclones and helps to determine recommendations to lessen the effects of such storms in this region. In addition, the findings of this study will serve as a practical and useful model in the field of disaster risk reduction and cyclone management. This model will facilitate the execution of analogous research endeavors.

Objectives of the study

1. To examine the socio-economic impacts of cyclones on the communities of Pangasia Union.
2. To identify and analyze the existing adaptation strategies employed to mitigate the socio-economic consequences of cyclones in the study area.

METHOLODOGY

Study area

For the present study, Dumki upazila in Patuakhali district was selected. The Pangasia Union under Dumki upazila has been selected as the study region. The Pangasia Union is located in the southernmost region of the Dhumki upazila. The geographical location of the study area is specified as follows: 22°26'21.998"N, 90°18'55.001"E. The total area of the Pangasia Union is approximately 4,738 acres. The total number of words is nine. According to recent statistics, approximately 56% of the population is living below the poverty line. The predominant occupations within this Union include fishing, rickshaw or auto puller work, agriculture, and small

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business. The primary agricultural products include watermelons, khesari, mug beans, and paddy. The municipality has only three cyclone shelters. The Dumki upazila is composed of nine Union s, among which the Pangasia Union is the most economically disadvantaged and consequently the most vulnerable to natural disasters. For this impoverished community, cyclones represent a primary source of natural disaster, causing significant destruction and hardship. For the assessment, the Pangasia Union was selected in accordance with the research topic, "Analyzing the Socioeconomic Impact of Cyclones". The study objective is to examine the villages within the Union that are predominantly vulnerable to cyclone hazards. Within the designated area, the socioeconomic status of the populace is particularly vulnerable.

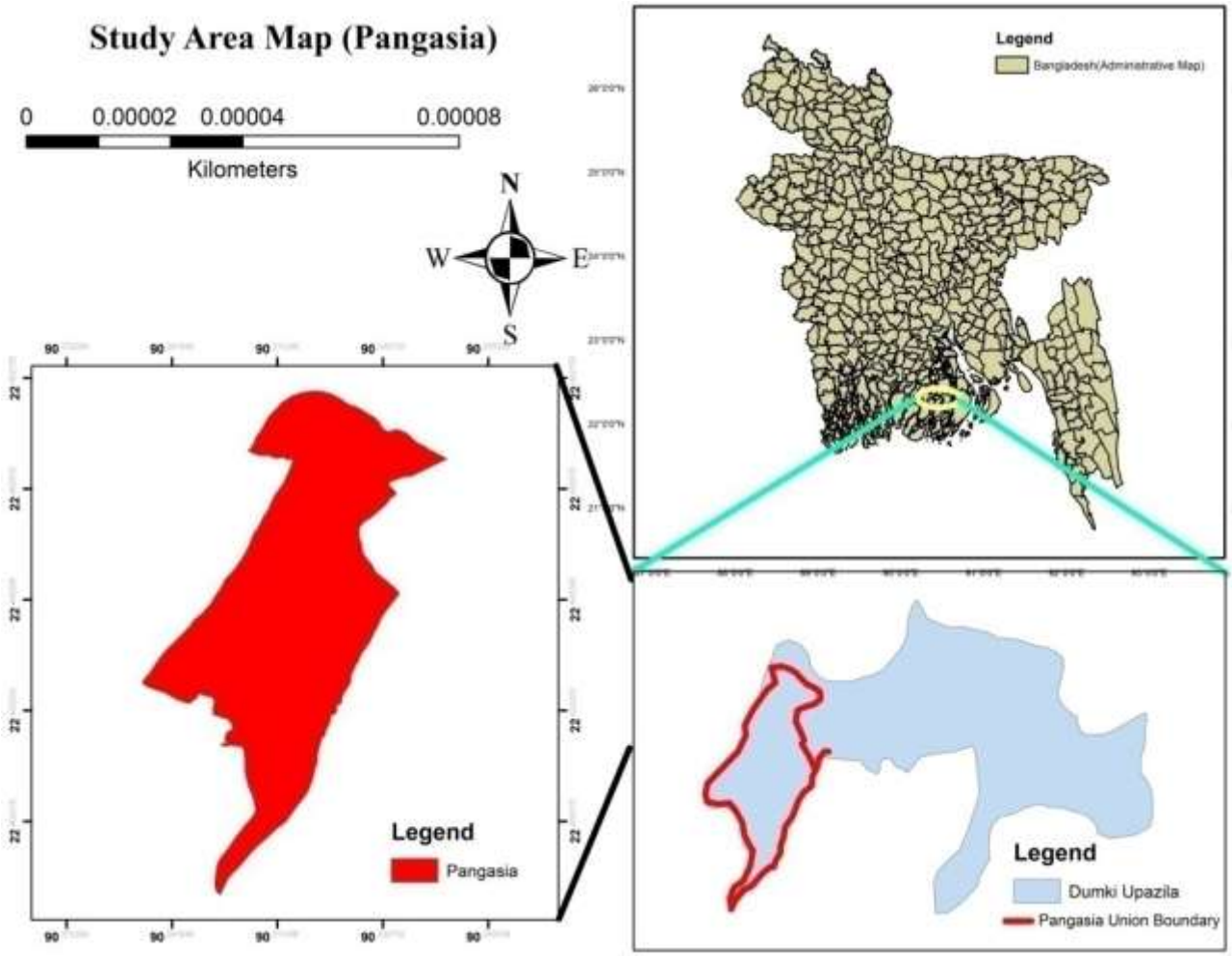

Figure 1: Location of the study area

Data sources & Data collection methods:

This study adopted a mixed-method approach, combining both primary and secondary data sources to assess the socio-economic impacts of cyclone at Pangasia union. The primary data was collected directly from community members, local stakeholders, and institutional representatives through household surveys, key informant interviews (KII), and focus group discussions (FGDs). A total of 100 household surveys were conducted using a semi-structured questionnaire designed to capture both quantitative and qualitative insights. Respondents were selected using purposive and stratified sampling, ensuring diversity across gender, age, socio-economic status, and geographic location within the location.

To enrich the understanding of institutional dynamics and operational practices, one Key Informant Interview (KII) was conducted with a Manager from the BRAC in Pangasia region. This KII provided insights into government policies, shelter design protocols, maintenance challenges, and community engagement strategies. In addition, three Focus Group Discussions (FGDs) were conducted to capture community-level experiences and collective opinions for using a guiding checklist to explore the socio-economic impacts of cyclone in different sectors.

Secondary data were gathered from relevant literature, official reports, and academic publications. Sources included the Disaster Management Bureau (DMB), Bangladesh Meteorological Department (BMD), Local Government Engineering Department (LGED), and previous studies published in peer-reviewed journals. These secondary materials were used to contextualize primary findings and validate the research framework.

Applied methodology

It is vital to possess valid method to conduct a study. The authors have utilized equally qualitative and quantitative strategy to accomplish objectives of this research. To begin with, qualitative analysis involves 100 household survey at 95% confidence level. On the other hand, quantitative analysis has been diagnosed with Microsoft excel data analysis software. Moreover, the study area map is prepared by the help of Arc GIS 10.5.

The sample size is calculated through the following equation

Sample size calculation equation is elucidating by –

$\eta = \sqrt{(1.96 \times \sigma)}/P$..... (i)

Where, σ = standard deviation, η = sample size, P =proportion to be estimated = 0.5, t =1.96 at 95% confidence level.

The study consisted of a combination of primary and secondary data collection methods from various sources. Information for this study has been collected through primary sources and secondary data sources. Secondary data was collected for a brief literature review.

RESULTS AND DISCUSSION

Respondent profile

Pangasia Union is susceptible to the impact of cyclones. It has been reported that the region is subject to the occurrence of numerous cyclones on an annual basis. The study revealed that approximately 60% of the respondents identified as male, while the remaining 40% identified as female. In the local context, the male progenitor of a family unit typically accrues the highest level of financial resources. Women are responsible for planning domestic activities and, on occasion, collaborate with men to ensure the well-being of their families. The average household is comprised of five members, and most of them are dependent on the income of a single male.

Occupational ratio of the respondents

In the designated study area, the predominant economic activity was agriculture. Fishing activities constitute the second primary livelihood option in this region. It is estimated that approximately 40% of families derive their livelihoods from agricultural pursuits. The subjects of this study have their own land, on which they cultivate their necessary crops. Approximately 12% of the population derives from fishing. According to recent studies, approximately 18% of the population is responsible for household chores. A proportion of the population, estimated at approximately 14%, derives income from temporary employment. A negligible percentage of families, amounting to approximately 4%, derive income from commercial activities such as shopkeeping. A slightly higher proportion, amounting to about 7%, earns money through the operation of rickshaws. A negligible percentage of families, amounting to approximately 5%, are involved in diverse occupational sectors and service domains. The local populace primarily relies on agriculture for its economic sustenance, engaging in the cultivation of the land to generate revenue. However, annual crop production is subject to considerable disruption due to the occurrence of cyclones.

Monthly average income

There is one main source of income for the people in this area. People achieve money on a monthly or daily basis. The figure shows the monthly average income of people. About 3% people earn less than 5000 BDT

monthly, 20% people earn 5000-10,000 BDT, and 27% people earn 10,000-15,000 BDT monthly. About 50% of people earn 15,000-20,000 BDT to survive their family.

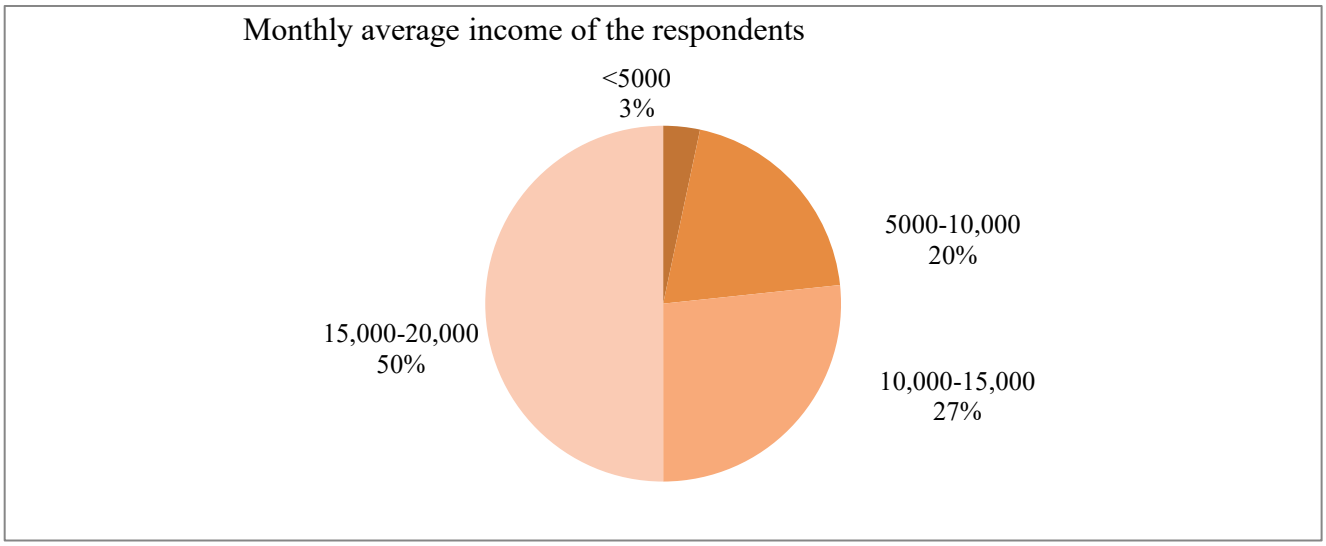

Figure 2: Monthly average income of the respondents. (Source: field survey, 2024)

This Union is predominantly characterized by economic disadvantages, with a significant proportion of its members subsisting below the poverty line. The overall quality of life within this demographic is notably ordinary. Due to their limited financial resources, the impact of the cyclone can intensify their efforts to attain the basic necessities. Furthermore, their economic constraints hinder their ability to reconstruct or refurbish their dwellings in the aftermath of the cyclone.

Intensity of cyclone in the study area

The intensity of cyclones in this region is notably high. The results of the field survey indicate that 50% of the areas were strongly impacted by cyclones, while 30% of the areas experienced significant damage from these storms. A mere 15% of the region is subject to medium-level cyclone damage, while a negligible 5% is directly impacted by these storms. Consequently, the region has been designated a "very cyclone-prone zone." In this area, the fifth ward is predominantly susceptible to cyclone hazards throughout the total nine wards.

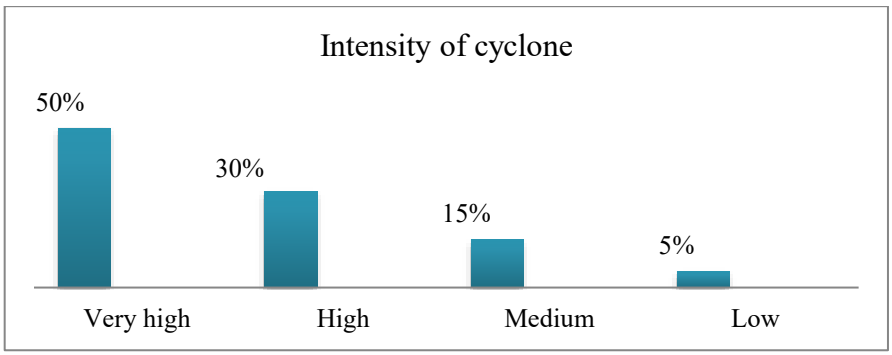

Figure 3: Intensity of cyclone in the study area (Source: Field survey, 2024)

It is an annual occurrence that this region is subject to the impact of cyclones. During periods of intense and frequent cyclones, the phenomenon is particularly pronounced. Most of the farmers have incurred substantial economic losses because of the cyclone. During the cyclone, a storm surge of saline water resulted in the complete destruction of the fish population in the pond.

Cyclone frequency by times per year

The field survey has also revealed that the cyclone has a frequency of more than one occurrence per year. According to the respondents' assessments, cyclones manifest approximately once per cent of the year. This

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phenomenon manifests itself three to four times per year in approximately 18% of cases. In contrast, it occurs two to three times per year. In addition to the 8% of cases mentioned, lower cyclones are also present in this area, occurring 1-2 times annually. Although this phenomenon occurs approximately two to three times per year, its deleterious effects on the area are invariably destructive.

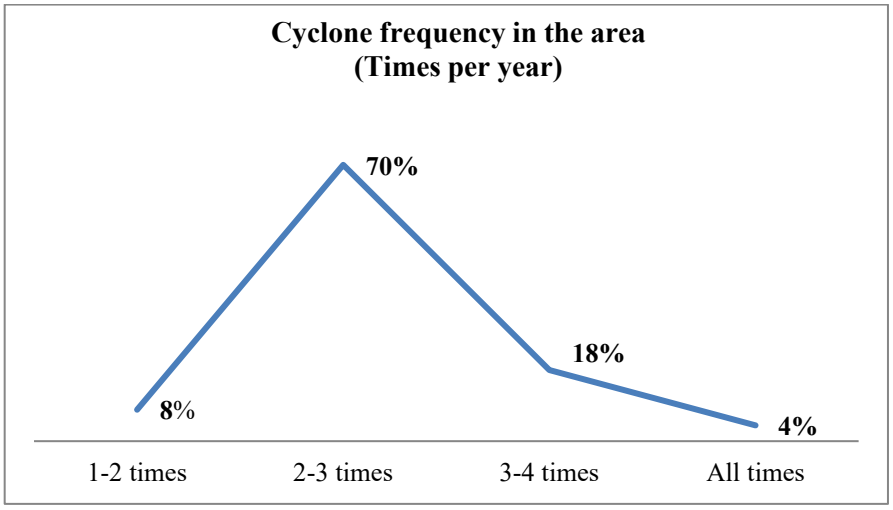

Figure 4: Cyclone frequency in the study area by times (Source: Field survey, 2024)

The respondents' assessments indicate that the area is subject to cyclones with a frequency of at least two to three times per year. The population of this region is predominantly impoverished, and there is a lack of awareness regarding cyclones and their mitigation strategies. Consequently, there is an absence of any preparedness measures implemented to mitigate the impact of cyclones.

Analyzing the socio-economic impacts of cyclone in the study area

Sectors which mostly damage due to cyclone

Cyclones in coastal regions can have a significant impact on a lot of different sectors. It is known from the field survey that cyclones are among the most common disasters and cause the largest amount of damage. It may be concluded from the thoughts of the respondents that cyclones have a significant impact on nearly every sector. Approximately 45% of the damage in this case probably happens in the agriculture sector, 10% in livestock, 8% in fisheries, 4% in health, 18% in water and sanitation, and 15% damage occurs in households or infrastructure.

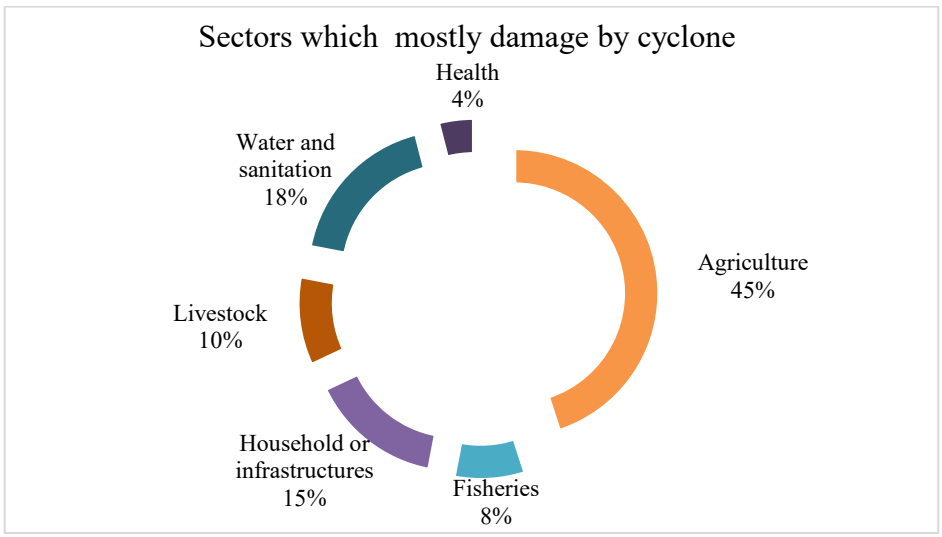

Figure 5: Sectors which mostly damage due to cyclone

Cyclones have the potential to render agricultural lands unsuitable for cultivation. Excessive cyclone activity has been demonstrated to exert a deleterious effect on fish production, disrupting the reproductive cycles of fish and

thereby reducing overall fishery productivity. In the aftermath of a cyclone, the repercussions on public health are manifold. Among the most salient are water contamination and compromised sanitation, which collectively impede the maintenance of optimal health conditions. It is susceptible to infection by waterborne diseases. Furthermore, the deleterious effects of cyclones have been demonstrated to impede the growth of livestock. A field survey revealed that, in the aftermath of Cyclone Sidr, one farmer lost three cows, with an estimated economic value of 30,000 BDT. Cyclones have been shown to result in substantial economic losses, often affecting both households and infrastructure. The majority of the population in this region is economically disadvantaged, and the majority of their dwellings consist of structures with a tin roof. Consequently, during a cyclone, the damage incurred is significantly more extensive.

Impact of agriculture

The findings of the field survey indicate that the agricultural sector is particularly susceptible to the impact of cyclones. It is estimated that approximately 50% of the total yield of paddy was lost due to the devastation caused by a cyclone.

Most affected crops due to cyclone in the study area

Cyclone disasters have been a recurring phenomenon in the region, exerting a deleterious effect on agricultural productivity. The severity of the cyclone is intensifying, exerting a growing impact on the yield of seasonal crops. In the aftermath of the cyclone, the inundation of flood water resulted in the destruction of agricultural crops. This event precipitated the loss of livelihoods for individuals who had customarily cultivated crops within the field. As illustrated in Figure 10, paddy (40%), wheat (10%), mustard (2%), peanut (20%), mung bean (25%), and chill (10%) have been identified as the most vulnerable crops. The findings, derived from field surveys, indicate that the production of paddy, peanut, and mung bean has been significantly impacted in this region due to the cyclone.

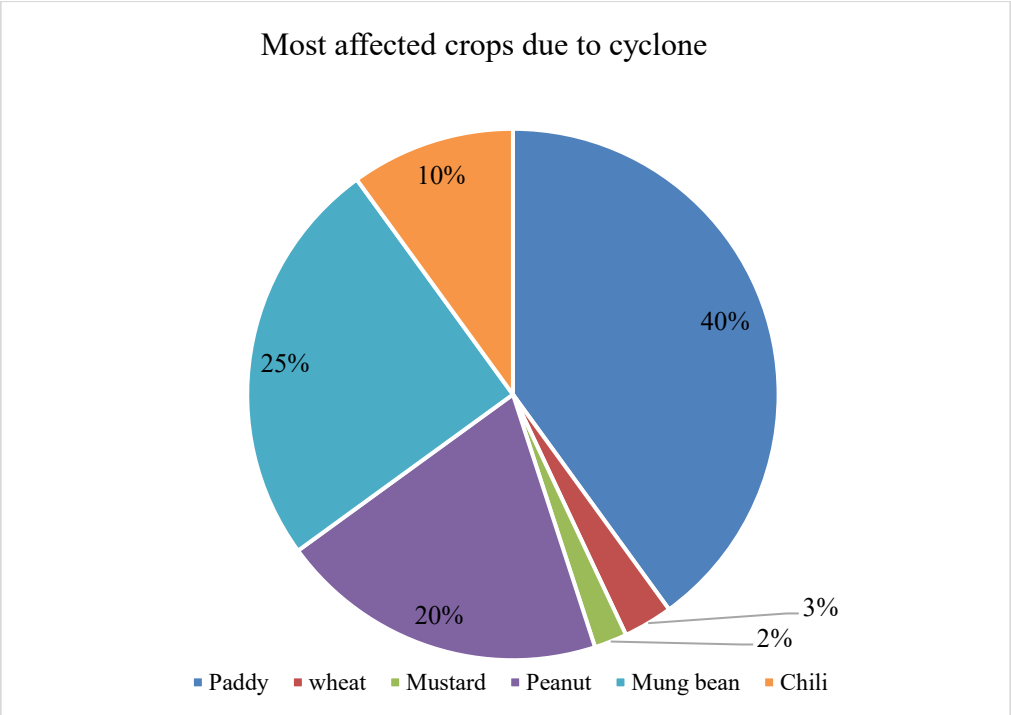

Figure 6: Most affected crops due to cyclone (Source: Field survey, 2024)

Paddy exhibits a high degree of sensitivity to cyclones. The deleterious effects of rainwater on rice crops are well documented. When it washes away the paddy field, it has been shown to adversely affect the germination, growth, and productivity of the crop. Mung bean demonstrates a moderate degree of sensitivity to cyclones. The ability of mung beans to withstand the impact of cyclones depends on many things. These include the stage of growth, how long and how strong the cyclone is, and the type of mung bean being grown. Every year, cyclones cause a lot of economic losses in areas where people grow rice.

Economic loss in agriculture sector

Cyclones have been shown to have a deleterious effect on agricultural production. During the peak months of cyclone activity, which occur from May to June and from October to November, agricultural production is significantly reduced. This phenomenon exerts a substantial influence on the agricultural sector of the region, thereby impacting on the economic stability of the area. According to the respondents, the economic losses can be categorized into four distinct classifications: The following percentages were observed: 15% for less than 20,000 BDT, 35% for 20,000–30,000 BDT, 32% for 35,000–50,000 BDT, and 17% for more than 50,000 BDT. Given the pervasive practice of paddy cultivation across all agricultural domains, farmers encounter heightened financial vulnerability. Paddy is the most susceptible to damage from cyclones. This phenomenon has resulted in significant economic losses for paddy growers.

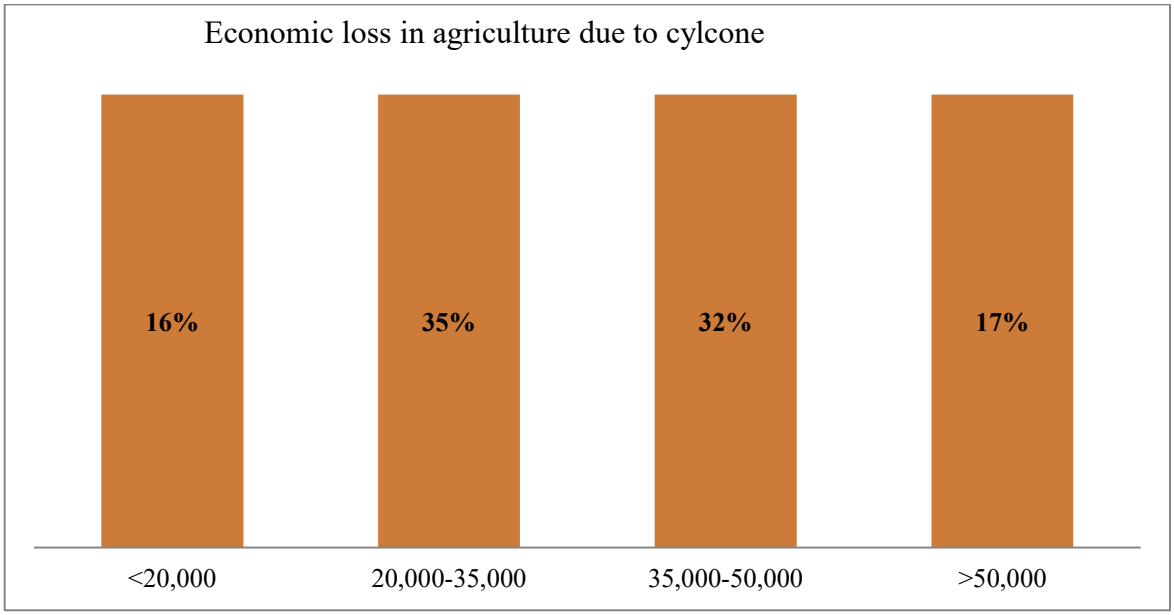

Figure 7: Economic loss in agriculture sector due to cyclone in the study area (Source: Field survey, 2024)

Most farmers encounter substantial economic losses because of cultivating paddy on their entire land holdings. Paddy is the most vulnerable crop to the impact of cyclones. This phenomenon has resulted in substantial financial losses for rice farmers. A field survey of the region's farmers revealed that they also cultivate crops on their land. In the aftermath of the cyclone, the total nut was completely destroyed, resulting in significant economic losses, as confirmed by the field survey.

Impact on fisheries

In the designated study area, aquaculture is a prevalent practice, with a significant proportion of the respondents' residences situated adjacent to ponds. Local fish varieties are cultivated for both personal consumption and commercial sales by individuals whose primary source of income is fishing. However, the state of fish culture in this region is suboptimal due to the frequent occurrence of cyclones and storm surges, which has led to an escalation in the frequency of disasters. During the cyclone, the resultant storm surge inundation effectively eradicated the fish population of the pond. Once more, the maximum pond bank remains unraised, thereby impeding the unobstructed ingress of floodwater into the freshwater sources.

Most vulnerable fisheries due to cyclone

Annually, the economic value of freshwater fisheries is diminished by 50%. Carp fishing represents prevalent aquaculture practice in this region. However, the occurrence of cyclones in the region has the potential to complicate matters. The annual economic loss resulting from carp fishing is estimated to be 50%. Despite the presence of fish farms in the region, rice-fish farming is considered a traditional integrated farming method. The aquaculture industry, which specializes in the cultivation of fish, has experienced a significant financial setback, with losses amounting to 17% of its annual revenue.

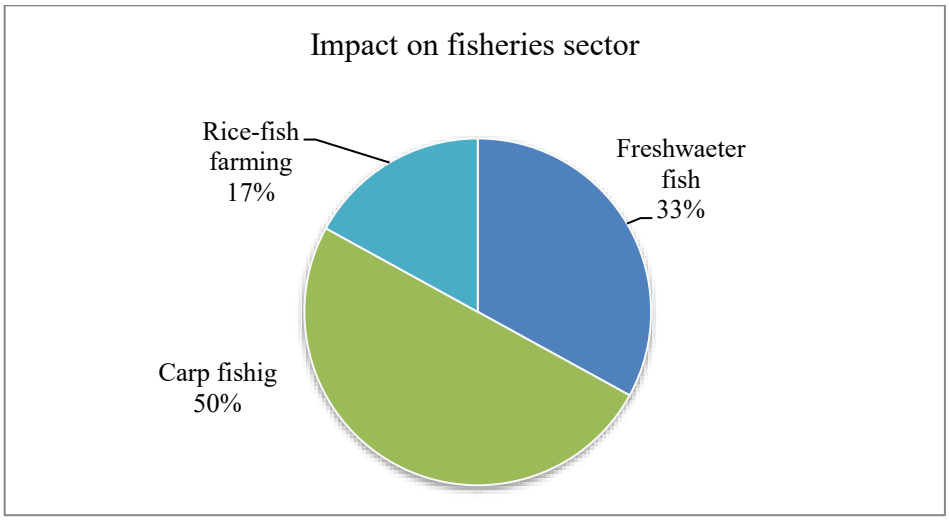

Figure 8: Most vulnerable fisheries due to cyclone (Source: Field survey)

In this region, the predominant fishing technique is carp fishing, which is predominantly practiced during cyclones. The resultant floodwaters have the potential to dislodge carp, thereby disrupting ecological balance and reducing the availability of suitable habitats for this fishing technique. Carp species, including rohu, catla, and mrigal, require an aquatic environment for optimal growth and health. In the event of a cyclone, the repercussions on the survival, growth, and overall productivity of carp farms can be deleterious. The people in this region are confronted with this problem on an annual basis, leading them to abandon hope for the revival of fish farming in their pond (Field survey). This phenomenon can impose limitations on the suitable areas for carp fishing, thereby affecting the establishment of new farms.

Impact on livestock sector

Cyclones have the potential to adversely impact on the production capacities of livestock. Freshwater supplies are often contaminated by these storms, which can make it difficult for livestock to access safe drinking water. The deleterious effects of cyclones can encompass a broad range of consequences, including but not limited to water contamination and diminished water intake, which can have a detrimental impact on the health and well-being of animals.

Annually, livestock production experiences a decline due to the impact of cyclones. As illustrated in Figure 13, the rate of drinking water scarcity for livestock due to cyclones is 30%. Additionally, the rate of reduction in grazing options for livestock is 21%. Cyclones have the potential to impact livestock production capacities. The decline in animal reproduction and fertility is 14%. The prevalence of livestock diseases due to cyclones is 35%. Exposure to cyclone environments has been shown to increase the prevalence of diseases such as foot rot, respiratory infections, fever, and skin diseases.

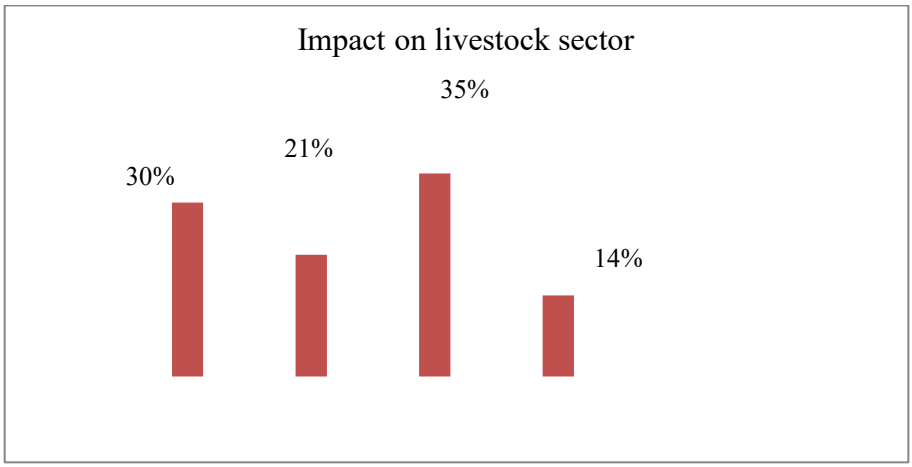

Figure 9: Impacts on livestock sector (Source: Field survey, 2024)

In the context of a cyclone, the occurrence of heavy rainfall and storm surges has been demonstrated to induce disruption to the natural system in its entirety. The contamination of freshwater sources has the potential to impede livestock's access to clean drinking water, thereby compromising their health and well-being. It has been demonstrated that cyclones of a high magnitude and frequency have the potential to result in significant diseases affecting animals. The stress induced by cyclones has been demonstrated to result in a variety of reproductive issues, including reduced fertility rates, decreased birth weights of offspring, and an overall decline in the reproductive performance of livestock. Livestock subjected to cyclone stress demonstrates an increased susceptibility to diseases and infections. It is postulated that diseases such as foot rot, respiratory infections, and gastrointestinal disorders may increase in prevalence among livestock exposed to an environment disrupted by a cyclone.

Economic losses on livestock sector

For livestock farmers in the Pangasia Union, the combined effects of decreased production, declining fertility, rising healthcare costs, and the possible loss of livestock could lead to significant financial losses. In the livestock sector, the rate of economic loss is as follows: The data indicates that 22% of respondents reported an income below 10,000 BDT, 41% reported an income between 10,000 and 20,000 BDT, 21% reported an income between 20,000 and 30,000 BDT, and 16% reported an income above 50,000 BDT.

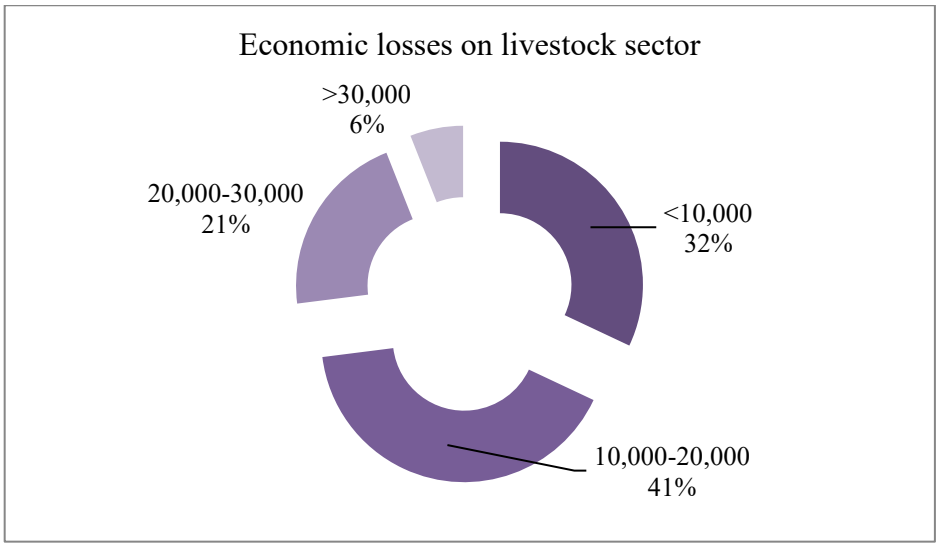

Figure 10: Economic loss on livestock sector (Source: Field survey, 2024)

In this region, a significant number of individuals have experienced the loss of their domestic animals due to the adverse environmental impact of cyclone disasters. During Cyclone Sidr in 2007, a farmer experienced the unfortunate loss of three cows, each possessing an economic value of 30,000. As indicated by the findings of the field survey conducted in 2024, diminished milk production has a deleterious effect on farmers' livelihoods, given that many of them are dependent on livestock for their income. This decline in production has been accompanied by weight loss in the affected animals.

Impacts on Household or infrastructure

The maximum population density of the Pangasia Union is located below the designated property line. Flooding resulting from cyclones has been demonstrated to have deleterious effects on infrastructure, including the deterioration of components, increased maintenance costs, a reduction in infrastructure lifespan, and the potential for failure.

Maximum household types in this area

The impact of the cyclone on household infrastructure has been substantial. The degree of damage to household property is contingent upon the intensity of the cyclone. The populace of this region is particularly susceptible to the impact of cyclones, a susceptibility that is largely attributable to the nature of their housing. As illustrated

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in Figure 15, the prevalence of tin-shaded structures stands at 55%, while the proportion of pucca houses is recorded at 24%. The figure further reveals that the presence of *khacha* (highly vulnerable) houses is 9%, and the remaining 12% consists of other types of structures. The data suggests a correlation between the prevalence of tin-shaded buildings and the presence of inadequate household infrastructure. Consequently, the populace of this region is susceptible to the threat of cyclones.

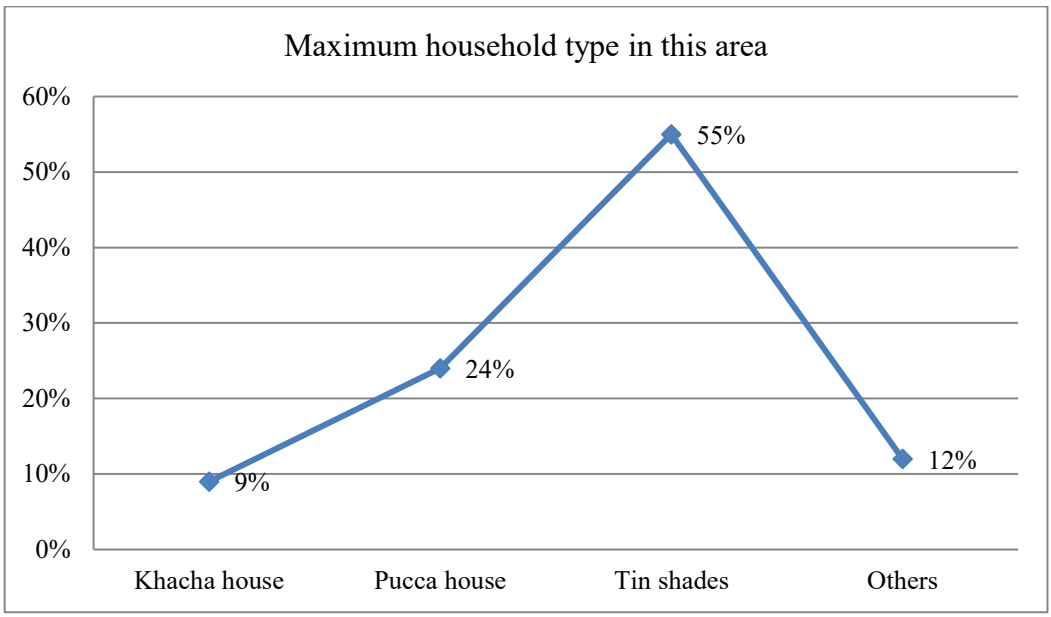

Figure 11: Maximum household types in this area (Source: field survey, 2024)

Bangladesh is a nation that is undergoing underdevelopment. Notwithstanding the rapid economic growth that has been observed, the issue of poverty remains a significant concern. In this region, the maximum household is tin-shade construction, which is particularly vulnerable to cyclones. Consequently, during periods of heavy rainfall, the situation is exacerbated, causing further hardship for those affected.

Impacts on human health

A cyclone has the potential to contaminate drinking water. The populace of this region is apprehensive about cyclones. Moreover, they exhibit a diminished inclination to seek refuge in the designated cyclone shelters during the occurrence of a cyclone. A comparative analysis reveals that the phenomenon exhibits a minimal direct impact on human health. The occurrence of water-borne diseases is precipitated by the impact of a high-intensity cyclone, which enables the entry of water into residential structures. As illustrated in Figure 16, the prevalence of waterborne diseases attributable to cyclones is 16%, the incidence of malnutrition is 19%, and the rate of inadequate health and hygiene is 10%. The figure also indicates that the proportion of individuals experiencing high levels of stress and anxiety is 55%.

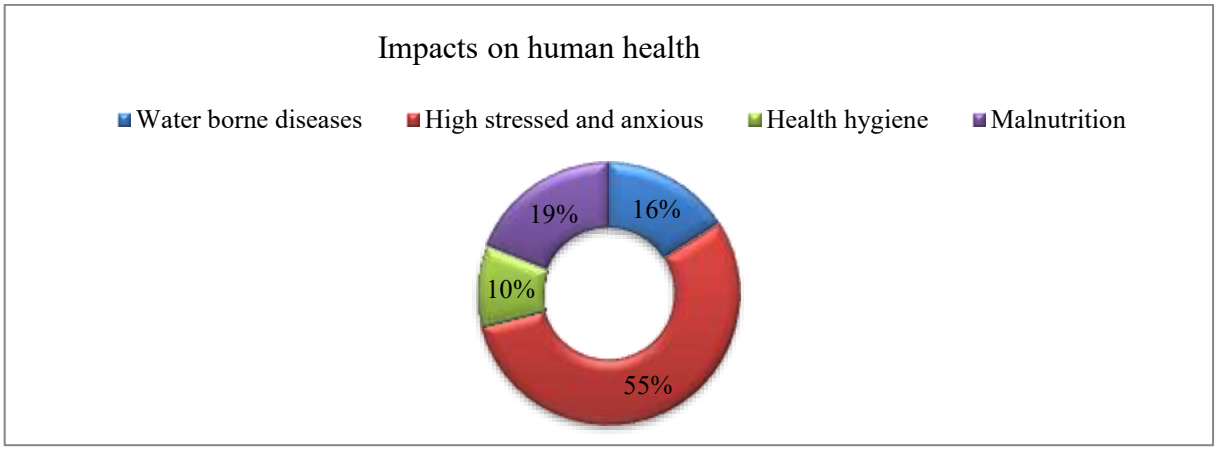

Figure 12: Impacts on human health (Source: Field survey, 2024)

In the context of cyclones, the infiltration of rainwater into residential structures precipitates conditions conducive to waterlogging. This phenomenon has been observed to contribute to the proliferation of waterborne diseases, including diarrhea, dysentery, and cholera, among the affected population. Cyclones and storm surges have recently been identified as catastrophic events for coastal communities, with indirect consequences for numerous individuals throughout the country (Hague et al., 2019). Furthermore, there has been a noted increase in stress and anxiety levels among affected populations during the cyclone. In this region, the population is predominantly affected by fever due to heavy rainfall coinciding with cyclones.

Social impacts due to cyclone

According to the respondents, the cyclone exerted minimal influence on the social aspects of the region's way of life. In regions where social bonds are less robust, the repercussions of cyclone damage can occasionally give rise to conflict, stemming from the decline in production from fisheries and agricultural sectors.

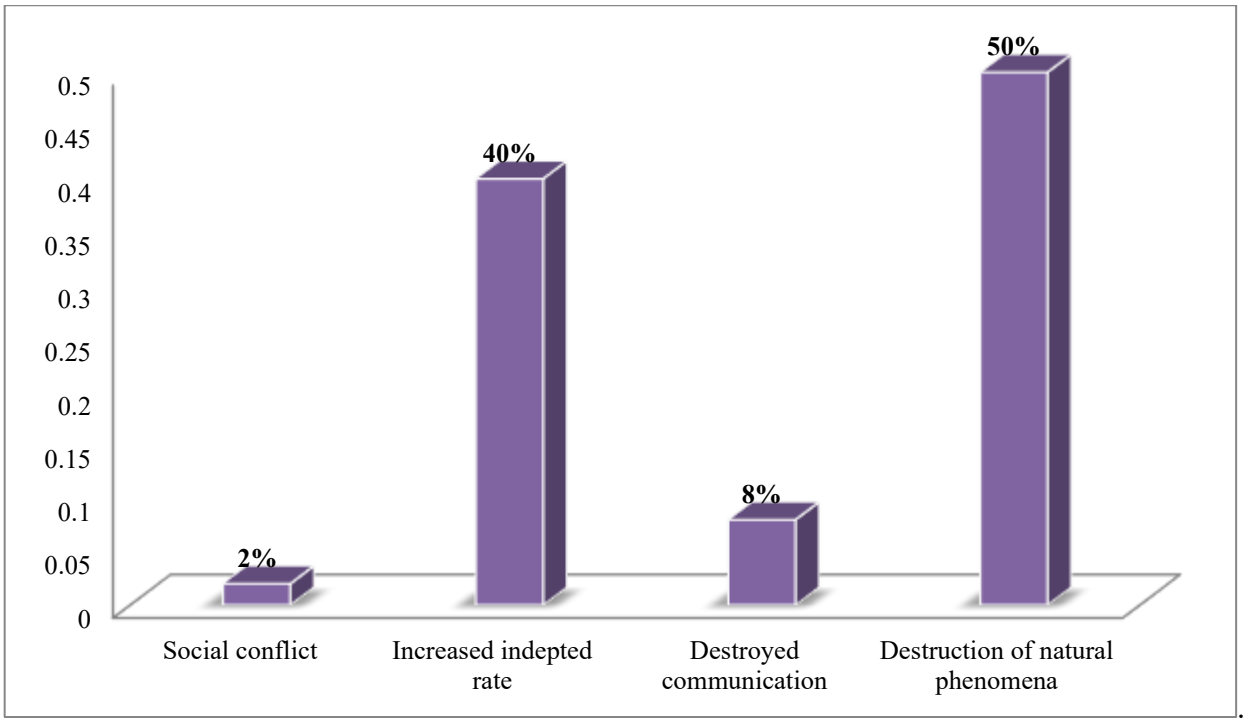

Figure 13: Social impacts due to cyclone

Cyclones have the potential to adversely impact family relationships, particularly by diminishing communication. The impact of cyclones frequently results in an increase in the number of indebted individuals, owing to the loss of their production. One of the most salient social and environmental issues is its potential to cause a complete disruption to the natural system that is the foundation for the development of other social problems and conflicts.

CONCLUSION AND RECOMMENDATION

The coastal regions of Bangladesh are particularly vulnerable to the multifaceted consequences of climate change. The coastal regions of Bangladesh are particularly vulnerable to the impacts of cyclones due to their geographical positioning and exposure to the open ocean. The geographical characteristics of coastal zones have been shown to exacerbate the impact of cyclones, with low-lying areas being particularly vulnerable to inundation. Coastal communities face a heightened risk of displacement and destruction of infrastructure. From an economic perspective, the repercussions of cyclones in coastal regions are substantial, impacting industries such as agriculture, fishing, and tourism. These consequences are further compounded by the financial obligations governments incur in the aftermath of these disasters, necessitating substantial reconstruction efforts. It is imperative for nations to acknowledge the multifaceted nature of cyclones, encompassing both the underlying causes and the potential ramifications. These phenomena, which have the capacity to affect any country at any moment, underscore the necessity for comprehensive understanding and preparedness. It is

imperative to allocate sufficient attention to this matter both locally and globally in order to achieve sustainability.

The Pangasia Union is a region of considerable vulnerability to the impact of cyclones. The geographical location of the Union is subject to the occurrence of cyclones with high frequency, which has the potential to result in considerable destruction to infrastructure, residential structures, and agricultural crops. The study's findings encompass a thorough examination of the adverse ramifications that cyclones exert on the socio-economic well-being of the local populace. Annually, cyclones result in damage across various sectors, particularly the livestock sector. The agriculture sector is particularly vulnerable to the destructive force of high winds and excessive rainfall, which hinders potential crop production. Consequently, the direct impact of these events on the livelihoods and income sources of the affected population is significant. Furthermore, the diversity of species in the fisheries sector has been diminished. A significant proportion of the population is economically disadvantaged and lacks formal education in disaster-related subjects, resulting in a dearth of adaptation strategies and technical expertise necessary to sustain livelihoods in the face of escalating cyclone impacts.

The issues mentioned earlier have put a lot of pressure on the region's economy. The implementation of such adaptation strategies has the potential to mitigate the adverse effects of cyclones in this region. The implementation of proper awareness initiatives and the development of adequate infrastructure can contribute to the establishment of a sustainable solution for mitigating the socio-economic impact of cyclones in the coastal regions of Bangladesh.

Pursuant to an exhaustive observation, discussion, and analysis, the following recommendations are hereby proposed to alleviate suffering and enhance the quality of life for vulnerable communities affected by cyclones.

1. Investing in robust early warning systems (EWS) that can accurately predict the path and intensity of cyclones is paramount. This enables authorities to disseminate timely alerts, affording individuals and communities additional time to prepare and evacuate if necessary.
2. To ensure the resilience of infrastructure in the face of cyclones, it is imperative to implement measures such as the construction of cyclone-resistant buildings, the installation of flood barriers, and the reinforcement of power and telecommunication lines. The retrofitting of existing infrastructure to enhance its resilience is also of paramount importance.
3. It is imperative to implement periodic drills and educational initiatives to enhance public awareness regarding the risks associated with cyclones and the measures necessary for preparedness. It is imperative that communities are encouraged to develop comprehensive disaster preparedness plans, which include the establishment of evacuation routes and shelters.
4. The practice of planting trees and restoring forest ecosystems has been demonstrated to contribute to the stabilization of soil, the reduction of erosion, and the mitigation of the impacts of heavy rainfall associated with cyclones. Forests function as natural buffers against landslides, mudslides, and flash floods, thereby protecting communities and infrastructure.
5. Governments have the capacity to establish dedicated coordination mechanisms, such as inter-agency task forces or working groups, with the objective of facilitating coordination and collaboration between government agencies and NGOs involved in cyclone mitigation.

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