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Climate Change Tempted Disaster Instigated Human Migration in the Coastal Districts of Bangladesh

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Abstract: Climate change is one of the world's major issues and its impact particularly on migration is attracting increased attention for policymakers and experts. The purpose of this study was to assess the effects of climate change on human migration and to highlight the number of migrants in Bangladesh's coastal areas. The research was carried out in the Barishal division's Barguna, Barishal, Bhola, Jhalokati, Patuakhali, Pirojpur, and Khulna division's Khulna, Bagerhat, and Satkhira districts using focus group discussion (FGD), key informant's interview (KII) and secondary data sources. The research findings are based on both primary data and secondary data gathered from various sources, which were conducted in nine coastal districts of Bangladesh from mid-February to mid-March 2020. This paper contains mapping by analyzing secondary information using ArcGIS 10 software of Geographic Information System technology. The study revealed the scenario of human migration and displacement in nine southwest districts due to different natural calamities like cyclones, riverbank erosion, floods, storm surges, and salinity intrusion. From household survey it was found that coastal erosion influenced about 74.73% people and floods forced only 3.51% of people to migrate. From 2014 to 2020, the highest and lowest disaster induced migrants have been found in 2017 and 2020. In addition, from 2014 to 2020, maximum and minimum migrants were in Barishal, and Jhalokati, separately in a row. In 2020, maximal and minimal number of migrants have been noted in Patuakhali and Satkhira with 38715 and 1900 migrants, respectively with the maximum disaster-induced migration in Barishal division. This research would be a great source of information for future investigations concerning human migration and displacement across the coastal districts of Bangladesh.

Keywords: Climatic stress; Disaster; Migration density; Displacement; Coastal districts; IDW interpolation

INTRODUCTION

Bangladesh is one of the most susceptible to the effects of climate change in the Global Climate Risk Index from 1993 to 2012 (Kreft et al., 2013). In Bangladesh among 64 districts, 19 cover the coastal zone whilst the natural disaster induced migration and displacement is higher in Barishal than Khulna (Sarker et al., 2019). The environmental degradation that is occurring in many rural areas is leading to an increase in people migrating from rural area to urban, which has been an usual occurrence in Bangladesh since long (Sen, 2003; Afsar, 2003; Walsham, 2010). The most climate-vulnerable locations frequently see temporary migration, which is thought to be an adaptive reaction to climatic stress. On the other side, people permanently move to other places after being destitute by disasters (Mollah and Ferdaush, 2015). However, either being forced to be migrants or other reasons, human migration is the most substantial consequence of climate change today and upcoming decades (Morton et al., 2008; Steiner, 2008).

Existing literature shows that several devastating disasters have struck the coastal parts of Bangladesh that pushed large number of people being displaced and taken shelter in nearby countries (Akhter et al., 2016). The coastal area is inhabited by 35 million people, making up roughly 25% of the country's population. The density of population currently stands at 738/km2 and is expected to touch 50

million by 2050 (OECD, 2003). The Bangladesh Centre for Advanced Studies estimated that if the water level rose by one meter, 17.5% of the land area would be flooded, forcing 11% of the population to migrate. This would cause a staggering 20 million people to become environmental refugees, posing a great challenge for Bangladesh due to its dense population (BCCSAP, 2009). Between 2008 and 2014, the Internal Displacement Monitoring Centre reported that 4.7 million people were displaced in Bangladesh as a result of disasters (IDMC, 2015). According to the Riverbank Erosion Impact Study, bank erosion is occurring in about 94 of the 462 upzillas, and it is decreasing in about 50 of the 64 zillas. It is indicated that flooding-related erosion and land flooding brought on by sea level are important causes of migration from Bangladesh (Swain, 1996). Estimates suggest that between 64,000 and 1 million Bangladeshi citizen become homeless each year as a result of riverbank erosion (Haque and Zaman 1994; Lein 2000; Siddiqui, 2005). Bangladesh has been hit by six disastrous floods in the last three decades, with 45 million and 30 million people affected by the floods of 1988 and 1998, respectively (Shamsuddoha et al., 2012). Meanwhile, each year more than 1,000,000 individuals in the country lose their homes due to riverbank erosion (RMMRU, 2007). In the years 2007–2009, storm surge and tropical cyclones affected roughly 9.2 million people in Bangladesh's South Coast region. Floods affected 19.3 million people in Bangladesh between 1984 and 2007, affecting the entire country (Alam, 2011).

Moreover, Khulna, Satkhira, and Bagerhat districts are especially susceptible to the effects of climate change as proven by the destruction caused by Super Cyclone Sidr in 2007 and Cyclone Aila in 2009, leading to human displacement and migration (Bahauddin et al., 2016). With an estimated 100,000 people migrated from four upazillas of Khulna district namely Koyra, Paikgacha, Dacope and Batiaghata (ECHO, 2009; Islam and Hasan, 2016). This displacement was caused by the destruction of homes due to extended waterlogging, the lack of job opportunities, as well as a dearth of access to fresh drinking water and sanitation facilities (Ahmad et al., 2019; Mehedi et al., 2010). In Barishal division, Barishal, Bhola, Barguna districts are most vulnerable to different natural calamities (Krantz, 1999; Biswas and Islam, 2017). The Bangladesh Water Development Board's fifteen-meter embankment was breached in the East Ilisha union of Bhola, resulting in severe flooding and a shortage of access to basic requirements (UNB News, 2020). It has been predicted by World Bank studies that between 16 and 26 million populaces will be displaced from their households in the years between 2011 and 2050 due to natural disasters such as floods, riverbank erosion, storm surges, and sea level rise. Additionally, approximately 2-5 million will be forced to move because of riverbank erosion, 5-7 million due to coastal storm surges, 6-8 million due to rising sea levels, and 3-6 million due to inland flooding (Siddiqui, 2017).

In the recent past, Geographic Information System (GIS) has increased the accessibility in the spatial pattern of human migration and displacement in order to develop map and assess the vulnerability of human lives in coastal areas became an excellent tool for migration flow (Yano et al., 2000). This study aims to analyze the current state of human migration and displacement due to extreme weather conditions in the coastal districts of Bangladesh using Geographic Information System (GIS).

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MATERIALS AND METHODS

Study Area

The coastal area of Bangladesh consists of 19 districts covering 47,211 km² and is regularly affected by climate phenomena and man-made hazards. The most prominent disasters like cyclones, floods, storm surges, droughts, environmental pollution and river erosion (DMB, 2010) affect coastal communities. Every year different disasters drive a vast amount of people to become migrants, especially in the coastal zones of Bangladesh. About 35 million people living in the coastal regions in this country are front line victims of climate change and natural disasters. Twelve of the coastal districts covering 50 percent of the land area of the coastal zone already face a combination of cyclone risk, salinity, and tidal water movement above critical levels. In Bagerhat, Bhola, Noakhali, and Satkhira, vulnerabilities in term of insecurity of food, income, water, health, and poverty are prominent. This study has been conducted in nine districts among 19 coastal districts namely Khulna, Satkhira, Bagerhat districts from Khulna Division and Barishal, Jhalokati, Bhola, Barguna, Patuakhali and Pirojpur districts from Barishal Division. Figure 1 shows the study areas of the coastal districts with their boundaries.

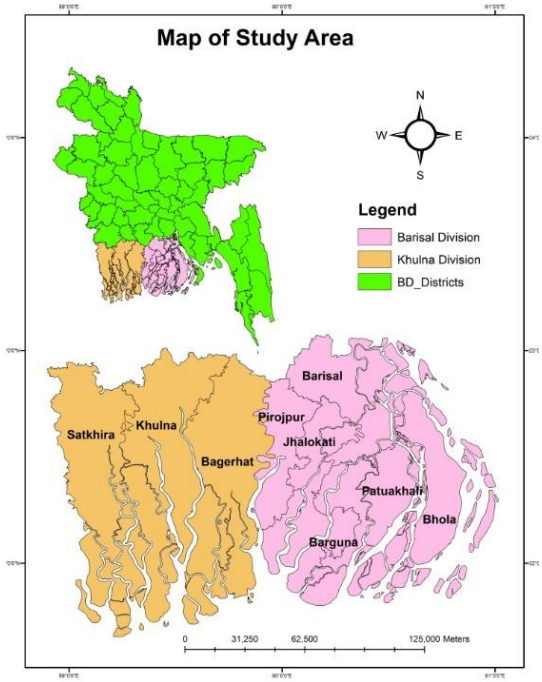

Figure 1. Study Area

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Data Collection and Analysis

This research is based on both primary data accumulated from Focus Group Discussion (FGD), Key Informant's Interview (KII), household survey, and secondary data collected from onsite. Data have been collected from February 2020 to March 2020. For this research, five FGDs in five districts (Khulna, Satkhira, Barishal, Patuakhali, Bhola) have been conducted. In household survey people were chosen randomly and asked if they were displaced due to natural disasters or not. On the other hand, district wise migration data have been gathered from DC office of the respective districts, Internal Displacement Monitoring Centre (IDMC), and Bangladesh Bureau of Statistics. A survey was conducted using the upazilla as the smallest unit, and a census/household listing of enumeration areas was conducted to ensure reliable data. Data of Population Census 2011 published by Ministry of Planning, GoB has been followed thoroughly. Microsoft Excel and ArcGIS 10were then used to analyze the collected information. GIS spatial analyst tools, interpolation (Inverse Distance Weighted) have been used in developing maps, and approximately 8 km^2 has been used as a grid size.

RESULTS AND DISCUSSION

New displacement in last decade in Bangladesh

The information on climate induced migration is very limited in Bangladesh. The number of populaces who are migrating due to ecological distresses and global climate change is often disputed (Black et al., 2008; Black 2010; Castles 2002). The main motivators for moving from one residence to another within the region were economic reasons. Migration decisions also depend on the severity and intensity of a climatic event. Bangladesh is particularly susceptible to disasters due to its geography, as coastal regions are exposed to extreme weather events like cyclones, sea-level rise and storm surge, leading to devastating consequences. According to Myers (2005), increased heat might displace as many as 200 million due to the interruptions of the monsoon scheme and other precipitation systems, by sea-level rise, droughts and coastal flooding. People tend to migrate from their home areas to nearby towns and cities in exploration of a range of potential income sources. The draw of such opportunities is often what drives people to move away from their original locations. According to IDMC new displacements in recent years in entire Bangladesh is shown in figure 2

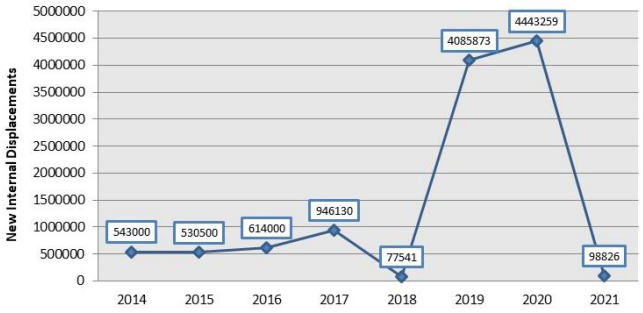

Figure 2. Year wise new internally displaced people in recent years in Bangladesh

Figure 2 shows data on internally evacuated people in past eight years in Bangladesh due to different climatic events. Bangladesh is a country that is especially prone to a diversity of natural disasters such as cyclones, flash floods, landslides, floods, and riverbank erosions, making it particularly vulnerable to geologically-related catastrophes. It is seen that the highest digit of internally displaced people has been recorded in 2020 whereas, the lowest one was in 2018.

Migration scenario of coastal districts in Bangladesh in last seven years

To reinforce the research, pertinent secondary information has been procured from the Bangladesh Sample Vital Statistics Reports of the Bangladesh Bureau of Statistics from 2015 to 2021, a survey that was initially administered in 1980 to evaluate the modifications in Bangladesh's demographic situation over the intercensal periods. The rate of in-migration and out-migration due to natural disasters is presented in Table 1.

Table 1. District wise migration from 2014 to 2020 (Source: Population Census, 2011 and MSVSB 2015-2021)

Division	Barishal		Khulna		Percentage of disaster induced migrants	
	Migration per 1000		Migration per 1000		(%)	
Year	In-migration	Out-migration	In-migration	Out-migration	In-migration	Out-migration
2014	37.5	34.3	36	34.8	3.4	2.8
2015	56.1	55.3	56	55.1	1.7	2
2016	95	93.9	80.9	81.1	1.6	1.8
2017	115.3	109.3	79.6	72.3	1.5	2
2018	95	76.7	60.9	55.7	1.2	1.4
2019	93.1	91.7	65.8	64.2	1.1	1.5
2020	83.2	70.3	60.9	56.7	1	1.1

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Table 1 presents the variation of migration rate in Barishal and Khulna division from 2014 to 2020. It is clear from the figure that, there are many fluctuations in the year wise migration rate. In 2017, Barishal Division had the highest rate of migration in and out, while in 2014 had the lowest . In the Khulna division, the highest rate of in-migration and out-migration occurred in 2016, while the lowest was seen in 2014. In 2014 and 2020, the highest and lowest proportions of migration caused by huge reported disasters . Overall, both of the divisions experienced a fluctuating trend of migration rate from 2014 to 2020.

Table 2. District wise disaster affected migrants in 2020 (Source: Population Census, 2011 and MSVSB, 2021)

Division	District	Total Population	Migration Rate per 1000		Total Migrants (According to Migration Rate)		Migrants for Disaster		Total Migrants for Disaster
			In	Out	In	Out	In (1.0%)	Out (1.1%)	
Barishal	Barguna	892781	83.2	70.3	74279.8	62762.5	742.8	690.4	1433
	Barishal	2324310			193382.6	163399	1922.8	1797.3	3720
	Bhola	1776795			147829.3	124908.7	1478.3	1374	2852
	Patuakhali	1535854			127783.1	107970.5	1277.8	1187.7	2466
	Jhalokati	682669			56798.1	47991.7	568	528	1096
	Pirojpur	1113257			92623	78262	926.2	861	1787
Khulna	Khulna	2318527	60.9	56.7	141198.3	131460.5	1412	1446	2858
	Bagerhat	1476090			89893.9	83694.3	899	920.6	1820
	Satkhira	1985959			120945	112603.9	1209.5	1238.6	2448

Table 2 presents the migration rate per 1000 in the selected nine coastal districts in 2020. In Barishal division the migration rate per 1000 for both in-migration and out-migration is higher than that of Khulna division. Migration rate for disaster affected population is 1.0% for in-migration and 1.1% for out-migration of total migrants eventually applicable for both divisions. In case of disaster's, all selected districts of Barishal and Khulna divisions had higher in-migration rate than that of out-migration.

Table 3. Year wise disaster induced migrants in investigated nine coastal districts

Division	Year / District	2014	2015	2016	2017	2018	2019	2020
Barishal	Barguna	1996	1839	2866	3496	1976	2142	1433
	Barishal	5196	4787	7461	9101	5146	5577	3720
	Bhola	3972	3660	5704	6957	3933	4264	2852
	Patuakhali	3433	3163	4930	6014	3400	3685	2466
	Jhalokati	1526	1406	2192	2673	1511	1638	1096
	Pirojpur	2489	2293	3574	4359	2465	2671	1787
Khulna	Khulna	5097	4762	6386	6121	3502	3911	2858
	Bagerhat	3245	3032	4065	3897	2230	2490	1820
	Satkhira	4366	4079	5470	5243	3000	3350	2448

Table 3 presents information about the migrants' number in respective nine coastal districts over a seven-year period from 2014 to 2020. The most significant amount of migration in the seven-year period was witnessed in Barishal in 2017 with 9,101 individuals, while the least number of migrants was observed in Jhalokati in 2020, with

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a total of 1,096. As Jhalokati is less vulnerable site to different natural disasters among all selected districts, it had minimum number of migrants in last seven years

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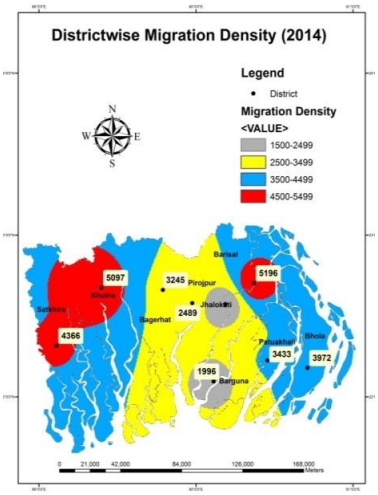

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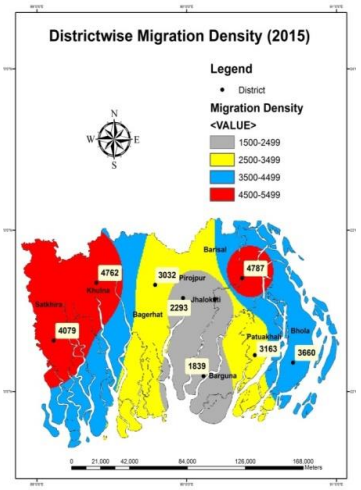

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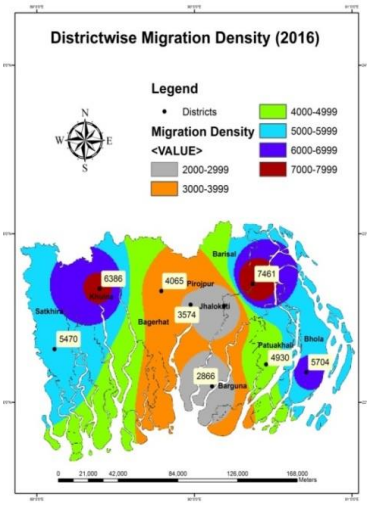

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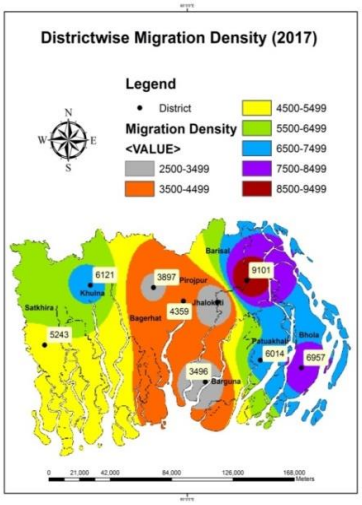

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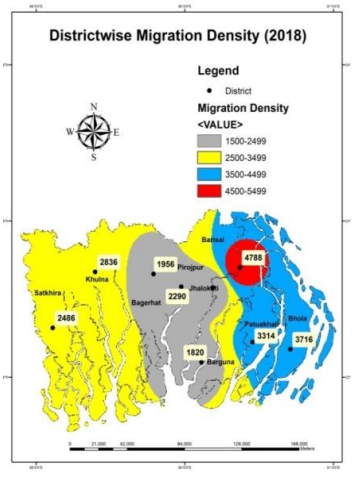

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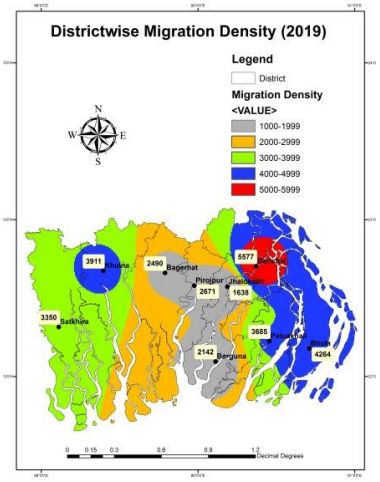

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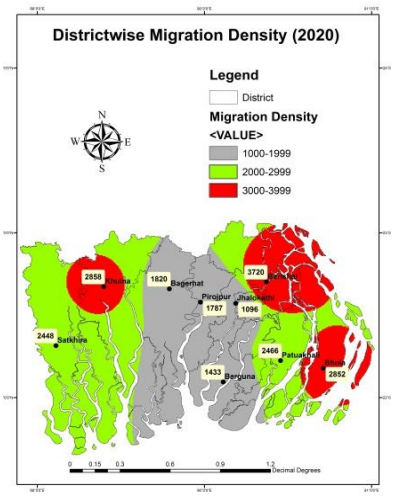

Figure 3. District wise migration density in Bangladesh (a) 2014, (b) 2015, (c) 2016, (d) 2017, (e) 2018 (f) 2019, and (g) 2020.

Figure 3 shows district-wise migrants in seven different years in Bangladesh based on Bangladesh Sample Vital Statistics. In this figure, class interval has been used as 1000 from figure (a) to (g). For MSVSB data, lowest and highest numbers of migrants were in Jhalokati and Barishal from 2014 to 2020, respectively. Due to the geographical location, Jhalokathi is not directly exposed to Bay of Bengal resulting minimum migration rate. Meanwhile, Barishal is connected to major rivers around that expose it to natural disasters most. It is also evident that highest number of displaced people in all districts found in 2016 whereas, the lowest numbers were in 2020 in most of the districts.

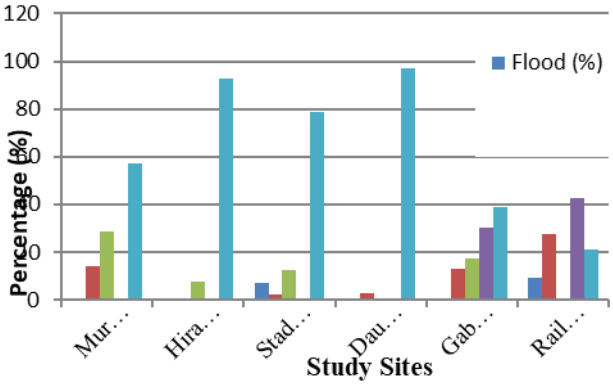

Figure 4. Migrated and displaced people due to different disasters (Source: Household Survey in Bangladesh, 2020)

Migration density due to disasters in southwest of Bangladesh

Coastal people blamed both slow and sudden onset calamities for the migration in study sites. Presence of salinity in coastal districts due to sea-level rise is affecting new areas every day. On the other hand, the intensity and frequency of sudden onset of disasters such as cyclones, river bank erosion, and tidal water incursion are also increasing. In case of Barishal division, approximately 97,105 people were displaced and in Khulna division, the number was only 16,000. By this period the GoB has established some relocation projects like Ashrayan' and 'Gucchagram' to provide shelter to the destitute people who lost their home during different disasters and migrated from their own places (Siddiqui et al., 2018). In this project, every family has been allocated with one house. Therefore, the living standard has developed compared to previous displaced places.

Different disasters that displaced people

Figure 4 illustrates the percentages of different hazards that affect five different places in Bangladesh which accelerated the migration and displacement. In Barishal division, people were displaced because of floods, cyclones, storm surges, and coastal erosion. In Khulna, the highest number of individuals were impacted by salinity whereas in the other sites, coastal erosion was the primary factor for displacement. In Barishal division, there were no salinity-induced displacements, while Daulatkhan and the Railway slum had no storm surge-affected populace. However, in Khulna Railway slum and Gabura union had just over 40% and nearly 30% salinity affected people. At the same time, the percentage of those affected by floods, cyclones, storm surges, and salinity intrusion were comparatively low and less than 30%.

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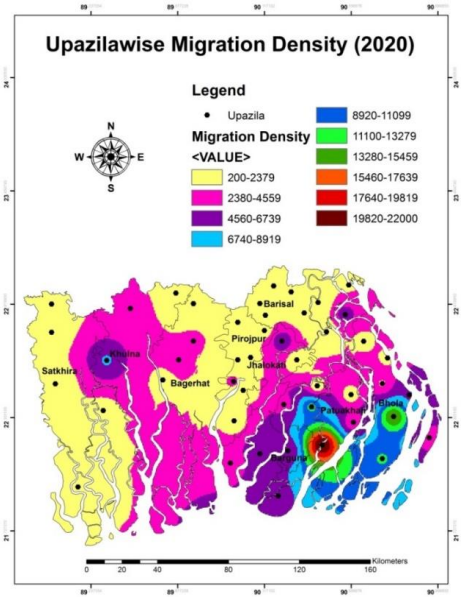

Figure 5. Map of upazilla wise migrants in Bangladesh (2020) (Source: DC office of the respective districts).

Data on the density of migrants in all upazillas of the chosen coastal districts in 2020 are shown in Figure 5. The number of migrant families was gathered between February and March 2020 for "The Ashrayan Project by the Prime Minister." In all sites, five has been used as average family member size. From the figure, the highest number of migrants found in Galachipa upazilla of Patuakhali district whereas, the lowest number was found in Gabua upazilla of Satkhira district. It is evident from the figure that, upazillas in Barishal division had more displaced people compared to upazillas in Khulna division. The data also shows that the coastal upazillas of the Barishal division had a greater number of individuals who were displaced in comparison to other upazillas in the same region.

District wise disaster instigated slum dwellers and floating people

Migration of slum dwellers from one slum area to another area is happening very often without notice. To know the migration in the slums of Barishal and Khulna cities, some data have been sorted from the Slum Census, 2014. Additionally, large cities frequently face the issue of overcrowding due to the influx of individuals from all over the country who are looking for work and shelter. Some are so destitute that they live a floating life. Floating people relocate continuously from one place to another place. This kind of movement does not typically fall under the category of migration, but if those people are affected by disasters, they have to relocate to other areas and can be considered as migrants.

Table 4. Details of slums in Khulna and Barishal City Corporation

Districts	Barishal	Khulna
Slum No	1134	137
Total City Corporation (Household)	9,629	20,658
Municipalities (Household)	2,407	23,789
Other Urban (Household)	96	937
Total Household	12132	45384
Total Population	45495	170190
River Erosion (Population %)	2415 (5.31%)	3710 (2.18%)
Natural Calamities (Population %)	172 (0.38%)	2076 (1.22%)
Total Population for Disasters	2587	5786

In slum census 2014, the number of slums found was 13,935 in the whole country. Barishal division had 1,134 slums and Khulna division had 137 slums, meanwhile Khulna had 45,384 households and Barishal had 12,132 households, an average 3.75 persons had been estimated in each house. It has been calculated that in Barishal division total number of slum dwellers was 45,495, among them 5.31% (2,415) and 0.38% (172) people were affected by riverbank erosion and natural calamities. Besides, in Khulna division total number of slum dwellers was 45,495, among them 2.18% (3,710) and 1.22% (2,076) people were affected by riverbank erosion and natural calamities, respectively.

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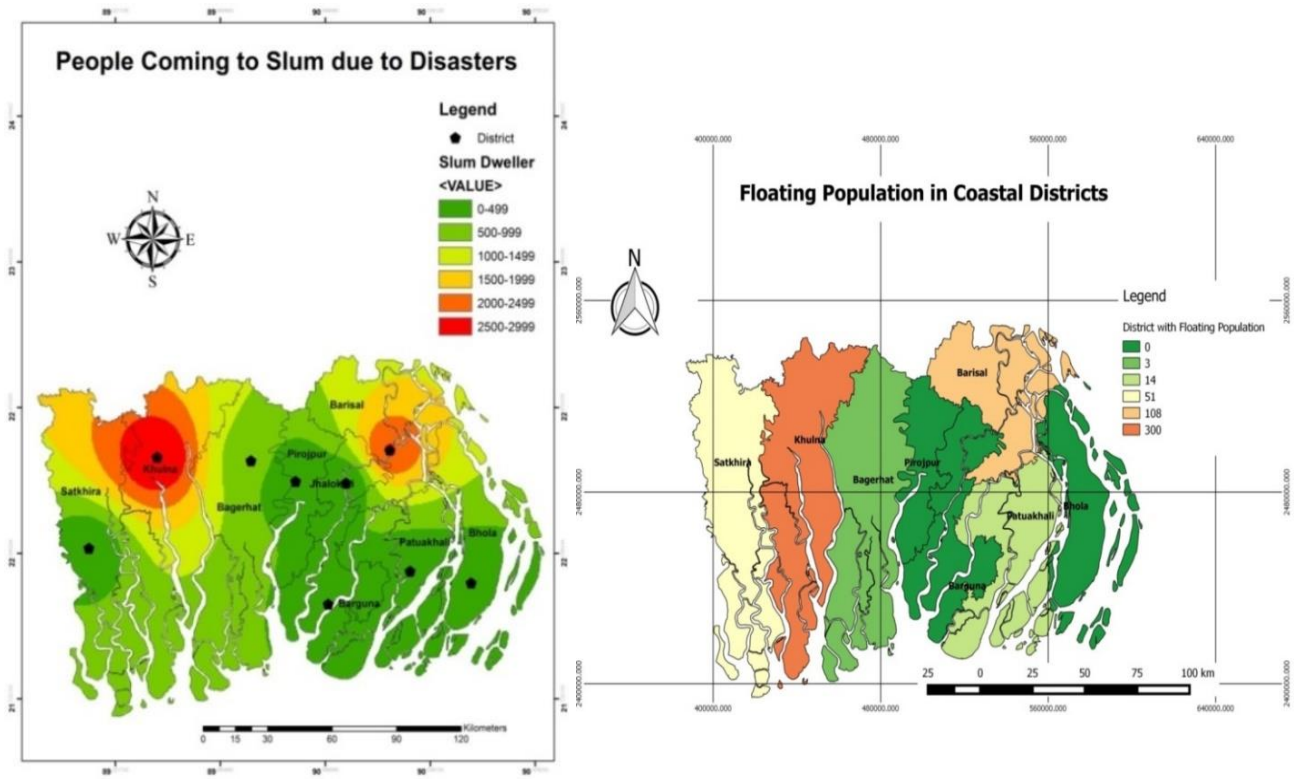

Figure 6. Map of disaster induced (a) slum dwellers (b) floating population in the coastal districts in Bangladesh

Figure 6 (a) illustrates the number of people who came to the informal settlements in nine different coastal districts after being affected by natural calamities. In Khulna district 2,726 people took shelter in slums after being displaced by disasters, and in case of Barishal the number was 2,104. On the other hand, Pirojpur had the lowest number of disasters affected slum dwellers (only 3), and the size of population was less than 200 in the rest of the districts except Bagerhat (465). Furthermore, figure 6 (b) shows the number of floating people in the study areas. In this figure, Khulna and Barishal had 300 and 108 floating people, respectively. On the contrary, Barguna, Bhola, Pirojpur had no floating people according to this census. From this figure it is clear that, the number of floating people in Khulna division was higher than in Barishal due to disaster induced migrations.

CONCLUSION

Bangladesh has frequently been affected by different natural disasters throughout its history, and as a result a large portion of population has been forced to migrate. In the recent years, the strength and frequency of climate change have multiplied the rate of migration and displacement. Bangladesh's coast is the biggest victim to different natural calamities. In this study, it has been discussed that cyclones, salinity intrusion, floods, storm surge, and riverbank erosion have affected vast number of people and magnified the migration in nine southern coastal districts. In this study, primary and secondary data have been used to highlight the migration situation of the nine study sites. ArcGIS 10 software has been used to plot these data in mapped forms using IDW interpolation. Findings of this study show that the migration rate is more acute in Barishal division compared to Khulna division whilst the highest and lowest numbers of migrants have been observed in Barishal and Jhalokati in 2017 and 2020, respectively. According to onsite data, the highest number of migrants was in Galachipa upazilla of Patuakhali and the lowest was recorded in Kalaroa upazilla of Satkhira. This research may serve as a starting point for future investigations that aim to gauge the extent of human migration and displacement across various coastal districts of Bangladesh.

Conflict of Interest

The authors have no relevant financial or non-financial interests to disclose.

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