POPULATION MONOGRAPH OF BANGLADESH

POPULATION DENSITY AND VULNERABILITY: A CHALLENGE FOR SUSTAINABLE DEVELOPMENT OF BANGLADESH

Population Monograph: Volume-7

Bangladesh Bureau of Statistics
Statistics and Informatics Division
Ministry of Planning

COMPLIMENTARY

POPULATION MONOGRAPH OF BANGLADESH

POPULATION DENSITY AND VULNERABILITY:
A CHALLENGE FOR SUSTAINABLE DEVELOPMENT OF BANGLADESH

November 2015

BANGLADESH BUREAU OF STATISTICS (BBS)
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Minister
Ministry of Planning
Government of the People's
Republic of Bangladesh

Message

I am delighted to know that Population and Housing Census 2011 Project of Bangladesh Bureau of Statistics, Statistics and Informatics Division has prepared fourteen Population Monographs using the census data of different years. This is the first time BBS is publishing population monographs with in- depth analysis of the population census data. The present monograph on 'Population Density and Vulnerability: A challenge for Sustainable Development of Bangladesh' is one of such monograph series.

Each monograph deals in a particular issue related to population and housing where census data have been used in multidimensional approaches. In addition, cross country comparison and in country comparison have also been made to oversee the representativeness of data with other national sources. It is expected that the monographs will useful in national planning and policy making particularly in the field of population and development.

I would like to thank Secretary, Statistics and Informatics Division, Director General, BBS and authors of the monographs for their relentless effort in preparing these monographs and publication thereof. Special thanks to European Union (EU) and United Nations Population Fund (UNFPA) for their generous support in conducting 5th decennial census of Bangladesh and preparing the population monographs.

AHM Mustafa Kamal, FCA, MP

Dhaka
November, 2015

State Minister
Ministry of Finance
and
Ministry of Planning
Government of the People's
Republic of Bangladesh

Message

I have come to learn that Population and Housing Census 2011 Project of Bangladesh Bureau of Statistics, Statistics and Informatics Division has prepared fourteen Population Monographs using census data of different years. Population is the main ingredient for national planning and policy making. Therefore, Population Monographs are of vital importance in the field of population planning of the country.

Each monograph has been prepared with a particular issue related to population and housing. To prepare these Monographs census data have been used widely in multidimensional way where secondary data from other sources have also been used. The monographs are a new dimension in the wide use of data generated through national censuses of the country.

My sincere thanks and gratitude to the honorable Minister, Ministry of Planning for his dynamic leadership and active guidance in implementing all our activities including census undertaking. I would like to thank Secretary, Statistics and Informatics Division, Director General, BBS for their relentless effort in preparing these monographs and publication thereof. Special thanks to European Union (EU) and United Nations Population Fund (UNFPA) for their generous support in conducting 5th decennial census of Bangladesh and preparing the population monographs.

M.A. Mannan, MP

Dhaka
November, 2015

Secretary
Statistics and Informatics Division (SID)
Ministry of Planning
Government of the People's Republic of Bangladesh

Foreword

Population Census is the single most important statistical undertaking in any country. Bangladesh Bureau of Statistics of the Statistics and Informatics Division has conducted the 5th decennial census of the country during 15-19 March, 2011. In order to supplement the main census a large scale sample survey was conducted in October 2011 which covered detailed information on Population & Housing. The Monograph on 'Population Density and Vulnerability: A challenge for Sustainable Development of Bangladesh' is mainly based on the findings of main census and sample census conducted during 2011. Data from other secondary sources have also been used to prepare the Monographs.

It may be mentioned that Bangladesh Bureau of Statistics (BBS) has been publishing a number of Population Monograph series and Population Monograph on 'Population Density and Vulnerability: A challenge for Sustainable Development of Bangladesh' which is one of the fourteen monographs being published by BBS using Population Census Data. Monographs are the in depth analysis of a particular topic of interest. It is worth mentioning that population density is an important area of concern for the equitable development of Bangladesh. The high density and vulnerable areas prone to natural disaster is also a great challenge for Bangladesh. These issues need to be addressed through proper planning.

In light of that, population monograph on 'Population Density and Vulnerability: A challenge for Sustainable Development of Bangladesh' will be useful for proper planning of the densely populated and vulnerable areas of the locality. This monograph has covered detailed information on population density and vulnerability in the context of Bangladesh.

I like to express my sincere thanks to Director General, Deputy Director General of BBS, Project Director of Population and Housings Census 2011 Project and his team for preparing this Monograph. I acknowledge with gratitude the support of European Union (EU) and United Nations Population Fund (UNFPA) for successful completion of the Population and Housing Census 2011 and preparing the Monographs.

Kaniz Fatema ndc

Dhaka
November, 2015

Director General
Bangladesh Bureau of Statistics (BBS)
Statistics and Informatics Division (SID)
Ministry of Planning
Government of the People's Republic of Bangladesh

Preface

The fifth population and housing census of Bangladesh was conducted during 15th March to 19th March, 2011. The main objective of the census was to collect information on the basic characteristics related to housing, households and population for developing a comprehensive database for development planning and human resource development programmes as well as economic management.

Population and Housing Census 2011 were conducted in three phases. In the First Phase, basic data about all households and individual members of the households were collected through ICR formatted questionnaire during 15th March to 19th March, 2011. In the Second Phase, quality and coverage of the main count were verified through a Post Enumeration Check (PEC) survey during 10th April to 14th April, 2011. For the first time in the census history of Bangladesh, PEC was conducted by an independent organization, namely Bangladesh Institute of Development Studies (BIDS). In the Third Phase, detailed socio-economic information was collected by administering a long machine readable questionnaire in a sample survey held during 15th October to 25th October, 2011.

One of the objectives of the Population and Housing Census 2011 Project was in-depth analysis of census data and preparation of Population Monograph series. Monographs are useful to the users to know the detailed information about the related area for taking appropriate policy measures and further research.

The Population Monograph on 'Population Density and Vulnerability: A Challenge for Sustainable Development of Bangladesh' is one of the 14 monograph series which covered the population density and vulnerability of Bangladesh population using census data.

I express my heartfelt gratitude to the Honorable Minister for Planning for his effective guidance and significant cooperation in making the census a success. I express my deepest gratitude to Secretary, Statistics and Informatics Division (SID) for her whole-hearted support and cooperation to the census. Moreover, members of 'Steering Committee', 'Standing Technical Committee', Consultants and the participants of the Seminar-cum-Expert Consultation deserve special thanks for their valuable contributions for finalizing the questionnaire and the census programme. I am thankful to the researchers of the Department of Statistics, University of Rajshahi for preparing this monograph. Thanks to European Union (EU) and United Nations Population Fund (UNFPA) for their technical and financial support to the Population and Housing Census 2011 Project.

Finally, I like to thank Deputy Director General, BBS, Project Director, Population and Housing Census 2011 Project, members of the Technical Committee and other officers & staff members of BBS for bringing out this monograph.

Dhaka
November, 2015

Mohammad Abdul Wazed

Representative
UNFPA Bangladesh

Message

This report is part of a series of 14 monographs developed by the Bangladesh Bureau of Statistics (BBS) with support from the United Nations Population Fund (UNFPA). UNFPA has supported the BBS since the very first census in 1974, a cooperation that has grown stronger with each census. Through the "Support to 2011 Bangladesh Population and Housing Census" project UNFPA has been working closely with the BBS to ensure that best use is made out of the resources invested in the census. The project has put a major emphasis on in-depth analysis of census data and the production of thematic reports in the form of these monographs. This series will provide its readers a better and clearer understanding of the trends, the current country scenarios and the gaps indicating where targeted interventions are necessary.

The availability of quality, reliable and timely data, as well as a thorough, methodologically sound and user-friendly analysis of data is more important than ever before. The information generated by population and housing census, the numbers of people, their distribution, their living conditions, are all critical for development. Without accurate data, policymakers do not know where to invest in schools, hospitals or roads and the most in need remain invisible. The implementation and monitoring of the Sustainable Development Goals, the guiding framework for the development agenda 2030, will require the production and analysis of a large amount of data, big data, requiring strong and independent National Statistics Offices, which UNFPA will continue to support.

I would like to take this opportunity to congratulate and thank the Statistics and Informatics Division and the Bangladesh Bureau of Statistics' authority and the project team for their efforts to produce this series, as well as the experts who contributed to the development of the monographs. My special gratitude goes to the Delegation of European Union in Bangladesh for their generous support and co-operation in implementing the "Support to Bangladesh Population and Housing Census 2011" project and in the preparation of these monographs.

Dhaka
November, 2015

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Acknowledgements

It is my great pleasure to acknowledge the contributors who were engaged in preparing the fourteen Population Monographs of Bangladesh under Population and Housing Census 2011 Project of Bangladesh Bureau of Statistics (BBS). This initiative of BBS is a new dimension with regard to the wide use of census data in the country and abroad.

Monographs have been prepared by the BBS in collaboration with public universities, research organizations and a local consultant of this project. A series of review meetings were organized to finalize the draft monographs.

I would like to express my profound regards and deep sense of gratitude to the Secretary, Statistics and Informatics Division (SID) and Director General, Bangladesh Bureau of Statistics for their valuable suggestions, continuous guidance and all out support in smooth completion of all the activities of this project and bringing out the population monographs.

It is worth mentioning that European Union (EU) has provided generous support in the implementation of the Population and Housing Census 2011 Project. I take the opportunity to express my indebtedness to United Nations Population Fund (UNFPA) for the partnership of this project of BBS.

I am extremely grateful to the institutions and the authors who were engaged in preparing the monographs. My sincere thanks to Mr. Nicholas Jhon Mcturk, Technical Expert on Population Development, Asia and the Pacific Regional Office, Dr. Chrisophe Lefrance, Technical Advisor, Population and Development, UNFPA Regional Office and the local consultant of this project Mr. Md. Shamsul Alam for their whole hearted co-operation in the preparation of monographs.

Thanks are also due to Mr. Iori Kato, Deputy Representative, Dr. Shantana Rani Halder, Chief PPR, UNFPA and Mr. Mehboob-E-Alam, NPO, UNFPA for their kind support and help. I am grateful to Mr. Md. Mostafa Ashrafuzzaman, Deputy Director, Mr. Md. Khorshed Alam, Assistant Statistical Officer, Mr. Mohammad Abdullah, Assistant Statistical Officer and all other officials of Population and Housing Census 2011 project of BBS who worked hard to conduct the census and to prepare the monographs.

Md. Mashud Alam

Dhaka
November, 2015

EXECUTIVE SUMMARY

Vulnerability is the propensity or predisposition to be adversely affected, has been studied as a composite of adaptive capacity, sensitivity and exposure to hazards. The size and density of the population together with regular extreme weather events such as floods and cyclones make Bangladesh extremely vulnerable to natural hazards becoming natural disasters. During the last ten years 12 major natural disasters have impacted upon millions of people in Bangladesh.

Bangladesh is located between the Indo-Himalayas and Indo-Chinese sub regions. About 80 percent of its total area consist of the confluence of the Ganges, the Brahmaputra (Jamuna), and the Meghna rivers and formed one of the largest deltaic plains in the world. The remaining 20 percent of the land area is comprised of the undulating, forested Hill Tracts. Different physiographic characteristics, variant in climatological condition and difference in the soil properties contribute in the development of the country. So, this monograph considers different regional variation and find out their vulnerability. There are 30 agro-ecological zones (AEZ) in Bangladesh and based on their soil characteristics 12 mutually exclusive region considered here. Besides these, some natural disaster such as flood, cyclone, drought, tornado etc. are frequent in Bangladesh. Earthquake is one of the most devastating natural hazards and in recent years it has become more frequent in Bangladesh. The distinction among vulnerabilities based on the natural disasters prone area also consider for analysis.

At the beginning of nineteen century the total population 28.93 million (Census, 1901) but in 2001 it become 124.33 million. The population became four times during this 100 years. There are some population characteristics that might have played a vital role in the measurement of vulnerability. Population density is one of the most important characteristic. The area with maximum density is treated as most vulnerable area. This monograph indicates the most vulnerable district by population density. The population density is shown by division from 1901 to 2011 which indicates the average increasing rate of population density is 398%. In this monograph the population density is presented by residence, sex, administrative division, districts, agro-ecological zone and natural disaster prone area.

Proxy variables are frequently used in disaster research where the parameter of interest cannot be directly assessed. Proxy vulnerability indicators such as female population, inactive population, floating population, disable population, ethnic population, vulnerable house, illiterate, divorced/ widow/ or separated and unsafe sanitation by country, residence and division for census 2001 and 2011 is shown. And proxy vulnerability indicators by district, AEZ, natural disaster prone area and earthquake risk area are also shown for 2011 census data. Besides these proxy indicators several indicators which are also treated as vulnerable population such as dependency ratio, young dependent, old dependent and non-active population by district is shown by GIS map.

Some groups of population are considering as vulnerable population. These are floating population, disable population, ethnic population and illiterate population. The distribution of these vulnerable groups of population by residence, sex and division along with their education and employment status is presented in this monograph.

Household is a dwelling unit where one or more persons live and eat together under a common cooking arrangement. In order to measure the household vulnerability index, some major components of socio-economic variables such as human, natural, social, physical and financial capital are used. The household vulnerability index and their coping, acute and emergency level is calculated by residence, administrative division, district, agro-ecological zone, natural disaster prone area and earthquake risk area.

Poverty is a core dimension of vulnerability. All poor people are vulnerable but not all vulnerable people are poor. The most used statistics on poverty are either income based or consumption based. Two different approaches such as cost-of-basic-needs (CBN) and direct calorie intake (DCI) used to measure the poverty. The analysis of poverty trends has showed a remarkable decline in poverty incidence during last 20 years which confirmed that the country is on the way to achieve Millennium Development Goals (MDGs) target to reduce poverty by 2015.

Recent economic growth in Bangladesh has no doubt improved the living standard of the population across the country. Household's assets such as durable and semi-durable goods describe household welfare. In order to assess the internal validity of the wealth index, quintiles of wealth are computed based on the index to assess the characteristics of the poor and rich. Distribution of wealth index using household asset indicators by district is presented by GIS map.

1. INTRODUCTION

1.1 Introduction

The vulnerability reduction measures are utmost important for Bangladesh. The participatory system in which all sectors (government, private sector, civil society) take measures to prevent and mitigate vulnerability to natural hazards. Environmental education provides communities with the necessary skills to make informed decisions as well as the motivation to participate in and take responsibility for environmental management.

Bangladesh is one of the most disaster-prone countries in the world. Natural disasters such as flood, cyclone, river erosion, earthquake, tornadoe and drought are common in Bangladesh. Almost every year, the country faces disaster of one kind or another, such as tropical cyclone, storm surge, coastal erosion, flood and drought causing heavy loss of life and property and jeopardizing the development activities (Ali, 1996). Over the past 30 years, Bangladesh faced more than 100 cyclones and about 60 flash floods with other natural disasters (Ahsan et al., 2011). Bangladesh's high vulnerability to climate change is due to a number of hydro-geological and socio-economic factors that include: (a) geographical location in South Asia; (b) flat deltaic topography with very low elevation; (c) extreme climate variability that is governed by monsoon and which results acute water distribution over space and time; (d) high population density and poverty incidence; and (e) majority of population being dependent on crop agriculture. Matthews (2009) showed the effect of global warming on Bangladesh which affects those who are living in the coastal belts for generations, making them homeless and refugees.

Shamsuddoha and Karim (2009) discused the geographical location of the coastal areas, the high densely population in coastal area, many low-lying islands have an unsteady and changing patterns' due to erosion and accretion. It is therefore of utmost importance to understand its vulnerability in terms of population and sectors at risk and its potential for adaptation to climate change.

Natural disasters are damaging economic assets, infrastructure and increasing risk of lives and livelihoods. In Bangladesh, extreme flood and drought have occurred in the last three decades and affected millions of people (EM-DAT, 2013). Thus, there is considerable variation in the food security level from one part of the country to another. Extreme poverty, incidence of natural disaster, cultural practice and access to health facility all play a role in explaining why certain areas are more vulnerable than others. In significance, high population density, different natural disasters, poverty make Bangladesh as a vulnerable country. In order to take practical steps to reduce human vulnerability, it is essential to identify

vulnerable regions, vulnerable groups of population and escalating factors, and to ensure relevant information for decision-making.

In this study, census data has been analysed to focus on vulnerable sectors and vulnerable groups of Bangladesh. Proxy indicators are provided to assess the social and economic vulnerability position of the country from local to national level. Potential hazard and vulnerability factors have derived from expert opinion. A combination of these factors is then used to create an integrated total risk assessment map that addresses the socio-economic, environmental and physical dimensions of vulnerability for the district level.

1.2 Characteristics of Bangladesh

Bangladesh is a developing country in South Asia located between 20°34′ to 26°38′ north latitude and 88°01′ to 92°42′ east longitude. The country has an area of 147,570 square kilometers and extends 820 kilometers north to south and 600 kilometers east to west. Bangladesh is bordered on the west, north, and east by a 4,095-kilometer land frontier with India and, in the southeast, by a short land and water frontier (193 km) with Burma (Myanmar). The south is a highly irregular deltaic coastline of about 580 kilometers, splitted by many rivers and streams flowing into the Bay of Bengal. The territorial water of Bangladesh extends 12 nautical miles (22 km), and exclusive economic zone of the country is 200 nautical miles (370 km). This country has seven administrative divisions: Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Sylhet and Rangpur. Divisions are subdivided into districts (zila). There are 64 districts in Bangladesh, each further subdivided into upazila (subdistricts) or Thana (Bangladesh Wikipedia).

The high population density, low economic growth, lack of institutional infrastructure, an intensive dependence on agriculture and agricultural products, geographical settings, and various other factors, all contribute to make the country weak in its economic development and quality of life. Table 1.1 presents summary of the social, economic, and environmental indicators for Bangladesh from 1981 to 2011.

Bangladesh is now widely recognized to be one of the most vulnerable countries to climate change. Natural hazards that come from flood, rising sea level and tropical cyclone are expected to increase as climate change and seriously affect agriculture, water and food security, human health and shelter (BCCSAP, 2008).

Table 1.1: Summary of social, economic and environmental indicators

Indicators	1981	1991	2001	2011
Population (million)(enumerated)	87.12	106.31	124.33	144.04
Land area (square kilometers)	144,000	147,570	147,570	147,570
Forest (percentage)	15.00	12.80	11.1	11.0
Agricultural(percentage)	60.523	55.08	NA	NA
Cultivable wasteland (percentage)	1.62	3.93	NA	NA
Current Fallow land	3.39	6.49	NA	NA
GDP per capita, PPP (US$ in million)	NA	1250.39	1660.92	2588.5
GDP per capita, Constant 2005 dollars	246.01	272.17	361.53	568.73
Industrial GDP (percentage)	20.89	21.74	25.94	28.2
Service GDP (percentage)	47.41	47.9	49.96	53.51
Agricultural GDP (percentage)	31.71	30.37	24.1	17.71
Urban population as % of Total Population	15.20	17.20	23.01	29.38
Upper Poverty linel	NA	56.7	48.9	31.5
Lower Poverty line	NA	41.1	34.3	17.6
Life expectancy at Birth (years)	55	60	66	70
Literacy Rate	29.23	35.32	47.49	57.2

Source: Bangladesh Population and Housing Census 2011, Statistical Year Book, World Bank and HIES 2010.

1.2.1 Agro-ecological Zones of Bangladesh

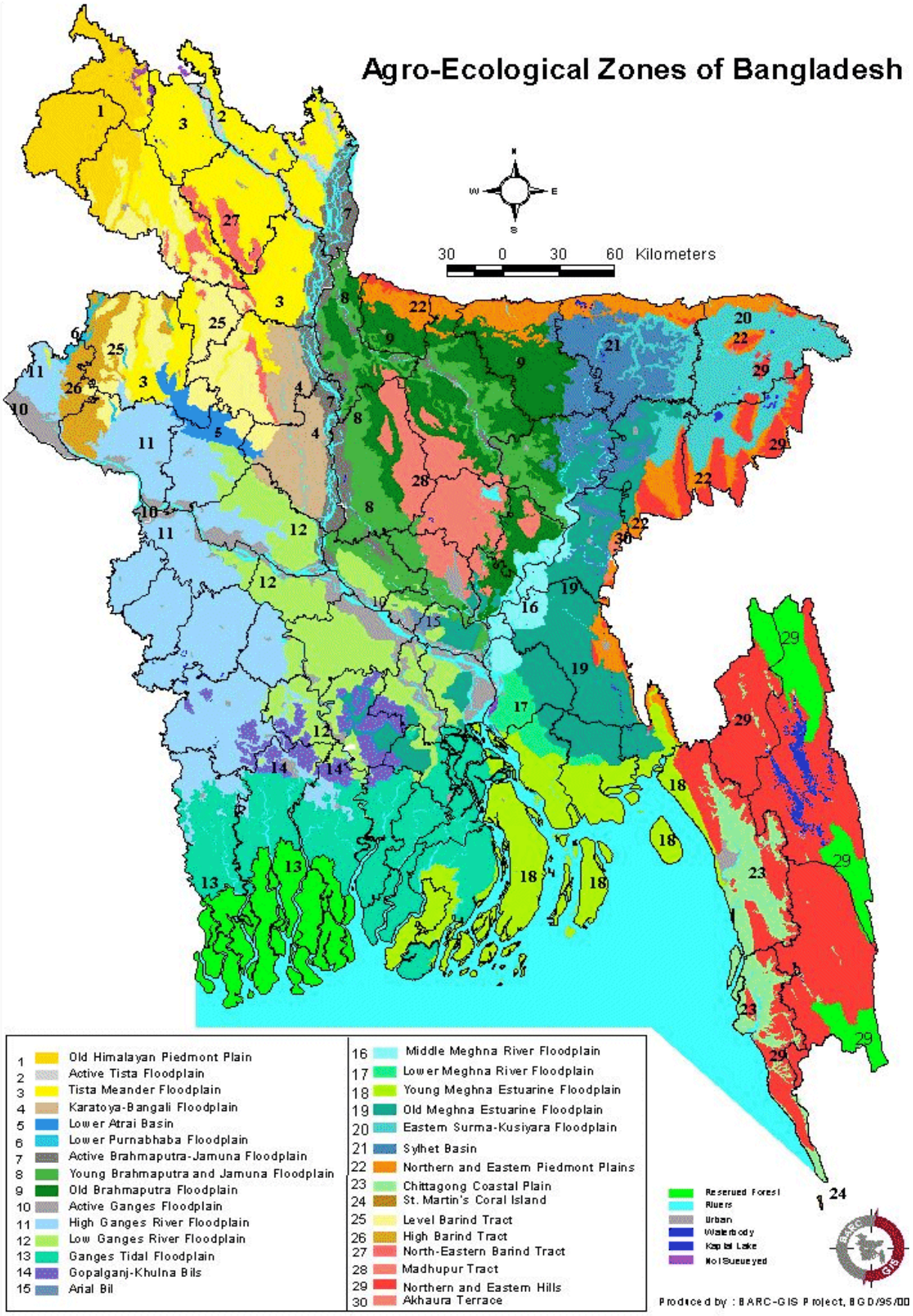
The Agroecological Zones (AEZ) database is unique and being extensively used for national and local level production planning purposes. The agroecological resources are increasingly playing an important role in agricultural planning, technology transfer and specific bio-physical resource utilisation programme activities. The database on AEZ, however, needs updating over time because there might have some changes in the land types because of roads and other structural measures, variability in rainfall and temperature as well as innovation of modern crop cultivation with different environmental conditions. Regions of 30 AEZ are listed in Table 1.2 and Map 1.1.

The regional variations are analyzed by considering stable regional base of homogeneous agro-ecological zones. Such zonal scheme would provide a base to explain the effects of agro-ecological conditions as well as agricultural development. Bangladesh consists of 30 agro-ecological zones (AEZ) some of which are overlapping with each other. For convenience of the study, two to three AEZs are combined and 12 mutually exclusive regions are considered for the study. Each region is the aggregate of a number of administrative districts. Each of the regions is not equally endowed by the nature with their geographical areas. The names of the regions with included districts and their nature are shown in Table 1.3 (Quddus, 2009).

Table 1.2: Regions of agro-ecological zones of Bangladesh

ID	Zones/Regions	Sub Regions
1	Old Himalayan Piedmont Plain	a) North-central; b) Northern; c) Southern
2	Active Tista Floodplain	Active Tista Floodplain
3	Tista Meander Floodplain	a) Central; b) Eastern; c) Lower Atrai Floodplain; d) Lower Little Jamuna Floodplain; e) North-eastern and Southern North-western; f) Upper Little Jamuna and Middle Atrai Floodplain
4	Karatoya-Bangali Floodplain	a) Northern and Central; b) South-western
5	Lower Atrai Basin	Lower Atrai Basin
6	Lower Punarbhaba Floodplain	Lower Punarbhaba Floodplain
7	Active Brahmaputra-Jamuna Floodplain	Active Brahmaputra-Jamuna Floodplain
8	Young Brahmaputra and Jamuna Floodplain	a) High Jamuna Floodplain; b) Upper Brahmaputra Floodplain; c) Upper Brahmaputra-Jamuna Floodplain
9	Old Brahmaputra Floodplain	a) Bansi Valley; b) High; c) Low; d) Medium High; e) Medium Low
10	Active Ganges Floodplain	Active Ganges Floodplain
11	High Ganges River Floodplain	a) Central and Southern; b) Ganges-Mahananda Floodplain; c) Northern
12	Low Ganges River Floodplain	a) Central; b) Eastern
13	Ganges Tidal Floodplain	a) Khulna Sundarban; b) Nonsaline, calcareous; c)Nonsaline, calcareous and non-calcareous; d) Nonsaline, noncalcareous; e) Saline, Acid Sulphate Soils; f) Saline, calcareous and noncalcareous; g) Saline, noncalcareous
14	Gopalganj-Khulna Beels	Beel centres
15	Arial Beel	Arial Beel
16	Middle Meghna River Floodplain	Middle Meghna River Floodplain
17	Lower Meghna River Floodplain	a) Calcareous, flood protected; b) Calcareous, unembanked; c) Noncalcareous, flood protected; d) Noncalcareous, unembanked
18	Young Meghna Estuarine Floodplain	a) Nonsaline: Central Bhola; b) Nonsaline: Meghna Estuary Charland; c) Nonsaline: North Bhola; d) Saline: Central Bhola; e) Saline: Noakhali, Hatiya and Meghna Estuary; f) Saline: Sandwip and South Bhola
19	Old Meghna Estuarine Floodplain	a) Dhaka-Narayanganj-Demra Project Area; b) High: Old Meghna Estuarine Floodplain; c) Low: Daudkandi-Habiganj; d) Low: Dhaka- Shariatpur-Barisal; e) Low: Eastern Kishoreganj; f) Low: Gopalganj Beels margins; g) Low: Habiganj-North Brahmanbaria; h) Low: Titas Floodplain; i) Medium Low; j) Very poorly drained: Laksham-Begumganj
20	Eastern Surma-Kushiyara Floodplain	Eastern Surma-Kushiyara Floodplain
21	Sylhet Basin	a) Central and Southern; b) Northern; c) Western
22	Northern and Eastern Piedmont Plain	a) Northern and Eastern Basins; b) Northern and Eastern Plains and Basins; c) North-western Plains and Basins; d) South Sylhet Piedmont Plains
23	Chittagong Coastal Plain	a) Beach Ridges, Mangrove Swamp and Mud Clay; b) Mangrove Tidal Floodplain; c) Piedmont Plains and River Floodplains; d) Young Tidal Floodplain
24	St Martin's Coral Island	St. Martin's Coral Island
25	Level Barind Tract	a) Highland and Medium Highland; b) Medium Lowland and Lowland
26	High Barind Tract	High Barind Tract
27	North-eastern Barind Tract	a) Mainly poorly drained; b) Mainly well drained; c) Mixed well drained and poorly drained
28	Madhupur Tract	a) Mainly poorly drained level terrace; b) Mainly well drained dissected terrace
29	Northern and Eastern Hills	a) Low hills and Piedmont Plains; b) Mainly high hill ranges; c) Mainly low hills
30	Akhaura Terrace	Akhaura Terrace

Source: Banglapedia



Map 1.1: Agro-ecological zones of Bangladesh

Table 1.3: Name of the mutually exclusive AEZs homogeneous regions and their characteristic features

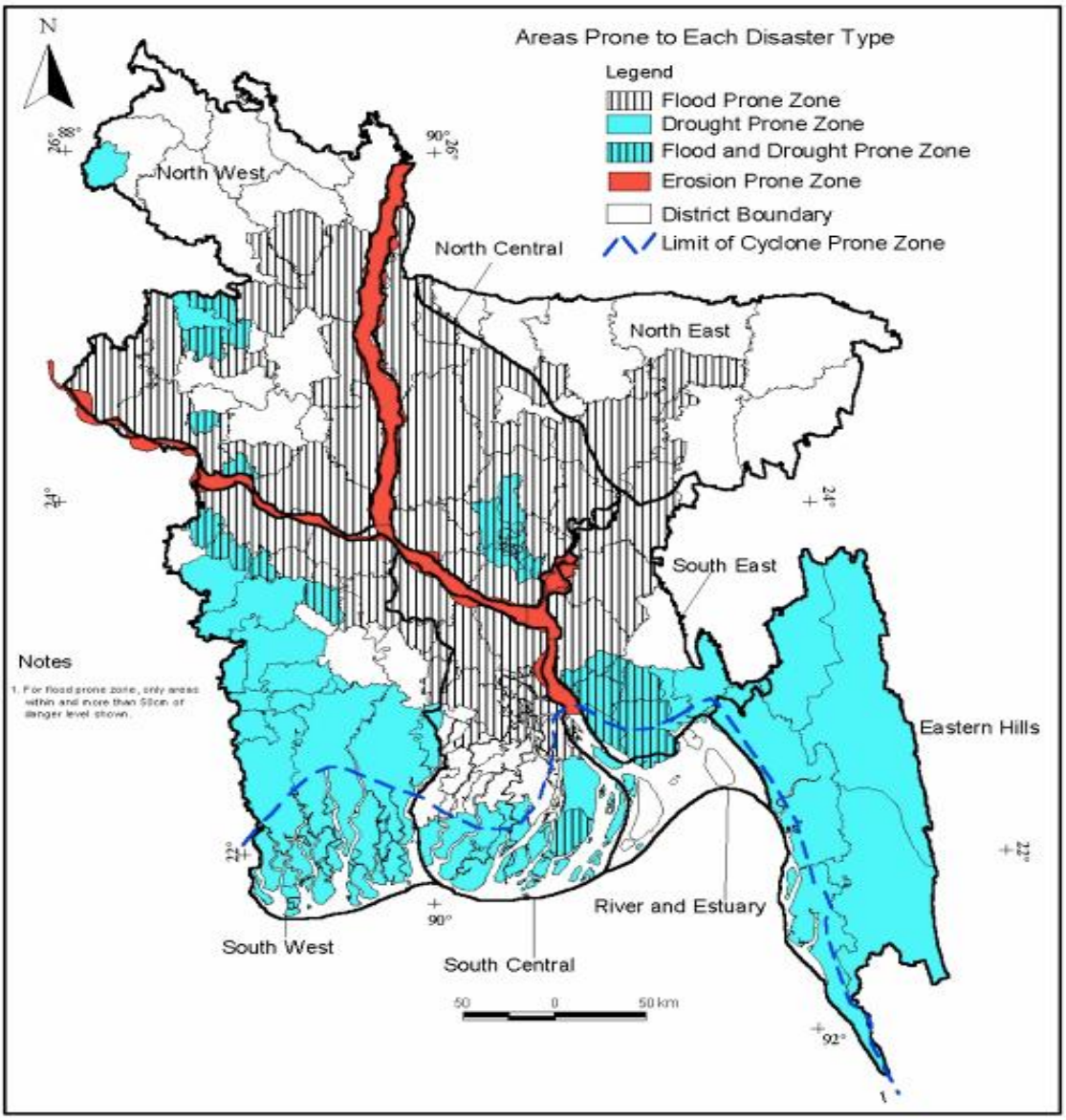
Symbol of Region	Name of Region	District included in the region	AEZ covered in the region	Population (mil), Area (000sqkm) and density (/sqkm)		Land type	Fertility conditions Organic material
				2001	2011		
HPTF	Old Himalayan Piedmont Plainand Tista Floodplain	Dinajpur, Panchagar, Thakurgaon, Rangpur, Gaibandah, Nilphamari, Kurigram, Lalmonirhat	AEZ 1,2,3, 27	13.8 16.3 844	15.7 16.3 975	High and medium high Sandy loam, loamy, Siltclay, loam	Low to medium Low/good
KFAB	Karatoya Floodplain And Atrai Basin	Rajshahi, Nawabgonj, Naogaon, Natore, Bogra, Joypurhat	AEZ 4,5,6, 26	11.5 13.3 861	12.8 13.3 962	Medium low Grey, silt loam and siltclay- loam	Moderate and medium Medium, low-medium
BJF	Brahmaputra-Jamuna Floodplain	Jamalpur, Sherpur, Tangail Mymensingh, Kishoregonj, Netrakona	AEZ 7,8,9, Part of 28	14.9 16.7 896	17.5 16.7 1044	High, medium high, medium, Silt loam to siltclay-loam	Low to medium Low
HGRF	High Ganges River Floodplain	Pabna, Sirajgonj, Jessore, Jhenaidah, Magura, Narail, Kustia, Meherpur, Chuadanga	Major part of AEZ 11,14	13.7 14.8 919	15.5 14.8 1043	High, medium high Siltloam, Siltclay-loam,	Low Low
LGRF	Low Ganges River Floodplain	Faridpur, Rajbari, Gopalgonj Madharipur, Shariatpur	Majorpart of AEZ 12, 14	6.0 7.0 864	6.45 6.91 934	Medium high, medium low Siltloam, Siltclay-loam	Medium Medium
GTF	Ganges Tidal Floodplain	Barisal, Bhola, Jhalkati, Pirojpur, Barguna, Patuakhali Khulna, Bagerhat, Satkhira	AEZ 13	13.9 25.5 544	14.5 25.39 572	Medium low, low Heavy silt clays, alkaline	Medium to high Medium
SBSKF	Sylhet Basin and Surma-Kusiyara Floodplain	Sylhet, Sunamgonj, Moulavi Bazar, Habigonj	AEZ 20,21 22	7.9 12.6 627	9.91 12.63 784	Medium low, low, very low Heavy silt clay loam, Grey colour	Low to medium Medium, High
MMRF	Middle Meghna River Floodplain	Comilla,Chandpur, Brahmanbaria	AEZ 16, 30 Minor part of 17,19,22	9.2 6.7 1371	10.6 6.67 1595	Medium low, low, very low Grey, Loam, Dark Grey loamy	Medium Low, Medium
LMREF	Lower Meghna River and Estuarine Floodplain	Noakhali, Feni, Lakshmipur	Major part of AEZ 17,18,19	5.3 6.0 879	6.27 6.11 1026	Medium, high-,medium, low Siltloam, siltclay	Medium Medium
CCPSI	Chittagong Coastal Plain & St.Martin's Coral Island	Chittagong, Cox's Bazar	AEZ 23,24	8.3 7.8 1068	9.90 7.77 1274	High, medium high, medium low Grey silt loam, Silt clay loam	Medium and low Low to moderate low
EH	Eastern Hills	Bandarban, Rangamati, Khagrachhari	Part of AEZ 29	1.3 13.3 101	1.59 13.3 120	High Yellow brown to strong brown	Low High
DHAKA	Grater Dhaka	Dhaka, Gazipur, Manikgonj, Munshigonj, Narayangonj, Narshingdi	AEZ 15 Part of 7,8,28	17.3 7.4 2326	23.4 7.49 3131	Low-lying, upland, alluvial Dark Grey, siltloam, clay loam	Low, medium, high Low and moderate

Sources: Quddus, 2009

1.2.2 Natural disaster prone area of Bangladesh

Almost every year, Bangladesh experiences disasters of one kind or another, such as tropical cyclone, storm surge, coastal erosion, flood and drought causing heavy loss of life and property and jeopardizing the development activities (Ali, 1996). Over the past 30 years

Bangladesh faced more than 100 cyclones and about 60 flash floods with other natural disasters (Ahsan et al., 2011). The vulnerability of Bangladesh to climate change is due to a number of hydro-geological and socio-economic factors: (a) its geographical location; (b) its flat deltaic topography with very low elevation; (c) its extreme climate variability that is governed by monsoon; (d) its high population density and poverty incidence; and (e) its majority of population being dependent on crop agriculture which is highly influenced by climate variability and change. Despite the recent stride towards achieving sustainable development, Bangladesh's potential to sustain its development is faced with significant challenges posed by climate change (Ahmed and Haque, 2002 and Ahmed, 2006). Natural disasters such as flood, cyclone, river erosion, earthquake, tornadoe and drought are common in Bangladesh. Disaster prone area of Bangladesh is shown at Map 1.2.



Source: http://www.saarc-sadkn.org/countries/bangladesh/hazard_profile.aspx

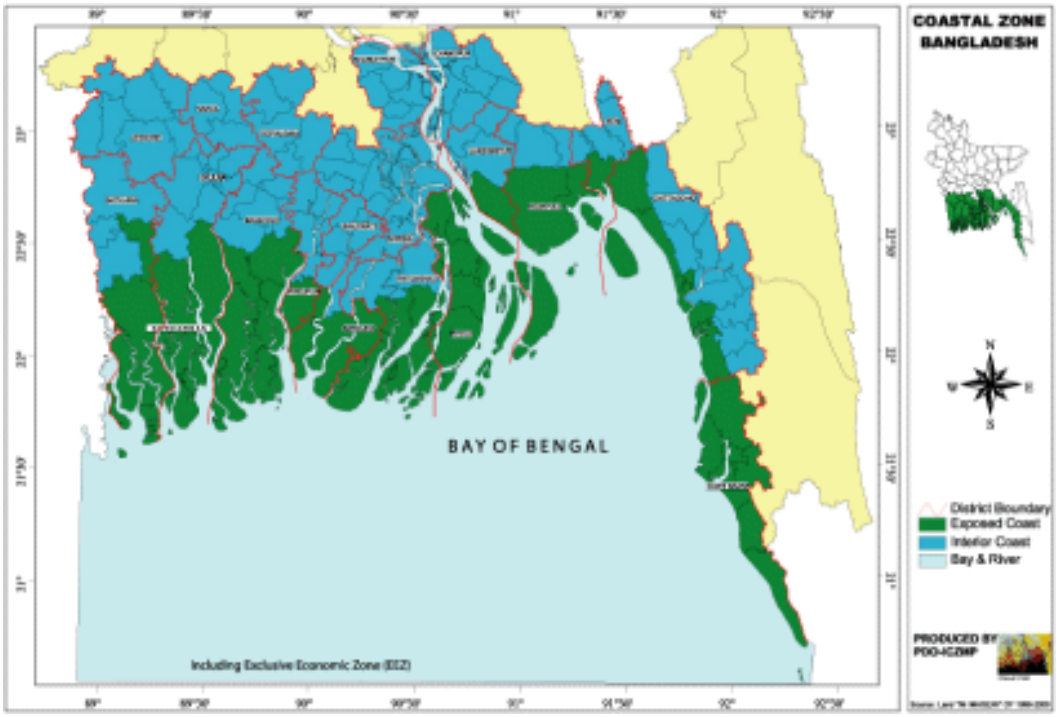
Map 1.2: Disaster prone area of Bangladesh

Table 1.4: Natural disaster prone area by district

Disaster Region	Districts
Flood Prone Region	Kurigram, Gaibandha, Sirajgonj,Jamalpur, Rajbari, Faridpur, Shariatpur, Manikgonj, Madaripur, Sunamgonj
Cyclone Prone Region	Patuakhali, Chittagong, Noakhali, Bagerhat, Shatkhira, Bhola, Barguna, Khulna, Pirozpur, Cox'sBazar
River Erosion Zone	Sirajgonj, Faridpur, Gaibandha, Jamalpur, Shariatpur, Madaripur, Chandpur, Bhola
Earthquake Zone	Dhaka, Chittagong, Sylhet, Rangpur, Mymensing
Tornadoe Prone Region	Gaibandha, Sirajgonj, Manikgonj, Tangail, Gazipur, Jamalpur, Netrikona
Drought Prone Region	Chapai Nawabgonj, Rajshahi, Natore, Nogaon, Joypurhat, Dinajpur, Rangpur, Lalmonirhat

1.2.3 Coastal zone of Bangladesh

Bangladesh has a difficult coastline with many rivers and distributaries and complex ecology which is affected by natural hazards like cyclone, coastal flooding, tidal surge, salinity and the like phenomenon. The coastline is of 734 km involving coastal and island communities of about 50 million people, nearly one-third of the total population of Bangladesh. Vulnerabilities in the coastal zone of Bangladesh are increasing with prominence of natural hazards and sea level rise caused by various factors (FEPPCAR, 2014). The coastal zone covers 19 out of 64 districts facing or in proximity to, the Bay of Bengal, encompassing 153 Upazilas (MoWR, 2006). Out of these 19 districts, only 12 districts meet the sea or lower estuary directly (Map 1.3). The coastal zone covers 47,201 square kilometer land area, which is 32% of total landmass of the country (Islam, 2004). Pramanik (1983) has divided the Bangladesh coastal zone into three regions namely; eastern, central and western coastal regions (Hossain and Hossain, 2008).



Source: Islam, 2004

Map 1.3: Coastal zone of Bangladesh

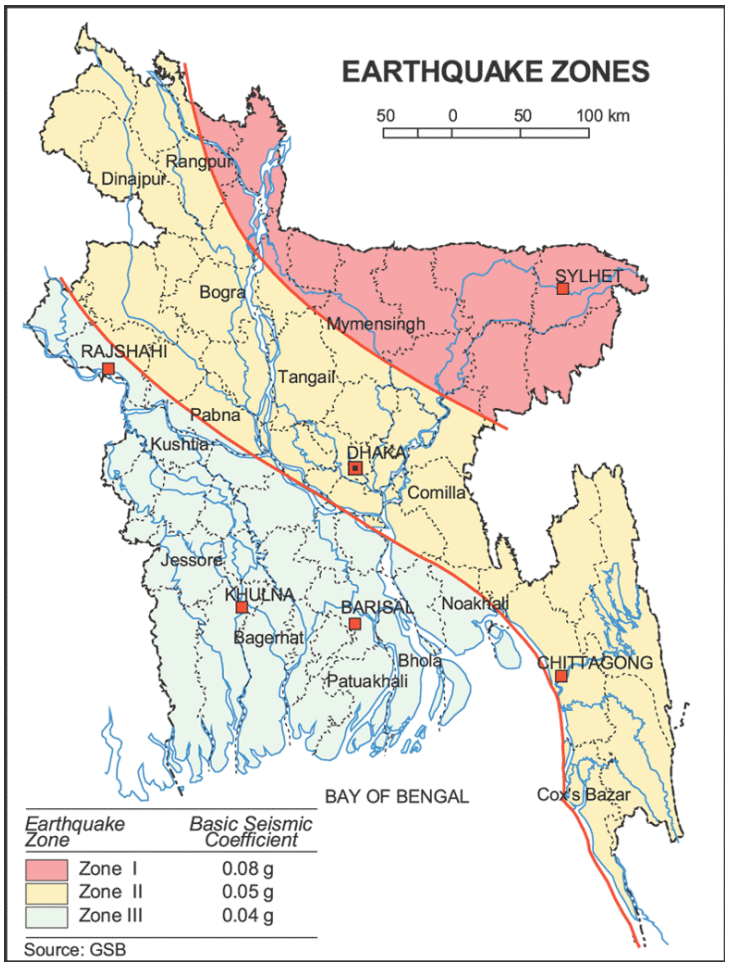
The eastern coastal zone starts from Bodormokam, the southern tip of mainland Teknaf to the Feni river estuary. This zone is very narrow. A series of small hills are run parallel to this zone. Karnafully, Sangu and Matamuhury river fall into the Bay of Bengal in this area. The Naf river falls to the Bay of Bengal dividing Bangladesh from Myanmar. Chittagong, Cox's Bazar and Noakhali are located in this coastal zone. Fish farming, fishing in the bay, salt production and tourism are main economic activities of the zone.

Central coastal zone extends from Feni river estuary to the eastern corner of the Sundarbans, covering Noakhali, Barisal, Bhola and Patuakhali districts. The zone receives a large volume of discharge from the Ganges-Bhrahmputra-Meghna river system, forming highvolume of silty deposition. Numerous islands are located in the area including the country's only island district Bhola, other districts such as Barguna, Barisal, Bhola, Jhalokati, Patuakhali and Pirojpur are included in this zone.

The western coastal zone is covered by the Sundarbans mangrove forest, covering greater Khulna, Bagerhat and Satkhira district. Because of presence of mangrove forest, the zone is relatively stable in terms of soil erosion. Mangrove swamps, tidal flats, natural levees and tidal creeks are characteristics of the zone. Mangroves of the area support feeding and breeding grounds for fish and shrimps species, enriching the area in fisheries bio-diversity.

1.2.4 Earthquake risk zone of Bangladesh

Bangladesh University of Engineering and Technology (BUET) idenfied the high risk districts (zone 1) for earthquake are Habiganj, Maulvibazar, Sunamganj, Sylhet, Mymensingh, Kishoregonj, Jamalpur, Lalmonirhat, Netrakona, Kurigram and Sherpur; medium risk districts (zone 2) are Khagrachhari, Bandarban, Brahmanbaria, Rangamati, Chittagong, Cox's Bazar, Feni, Comilla, Dhaka, Narayanganj, Munshiganj, Manikganj, Tangail, Pabna, Sirajganj, Bogra, Natore, Naogaon, Rangpur, Dinajpur, Nilphamari, Panchagarh, Thakurgaon, Joypurhat, Gaibandha, Gazipur, Narsingdi and Chandpur; and low risk districts (zone 3) are Barguna, Barisal, Bhola, Jhalokati, Patuakhali, Pirojpur, Lakshmipur, Bagerhat, Chuadanga, Jessore, Jhenaidah, Khulna, Kushtia, Magura, Meherpur, Narail, Madaripur, Satkhira, Rajshahi, Chapai Nawabganj, Shariatpur, Faridpur, Gopalganj, Rajbari, and Noakhali (Map 1.4). Although Dhaka is in medium risk zone but it is treated as high risk area due to high population density, rapid growth of urbanization and neglecting building code for preparing houses. In the zoning map of 1993 (not listed here), 26 percent of the country was high risk, 38 percent moderate and 36 percent low in terms of earthquake vulnerability.



Source: http://3.bp.blogspot.com/-f_8eclI_eD4/To6xxVTf0DI/AAAAAAAAAFs/Sm3mejfXDms/s1600/Earthquakezone.gif

Map 1.4: Earth quake zone of Bangladesh

1.3 Background

Bangladesh is one of the most densely populated (976/sq.km, Census, 2011) and climate change vulnerable country in the world. Vulnerability relates to the consequences of perturbation, rather than its agent. Thus, people are vulnerable to loss of life, livelihood, assets and income, rather than to specific agents of disaster, such as flood, windstorm or techtonic hazard. The focus of vulnerability is an individual related to the social structure of household, community, society and world-system. The concept of vulnerability shifts the focus of vulnerability away from a single hazard to the characteristics of the social system. Thus, vulnerability is explicitly, a social phenomenon, a threat to human system of social structure. The size and density of the population, together with regular extreme weather events such as flood and cyclone, make the country extremely vulnerable to natural hazard.

Vulnerability is an important part of hazard and risk. Vulnerability refers to the susceptibility of people, communities and regions to natural, human made, or technological hazard (Kumpulainen, 2011).

In general, vulnerability is the expression of social, economic and political structure and environmental setting. It is constituted with two elements: i) exposure to hazard and ii) coping capability. People having more capability to cope with extreme events are naturally less vulnerable to risk.

The developing world is more vulnerable because of increasing exposure of more and more people to various hazards and their limited coping capacity. To understand the vulnerability of people, one would have to integrate data from different sources for a particular context to mitigate the situation. A country needs its enormous expansion in economic activities, infrastructural development, human settlement, industrial growth, technological deployment and interdependence. Their growths are not parallel to each other. This unparallel growth has significantly increased social vulnerability to a host of human-induced natural hazards.

The Government of Bangladesh has developed an integrated approach to disaster risk reduction, which includes the management of disaster risk, responding to disaster through emergency operation and social safety nets and protection for long term risk reduction.

1.4 Basic Concepts and Definitions

Vulnerability

Vulnerability derives from the Latin word *vulnerare* (to be wounded) and describes the potential to be harmed physically and/or psychologically. In 1970, the concept of vulnerability was introduced within the discourse community on natural hazards and disaster (O´Keefe et al., 1976). In “taking the naturalness out of natural disasters” they insisted that

socio-economic conditions are the causes for natural disasters. Definitions of vulnerability range from a focus on physical exposure (Mitchell, 1998; Schneider and Chen, 1980; Barth and Titus,1984), through measures of socio-economic status and access to resources (Susmanet al.,1983; Timmerman,1981; Cannon,1994) and sociological investigations of the differential ability of groups to resist harmand to re cover afterwards (Drabek,1996; Bolin,1982; Quarentelli,1992), to discussions of how the 'hazard of place' is linked to social profiles (Dow,1992; Cutter,1996).

Intergovernmental Panel on Climate Change (2001) defined vulnerability of climate change as "the degree, to which a system is susceptible to or unable to cope with adverse effects of climate change including climate variability and extremes". Vulnerability is "a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity". The term exposure is defined as the nature and level to which the system is exposed to climate change like population, natural resources, infrastructure; sensitivity is the degree to which a system is affected, either adversely or beneficially by climate-related stimuli like impact on food production or livelihood activities; and adaptive capacity is the ability of a system to adjust to climate change, to moderate potential damages, to take advantage of opportunities, or to cope with the consequences. In other words, vulnerability is a function of exposure, sensitivity and adaptive capacity (De León, 2006), or, in mathematical terms, vulnerability can be expressed as:

V (Vulnerability) = f (exposure, sensitivity, adaptive capacity)

Again the three main areas covered by this approach (exposure, sensitivity, and adaptive capacity), collectively can determine the level of social vulnerability to climate change impacts (Wongbusarakum and Loper, 2011).

Vulnerability is also typically seen as being dynamic, and so the vulnerability profile of an individual or household is subject to change over time. Finally, Vulnerability is a characteristic of all people, ecosystems, and regions confronting environmental or socio-economic stresses and, although the level of vulnerability varies widely, it is generally higher among poorer people (Kasperson et al. 2003).

Besides these many international organizations have defined vulnerability from different aspects (WEP, 1999; USAID 1999; CS, 1997; UN 1982; UNDRO, 1982; SOPAC, 1999).

Types of vulnerability

Vulnerability is an essential part of hazards and risk research and refers to the susceptibility of people, communities or regions to natural or technological hazards. It involves a combination of factors that determine the degree to which someone's life, livelihood, property and other assets are put at risk by a discrete and identifiable event (or series or cascade of such events) in nature and society.

Social Vulnerability

A conventional Vulnerability assessment have been focused on biological, physical and environmental aspects (Gitay et al., 2011) but the relationship of people impacted to physical environment and ecosystem and their capacity to cope with and adjust to the new situation play a fundamental role in the level of understanding and sustainabile development concept. The foundation of sustainable development depends on society, the economy and the environment. Furthermore, it is interesting to note that social vulnerability has close link to economic vulnerability. Socio economic indicators such as population, per capita land, food security, poverty etc. could be used to assess vulnerability of climate change (Hossain et al, 2009).

Economic Vulnerability

Economic vulnerability is well-documented in the literature from the conceptual and empirical view points (Briguglio, 1995; 2003; and Atkins et al., 2000). Most studies on economic vulnerability provide empirical evidence that small states, particularly island ones, tend to be characterized by high degrees of economic openness and export concentration. Economic vulnerability focuses on the potential negative effects of a range of factors, including economic structure and size, geographical handicaps and exposure to environmental risks, on economic growth and on the level of development.

Environmental Vulnerability

Global warming is one of the most serious global environmental issues facing mankind. Effect of global warming is now visible. The global mean temperature has increased by 0.6^0C over the last century and many organisms and ecosystems have experienced changes (Mollah et al. 2006). These changes enlarge vulnerability. The South Pacific Applied Geoscience Commission (SOPAC), the United Nations Environment Programme (UNEP) and their partners' vulnerability index for natural environment through consultation and collaboration with countries, institutions and experts across the globe. The Environmental Vulnerability Index (EVI) developed to focus the environmental management. The scale of entire countries is appropriate because it is the one at which major decisions affecting the environment in terms of policies, economics and social and cultural behaviors are made.

Vulnerability to natural disasters (density, drought and flood)

The percentage of national population living in areas subject to significant risk of death or damage caused by prominent hazards: cyclones, drought, floods, earthquake, volcanoes and landslides. The indicator may be calculated separately for each relevant prominent hazard. The risk of death in a disaster caused by natural hazards is a function of physical exposure to a hazardous event and vulnerability to the hazard.

Vulnerability to Food Insecurity

The World Food Programme (WFP) (1999, 2008) discriminated the need for food assist

between population and area. The past decade has witnessed a number of conceptual, technical and organizational developments in relation to food-related vulnerability. These results described the concept of vulnerability and also increased interest in the spatial distribution of vulnerability. They showed the geographic area where people are vulnerable to food insecurity by GIS mapping technology.

Vulnerability assessments by Famine Early Warning System (FEWS) of USAID (1999) calculated components of national and household food security to identify which people are insecure in food and where they are living and the factors that would influence their food security, and possible interventions. This information is useful for policy makers to take proper action to protect or improve the food security of that section of population.

Human Insecurity

Human security is a promising pattern for understanding global vulnerabilities whose promoters challenge the traditional concept of national security by arguing that the proper referent for security should be individual rather than the state. Recently, the traditional concept of security has been expanding to include non-conventional threats such as resource scarcity, rapid population growth, human rights abuses, ozone deplation, global warming, air and water pollution and human poverty by toxic contamination (Ullman, 1983; Renner, 1989; Westing, 1989).

Causes of Vulnerability

Natural hazards such as earthquake, flood, landslide, drought, wildfire, tropical cyclone with storm surge and volcanic eruption have exacted a heavy toll in terms of the loss of human lives and the destruction of economic and social infrastructure. It will continue to occur, human action can either increase or reduce the vulnerability of societies to these hazards and related technological and environmental disasters by focusing on socio-economic factors determine such vulnerability. For example, population growth, demographic change, economic pattern, uncontrolled urbanization, together with wide spread poverty has forced large number of people to live in disaster-prone areas and sub-optimal shelters which increase vulnerability.

Many factors are responsible for vulnerability. These factors work to weaken capacity for self-protection, shrink access to social protection, delay recovery, or expose some groups of more frequent hazards than other groups including rapid population growth, poverty, poor health, low level of education, gender inequality, fragile and hazardous location, and lack of access to resource, service, knowledge, public awareness, information, disintegration of social pattern (social vulnerability) and limited access to political and representation (political vulnerability) (Aysan, 1993). The economic vulnerability is related to overall national economy, trade, foreign-exchange earning, aid, investment, international commodity price, production and consumption pattern. Environmental vulnerability concerns land degradation,

earthquake, flood, tsunami, hurricane, drought, storm, water shortage, deforestation, and other threats to biodiversity.

1.5 Methodology

Theoretical Approach of Vulnerability

The concept of vulnerability has been amended and adapted in various approaches. The United Nation Framework Convention on Climate Change (UNFCCC, 2008) mentioned two types of vulnerability assessment framework: impacts (top-down) and adaptation (bottom-up) (Figure 1.1) (Laila 2013).

Since different frameworks have different strengths, adaptation framework emphasized on stakeholder involvement more than others and therefore it played significant role to select this framework.

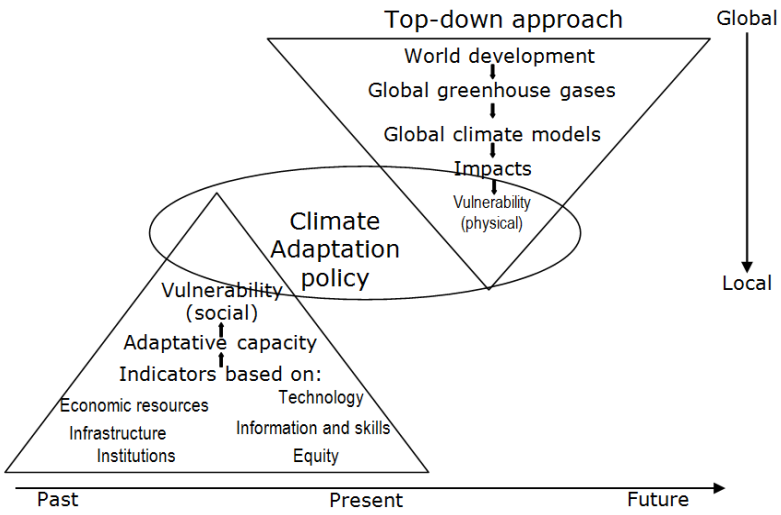


Figure 1.1: Framework approach by UNFCCC

The country's census data are specifically useful for the formulation of poverty alleviation measures and policies to improve the quality of life of the people. The data collected through census serve as a basis for monitoring progress in achieving the Millennium Development Goals (MDG) and are necessary to facilitate meaningful improvement through structural change and modernization in all socio-economic dimensions including education, employment, and health for identify vulnerable groups in densely population.

Statistical analysis and Geographic Information System (GIS) approaches will be used to analyze the Census 2011 data to prepare this monograph.

Statistical Analysis

In our study different types of tables, graphs and charts will be provided. Statistical tests of independence of attributes, proportions test, correlation coefficients test will be performed. Composite vulnerability index and different multivariate techniques will be used by Excel, SPSS and R software.

Population vulnerability and Density

Population vulnerability and density are simple, yet important factors in the risk ranking assigned to a jurisdiction. Two population parameters were used, accounting for jurisdiction with high population and jurisdiction with densely populated area. Population vulnerability was calculated as the percent of the total population in each jurisdiction. A value between one and five was assigned to each district according to densities using a k-mean cluster technique. By categorize jurisdictions this way, districts, divisions and regions with significantly larger populations would be considered highly vulnerable.

Household vulnerability index

A number of disciplines and studies have proposed numerous ways of measuring or quantifying vulnerability of households in different phenomena. Despite their differences in defining vulnerability and hence the variables selected and methodologies (Luers et al., 2003), they all agree that the measures of vulnerability is complicated by the lack of consensus on the exact meaning of the term, the complexity of the systems analyzed, and the fact that vulnerability is not a directly observable phenomenon (Luers, 2005; Mani, 2001; Pritchett et al, 2000; Downing et al., 2001). The vulnerability index measures the degree of vulnerability of a given household as a weighting function of a given set of attributes. The weight attached to each attribute would represent the intensity of vulnerability of that attribute.

A household livelihood generally has five assets, i.e., human, physical, financial, social and natural capital. Thus, in general, the vulnerability of a household can be broken down into m specific dimensions and assign a weight $(w_j, j = 1,...,m)$ to each dimension. Proper variable should be selected to describe these dimensions. Let X_{ij} be the vulnerability measure for i-th household due to j-th dimension that takes values 0 and 1 (0=no impact and 1= full impact). Then $w_{ij}X_{ij}$ is the corresponding weighted vulnerability. The sum of the weighted vulnerabilities across all dimensions will give the particular household's total vulnerability:

$$HHVI_i = \frac{\sum_{j=1}^{m} w_j X_{ij}}{\sum_{j=1}^{m} w_j} \qquad (1)$$

GIS mapping Approach

A geographic information system (GIS) is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface. GIS can show many

different kinds of data on one map. This enables people to understand the patterns and differences more easily. A person can point to a spot on a computerized map to find other information stored in the GIS about that location.

A geographic information system (GIS) can us visualize, analyze, and interpret data to understand relationships, patterns, and trends by ArcView software. Proxy indices as well as the household index will be integrated in GIS map to visualize vulnerability pattern across different regions of Bangladesh.

Method of Principal Component Analysis

In Principal Component Analysis, a new set of variables is created as a linear combination of the original set of variables. If a_1, a_2,...,a_p are the original set of p variables, then a variable Y formed by a linear combination of these variables is defined by

$$Y = w_1 a_1 + w_2 a_2 + \ ... + w_p a_p \qquad (2)$$

where the w_i's are the principal component coefficients.

Construction of Wealth Index using household asset indicators

The linear combination that explains the maximum amount of variation is called the first principal component. By definition, the first principal component has variance λ, which is equal to the largest eigenvalue of the correlation matrix of original variables. A second principal component (another linear combination) is then found, independent of the first, so that it explains as much as possible of the remaining variability. Further components are then created sequentially, each new component being independent of the previous ones.

We will implement a weighting system for constructing wealth indexes based on assets that relies on Principal Component Analysis (PCA). Filmer and Pritchett (2001) popularized the use of PCA for estimating wealth levels using asset indicators to replace income or consumption data. This procedure first standardizes the indicator variables (calculating zscores); then the factor coefficient scores are calculated; and finally, for each household, the indicator values are multiplied by the coefficient scores and summed to produce the household's index value. Formally, the wealth index for household *i* is the linear combination

$$WI_i = \sum_k \left[w_k \frac{(a_{ik} - \bar{a}_k)}{s_k} \right];\ k = 1,2,..., p \qquad (3)$$

where a_{ik} is the value of asset k for household *i*, $\bar{a}_k$ is the sample mean, $s_k$is the sample standard deviation and w_k represents the weight for each variable a_k for the first principal component. The resulting sum is itself a standardized score with mean zero and standard deviation one.

Data Source & Characteristics

Population Census is the primary source of basic national population data required for administrative purposes and for many aspects of economic and social research and planning. Censuses are usually sought to get comparable information in a fixed sequence on social and

living conditions of people of various region, religion, community, gender, age, educational status etc. Data on many issues like sex ratio, education level and income, fertility rate, mortality rate, ratio of working women and men, number of disabled persons etc. are found to be of primary interest of various government and non-government sectors.

Bangladesh Bureau of Statistics (BBS) had started the census preparatory activity from the beginning of 2009 with updating of maps and area Geo-codes. The questionnaire was designed by BBS in a machine readable format with the technical assistance from US Census Bureau and was printed abroad with the financial assistance from European Union (EU) through the United Nations Population Fund (UNFPA).

Bangladesh Bureau of Statistics had conducted the fifth Population and Housing Census of Bangladesh in 2011 in three phases as follows:

In phase I, basic data about all households and individual members of the households were gathered through using ICR formatted questionnaire during March 15-19, 2011.

In phase II, quality and coverage of the main count were verified through a Post Enumeration Check (PEC) survey during April 10-14, 2011. For the first time in census history of Bangladesh, the PEC was conducted by an independent organization, Bangladesh Institute of Development Studies (BIDS).

In phase III, detailed socio-economic information was collected by adopting a long machine readable questionnaire in a sample survey to supplement the main census held during October 15-25, 2011.

BBS employees were the supervisors and hired females were the interviewers. Data was collected carefully from the head of household or reliable respondent of the household. A total of 25 sample households per enumeration area were covered within 10 days by 3360 female interviewers deployed all over the country and they all were supervised by 840 BBS employees with a proper chain of command under the guidance of the Director General of BBS. Ten separate modules of the sample questionnaire are given below: (i) Identification and Household Summary, (ii) Housing Related, (iii) Household Related, (iv) Individual, (v) Economic Activities, (vi) Nuptiality, (vii) Fertility, (viii) Members Returned from Abroad, (ix) International Migration and (x) Death. From this census, we collected our data on different aspect. In our monograph we use data from Censuses 2011 and 2001 and other data published at different issue of BBS and HIES 2010.

1.6 Objective of the Study

The Bangladesh Bureau of Statistics conducted the Fifth decennial population census in the country on March 15-19, 2011. As per preliminary report, the population of the country stood at 144.04 million in 2011. The male population is 72.10 million and female 71.93 million. The growth rate of population in 2011 census is 1.3 per annum. This preliminary report is based on

the tally sheet and may increase after processing the entire questionnaire and adjusting the under enumeration. The density of population was 839 per sq.km. in 2001which increased to 976 per sq.km. in 2011. The sex ratio of the population is 100.2 males per 100 females. There are 32.1 million households in the country distributed over 59,229 mauzas (revenue villages). The information accommodated in census data can be a great source to evaluate our capability and identify the areas to develop if analyzed in a proper academic approach. The objectives of this study are:

- To review the various concepts and issues of vulnerability;
- To review the methodologies for vulnerability assessment and vulnerability indices;
- To categorize different administrative units (divisions and districts) in terms of vulnerability sevearness using proxy vulnerability indicators;
- To evaluate vulnerability situation of homogeneous mutually exclusive AEZs regions;
- To identify capacity and weakness of natural disaster prone areas;
- To find out the most vulnerable groups in Bangladesh;
- To develop a general framework and attempt to construct a composite index to provide a measure of increasing environmental vulnerability due to multiple hazards such as environmental changes;
- To measure household vulnerability index by using socio-economic variables of major components such as human, natural, social, physical and financial capital;
- To develop a wealth index using household assest indicators and evaluate capacity of economically vulnerable population;
- To provide recommendation for policy makers to ensure proper hazard mitigation plan.

2. POPULATION DENSITY

2.1 Introduction

Bangladesh has made remarkable progress in the last three decades towards achieving self sufficiency in food grains, economic development, health and sanitation. At the beginning of nineteen century, the total population was 28.93 million in East Bengal, the region that became East Pakistan and eventually Bangladesh. After partitioned from India in 1947, the population of East Pakistan was 42.06 million according to 1951 census; it was the 11th most densely populated country in the world. The first post independence census, taken in 1974, reported the national population 71.48 million. The 1981 census reported a population of 87.12 million and a 2.3 percent annual growth rate. Thus the population of Bangladesh became tripled within 80 years. In July 1988, the population, by then the eighth largest in the world, stood at 109,963,551 and the average annual growth rate was 2.6 percent (Bangladesh, Country Study). The recent population size is 144,043,697 (Census, 2011).

Population density is midyear population divided by land area in square kilometers. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship-except for refugees not permanently settled in the country of asylum, which are generally considered part of the population of their country of origin. Land area is a country's total area, excluding area under inland water bodies, national claims to continental shelf, and exclusive economic zones. In most cases the definition of inland water bodies includes major rivers and lakes.

Different scholars have devised different types of densities for utilization in different situations with the aim to arrive at a better indicator for the population–resource relationship. These ratios are known as arithmetic density, physiological or nutritional density, agricultural density, economic density etc. The analysis of population density is confined to the ratio of population of a given geographical or administrative unit to the area occupied by that unit. In terms of land mass, Bangladesh is only the 94th largest country in the world with a surface area of 147,570 square kilometres (56,977 square miles) but it certainly makes up for its size through its density statistics and recently in every square kilometer there is an average 976 person which confirm the country’s 9th largest position in terms of population density around the world (World Population Review, 2014). The highest population density is considered as most vulnerable. The population density by divisions, districts, agro-ecological zones and natural disaster prone area and earthquake risk area are given below.

2.2 Population Density by Divisions

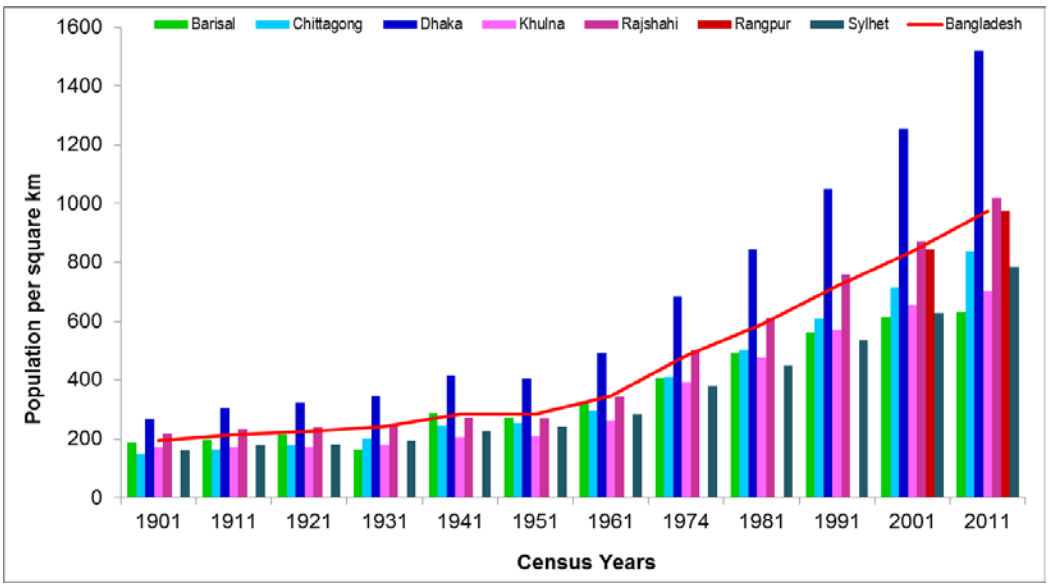
Bangladesh is divided into seven major administrative regions called division (*bangali: Bibhag*) such as: Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur and Sylhet. Data obtained from different censuses indicate that the density of the population is increasing in all

divisions. The population density from 1901 to 2011 is given at Table 2.1 and trend of population density for the same time period is listed at Figure 2.1.

Table 2.1: Distribution of population density by division, 1901-2011

Census Years	Bangladesh	Barisal	Chittagong	Dhaka	Khulna	Rajshahi	Rangpur	Sylhet
1901	196	187	146	267	171	218	-	161
1911	214	197	165	303	171	233	-	177
1921	225	214	178	323	173	240	-	182
1931	241	165	199	345	179	244	-	195
1941	285	287	244	415	205	273	-	224
1951	284	274	253	404	209	271	-	243
1961	345	321	294	491	261	343	-	285
1974	484	408	411	685	394	502	-	378
1981	590	490	502	843	478	612	-	449
1991	720	561	608	1050	570	759	-	537
2001	839	613	714	1253	656	872	845	627
2011	976	630	838	1521	704	1018	975	784

Source: Bangladesh Bureau of Statistics



Source: Bangladesh Bureau of Statistics

Figure 2.1: Distribution of population density by division, 1901-2011

The Table 2.1 and Figure 2.1 show that in 1901 an average 196 persons was inhabited per square kilometer in Bangladesh. From this time population density increased every year with almost same rate until 1961 and after that population density increased little bit higher rate. By 1991 an average 587 persons inhabited per square kilometer, in 2001 reached 857 and finally 976 persons lived per square kilometer in 2011. The increasing rate over the time is

398%. The rank of population density for individual division was Dhaka, Rajshahi, Barisal, Khulna and Chittagong in 1901 census. The population density for Dhaka division was increasing at low rate until 1961 but after that it was increasing at very high rate. In 2001 the density for Dhaka division is 1252 and 2011 is 1521 which is higher than average density of Bangladesh. This is mainly due to the migration of people from different part of the country, came to Dhaka for job, education, business etc. In Rajshahi division the population density was increasing at almost same rate until 1961 but after this time the population density increases at high rate and in 2001 it become 872 persons per sq km and 2011 it become 1018. The reasons that people migrate would be due to push and pull factors. Push and Pull factors are forces that can either induce people to move to a new location or oblige them to leave old residences; they can be economic, political, cultural, and environmentally based. Push factors such Primitive conditions, desertification, famine/drought, political fear/persecution, poor medical care, loss of wealth and natural Disasters are less in this division and pull factors such as better living conditions, political and/or religious freedom, education facility, better medical care increasing day by day. The rank of population density for 2001 and 2011 is almost similar except Khulna and Sylhet division. The density of Barisal division is low. Finally, the highest increase of population density from 1901 to 2011 was observed in Chittagong Division (474%) followed by Dhaka Division (470%) and Sylhet Division (387%) and the lowest increase were observed in Barisal Division (237%). The population density based on 2011 census by division is given at Figure 2.2.

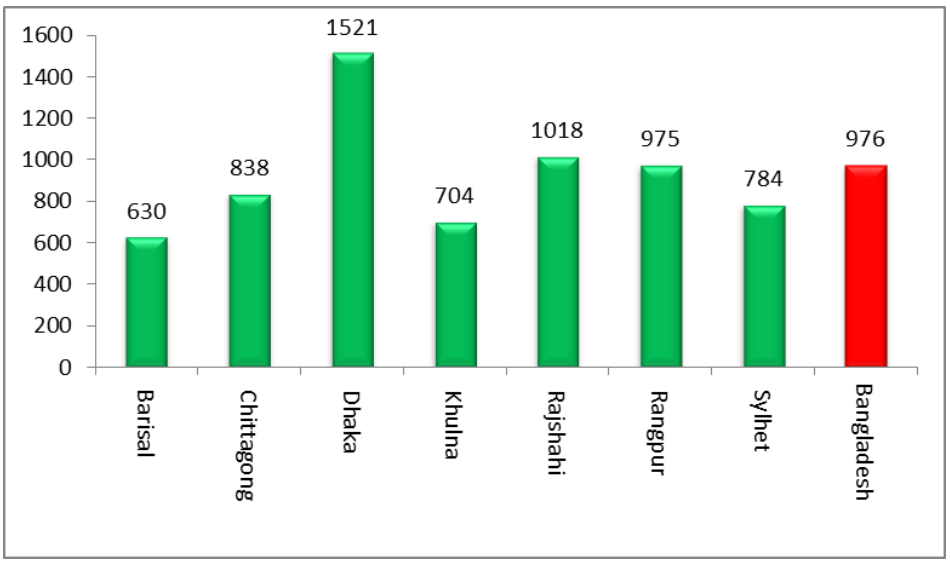


Figure 2.2: Distribution of population density by division, 2011

Figure 2.2 indicates that the population density of Dhaka and Rajshahi division are 1521 and 1018 respectively which are higher than national population density 976. The least densely populated division is Barisal.

2.3 Population Density by Districts

The Population density by districts is given at Table 2.3. The districts are categorized into five mutually exclusive and assigned numbers 1 to 5 in term of respective population density; a vlue 1 refers low density and a value 5 refers high density. This grouping is done using a k-mean cluster technique, which is usually used to divide the given data into k relatively homogenous subsets. The process of categorization is displayed in Figure 2.3 and is summarized in Table 2.2. We follow the same rule of categorization for the population density in case of AEZ regions, natural disaster prone areas and earthquake risk areas.

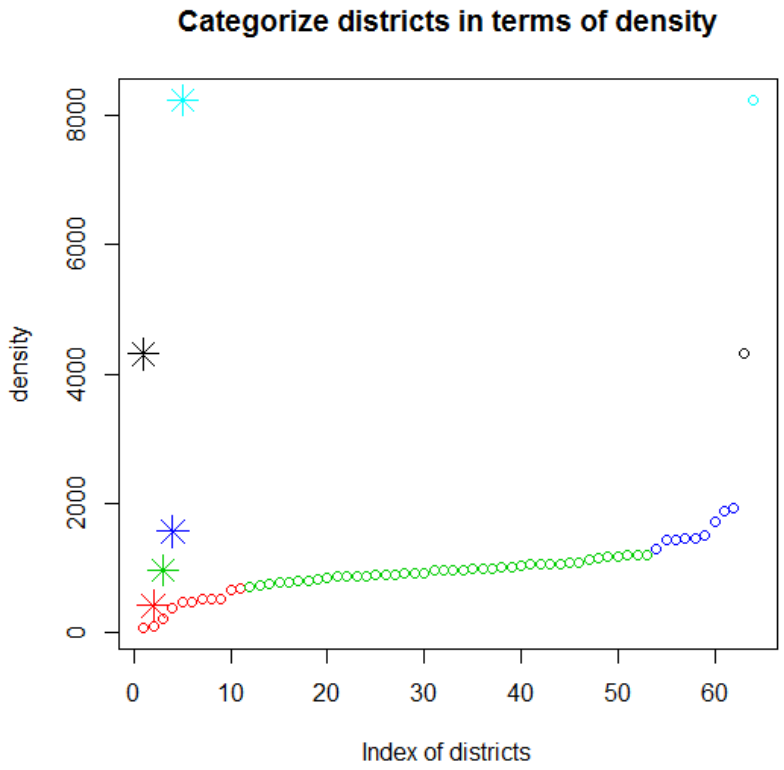


Figure 2.3: Category of population density

Table 2.2: Categories of population density

Rank	Definition: Population Density
1	<=686 people/sq km
2	687 -1211 people/sq km
3	1212-1935 people/sq km
4	1936-4308 people/sq km
5	>4309 people/sq km

Table 2.3: Distribution of population density by district and sex, 2011

District name	Area in sq km	Population density 1991	Population density 2001	Population density 2011	Category
Barguna	1831.31	424	462	488	1
Barisal	2784.52	792	843	835	2
Bhola	3403.48	434	500	522	1
Jhalokati	706.77	889	925	966	2
Patuakhali	3221.31	396	455	477	1
Pirojpur	1277.80	813	841	871	2
Barisal Division Total	13225.18			630	1
Bandarban	4479.01	52	67	87	1
Brahmanbaria	1881.21	1112	1234	1510	3
Chandpur	1645.32	1192	1315	1468	3
Chittagong	5282.92	1002	1239	1442	3
Comilla	3146.30	1307	1488	1712	3
Cox's Bazar	2491.85	569	706	919	2
Feni	990.36	1182	1300	1451	3
Khagrachhari	2749.16	127	191	223	1
Lakshmipur	1440.40	901	1021	1200	2
Noakhali	3685.87	616	714	843	2
Rangamati	6116.10	66	86	97	1
Chittagong Division Total	33908.50			838	2
Dhaka	1463.61	3989	5887	8229	5
Faridpur	2052.87	726	841	932	2
Gazipur	1806.37	901	1124	1884	3
Gopalganj	1468.74	712	773	798	2
Jamalpur	2115.16	922	1036	1084	2
Kishoregonj	2688.59	858	951	1083	2
Madaripur	1125.69	934	987	1036	2
Manikganj	1383.66	853	944	1007	2
Munshiganj	1004.29	1244	1350	1439	3
Mymensingh	4394.57	907	1022	1163	2
Narayanganj	684.37	2504	3097	4308	4
Narsingdi	1150.14	1448	1667	1934	3
Netrakona	2794.29	616	702	798	2
Rajbari	1092.28	746	851	961	2
Shariatpur	1174.06	806	914	984	2
Sherpur	1364.67	835	930	995	2
Tangail	3414.34	879	955	1056	2
Dhaka Division Total	31178			1521	3
Bagerhat	3959.11	361	383	373	1
Chuadanga	1174.10	686	854	962	2
Jessore	2606.94	821	962	1060	2
Jhenaidah	1964.77	694	800	902	2
Khulna	4394.45	458	537	528	1
Kushtia	1608.80	938	1085	1210	2
Magura	1039.10	690	783	884	2
Meherpur	751.63	687	821	872	2
Narail	967.99	665	702	746	2
Satkhira	3817.29	414	478	520	1

District name	Area in sq km	Population density 1991	Population density 2001	Population density 2011	Category
Khulna Division Total	22284			704	2
Bogra	2898.68	914	1033	1173	2
Joypurhat	1012.42	793	888	903	2
Naogaon	3435.65	625	694	757	2
Natore	1900.19	732	800	898	2
Chapai Nawabganj	1702.55	688	835	968	2
Pabna	2376.13	809	913	1062	2
Rajshahi	2425.37	784	945	1070	2
Sirajganj	2402.06	906	1070	1290	3
Rajshahi Division Total	18153			1018	2
Dinajpur	3444.30	657	768	868	2
Gaibandha	2114.77	894	977	1125	2
Kurigram	2245.04	698	768	922	2
Lalmonirhat	1247.37	768	890	1007	2
Nilphamari	1546.60	853	988	1186	2
Panchagarh	1404.62	507	596	703	2
Rangpur	2400.56	912	1067	1200	2
Thakurgaon	1781.74	559	671	780	2
Rangpur Division Total	16185			975	2
Habiganj	2636.59	579	664	792	2
Maulvibazar	2799.38	492	575	686	1
Sunamganj	3747.17	466	542	659	1
Sylhet	3452.07	617	730	995	2
Sylhet Division Total	12635			784	2

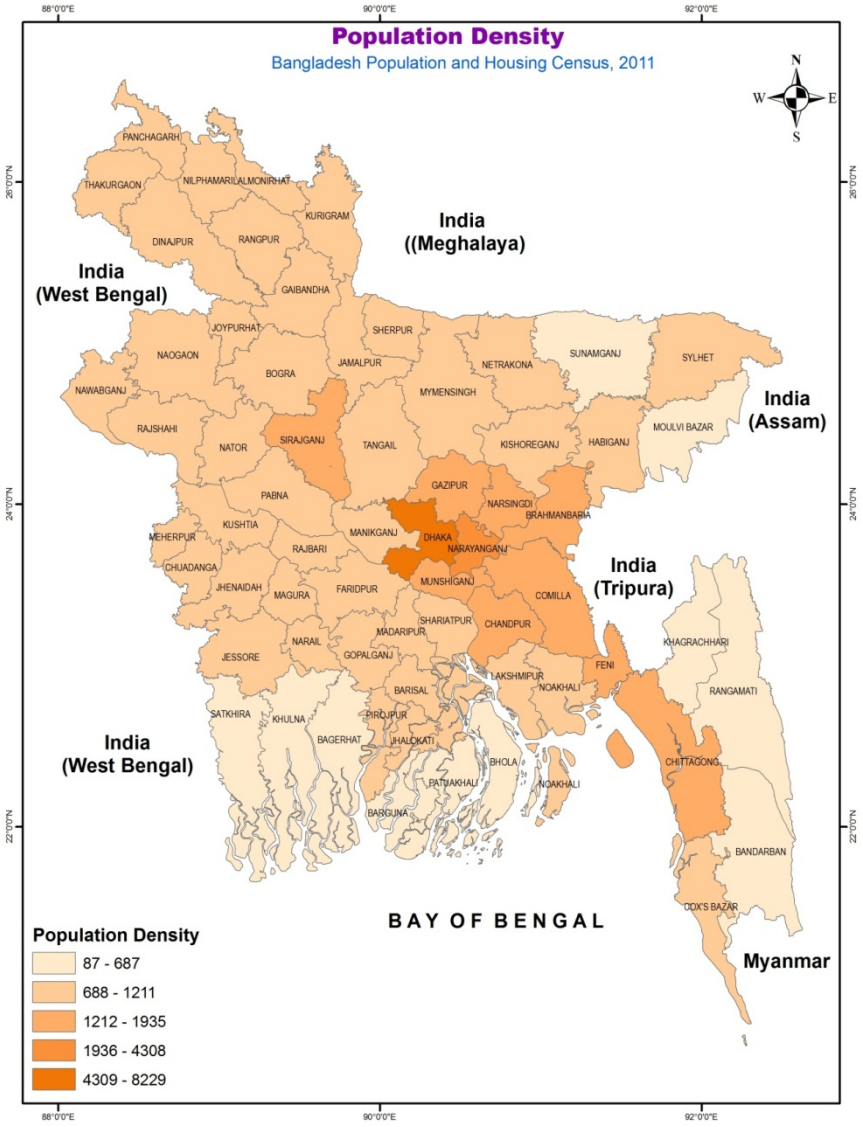
Table 2.3 shows that the district with highest population density in 2011 are Dhaka (8229), Narayanganj (4308), Narsingdi (1934), Gazipur (1884), Comilla (1712), Brahmanbaria (1510), Chandpur (1468), Feni (1451), Munshiganj (1439) and Chittagong (1442). Among these ten districts most of the districts have almost similar densities except Dhaka and Narayanganj. This is due to most of the administrative centers and geographically suitable localities for inland transportation and commercial facilities. There was no particular concentration of towns in any part of the country. In fact, the only large cities close to each other were Dhaka and Narayanganj. So, migrant workers are very populous in these districts. Dhaka is considered as the commercial heart of the country. A majority of the workforce works in household and unorganized labor opportunities. Finance, banking, tourism, and hotels are large parts of the economy. On the other hand, Narayanganj is also the center of business industry, especially the jute trade and processing plants and textile sector of the country. The Table 2.3 also indicates the least densely populated districts are Bandarban (87), Rangamati (97), Khagrachhari (223), Bagerhat (373), Patuakhali (477), Barguna (488), Satkhira (520), Bhola (522), Khulna (528) and Sunamgang (659). Bandarban District is the remotest and least populated district in Bangladeshdue to geographic location, bad communication and lack of modern facilities. The Districts of the country has been classified into 5 based on rank and the frequency distribution of the districts by population density is reported at Table 2.4.

Table 2.4: Frequency distribution of population density by district, 2011

Density Range	Number of Districts
<=659 people/sq km	11
660 -1211 people/sq km	42
1212-1935 people/sq km	9
1936-4308 people/sq km	1
>4309 people/sq km	1

Table 2.4 indicates that the population density range between 660-1211 contain the maximum number of 42 districts followed by the density range 1212-1935 which is revealed in 9 districts. The density range less than 659 was found in 11 districts and greater than 4309 were found in 1 district. Distribution of population density by districts is given at Map 2.1.

The Map 2.1 indicates that Dhaka and Narayanganj are the most densely populated districts where Bandarban, Rangamati, Khagrachhari, Satkhira, Khulna, Bagerhat, Barguna, Patuakhali, Bhola and Sunamganj are the least densely populated districts.



Map 2.1: Distribution of population density by district, 2011

2.4 Population Density by AEZ

There are regional differences in agricultural sectors of Bangladesh since farming practices, techniques, availability of irrigation facilities and attitude of farmers are not same across the country. The differences in agricultural productivity among the region to some natural phenomena such as rainfall, temperature, humidity and some other agro-ecological features are relatively less favorable in the lagging regions. The land areas of AEZ are classified based on hydrology, physiographic, soil types, tidal activity, cropping patterns and seasons. Depending on the homogeneity of the 30 AEZ regions the 12 regions are considered for this study (Quddus, 2009). There are some population characteristics that might have played a vital role in the regional variations in the agricultural development. Population density is one of them. The population density for last few decades is given at Table 2.5.

Table 2.5: Distribution of population density by AEZ, 1991, 2001 and 2011

Regions	Districts (in decending order of density)	Area in sq km	1991	2001	2011
HPTF	Rangpur, Nilphamari, Gaibandah, Lalmonirhat, Kurigram, Dinajpur, Thakurgaon, Panchagar	16318	735	844	975
KFAB	Bogra, Rajshahi, Nawabgonj, Joypurhat, Natore, Naogaon	13099	770	865	968
BJF	Mymensingh, Jamalpur, Kishoregonj, Tangail, Sherpur, Netrakona	16672	840	937	1044
HGRF	Sirajgonj, Kustia, Pabna, Jessore, Chuadanga, Jhenaidah, Magura, Meherpur, Narail	14931	793	919	1043
LGRF	Madharipur, Shariatpur, Rajbari, Faridpur, Gopalgonj	7191	780	868	934
GTF	Jhalokati, Pirojpur, Barisal, Khulna, Bhola, Satkhira, Barguna, Patuakhali, Bagerhat	25508	490	544	556
SBSKF	Sylhet, Habigonj, Moulavi Bazar, Sunamgonj	12596	537	627	784
MMRF	Comilla, Brahmanbaria, Chandpur	6716	1222	1371	1595
LMREF	Feni, Lakshmipur, Noakhali	5985	773	879	1026
CCPSI	Chittagong, Cox's Bazar	7775	864	1068	1274
EH	Khagrachhari, Rangamati, Bandarban	13295	73	101	120
DHAKA	Dhaka, Narayanganj, Narshingdi, Gazipur, Munshiganj, Manikganj	7440	1779	2326	3131

Source: Census 2011 and Quddus (2009)

Table 2.5 presents the population density for the census year 1981, 2001 and 2011 of these 12 homogeneous AEZ which indicate that population density increased almost at same rate all over the regions but for the DHAKA region it increases at very high rate. The population densities based on Census 2011 of these 12 regions are given at Table 2.6.

Table 2.6 indicatess that the population density is the maximum in Greater Dhaka (DHAKA) region and second maximum density is observed at Middle Meghna River Floodplain (MMRF) and Chittagong Coastal Plain & St.Martin's Coral Island (CCPSI) region. And this table also indicates that the regions with minimum densities are Eastern Hills (EH) and

Ganges Tidal Floodplain (GTF). The density of population was lowest in Chittagong Hill Tracts followed by Sylhet basin and coastal regions because these were lagging regions.

Table 2.6: Distribution of population density by AEZ and sex with rank

Regions	Population Density (sq km), Census, 2011					
	Density	Category	Male	%	Female	%
HPTF	975	**2**	487	49.92	488	50.08
KFAB	968	**2**	482	50.08	480	49.92
BJF	1044	**2**	515	49.37	528	50.63
HGRF	1043	**2**	521	49.96	522	50.04
LGRF	934	**2**	459	49.15	475	50.85
GTF	556	**1**	275	49.54	280	50.46
SBSKF	784	**2**	390	49.78	394	50.22
MMRF	1595	**3**	762	47.80	833	52.20
LMREF	1026	**2**	492	47.92	534	52.08
CCPSI	1274	**3**	644	50.56	630	49.44
EH	120	**1**	62	51.95	58	57.55
DHAKA	3131	**4**	1649	52.66	1482	47.34

2.5 Population Density by Natural Disaster Prone Areas

A natural disaster is the effect of a natural hazard. Bangladesh is widely known as a land of natural disasters. It is highly vulnerable to floods, famine, drought, earthquake, cyclones and river erosions. Due to the effects of these disasters the country is now permanently in distress. These disasters have become regular phenomena and have been causing suffering to millions of residents for many decades. Natural Disasters are occurring every year in our country. Population density based on different disaster prone areas is given at Table 2.7.

The Table 2.7 indicates that the natural disaster earthquake zone which contain Dhaka, Chittagong, Sylhet, Rangpur and Mymensing districts are most densely populated area and cyclones prone region are least densely populated area. The reason is that Dhaka and Chittagong are the main commercial area of Bangladesh and earthquakes are an inevitable, natural event–often catastrophic. So, people came these areas for better life, education, health facilities. On the other hand a cyclone is regular phenomena in the coastal area of Bangladesh and the opportunity for economic activity is less in these areas. So, people usually migrate from these areas to other area for better and safe life. In case of coastal zone, the population density is maximum at eastern coastal area and minimum at western coastal areas.

Table 2.7: Distribution of population density by natural disaster prone area and sex, 2011

Disaster prone area	Districts (in decending order of density)	Area in sq km	Density	Category	Male		Female	
					N	%	N	%
Eastern coastal	Chittagong, Cox's Bazar, Noakhali	11460.64	1136	2	567	49.89	569	50.1
Central coastal	Jalokathi, Pirojpur, Barisal, Bhola, Barguna, Patuakhali	13225.19	630	1	309	49.11	321	50.89
Western coastal	Khulna, Satkhira, Bagerhat	12170.85	475	1	238	50.14	237	49.85
Flood Prone Region	Sirajganj, Gaibandha, Jamalpur, Madaripur, Manikganj, Shariatpur, Rajbari, Faridpur, Kurigram, Sunamganj	19452.76	976	2	482	49.34	494	50.65
Cyclone Prone Region	Chittagong, Cox'sBazar, Pirozpur, Noakhali, Khulna, Bhola, Shatkhira, Barguna, Patuakhali, Bagerhat	33365.39	723	2	360	49.82	362	50.17
River Erosion Zone	Chandpur, Sirajganj, Gaibandha, Jamalpur, Madaripur, Shariatpur, Faridpur, Bhola	16033.41	1010	2	496	49.11	514	50.88
Earthquake Zone	Dhaka, Chittagong, Rangpur, Mymensing, Sylhet	16993.73	1829	3	947	51.8	882	48.19
Tornadoe Prone Region	Gazipur, Sirajganj, Gaibandha, Jamalpur, Tangail,Manikganj, Netrikona	16030.65	1147	2	572	49.83	575	50.16
Drought Prone Region	Rangpur, Rajshahi, Lalmonirhat, Chapai Nawabgonj, Joypurhat, Natore, Dinajpur, Naogaon	17568.41	924	2	463	50.05	461	49.94

2.6 Population Density by Earthquake Risk Area

Earthquakes are related to faulting and tectonic instability of an area. The overall tectonics of the Bangladesh and adjoining region is conducive for the frequent and recurring earthquakes. The geo-tectonic setting of the country is seismically very active. The population densities based on earthquake risky areas are given (Zone are classified by BUET expert) at Table 2.8.

Although the population density of three earthquake risk zones shows the same rank but these densities are not same in figures. The maximum population density is observed at zone 2 which is medium earthquake risk area and minimum population density is found at lowest earthquake risk area zone 3 (Table 2.8). So, zone 2 which contain Khagrachhari, Bandarban, Brahmanbaria, Rangamati, Chittagong, Cox's Bazar, Feni, Comilla, Dhaka, Narayanganj, Munshiganj, Manikganj, Tangail, Pabna, Sirajganj, Bogra, Natore, Naogaon, Rangpur, Dinajpur, Nilphamari, Panchagarh, Thakurgaon, Joypurhat, Gaibandha, Gazipur, Narsingdi and Chandpur districts are most vulnerable area due to earthquake.

Table 2.8: Distribution of population density by earthquake risk area and sex, 2011

Earthquake risky areas	Districts (in decending order of density)	Area in sq km	Density	Category	Male		Female	
					N	%	N	%
Zone 1	Mymensingh, Jamalpur, Kishoregonj, Lalmonirhat, Sherpur, Sylhet, Kurigram, Netrakona, Habiganj, Maulvibazar, Sunamganj	29484.9	920	**2**	457	49.59	464	50.4
Zone 2	Dhaka, Narayanganj, Narsingdi, Gazipur, Comilla, Brahmanbaria,Chandpur, Feni, Chittagong, Munshiganj, Sirajganj, Rangpur,Nilphamari, Bogra, Gaibandha, Pabna, Tangail, Manikganj, Cox's Bazar, Joypurhat, Natore, Dinajpur, Thakurgaon, Naogaon,Panchagarh, Khagrachhari, Rangamati, Bandarban	66406.73	1165	**2**	589	50.55	576	49.44
Zone 3	Kushtia, Lakshmipur, Rajshahi, Jessore, Madaripur, Shariatpur, Chapai Nawabganj, Jhalokati, Chuadanga, Rajbari, Faridpur, Jhenaidah, Magura, Meherpur, Pirojpur, Noakhali, Barisal, Gopalganj, Narail, Khulna, Bhola, Satkhira, Barguna, Patuakhali, Bagerhat	51677.2	765	**2**	378	49.4	387	50.6

2.7 Conclusion

The population density of Dhaka and Rajshahi divisions are higher than average density of Bangladesh. Dhaka and Narayanganj are the most densely populated districts, whereas Bandarban, Rangamati, Khagrachhari, Satkhira, Khulna, Bagerhat, Barguna, Patuakhali, Bhola and Sunamganj are the least densely populated districts. For agro-ecological regions, the population density for Greater Dhaka (DHAKA) region is the highest and Eastern Hills (EH) region is the least densely populated region. Earthquake prone regions such as Dhaka, Chittagong, Sylhet, Rangpur and Mymensing districts are most densely populated, whereas cyclones risky regions are least densely populated.

3. PROXY VULNERABILITY INDICATORS

3.1 Introduction

Vulnerability, commonly defined as the propensity or predisposition to be adversely affected, has been studied as a composite of adaptive capacity, sensitivity and exposure to hazards. Most of the world is undergoing fundamental demographic, political, socio-economic and environmental change. Assessments of vulnerability, carried out holistically, can provide an important guide to the planning process and to decisions on resource allocation at various levels, and can help to raise public awareness of risks. Such assessments can help to identify vulnerable groups and places, and reasons of vulnerability as well what are essential for developing early warning systems to improve preparedness.

This chapter provides some measures of vulnerability to hazards in context of Bangladesh using some indicators and indices. The use of these indicators has important policy relevance in ensuring that adaptation interventions do indeed contribute to sustainable and equitable development.

3.2 Proxy Vulnerability

Proxy variables can be statistical census data, grey values of single pixels (e.g. Lawrence et al. 2002), or data related to diverse object characteristics. These variables are frequently used in disaster research where the parameter of interest cannot be directly assessed. Cutter et al. (2003) identified a total of 17 measures such as age, gender or socio-economic status to characterize social vulnerability. Other authors also identified different proxy variable for different purpose (Rashed and Weeks 2003; Wu et al. 2002; Ebert et al. 2009). Recently climate change regard as one of the most important factor for making Bangladesh vulnerable. Natural hazards that come from increased rainfall, rising sea levels and tropical cyclones are expected to increase as climate changes and these factors seriously affecting agriculture, water and food security, human health and shelter.

3.2.1 Proxy Vulnerability Indicators

Proxy vulnerability indicators for a region are measured as proportions of different vulnerable groups those have limited access to resources or greater susceptible to hazard due to physical weakness and level of physical or structural vulnerability. Excess proportion of vulnerable groups such as female, young, elderly, floating, disable, ethnic, illiterate, divorced, widow and separated population in a region is alarming for that locality. Structural vulnerability is assessed in terms of weak housing condition and unsafe sanitation.

Women usually disproportionately suffer the impacts of disasters, severe weather events, and

climate change because of cultural norms and the inequitable distribution of roles, resources, and power, especially in developing countries. Women tend to have lower incomes and are more likely to be economically dependent than men.

Children and some elderly are considered vulnerable since they are at a stage where there is greater reliance on others to get things done. In the case of children, they don't have knowledge of real world situation and wouldn't know right from wrong etc so someone can easily harm a child. The elderly would have this knowledge however because of probably physical restrictions and even mental, they become vulnerable. Physical strength and general knowledge and sense make children and elderly vulnerable.

The illiterate group is more vulnerable to food insecurity in the country's hill districts due to lack of technological knowledge in farming. There is a significant relationship between education level and food security. The illiterate group is less secure when it comes to food security.

The relationship that exists between poor housing (or a lack of housing) and poor mental and physical health is well-documented. From structural to social issues, there are a myriad of concerns that surface including (but not limited to): density of housing; internal conditions (such as dampness, heat, and air conditions); the presence of contaminants, vermin, or pests; special needs, supports, and resources critical for the sustainability of housing for vulnerable populations.

Proxy vulnerability indicators for different divisions of Bangladesh based on census data of 2001 and 2011 are reported in Table 3.1. It is observed that from 48.41% in 2011, female population of Bangladesh increased to 49.94%; the proportion is little higher in rural than urban areas. At present (2011), maximum percentage of females is observed in Chittagong division while in 2001, maximum proportion of females was in Barisal division. The percentage of young population of Bangladesh has been decreased from 39.33 in 2001 to 34.63% in 2011. Currently, the proportion of young population in rural areas is higher than that in urban areas. A maximum 40% population of Sylhet division is aged below 15 in 2011 which is estimated 49.03% in 2001 for Barisal division. In Bangladesh, population aged greater than 65 increased from 3.84% in 2001 to 4.75% in 2011. Greater proportion of elderly population lives in rural areas. Maximum proportion of elderly population is inhibited in Barisal division; it is estimated 5.73% in 2011 and 4.49% in 2001. Floating population of Bangladesh is 0.10%. Most of them live in urban areas; they share 0.30% of total urban population. A maximum 0.15% of Dhaka division is floating population. 1.10% population of Bangladesh population are from ethnic community. Most of them live in rural areas (1.22%) and in Chittagong division (3.16%). Disable population shares 1.41% of Bangladesh population in 2011; they were only 0.50% in 2001. Proportion of disables is higher in rural areas (1.51%). In Bangladesh, illiteracy has been greatly reduced from 54.68% in 2001 to

27.22%. Higher proportion of rural areas (29.78%) and Rangpur division (32.94% in 2011 and 60.61% in 2001) is illiterate. In 2011, 3.76% population of Bangladesh is divorced/widow/separated; in 2001, they were 3.11% of total population. The rate is higher in rural areas (3.93) and in Rangpur division (4.36% in 2011 and 3.65% in 2001). Proportion of vulnerable house (Jhupri) in Bangladesh has been greatly reduced from 8.04% in 2001 to 0.65% in 2011; the proportion is little higher in rural areas (0.67%) and in Chittagong division (0.79%). Proportion of unsafe sanitation users in Bangladesh also decreased greatly from 59.81% in 2001 to 8.09% in 2011. This rate is again higher in rural areas (9.33%) and Rangpur division (13.54% in 2011 and 79.94% in 2001).

As a whole, in Bangladesh, proportion of unsafe sanitation, illiteracy and vulnerable house sharply reduced within last decade. All the indicators except floating population show that in 2001, rural areas were more vulnerable than urban areas which remain unchanged in 2011. Three indicators- illiteracy, proportion of divorced/widow/separated population and use of unsafe sanitation show that Rangpur division is more vulnerable than other divisions of Bangladesh. Both the census data confirm that proportion of floating population in urban areas is naturally higher than that in rural area.

The proxy indicators for district level are further displayed in GIS Map 3.1 to 3.10 and are reported in Table 3.2. Map 3.1 indicates that proportion of female population is higher in Chandpur, Noakhali, Comilla, Lakshmipur, Brahmanbaria, Jhalokati, Feni and Shariatpur districts; the highest proportion of female is found in Chandpur district (52.57%). On the other hand, the female population at Dhaka, Rangamati, Bandarban, Gazipur and Narayanganj districts are lower.

Table 3.1: Distribution of proxy vulnerability indicator by division, 2001 and 2011

Area/Zone	Total Population	Proxy Indicators (%)									
		Female	Age<15	Age>65	Floating Population	Ethnic Population	Disable Population	Illiterate	Divorced/widow/ Separated	Vulnerable House	Unsafe Sanitation
2011											
Bangladesh	144.04	49.94	34.63	4.75	0.10	1.10	1.41	27.22	3.76	0.65	8.09
Rural	110.48	50.60	35.97	5.13	0.04	1.22	1.51	29.78	3.93	0.67	9.33
Urban	33.56	47.77	30.23	3.48	0.30	0.70	1.06	18.78	3.20	0.58	4.02
Divisions											
Barisal	8.33	50.88	36.37	5.73	0.12	0.03	1.64	19.12	3.70	0.72	5.75
Chittagong	28.42	50.98	38.05	4.59	0.11	3.16	1.37	23.91	3.23	0.79	5.87
Dhaka	47.42	49.03	33.36	4.46	0.15	0.31	1.21	27.11	3.48	0.49	6.64
Khulna	15.69	50.01	31.08	5.45	0.06	0.26	1.56	26.37	4.22	0.71	8.68
Rajshahi	18.48	49.92	31.86	4.85	0.05	1.33	1.54	31.63	4.32	0.70	10.56
Rangpur	15.79	50.08	34.75	4.74	0.04	0.65	1.62	31.94	4.36	0.74	13.54
Sylhet	9.91	50.22	40.00	4.46	0.08	1.50	1.47	29.64	3.94	0.54	9.13
2001											
Bangladesh	123.85	48.41	39.33	3.84	-	-	0.50	54.68	3.11	8.04	59.81
Rural	95.25	49.12	40.89	4.12	-	-	0.52	59.41	3.26	8.43	68.96

Area/Zone	Total Population	Proxy Indicators (%)									
		Female	Age<15	Age>65	Floating Population	Ethnic Population	Disable Population	Illiterate	Divorced/widow/ Separated	Vulnerable House	Unsafe Sanitation
Urban	28.61	46.05	34.15	2.92	-	-	0.43	39.75	2.64	6.72	29.37
Divisions											
Barisal	8.15	49.03	41.23	4.49	-	-	-	46.83	2.9	-	56.45
Chittagong	24.12	48.99	43.02	4.04	-	-	-	53.12	2.61	-	48.44
Dhaka	38.99	47.73	37.93	3.77	-	-	-	53.78	2.98	-	53.19
Khulna	14.60	48.43	36.25	4.14	-	-	-	51.86	3.3	-	61.64
Rajshahi	16.31	48.37	37.12	3.62	-	-	-	57.86	3.54	-	72.88
Rangpur	13.78	48.76	39.67	3.24	-	-	-	60.61	3.65	-	79.94
Sylhet	7.90	48.82	42.74	3.85	-	-	-	60.43	3.4	-	65.25

Map 3.2 indicate that the proportion of population under age 15 is Cox's Bazar, Sunamganj, Brahmanbaria, Noakhali, Bhola, Habiganj, Kishoregonj, Netrokona, Bandarban and Lakshmipur districts are higher and it is lower in Dhaka and Gazipur districts. The highest proportion of young population is found in Cox's Bazar district (43.01%).

The Map 3.3 indicates that the proportion of population over 65 years is higher in Jhalokati, Pirojpur, Bagerhat, Manikganj, Tangail, Barguna, Shariatpur, Narail, Chandpur, Rajbari and Barisal districts and lower in Dhaka, Cox's Bazaar, Bandarban, Narayanganj and Gazipur districts. Proportion of elderly population is highest in Jhalokati district (6.62%).

Map 3.4 indicate that proportion of floating population is highest in Cox's Bazar (0.65%) followed by Dhaka, Bandarban, Bagerhat and Munshiganj districts and is lower in Western part of Bangladesh specifically in Gaibandha, Kurigram, Sherpur, Chuadanga, Kushtia, Narail, Satkhira, Chapai Nawabganj districts.

Map 3.5 indicates that the proportion of ethnic population is unparalelly higher in Rangamati (59.76%), Khagrachhari (51.63%) and Bandarban (44.39%) districts and lower in Barisal, Bhola, Jhalokati, Pirojpur, Brahmanbaria and Meherpur districts.

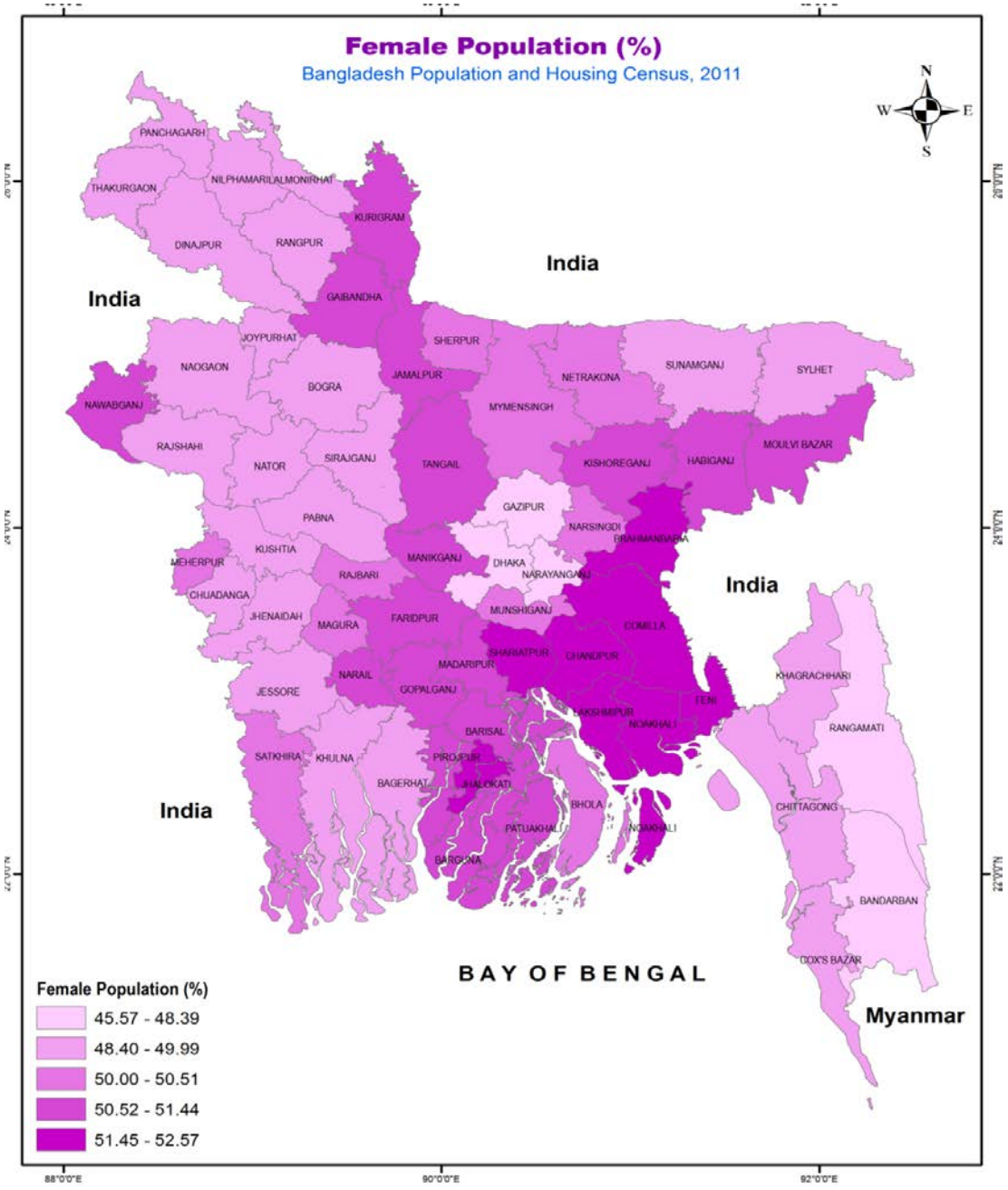
Map 3.6 indicates that the proportion of disable population is higher in Barguna, Pirojpur, Gaibandha, Jhalokati and Chandpur districts and is lower in Dhaka, Gazipur and Narayanganj districts. The maximum proportion of disability is reported for Barguna district (2.09%).

Map 3.7 indicates proportion of illiterate population is higher in Jamalpur, Bandarban, Sherpur, Gaibandha, Kurigram, Netrakona and Sunamganj districts and is lower in Pirojpur, Jhalokati, Barguna, Dhaka, Barisal, Bagerhat, Feni, Chittagong, Chandpur, Patuakhli, Khulna,Gazipur and Gopalgang districts. Illiteracy is highest in Jamalpur district (41%).

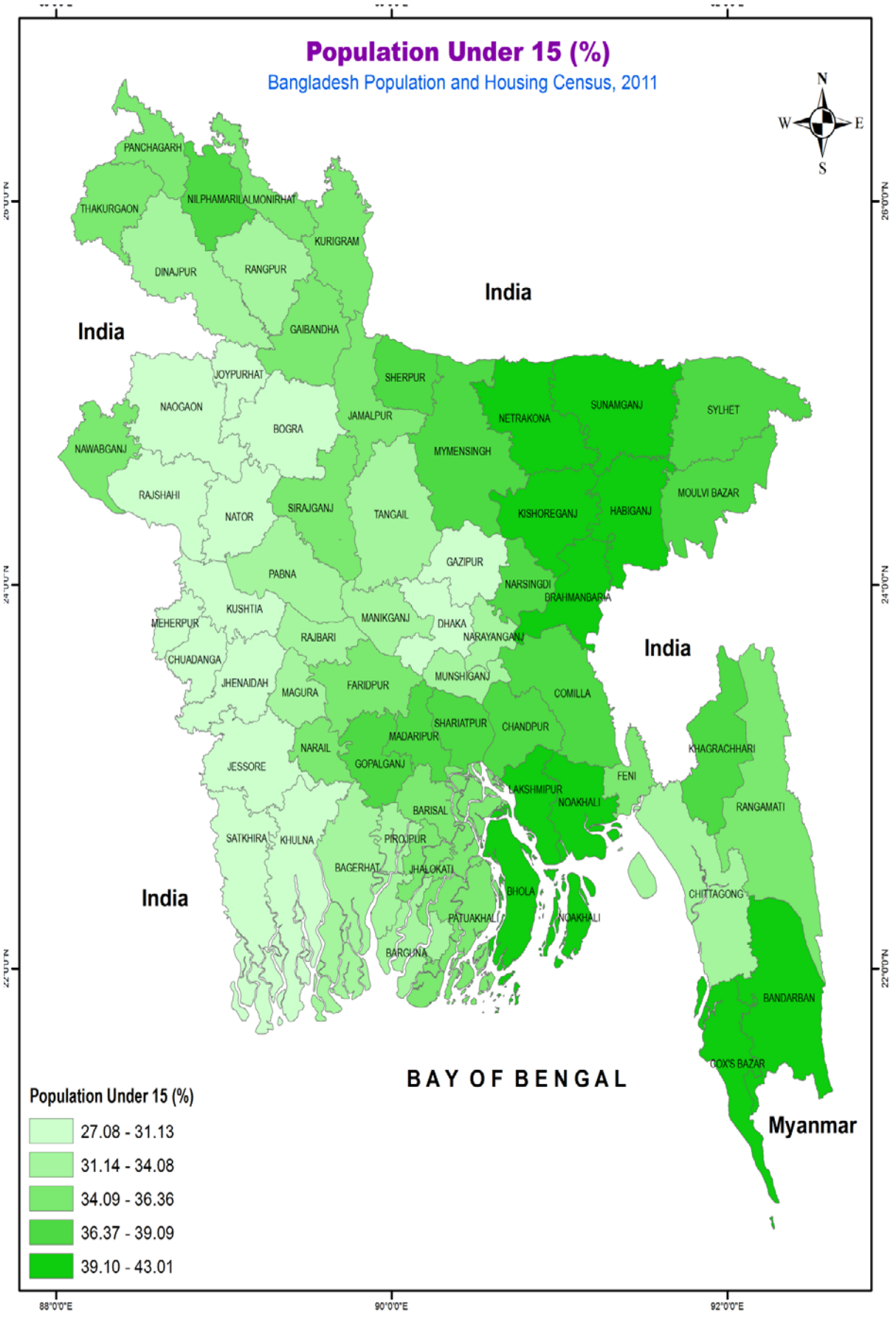
Map 3.8 indicates that the proportion of divorced/widowed/separated population is higher in Naogaon, Joypurhat, Kurigram, Bogra and Narail and is lower in Cox's Bazar, Bhola, Dhaka, Gazipur, Lakshimipur, Narayanganj, Bandarban and Noakhali districts. In Naogaon, the maximum proportion of marital disorder is found (5.10%).

Map 3.9 indicates that the percentage of vulnerable house (Jhupri) is higher in Cox's Babzar and Netrakona districts and is lower in Chandpur, Brahmanbaria, Narsingdi, Gopalganj, Shariatpur, Narail, Feni, Tangail, Kushtia, Comilla, Madaripur, Sirajganj and Jamalpur districts. The maximum proportion of Jhupri is found in Cox's Babzar district (2.40%)

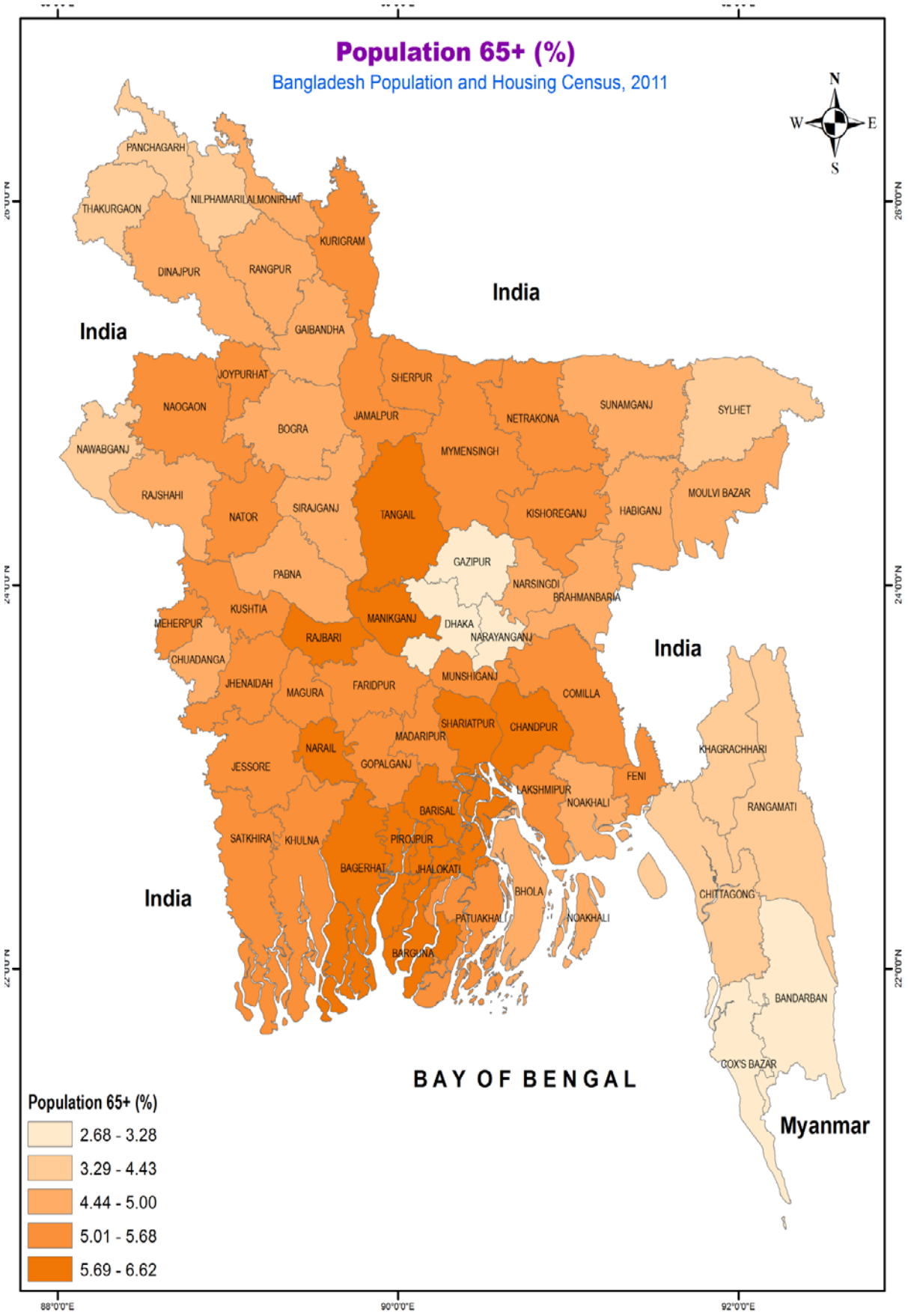
Map 3.10 indicates that the percentage of households with unsafe sanitation is higher in Gaibandha, Thakurgaon, Naogaon, Nilphamari, Bandarban, Rangpur and Chapai Nawabganj districts and is lower in Dhaka, Jhalokati, Gopalganj, Barisal, Shariatpur, Munshiganj, Faridpur, Gazipur and Comilla districts. Gaibandha is the district with highest proportion of unsafe sanitation.



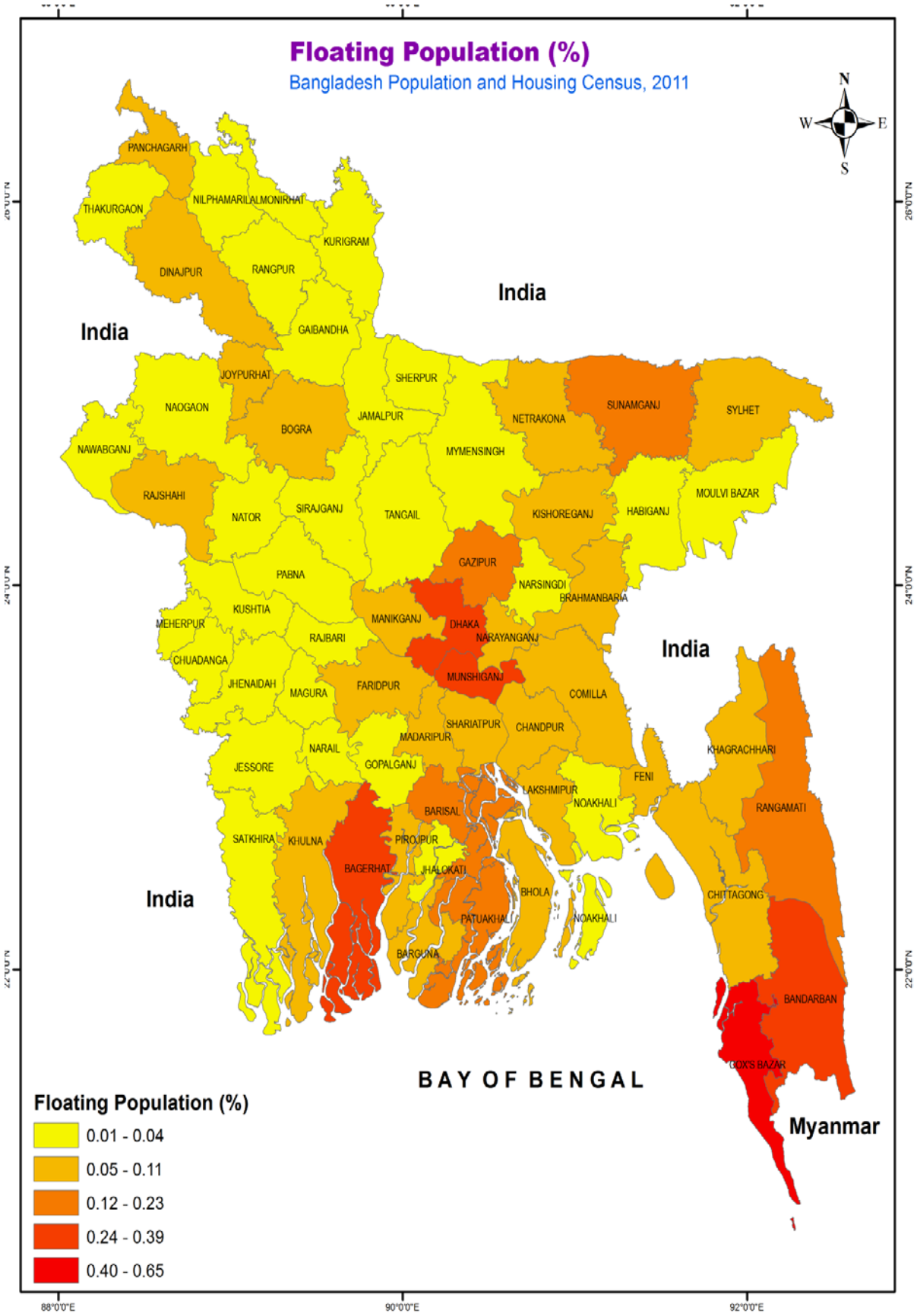
Map 3.1: Distribution of female population by district, 2011



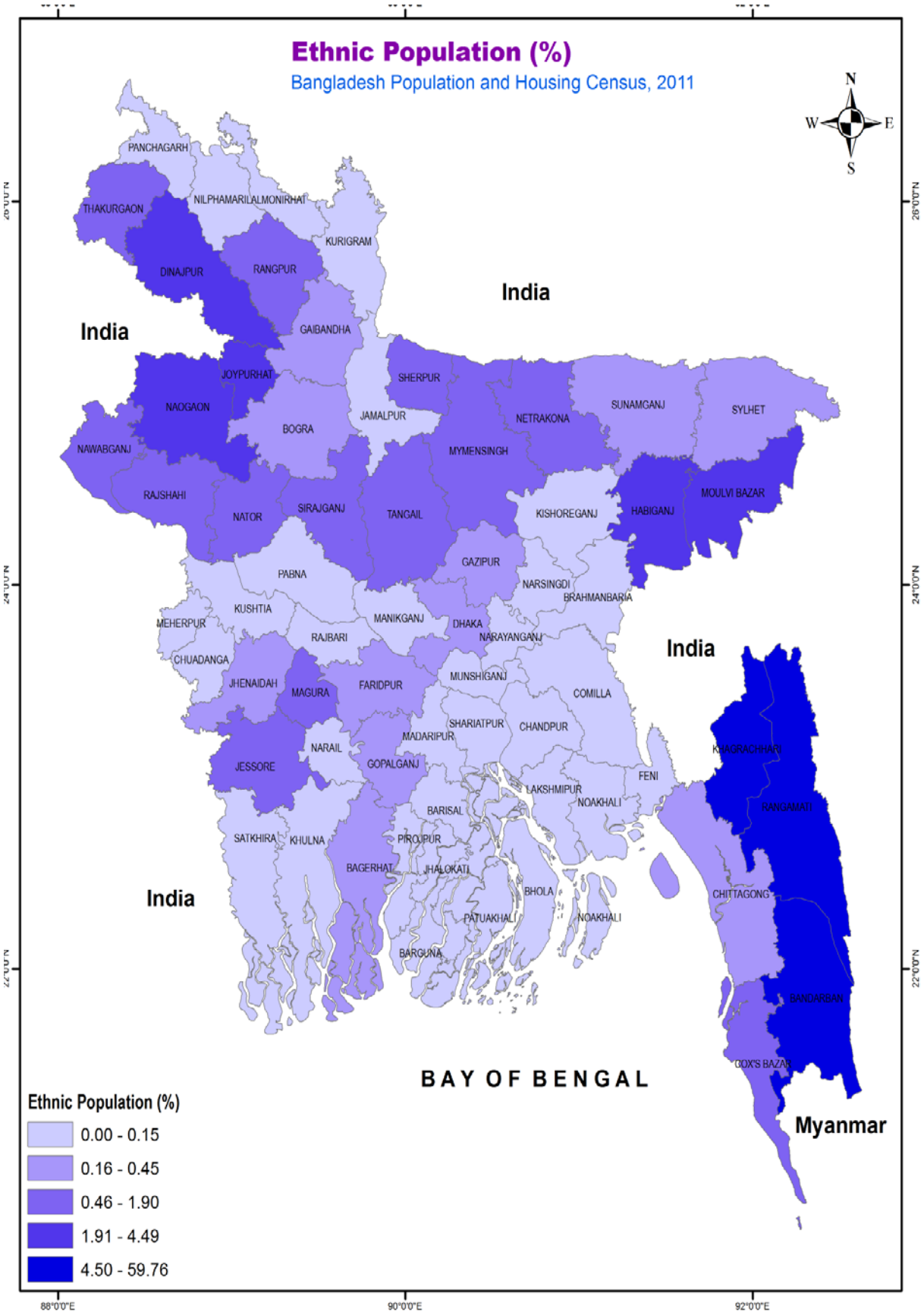
Map 3.2: Distribution of population under age 15 by district, 2011



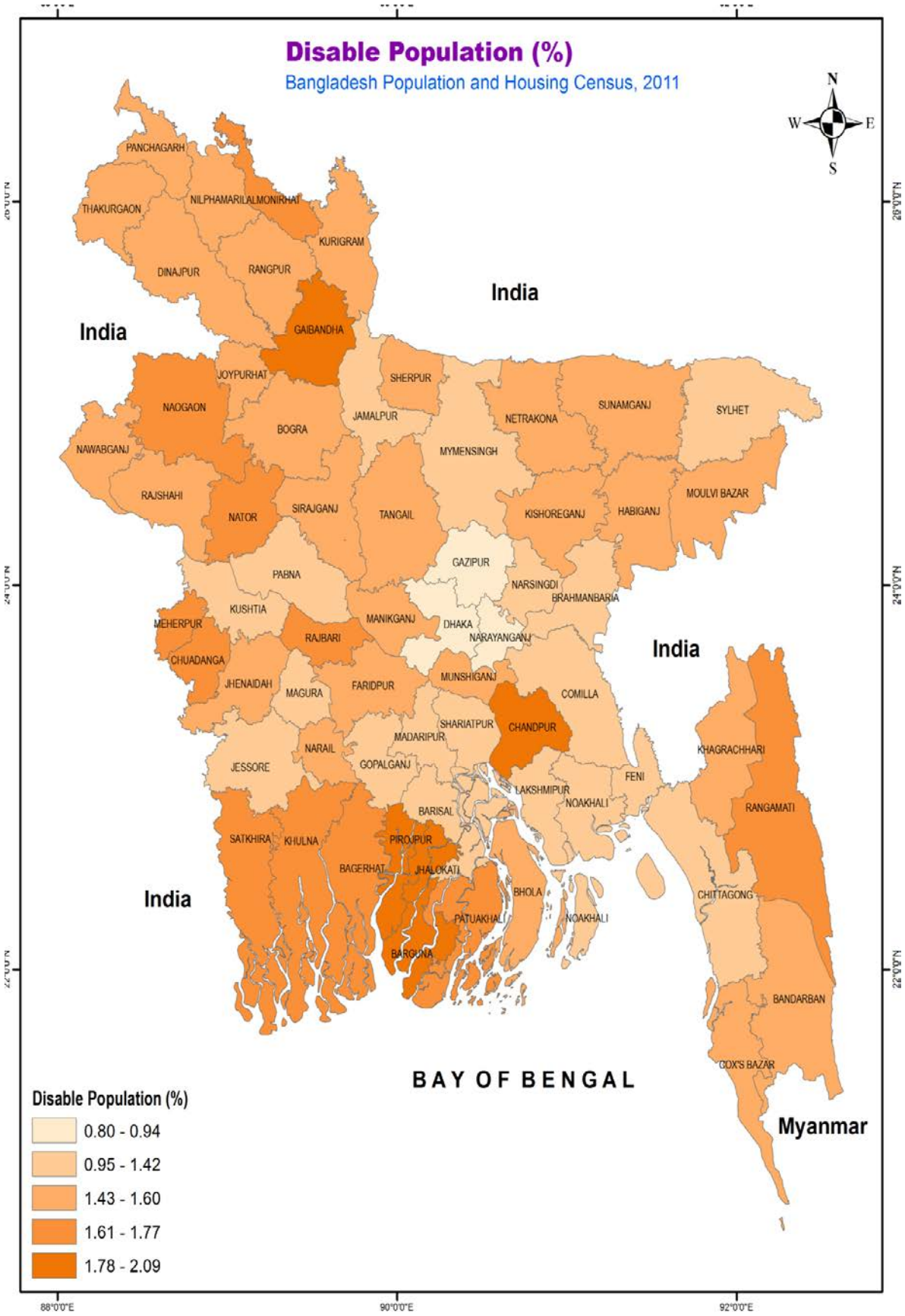
Map 3.3: Distribution of population over age 65 by district, 2011



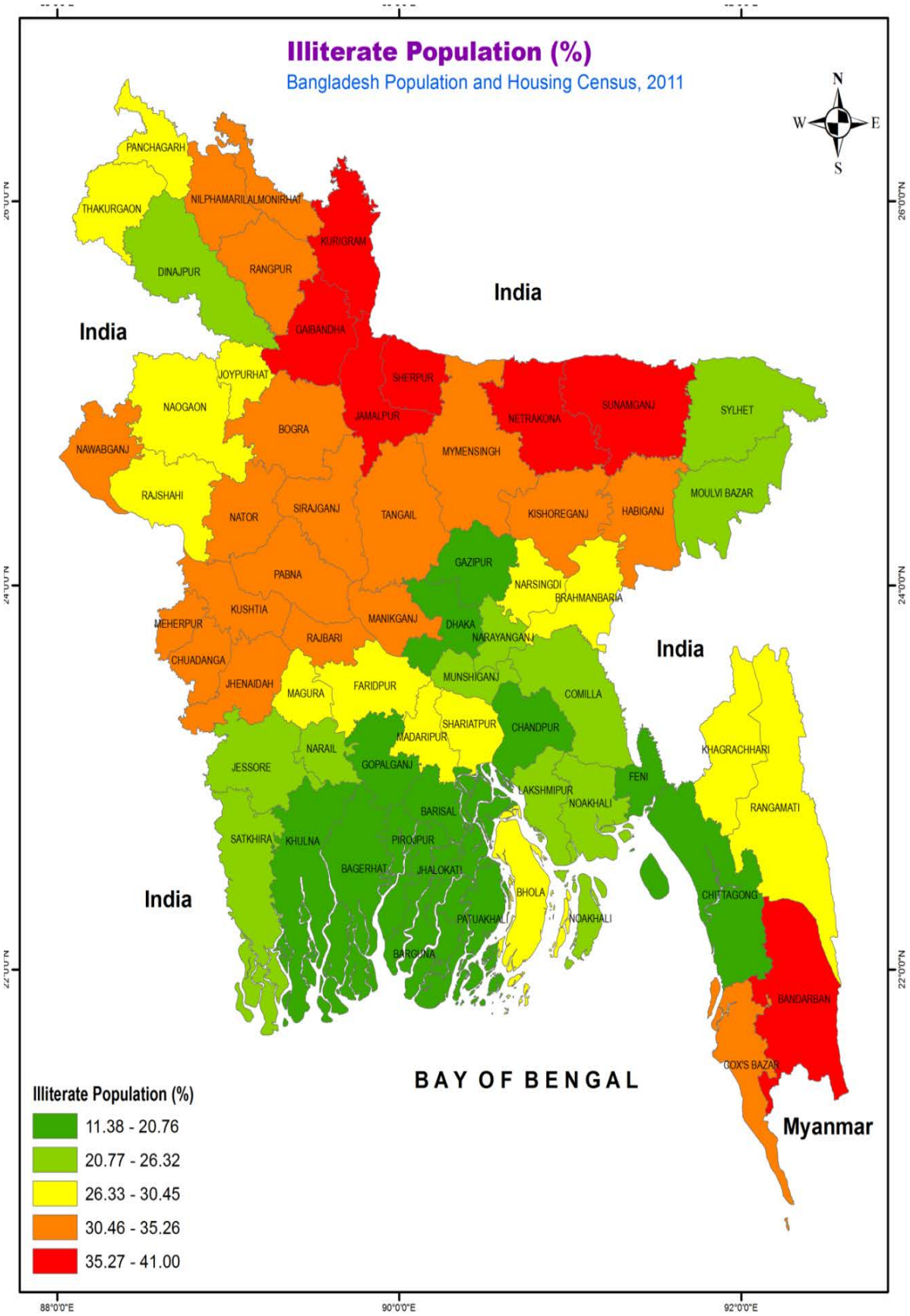
Map 3.4: Distribution of floating population by district, 2011



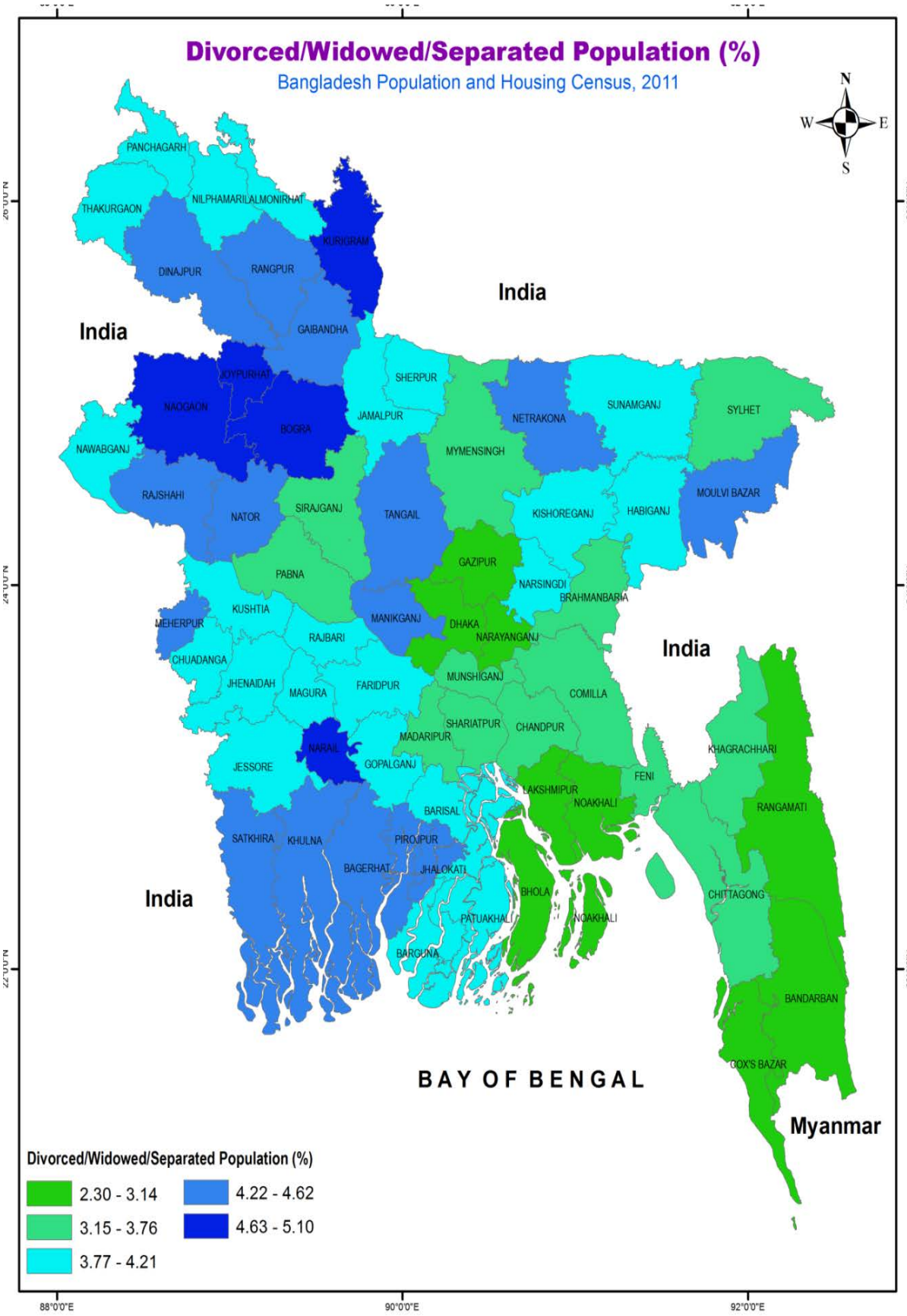
Map 3.5: Distriburion of ethnic population by district, 2011



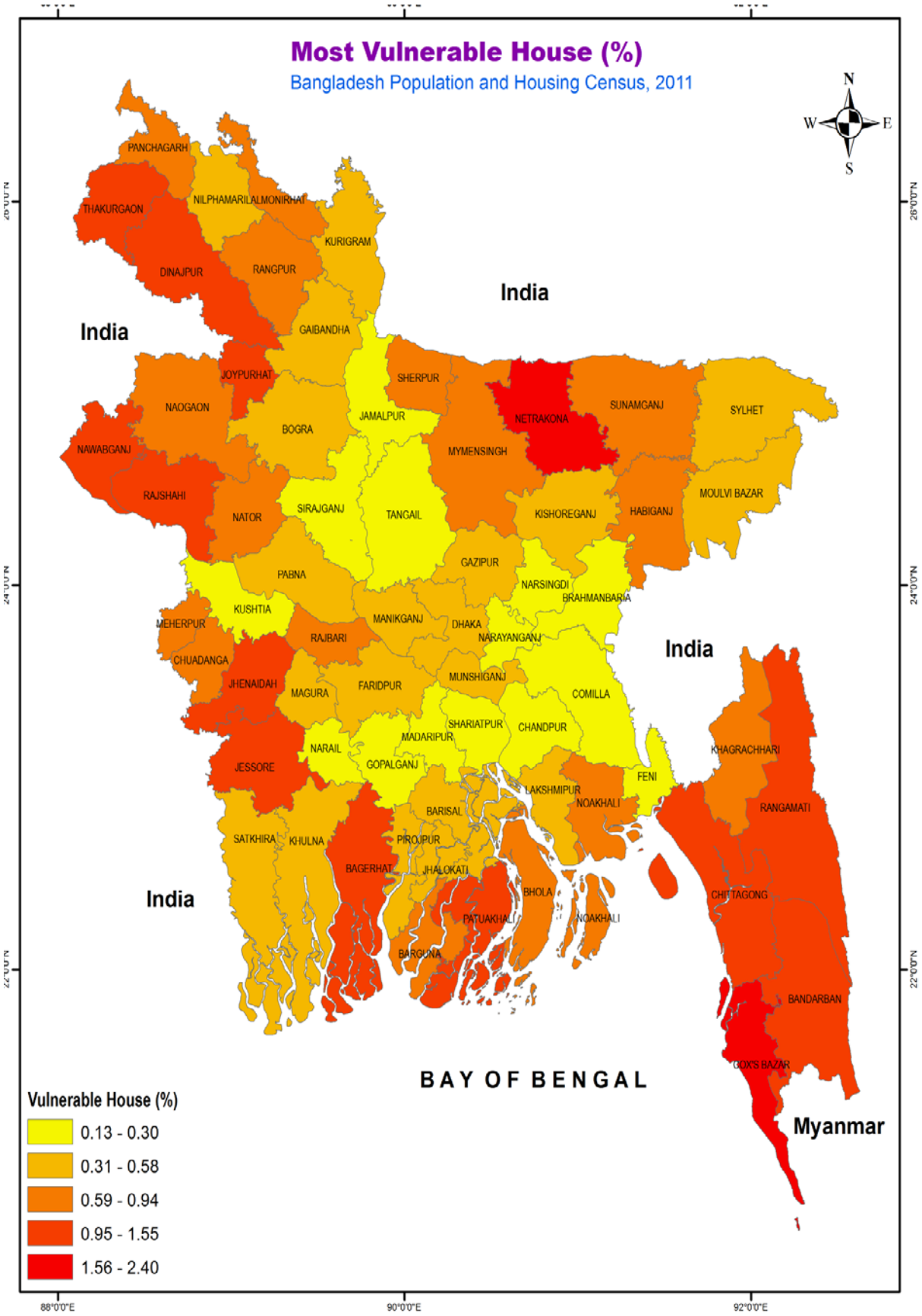
Map 4.6: Distribution of disable population by district, 2011



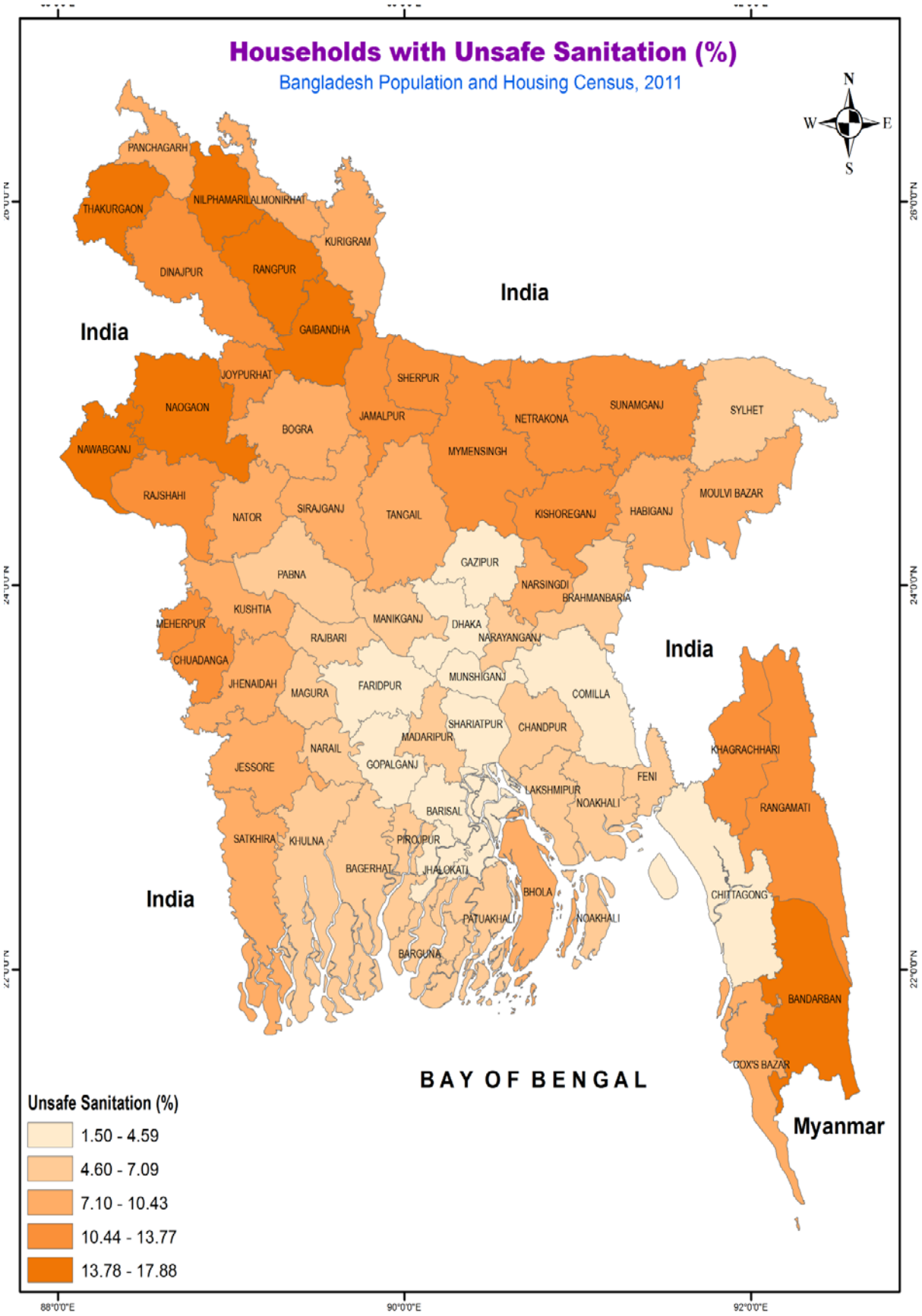
Map 3.7: Distribution of illiterate population by district, 2011



Map 3.8: Distribution of divorced/widowed/separated population by district, 2011



Map 3.9: Distribution of vulnerable house by district, 2011



Map 3.10: Distribution of household with unsafe sanitation by district, 2011

Table 3.2: Distribution of proxy vulnerability indicator by district, 2011

District	Total Population	Proxy Indicators (%)									
		Female	Age<14	Age>65	Floating Pop	Ethnic Pop^n	Disable Pop^n	Illiterate	Divorced/widow/ Separated	Vulnerable House	Unsafe Sanitation
Barguna	892781	51.01	33.79	5.97	0.11	0.13	2.09	14.33	4.16	0.88	6.33
Barisal	2324310	51.07	35.80	5.82	0.14	0.00	1.34	17.39	3.79	0.39	3.86
Bhola	1776795	50.24	40.68	4.75	0.06	0.00	1.47	30.32	2.45	0.94	8.33
Jhalokati	682669	51.79	34.90	6.62	0.03	0.00	1.92	12.57	4.41	0.58	3.09
Patuakhali	1535854	50.94	36.17	5.64	0.23	0.09	1.62	20.09	3.81	1.14	6.46
Pirojpur	1113257	50.75	33.95	6.48	0.06	0.00	2.01	11.38	4.55	0.41	5.77
Bandarban	388335	47.64	39.86	3.13	0.31	44.39	1.44	39.48	3.12	1.21	15.06
Brahmanbaria	2840498	51.88	42.55	4.89	0.05	0.00	1.18	29.66	3.40	0.21	5.66
Chandpur	2416018	52.57	37.06	5.88	0.06	0.05	1.93	19.72	3.51	0.13	6.41
Chittagong	7616352	49.60	33.90	3.78	0.07	0.42	1.26	19.71	3.22	1.22	4.59
Comilla	5387288	52.20	38.68	5.23	0.05	0.06	1.32	24.78	3.49	0.26	4.55
Cox's Bazar	2289990	48.93	43.01	3.12	0.65	0.64	1.48	32.66	2.30	2.40	8.71
Feni	1437371	51.71	35.62	5.43	0.06	0.04	1.34	17.87	3.49	0.25	4.93
Khagrachhari	613917	48.89	37.95	4.43	0.10	51.63	1.55	30.27	3.73	0.84	13.46
Lakshmipur	1729188	52.13	39.51	5.17	0.07	0.01	1.28	23.69	2.93	0.52	5.43
Noakhali	3108083	52.22	40.69	4.91	0.04	0.01	1.36	22.8	3.13	0.81	5.53
Rangamati	595979	47.47	35.65	3.91	0.23	59.76	1.77	29.78	3.14	1.14	13.43
Dhaka	12043977	45.57	27.08	2.68	0.39	0.17	0.80	17.35	2.53	0.45	1.50
Faridpur	1912969	50.74	35.74	5.27	0.10	0.17	1.60	29.68	4.00	0.34	4.41
Gazipur	3403912	47.85	28.18	3.28	0.16	0.45	0.94	20.44	2.63	0.35	4.44
Gopalganj	1172415	50.71	37.23	5.50	0.03	0.18	1.38	20.76	4.15	0.22	3.11
Jamalpur	2292674	50.77	36.30	5.10	0.04	0.07	1.42	41.00	4.21	0.29	11.89
Kishoregonj	2911907	50.81	40.54	5.19	0.05	0.01	1.58	33.07	4.05	0.37	11.86
Madaripur	1165952	50.72	37.26	5.43	0.05	0.01	1.29	27.58	3.43	0.26	6.44
Manikganj	1392867	51.44	32.06	6.28	0.07	0.04	1.48	32.75	4.62	0.46	6.40
Munshiganj	1445660	50.09	33.02	5.44	0.39	0.01	1.50	23.98	3.62	0.47	3.97
Mymensingh	5110272	50.31	38.29	5.46	0.04	0.70	1.35	33.11	3.72	0.84	12.64
Narayanganj	2948217	48.39	31.80	3.25	0.06	0.03	0.93	22.6	2.97	0.30	5.00
Narsingdi	2224944	50.43	37.55	4.48	0.04	0.01	1.17	27.55	3.88	0.21	8.33
Netrakona	2229642	50.16	40.22	5.58	0.05	1.13	1.48	36.63	4.31	1.82	13.14
Rajbari	1049778	50.47	33.67	5.83	0.03	0.12	1.63	32.82	4.02	0.64	4.95
Shariatpur	1155824	51.63	38.94	5.93	0.07	0.01	1.33	28.3	3.64	0.22	3.87
Sherpur	1358325	50.20	37.31	5.24	0.02	1.19	1.59	39.4	4.04	0.68	12.57
Tangail	3605083	51.25	32.54	5.97	0.04	0.71	1.44	34.33	4.42	0.25	8.83
Bagerhat	1476090	49.86	32.25	6.31	0.30	0.23	1.73	17.39	4.48	1.15	5.23
Chuadanga	1129015	49.97	30.62	5.00	0.02	0.11	1.68	31.74	4.12	0.90	13.42
Jessore	2764547	49.85	30.55	5.26	0.03	0.63	1.35	23.36	4.09	1.24	9.38
Jhenaidah	1771304	49.96	31.13	5.39	0.04	0.18	1.57	31.13	3.86	1.00	10.17
Khulna	2318527	49.29	29.77	5.33	0.07	0.09	1.70	20.19	4.39	0.48	5.15
Kushtia	1946838	49.99	31.07	5.12	0.02	0.09	1.38	34.61	3.95	0.25	9.98
Magura	918419	50.49	34.08	5.57	0.03	0.88	1.19	28.8	4.20	0.35	5.07
Meherpur	655392	50.47	29.36	5.31	0.03	0.00	1.74	35.11	4.31	0.79	13.77
Narail	721668	51.01	35.07	5.89	0.02	0.13	1.59	25.43	4.67	0.22	6.53
Satkhira	1985959	50.51	30.46	5.68	0.02	0.13	1.72	25.43	4.49	0.33	9.87
Bogra	3400874	49.75	30.75	4.94	0.08	0.23	1.51	31.1	4.73	0.36	8.81
Joypurhat	913768	49.74	28.59	5.20	0.10	2.53	1.54	27.38	4.92	1.16	12.88

District	Total Population	Proxy Indicators (%)									
		Female	Age<14	Age>65	Floating Pop	Ethnic Popⁿ	Disable Popⁿ	Illiterate	Divorced/widow/ Separated	Vulnerable House	Unsafe Sanitation
Naogaon	2600157	49.99	29.26	5.11	0.04	4.49	1.62	30.45	5.10	0.92	15.93
Natore	1706673	49.95	30.47	5.20	0.04	0.70	1.61	32.54	4.32	0.73	7.55
Chapai Nawabganj	1647521	50.82	35.17	4.25	0.02	0.86	1.54	32.36	3.99	1.55	14.26
Pabna	2523179	49.95	33.67	5.00	0.02	0.08	1.39	33.65	3.46	0.38	7.09
Rajshahi	2595197	49.53	29.39	4.61	0.05	1.90	1.56	27.65	4.50	1.02	11.45
Sirajganj	3097489	49.92	35.84	4.63	0.04	0.64	1.58	35.26	3.76	0.28	9.07
Dinajpur	2990128	49.54	32.51	4.93	0.08	2.24	1.52	26.14	4.51	1.23	12.43
Gaibandha	2379255	50.86	35.42	4.91	0.01	0.18	1.98	37.22	4.53	0.54	17.88
Kurigram	2069273	51.17	35.88	5.20	0.01	0.02	1.53	36.96	4.79	0.36	10.43
Lalmonirhat	1256099	49.94	36.36	4.73	0.04	0.01	1.67	31.23	4.17	0.67	9.36
Nilphamari	1834231	49.68	36.78	4.10	0.03	0.03	1.49	33.78	3.87	0.37	15.39
Panchagarh	987644	49.71	35.31	4.08	0.05	0.15	1.59	26.89	4.05	0.64	8.09
Rangpur	2881086	49.89	33.42	4.91	0.04	0.64	1.60	32.74	4.46	0.79	14.35
Thakurgaon	1390042	49.55	34.99	4.33	0.02	0.69	1.55	28.06	3.97	1.14	16.65
Habiganj	2089001	50.91	40.61	4.77	0.03	3.15	1.47	32.2	4.12	0.62	10.04
Maulvibazar	1919062	50.77	37.53	4.57	0.03	3.31	1.51	26.32	4.37	0.47	9.02
Sunamganj	2467968	49.91	42.66	4.67	0.21	0.28	1.54	35.95	4.03	0.75	11.99
Sylhet	3434188	49.71	39.09	4.05	0.05	0.37	1.39	25.39	3.53	0.37	6.59

3.2.2 Proxy Vulnerability Indicators by AEZ

Table 3.3: Distribution of proxy vulnerability indicator by agro-ecological zone, 2011

AEZ	Total Population	Proxy Indicators (%)									
		Female	Age<15	Age>65	Floating Popⁿ	Ethnic Popⁿ	Disable Popⁿ	Illiterate	Divorced/widow/ Separated	Vulnerable House	Unsafe Sanitation
HPTF	12906742	50.12	35.05	4.70	0.04	0.65	1.63	31.76	4.34	0.73	13.36
KFAB	12864190	49.92	30.55	4.87	0.05	1.74	1.56	30.36	4.62	0.86	11.60
BJF	17507903	50.62	37.39	5.47	0.04	0.60	1.45	35.32	4.08	0.68	11.69
HGRF	15527851	50.04	32.62	5.12	0.03	0.35	1.47	31.23	3.92	0.61	9.20
LGRF	6456938	50.85	36.52	5.55	0.06	0.10	1.46	27.94	3.87	0.33	4.53
GTF	13034051	50.40	34.19	5.69	0.13	0.24	1.65	19.69	4.00	0.75	6.08
SBSKF	9910219	50.22	40.00	4.46	0.08	1.50	1.47	29.64	3.94	0.54	9.13
MMRF	9356801	51.84	38.88	5.10	0.04	0.05	1.32	27.10	3.54	0.32	5.95
LMREF	6274642	52.08	39.20	5.10	0.05	0.02	1.34	21.92	3.16	0.60	5.37
CCPSI	9906342	49.44	36.01	3.63	0.20	0.47	1.31	22.70	3.01	1.50	5.54
EH	1598231	48.05	37.56	3.92	0.20	52.90	1.60	32.32	3.36	1.04	13.84
DHAKA	23459577	47.34	29.49	3.40	0.26	0.16	0.95	20.75	2.92	0.39	3.46

Table 3.3 indicates that female population in Lower Meghna River and Estuarine Floodplain (LMREF), inactive population under age 15 in Sylhet Basin and Surma- Kusiyara Floodplain (SBSKF), inactive population over age 65 in Low Ganges River Floodplain (LGRF), floating population in Greater Dhaka (DHAKA), ethnic population in Eastern Hills (EH), disable population in Ganges Tidal Floodplain (GTF), vulnerable house user in Chittagong Coastal Plain & St.Martin's Coral Island (CCPSI), illiterate population in Brahmaputra-Jamuna

Floodplain (BJF), divorced or separated population in Karatoya Floodplain And Atrai Basin (KFAB) and unsafe sanitation user in EH regions are maximum vulnerable.

3.2.3 Proxy Vulnerability Indicators by natural disaster prone area

Table 3.4 identify the female population in Central coastal, inactive population under age 15 in eastern coastal, inactive population over age 65 in central coastal, floating population in eastern coastal, ethnic population in Drought Prone Areas, disable population in central coastal, vulnerable house in eastern coastal, illiterate population in Flood Prone areas, divorced or separated population in Drought Prone areas and unsafe sanitation user in Drought Prone areas are maximum vulnerable.

Table 3.4: Distribution of proxy vulnerability indicator by natural disaster prone area, 2011

Hazard Zone	Total Population	Proxy Indicators (%)									
		Female	Age<15	Age>65	Floating Pop^n	Ethnic Pop^n	Disable Pop^n	Illiterate	Divorced/widow/ Separated	Vulnerable House	Unsafe Sanitation
Eastern coastal	13014425	50.25	39.2	3.93	0.253	0.356	1.36	25.05	2.88	1.47	6.27
Central coastal	3331780	51.16	35.01	6.24	0.11	0.03	1.85	14.68	4.25	0.71	5.10
Western coastal	5780576	49.88	30.82	5.77	0.13	0.15	1.71	21.00	4.45	0.65	6.75
Cyclone Prone Areas	24113688	50.17	35.50	4.72	0.14	0.24	1.51	21.94	3.49	1.06	6.14
Tornado Prone Areas	18400922	50.17	34.02	4.98	0.06	0.50	1.44	33.28	3.97	0.52	9.95
Flood Prone Areas	18984049	50.65	36.60	5.17	0.07	0.20	1.56	34.7	4.13	0.42	9.67
River Erosion Zone	16196976	50.89	36.87	5.16	0.05	0.19	1.62	31.79	3.75	0.37	9.18
Drought Prone Areas	16590629	49.88	31.80	4.86	0.05	1.81	1.58	29.93	4.52	1.01	12.63
Earthquake Prone Areas	31085875	48.19	32.51	3.77	0.18	0.38	1.14	22.83	3.18	0.73	5.84

3.2.4 Proxy Vulnerability Indicator by Earthquake risk area

Table 3.5: Distribution of proxy vulnerability indicator by earthquake risk area, 2011

Hazard Zone	Total Population	Proxy Indicators (%)									
		Female	Age<15	Age>65	Floating Pop^n	Ethnic Pop^n	Disable Pop^n	Illiterate	Divorced/widow/ Separated	Vulnerable House	Unsafe Sanitation
Zone 1	27138411	50.42	38.61	4.96	0.052	0.930	1.50	33.75	4.12	0.66	10.87
Zone 2	77354934	49.80	34.42	4.59	0.12	6.11	1.45	28.5	3.77	0.67	9.33
Zone 3	39550352	50.64	34.29	5.48	0.06	0.23	1.56	24.99	3.98	0.66	7.27

The Table 3.5 indicates that female population in zone 3, population under age 15 in zone 1, population over 65 year in zone 3, floating population in zone 2, ethnic population in zone 2, disable population in zone 3, vulnerable house in zone 2, illiterate population in zone 1, divorced and unsafe sanitation user population in zone 1 are maximum vulnerable.

4. CHARACTERISTICS OF VULNERABLE GROUPS

4.1 Introduction

Although some groups of population is considered as theoretically vulnerable, the degree of their vulnerability may vary in different regions and depends of some other set of variable. For example women with proper education and employment should not be vulnerable at al. This chapter characterizes some vulnerable groups such as floating population, disable population, ethnic population and illiterate population in context of Bangladesh.

4.2 Floating Population

Floating population is a terminology used to describe a group of people who reside in a given population for a certain amount of time and for various reasons, but are not generally considered part of the official census count (Francesco, 2003). Homeless people in Bangladesh are usually referred to as 'the floating population'or 'rootless people'. Central to the census definition of 'the floating population' is root lessness; implicit in this perception are notions of root lessness and resource-lessness. The vagrant, the displaced, the landless or people exposed to the risk of total economic deprivation are considered rootless. Rootless people are defined as belonging to one of the following categories (BBS, 1999): first, landless people who have lost their own or their parents' home stead areas; second, landless people who have lost their land and homestead areas because of political, economic or social reasons; third, abandoned women, people affected by flooding and people driven out of their own homestead areas. In urban areas, the definition used by the Census of Slum Areas and Floating Population 1997: 'Floating population' is the mobile and vagrant category of rootless people who have no permanent dwelling units, however bad, and who are found on the census night in the railway station, launchghats (water transport terminals), bus stations, hat-bazaar (market places), mazar (shrines), the staircases of public/government buildings, open spaces, etc. (BBS, 1994 and Ghafur, 2004).

In Bangladesh the number of urban population is growing up day by day.The urban migration is motivated by rural poverty, river erosion and natural disaster forcing them to migrate to urban area. These new comers floating people in the city end up sleeping in public places such as street corners, railway station, bus stop and open places. The distribution of floating population by residence is given at Figure 4.1.

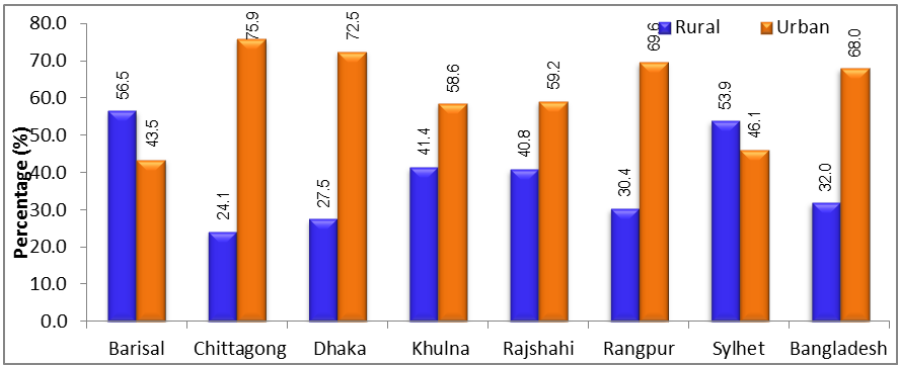


Figure 4.1: Distribution of floating population by division and residence, 2011

Figure 4.1 indicates that in Bangladesh 68% floating people live in urban area where 32% live in rural area. The percentage of floating population is high in case of urban area at Chittagong divisions followed by Dhaka, Khulna, Rajshahi and Rangpur divisions. The rural areas of Barisal and Sylhet division have largest percentage of floating population. Among the floating population 85% are male and this figure is almost similar to all of the divisions except Rajshahi division (Figure 4.2).

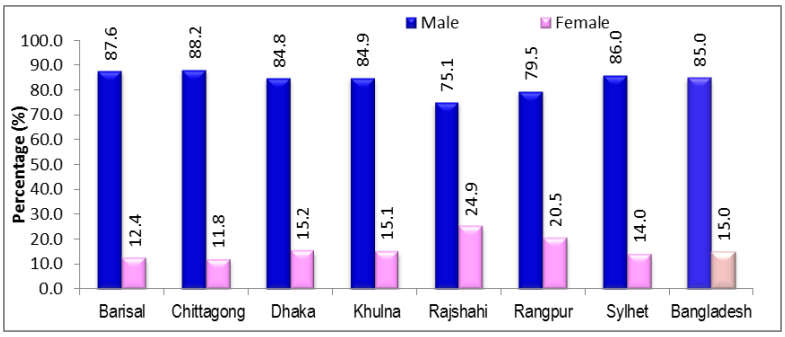


Figure 4.2: Distribution of floating population by division and sex

4.2.1 Education of Floating Population

Education field of floating population by country and division is given at Figure 4.3.

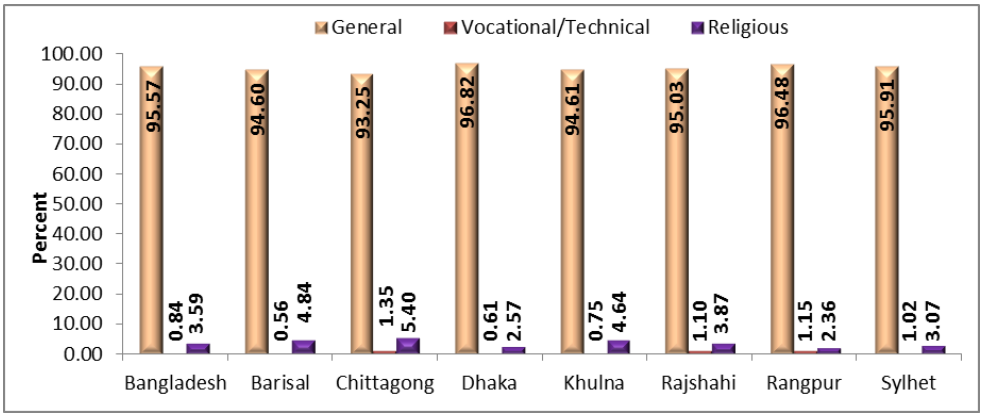


Figure 4.3: Distribution of field of education of floating population by division, 2011

The literacy rate of floating population is very low, only few percent floating have education background. Figure 4.3 indicates that in Bangladesh 95.57% of floating population follow general education where 3.59% follow religious education and only 0.84% of floating population follow vocational education and the similar patterns are obtain for all of the divisions. Distribution of educational attainment of floating population by division and residence is given at Figure 4.4.

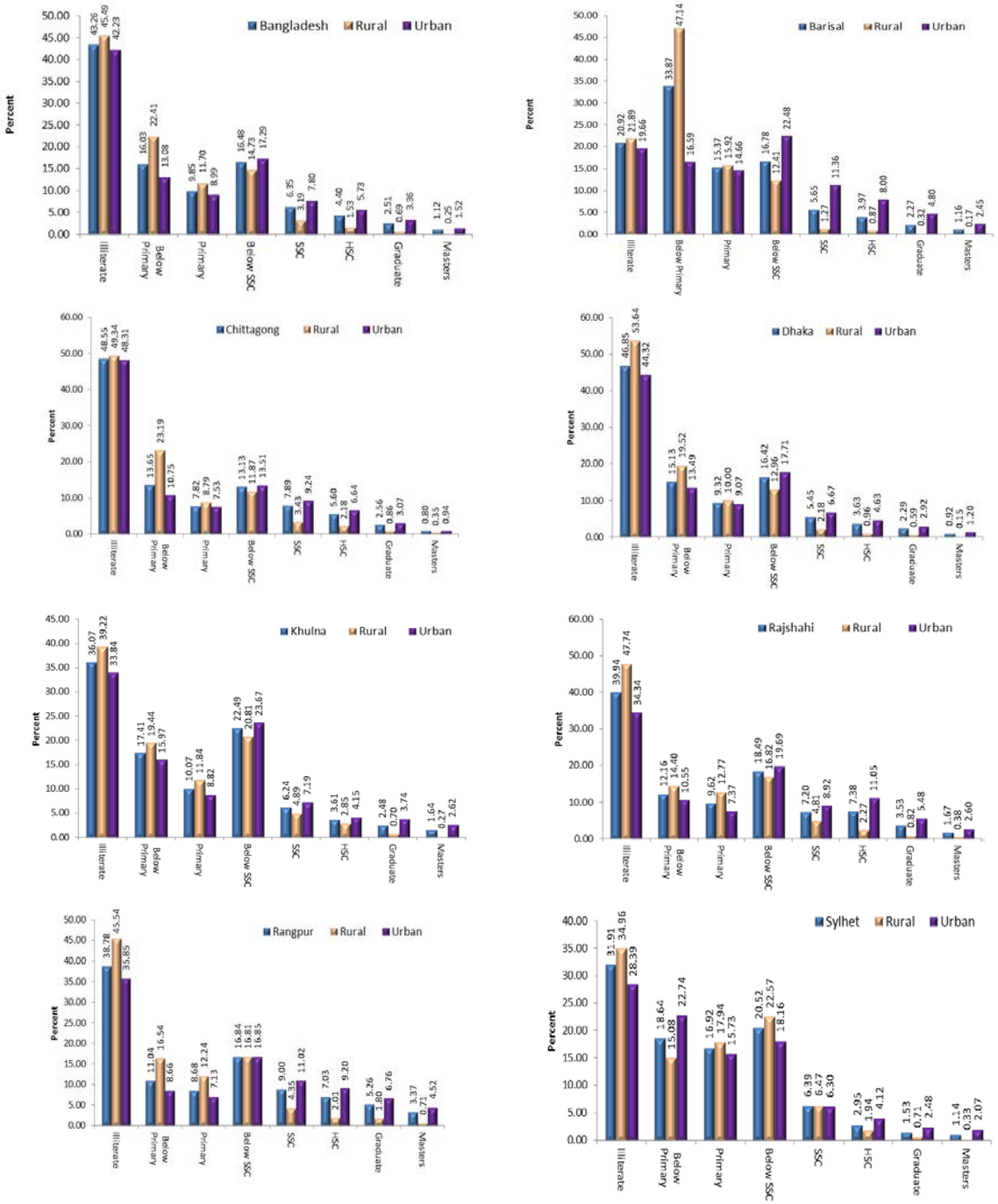


Figure 4.4: Distribution of educational attainment of floating population by division and residence, 2011

Figure 4.4 presents the percentage of floating people attained highest class of education by country and administrative divisions. It is found that 43.26 percent floating population are illiterate, 16.03 percent floating population's education level are below primary. 9.85 percent

of floating population has completed their primary level and 6.35 percent has completed SSC and 4.40 percent has completed HSC level. It is also found that illiteracy is higher among rural floating population all over the divisions. Only 1.12 percent of floating population has completed Masters Degree.

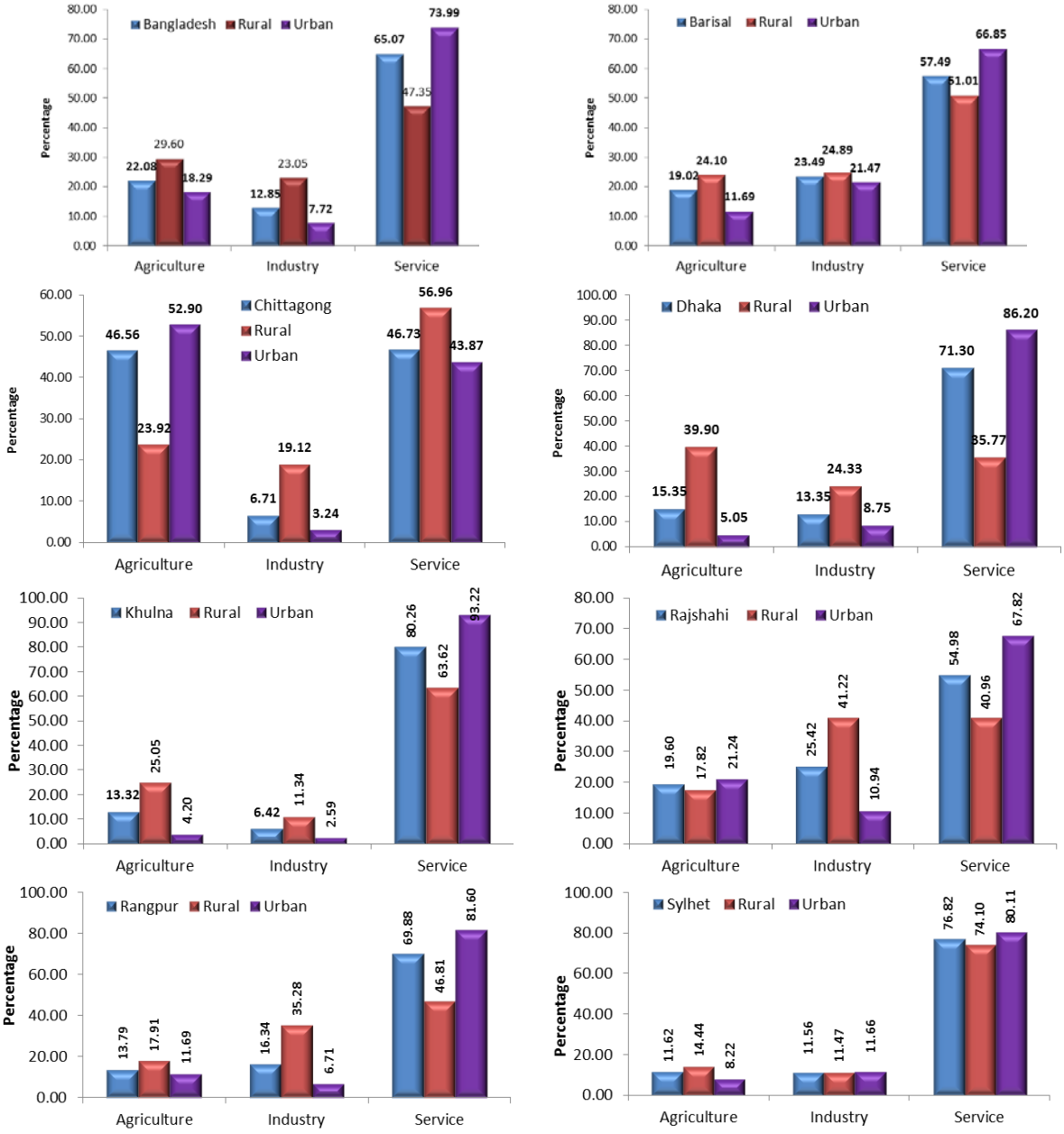


Figure 4.5: Distribution of employment field of floating population by division and residence, 2011

4.2.2 Eployment field of floating population

Distribution of employment filed of floating population is given at Figure 4.5. It is found that 22.03 percent floating population engaged in agricultural sector, 6.42 percent in industry and 80.26 percent in service sector. Most of the floating population's employments filed are service because floating people normally come to urban area in search for work and most of

them involves in industries as a worker. The percentage of floating population engaged in agricultural is higher in rural area in all the divisions except Chittagong division. On the other hand, the percentage of floating population engaged in service is higher in urban area in all divisions except Chittagong.

4.3 Disable Population

The Bangladeshi Parliament adopted its first comprehensive disability legislation, the Bangladesh Persons with Disability Welfare Act-2001, on April 2001. It includes that following definition and identification of persons with disability (Disability World Retrieved February 6, 2002. http://www.disabilityworld.org/).

1. Person with disabilities are those who, have physical disabilities either congenitally, as a result of disease or accident or have become physically incapacitated or mentally imbalanced due to maltreatment or any other reasons

   Or, have become incapacitated or are unable to lead a normal life, either partially or fully as a result of such disabilities or mental impairment,

   Those who have disabilities described hereunder shall be included in the meaning and scope of the definition under section 1 of the Disability Welfare Act.
2. Persons with visual impairment mean those who have,

   No vision in one eye, no vision in both eyes, visual acuity not exceeding 6/60 or 20/200 (Snellen) in th better eye using corrective lenses or limitation of the field of vision subtending an angle of 20 degrees or worse.
3. Persons with physical disabilities refer to those who have,
   a) Lost either one or both hand(s),
   b) lost sensation, partly or totally, in either hand, or have weak sensation that the situations stated under subsection 1(i) and (ii) are applicable to him/her
   c) lost either one or both leg (s),
   d) lost sensation, partly or totally, in either or both leg(s), or weak sensation that the situations stated under subsection 1(i) and (ii) are applicable to him/her
   e) have physical deformity,
   f) have permanently lost physical equilibrium owing to neuro-disequilibrium/imbalance
4. Persons with a “hearing impairment”, means those who have loss of hearing capacity in the better ear in the conversation range of frequencies at 40 decibels or more, damaged or ineffective hearing abilities
5. Persons with speech impairment are those who have loss, damage, partially or wholly or dysfunction of ones capacity in pronouncing meaningful vocabulary and sounds.
6. Persons with mental disability are those who
   a) One’s mental development is not at the same level of his/her chronological age or whose IQ (intelligent Quotient) is below the normal range
   b) Loss or damage, partially or wholly, of mental balance
7. Person who has multiple disabilities suffer from more than one type of impairment stated above.

There are major problems in measuring disability and comparing findings. Variations between and within countries are probably as much due to differences in criteria for identification, types and diversity of classification and data collection methods as to real differences.

Another complication in this regard is the difference between measuring impairment and degrees of functional disabilities, which are not necessarily the same. The prevalence of disability is believed to be high for reasons relating to over population, extreme poverty, illiteracy, lack of awareness, and above all, lack of medical care and services. Although disability is a major social and economic phenomenon in Bangladesh, there is very little reliable data is available. The Government of Bangladesh surveys in 1982, 1986 and 1998 estimated a national prevalence rate of disability at 0.64%, 0.5% and 1.60% respectively (Country Profile on Disability, Bangladesh). Distribution of disable population by division and residence is given at Figure 4.6.

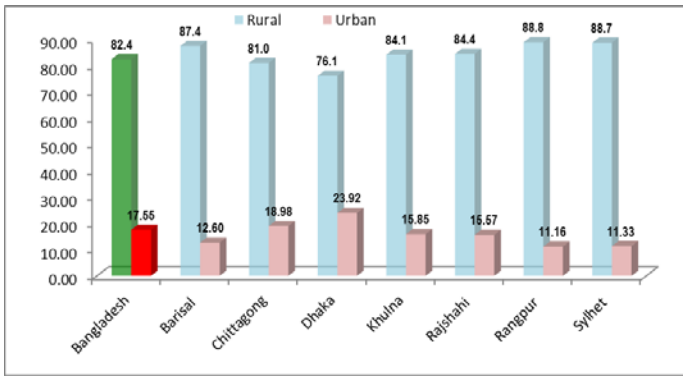


Figure 4.6: Distribution of disable population by division and residence, 2011

The percentage of disable population is higher in urban area compare to its rural area in Bangladesh. In Bangladesh the percentage of population suffering from physical disability was 9.07 % in 2010 (SPB, 2013). The figure 4.6 indicates that about 82.40% disable population live at rural area where 17.55% disable population live at urban area. In the rural area the percentage of disable population is higher in Rangpur and Sylhet division and less in Dhaka division. On the other hand, the percentage of disable population is higher in Dhaka and Chittagong division in case of urban area.

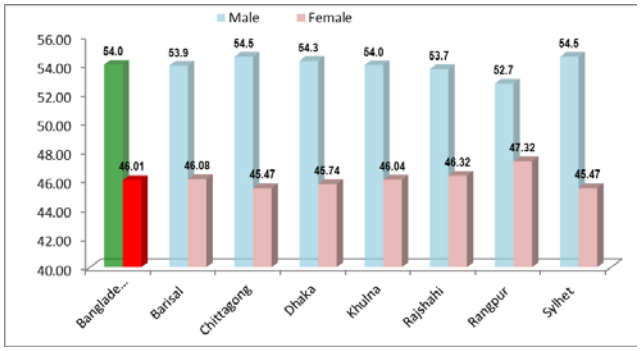


Figure 4.7: Distribution of disable population distribution by division and sex, 2011

Figure 4.7 indicate, among the disble population 54% are male and 46% female in Bangladesh. All of the divisions have same picture that male disable person is higher than female. This may indicate that severe impairments are male-dominated, that women's disabilities are under reported, and/or that they are cared less for and die sooner.

Table 4.1: Distribution of disable population by type, division, sex and residence, 2011

	P19. Disability								Total disable	% of Total	% by sex	% byresidence
	Total	None	Speech	Vision	Hearing	Physical	Mental	Autistic				
Bangladesh	144043697	142014467	276103	394552	183278	797420	255103	122774	2029230	1.41	100.00	
Male	72109796	71014152	154771	187856	88322	458963	138934	66798	1095644	1.52	53.99	100.00
Female	71933901	71000315	121332	206696	94956	338457	116169	55976	933586	1.30	46.01	
Rural	110480514	108807462	228593	329338	157584	659095	202271	96171	1673052	1.51	100.00	
Male	54580004	53678901	128699	156124	76087	379079	108993	52121	901103	1.65	53.86	82.45
Female	55900510	55128561	99894	173214	81497	280016	93278	44050	771949	1.38	46.14	
Urban	33563183	33207005	47510	65214	25694	138325	52832	26603	356178	1.06	100.00	
Male	17529792	17335251	26072	31732	12235	79884	29941	14677	194541	1.11	54.62	17.55
Female	16033391	15871754	21438	33482	13459	58441	22891	11926	161637	1.01	45.38	
Barisal Division	8325666	8189310	19063	26636	12236	56312	13991	8118	136356	1.64	100.00	
Male	4089508	4015981	10777	12864	6039	32113	7336	4398	73527	1.80	53.92	100.00
Female	4236158	4173329	8286	13772	6197	24199	6655	3720	62829	1.48	46.08	
Rural	6963723	6844551	16600	23693	10886	49410	11740	6843	119172	1.71	100.00	
Male	3401166	3336962	9381	11447	5400	28159	6130	3687	64204	1.89	53.88	87.40
Female	3562557	3507589	7219	12246	5486	21251	5610	3156	54968	1.54	46.12	
Urban	1361943	1344759	2463	2943	1350	6902	2251	1275	17184	1.26	100.00	
Male	688342	679019	1396	1417	639	3954	1206	711	9323	1.35	54.25	12.60
Female	673601	665740	1067	1526	711	2948	1045	564	7861	1.17	45.75	
Chittagong Division	28423019	28032324	56266	71402	31113	156224	47989	27701	390695	1.37	100.00	
Male	13933314	13720249	31875	33844	15528	89302	27221	15295	213065	1.53	54.53	100.00
Female	14489705	14312075	24391	37558	15585	66922	20768	12406	177630	1.23	45.47	
Rural	21517539	21200987	45949	58637	26312	126623	37774	21257	316552	1.47	100.00	
Male	10389913	10217644	26184	27545	13103	72331	21363	11743	172269	1.66	54.42	81.02
Female	11127626	10983343	19765	31092	13209	54292	16411	9514	144283	1.30	45.58	
Urban	6905480	6831337	10317	12765	4801	29601	10215	6444	74143	1.07	100.00	
Male	3543401	3502605	5691	6299	2425	16971	5858	3552	40796	1.15	55.02	18.98
Female	3362079	3328732	4626	6466	2376	12630	4357	2892	33347	0.99	44.98	
Dhaka Division	47424418	46852561	81444	111507	50392	213930	76071	38513	571857	1.21	100.00	
Male	24172317	23862037	45526	53137	24549	124436	41687	20945	310280	1.28	54.26	100.00
Female	23252101	22990524	35918	58370	25843	89494	34384	17568	261577	1.12	45.74	
Rural	31839583	31404488	62256	85760	40817	163666	55640	26956	435095	1.37	100.00	
Male	15825650	15590907	34970	40393	19838	94938	30126	14478	234743	1.48	53.95	76.08
Female	16013933	15813581	27286	45367	20979	68728	25514	12478	200352	1.25	46.05	
Urban	15584835	15448073	19188	25747	9575	50264	20431	11557	136762	0.88	100.00	
Male	8346667	8271130	10556	12744	4711	29498	11561	6467	75537	0.90	55.23	23.92
Female	7238168	7176943	8632	13003	4864	20766	8870	5090	61225	0.85	44.77	
Khulna Division	15687759	15443651	30253	44857	22000	103537	31083	12378	244108	1.56	100.00	
Male	7842533	7710808	16822	21775	10389	59672	16422	6645	131725	1.68	53.96	100.00
Female	7845226	7732843	13431	23082	11611	43865	14661	5733	112383	1.43	46.04	
Rural	12865638	12660229	25936	37410	19084	87286	25378	10315	205409	1.60	100.00	
Male	6404666	6293750	14495	18169	9041	50438	13247	5526	110916	1.73	54.00	84.15
Female	6460972	6366479	11441	19241	10043	36848	12131	4789	94493	1.46	46.00	
Urban	2822121	2783422	4317	7447	2916	16251	5705	2063	38699	1.37	100.00	15.85

	P19. Disability								Total disable	% of Total	% by sex	% byresidence
	Total	None	Speech	Vision	Hearing	Physical	Mental	Autistic				
Male	1437867	1417058	2327	3606	1348	9234	3175	1119	20809	1.45	53.77	
Female	1384254	1366364	1990	3841	1568	7017	2530	944	17890	1.29	46.23	
Rajshahi Division	18484858	18199758	35042	58512	26383	113819	38021	13323	285100	1.54		100.00
Male	9256910	9103861	19416	27547	12184	66151	20571	7180	153049	1.65	53.68	
Female	9227948	9095897	15626	30965	14199	47668	17450	6143	132051	1.43	46.32	
Rural	15167836	14927124	29892	50369	23094	95832	30608	10917	240712	1.59	100.00	84.43
Male	7569690	7440500	16582	23746	10748	55918	16300	5896	129190	1.71	53.67	
Female	7598146	7486624	13310	26623	12346	39914	14308	5021	111522	1.47	46.33	
Urban	3317022	3272634	5150	8143	3289	17987	7413	2406	44388	1.34	100.00	15.57
Male	1687220	1663361	2834	3801	1436	10233	4271	1284	23859	1.41	53.75	
Female	1629802	1609273	2316	4342	1853	7754	3142	1122	20529	1.26	46.25	
Rangpur Division	15787758	15531871	33748	51739	27527	100068	29585	13220	255887	1.62	100.00	100.00
Male	7881824	7747019	18722	24285	12852	56150	15675	7121	134805	1.71	52.68	
Female	7905934	7784852	15026	27454	14675	43918	13910	6099	121082	1.53	47.32	
Rural	13678687	13451351	30098	46135	24939	89228	25303	11633	227336	1.66	100.00	88.84
Male	6811805	6691942	16833	21722	11778	49971	13304	6255	119863	1.76	52.73	
Female	6866882	6759409	13265	24413	13161	39257	11999	5378	107473	1.57	47.27	
Urban	2109071	2080520	3650	5604	2588	10840	4282	1587	28551	1.35	100.00	11.16
Male	1070019	1055077	1889	2563	1074	6179	2371	866	14942	1.40	52.33	
Female	1039052	1025443	1761	3041	1514	4661	1911	721	13609	1.31	47.67	
Sylhet Division	9910219	9764992	20287	29899	13627	53530	18363	9521	145227	1.47	100.00	100.00
Male	4933390	4854197	11633	14404	6781	31139	10022	5214	79193	1.61	54.53	
Female	4976829	4910795	8654	15495	6846	22391	8341	4307	66034	1.33	45.47	
Rural	8447508	8318732	17862	27334	12452	47050	15828	8250	128776	1.52	100.00	88.67
Male	4177114	4107196	10254	13102	6179	27324	8523	4536	69918	1.67	54.29	
Female	4270394	4211536	7608	14232	6273	19726	7305	3714	58858	1.38	45.71	
Urban	1462711	1446260	2425	2565	1175	6480	2535	1271	16451	1.12	100.00	11.33
Male	756276	747001	1379	1302	602	3815	1499	678	9275	1.23	56.38	
Female	706435	699259	1046	1263	573	2665	1036	593	7176	1.02	43.62	

Table 4.1 indicates that the percentage of disable population is 1.41% in Bangladesh and maximum number of disable person live in Barisal and Rangpur division and this number is minimum in Dhaka and Chittagong division. Among six types of disability the percentage share of different types of impairments are speech 10.00%, vision 19.94%, hearing 8.71%, physical 44.59%, mental 10.53% and autistic 6.19 %. The rate of prevalence of particular type of impairment is difficult to compare with the existing knowledge on prevalence due to lack of such specific national level survey. The number of physical disability is maximum and autistic is minimum in Bangladesh and similar pattern is observed in all division.

4.3.1 Education of disable population

Distribution of educational attainment of disable population by division is given at Figure 4.8 and the filed of education is reported at Figure 4.9.

Education has a significant affect on all aspects of human life including demographic and health behavior. Figure 4.8 present the education status of disable population. A steady decreasing percentage of no education is observed in each division. The proportion of no

education ranges from 48.85% (Barisal) to 66.03% (Rangpur). About 13.41% disable population did not finish their primary studies, 8.38% complete their primary education, 8.33% complete SSC and after SSC their education rate is very low.

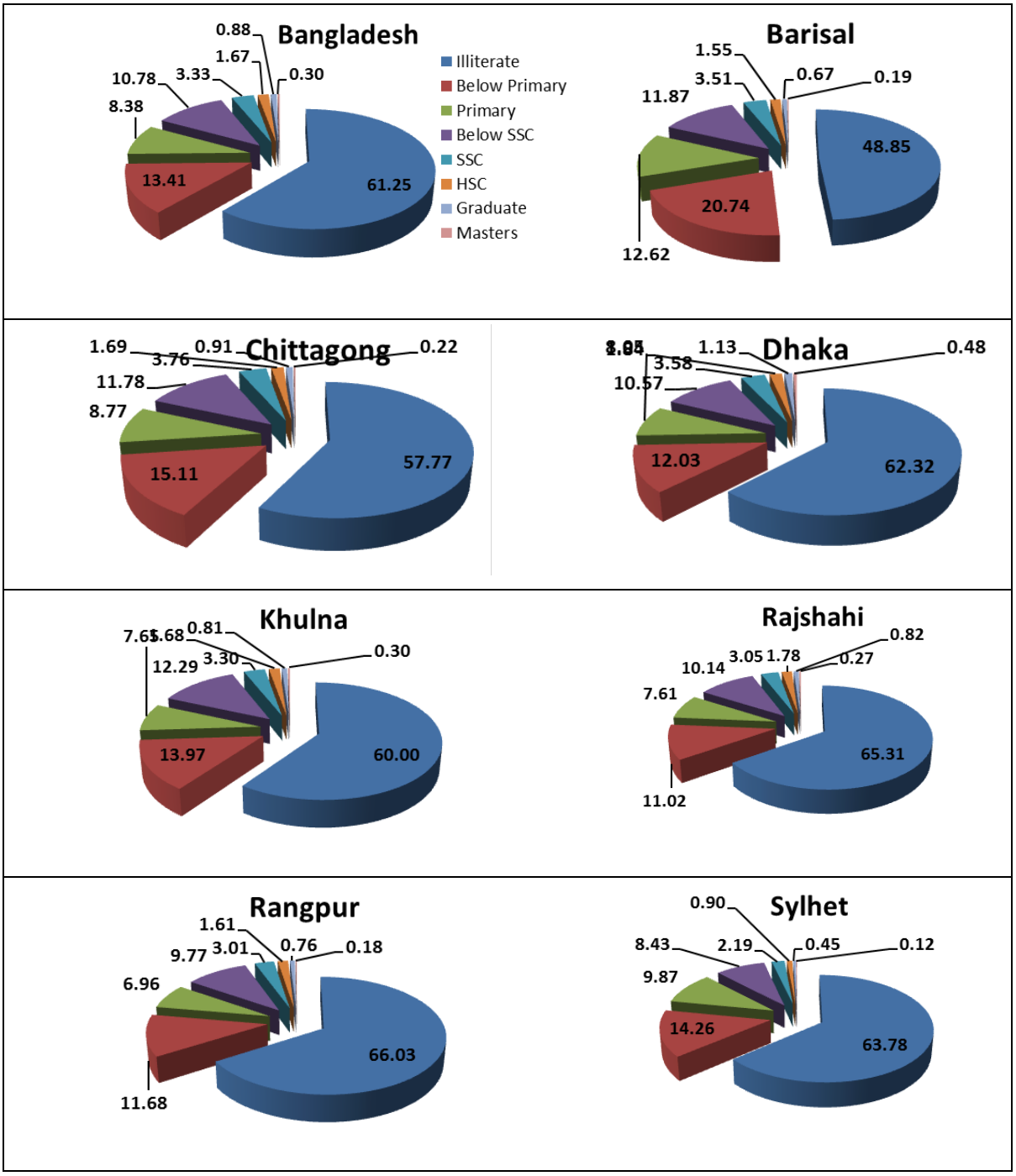


Figure 4.8: Distribution of educational attainment of disable population by division, 2011

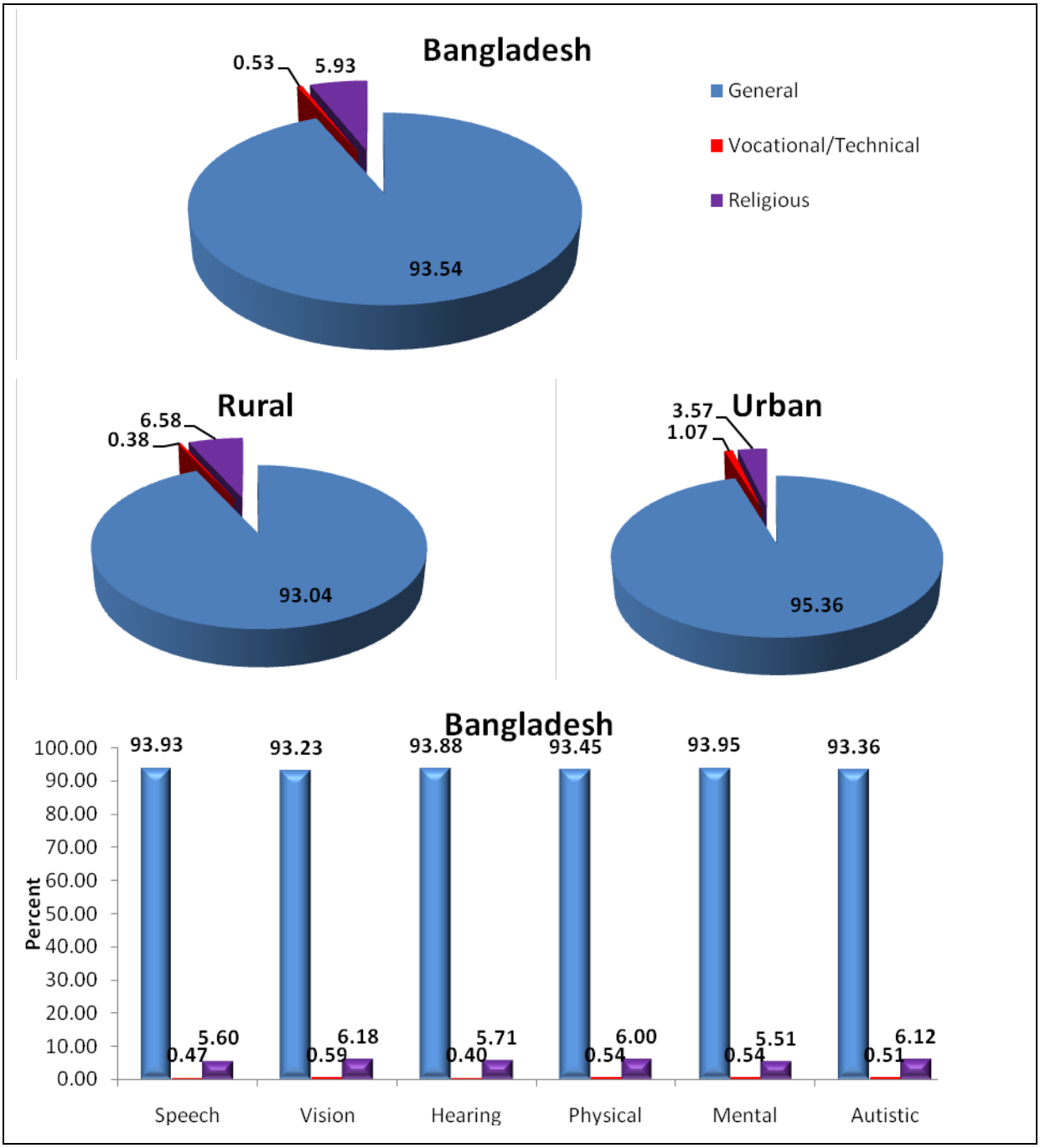


Figure 4.9: Distribution of education field of disable population by type and residence, 2011

Figure 4.9 specify that 93.54% disable population follow general education where 5.93% disable population follow religious education and only negligible 0.53% follow vocational education. And there is little variation in case of rural and urban area. The religious education is higher in rural area where vocation education is higher in urban area. Distribution of disable population by type, filed of education by residence and division is given at Table 4.2.

Table 4.2: Distribution of disable population by type, field of education, division and residence

		Field of Education			
	Disability Type	Total	General	Vocational/Technical	Religious
Bangladesh		733496	686122 (93.54)	3882 (0.53)	43492 (5.93)
	Speech	73396	68938 (93.93)	347 (0.47)	4111 (5.6)
	Vision	146272	136374 (93.23)	856 (0.59)	9042 (6.18)
	Hearing	63940	60030 (93.88)	257 (0.4)	3653 (5.71)
	Physical	327107	305696 (93.45)	1772 (0.54)	19639 (6)
	Mental	77306	72628 (93.95)	416 (0.54)	4262 (5.51)
	Autistic	45475	42456 (93.36)	234 (0.51)	2785 (6.12)
Rural		574240	534255 (93.04)	2175 (0.38)	37810 (6.58)
	Speech	57915	54075 (93.37)	200 (0.35)	3640 (6.29)
	Vision	113881	105697 (92.81)	408 (0.36)	7776 (6.83)
	Hearing	52719	49323 (93.56)	147 (0.28)	3249 (6.16)
	Physical	259003	240728 (92.94)	1053 (0.41)	17222 (6.65)
	Mental	57478	53610 (93.27)	249 (0.43)	3619 (6.3)
	Autistic	33244	30822 (92.71)	118 (0.35)	2304 (6.93)
Urban		159256	151867 (95.36)	1707 (1.07)	5682 (3.57)
	Speech	15481	14863 (96.01)	147 (0.95)	471 (3.04)
	Vision	32391	30677 (94.71)	448 (1.38)	1266 (3.91)
	Hearing	11221	10707 (95.42)	110 (0.98)	404 (3.6)
	Physical	68104	64968 (95.4)	719 (1.06)	2417 (3.55)
	Mental	19828	19018 (95.91)	167 (0.84)	643 (3.24)
	Autistic	12231	11634 (95.12)	116 (0.95)	481 (3.93)
Barisal Division		65409	60971 (93.22)	204 (0.31)	4234 (6.47)
	Speech	6931	6444 (92.97)	26 (0.38)	461 (6.65)
	Vision	13022	12154 (93.33)	33 (0.25)	835 (6.41)
	Hearing	5987	5573 (93.09)	15 (0.25)	399 (6.66)
	Physical	29844	27881 (93.42)	103 (0.35)	1860 (6.23)
	Mental	5878	5472 (93.09)	17 (0.29)	389 (6.62)
	Autistic	3747	3447 (91.99)	10 (0.27)	290 (7.74)
Rural		56595	52644 (93.02)	130 (0.23)	3821 (6.75)
	Speech	5977	5537 (92.64)	16 (0.27)	424 (7.09)
	Vision	11439	10667 (93.25)	23 (0.2)	749 (6.55)
	Hearing	5283	4908 (92.9)	9 (0.17)	366 (6.93)
	Physical	25954	24199 (93.24)	64 (0.25)	1691 (6.52)
	Mental	4866	4509 (92.66)	11 (0.23)	346 (7.11)
	Autistic	3076	2824 (91.81)	7 (0.23)	245 (7.96)
Urban		8814	8327 (94.47)	74 (0.84)	413 (4.69)
	Speech	954	907 (95.07)	10 (1.05)	37 (3.88)
	Vision	1583	1487 (93.94)	10 (0.63)	86 (5.43)
	Hearing	704	665 (94.46)	6 (0.85)	33 (4.69)
	Physical	3890	3682 (94.65)	39 (1)	169 (4.34)
	Mental	1012	963 (95.16)	6 (0.59)	43 (4.25)
	Autistic	671	623 (92.85)	3 (0.45)	45 (6.71)

	Disability Type	Field of Education			
		Total	General	Vocational/Technical	Religious
Chittagong Division		153009	140436 (91.78)	616 (0.4)	11957 (7.81)
	Speech	16487	15127 (91.75)	50 (0.3)	1310 (7.95)
	Vision	28315	25813 (91.16)	141 (0.5)	2361 (8.34)
	Hearing	11620	10608 (91.29)	40 (0.34)	972 (8.36)
	Physical	68107	62674 (92.02)	262 (0.38)	5171 (7.59)
	Mental	17331	15987 (92.25)	86 (0.5)	1258 (7.26)
	Autistic	11149	10227 (91.73)	37 (0.33)	885 (7.94)
Rural		119245	108600 (91.07)	357 (0.3)	10288 (8.63)
	Speech	13111	11929 (90.98)	31 (0.24)	1151 (8.78)
	Vision	22041	19988 (90.69)	71 (0.32)	1982 (8.99)
	Hearing	9540	8660 (90.78)	24 (0.25)	856 (8.97)
	Physical	53344	48690 (91.28)	152 (0.28)	4502 (8.44)
	Mental	13164	12038 (91.45)	62 (0.47)	1064 (8.08)
	Autistic	8045	7295 (90.68)	17 (0.21)	733 (9.11)
Urban		33764	31836 (94.29)	259 (0.77)	1669 (4.94)
	Speech	3376	3198 (94.73)	19 (0.56)	159 (4.71)
	Vision	6274	5825 (92.84)	70 (1.12)	379 (6.04)
	Hearing	2080	1948 (93.65)	16 (0.77)	116 (5.58)
	Physical	14763	13984 (94.72)	110 (0.75)	669 (4.53)
	Mental	4167	3949 (94.77)	24 (0.58)	194 (4.66)
	Autistic	3104	2932 (94.46)	20 (0.64)	152 (4.9)
Dhaka Division		200535	190056 (94.77)	1445 (0.72)	9034 (4.5)
	Speech	21879	20888 (95.47)	174 (0.8)	817 (3.73)
	Vision	40148	37915 (94.44)	332 (0.83)	1901 (4.73)
	Hearing	16807	15956 (94.94)	86 (0.51)	765 (4.55)
	Physical	83931	79419 (94.62)	591 (0.7)	3921 (4.67)
	Mental	22934	21851 (95.28)	158 (0.69)	925 (4.03)
	Autistic	14836	14027 (94.55)	104 (0.7)	705 (4.75)
Rural		137894	130098 (94.35)	583 (0.42)	7213 (5.23)
	Speech	15216	14459 (95.02)	84 (0.55)	673 (4.42)
	Vision	26730	25158 (94.12)	90 (0.34)	1482 (5.54)
	Hearing	12415	11754 (94.68)	31 (0.25)	630 (5.07)
	Physical	59178	55740 (94.19)	266 (0.45)	3172 (5.36)
	Mental	15033	14238 (94.71)	74 (0.49)	721 (4.8)
	Autistic	9322	8749 (93.85)	38 (0.41)	535 (5.74)
Urban		62641	59958 (95.72)	862 (1.38)	1821 (2.91)
	Speech	6663	6429 (96.49)	90 (1.35)	144 (2.16)
	Vision	13418	12757 (95.07)	242 (1.8)	419 (3.12)
	Hearing	4392	4202 (95.67)	55 (1.25)	135 (3.07)
	Physical	24753	23679 (95.66)	325 (1.31)	749 (3.03)
	Mental	7901	7613 (96.35)	84 (1.06)	204 (2.58)
	Autistic	5514	5278 (95.72)	66 (1.2)	170 (3.08)
Khulna Division		91813	87059 (94.82)	397 (0.43)	4357 (4.75)
	Speech	7597	7228 (95.14)	26 (0.34)	343 (4.51)
	Vision	18130	17193 (94.83)	71 (0.39)	866 (4.78)
	Hearing	8124	7764 (95.57)	23 (0.28)	337 (4.15)

	Disability Type	Field of Education			
		Total	General	Vocational/Technical	Religious
	Physical	45165	42755 (94.66)	216 (0.48)	2194 (4.86)
	Mental	8519	8076 (94.8)	42 (0.49)	401 (4.71)
	Autistic	4278	4043 (94.51)	19 (0.44)	216 (5.05)
Rural		74253	70142 (94.46)	265 (0.36)	3846 (5.18)
	Speech	6336	5990 (94.54)	21 (0.33)	325 (5.13)
	Vision	14337	13555 (94.55)	40 (0.28)	742 (5.18)
	Hearing	6833	6515 (95.35)	17 (0.25)	301 (4.41)
	Physical	36754	34653 (94.28)	146 (0.4)	1955 (5.32)
	Mental	6598	6234 (94.48)	28 (0.42)	336 (5.09)
	Autistic	3395	3195 (94.11)	13 (0.38)	187 (5.51)
Urban		17560	16917 (96.34)	132 (0.75)	511 (2.91)
	Speech	1261	1238 (98.18)	5 (0.4)	18 (1.43)
	Vision	3793	3638 (95.91)	31 (0.82)	124 (3.27)
	Hearing	1291	1249 (96.75)	6 (0.46)	36 (2.79)
	Physical	8411	8102 (96.33)	70 (0.83)	239 (2.84)
	Mental	1921	1842 (95.89)	14 (0.73)	65 (3.38)
	Autistic	883	848 (96.04)	6 (0.68)	29 (3.28)
Rajshahi Division		92866	86114 (92.73)	715 (0.77)	6037 (6.5)
	Speech	7833	7311 (93.34)	41 (0.52)	481 (6.14)
	Vision	19957	18414 (92.27)	147 (0.74)	1396 (7)
	Hearing	8070	7540 (93.43)	55 (0.68)	475 (5.89)
	Physical	43711	40367 (92.35)	377 (0.86)	2967 (6.79)
	Mental	8976	8454 (94.18)	61 (0.68)	461 (5.14)
	Autistic	4319	4028 (93.26)	34 (0.79)	257 (5.95)
Rural		74636	68716 (92.07)	487 (0.65)	5433 (7.28)
	Speech	6338	5872 (92.65)	28 (0.44)	438 (6.91)
	Vision	16238	14875 (91.61)	93 (0.57)	1270 (7.82)
	Hearing	6810	6337 (93.05)	40 (0.59)	433 (6.36)
	Physical	35333	32393 (91.68)	268 (0.76)	2672 (7.56)
	Mental	6556	6116 (93.29)	37 (0.56)	403 (6.15)
	Autistic	3361	3123 (92.92)	21 (0.62)	217 (6.46)
Urban		18230	17398 (95.44)	228 (1.25)	604 (3.31)
	Speech	1495	1439 (96.25)	13 (0.87)	43 (2.88)
	Vision	3719	3539 (95.16)	54 (1.45)	126 (3.39)
	Hearing	1260	1203 (95.48)	15 (1.19)	42 (3.33)
	Physical	8378	7974 (95.18)	109 (1.3)	295 (3.52)
	Mental	2420	2338 (96.61)	24 (0.99)	58 (2.4)
	Autistic	958	905 (94.47)	13 (1.36)	40 (4.18)
Rangpur Division		81334	76596 (94.17)	362 (0.45)	4376 (5.38)
	Speech	7445	7085 (95.16)	21 (0.28)	339 (4.55)
	Vision	17407	16293 (93.6)	98 (0.56)	1016 (5.84)
	Hearing	8768	8329 (94.99)	24 (0.27)	415 (4.73)
	Physical	36478	34270 (93.95)	168 (0.46)	2040 (5.59)
	Mental	7397	7010 (94.77)	31 (0.42)	356 (4.81)
	Autistic	3839	3609 (94.01)	20 (0.52)	210 (5.47)
Rural		69972	65652 (93.83)	261 (0.37)	4059 (5.8)
	Speech	6497	6165 (94.89)	14 (0.22)	318 (4.89)

	Disability Type	Field of Education			
		Total	General	Vocational/Technical	Religious
	Vision	14860	13850 (93.2)	73 (0.49)	937 (6.31)
	Hearing	7754	7347 (94.75)	19 (0.25)	388 (5)
	Physical	31543	29521 (93.59)	123 (0.39)	1899 (6.02)
	Mental	6048	5700 (94.25)	20 (0.33)	328 (5.42)
	Autistic	3270	3069 (93.85)	12 (0.37)	189 (5.78)
Urban		11362	10944 (96.32)	101 (0.89)	317 (2.79)
	Speech	948	920 (97.05)	7 (0.74)	21 (2.22)
	Vision	2547	2443 (95.92)	25 (0.98)	79 (3.1)
	Hearing	1014	982 (96.84)	5 (0.49)	27 (2.66)
	Physical	4935	4749 (96.23)	45 (0.91)	141 (2.86)
	Mental	1349	1310 (97.11)	11 (0.82)	28 (2.08)
	Autistic	569	540 (94.9)	8 (1.41)	21 (3.69)
Sylhet Division		48530	44890 (92.5)	143 (0.29)	3497 (7.21)
	Speech	5224	4855 (92.94)	9 (0.17)	360 (6.89)
	Vision	9293	8592 (92.46)	34 (0.37)	667 (7.18)
	Hearing	4564	4260 (93.34)	14 (0.31)	290 (6.35)
	Physical	19871	18330 (92.24)	55 (0.28)	1486 (7.48)
	Mental	6271	5778 (92.14)	21 (0.33)	472 (7.53)
	Autistic	3307	3075 (92.98)	10 (0.3)	222 (6.71)
Rural		41645	38403 (92.22)	92 (0.22)	3150 (7.56)
	Speech	4440	4123 (92.86)	6 (0.14)	311 (7)
	Vision	8236	7604 (92.33)	18 (0.22)	614 (7.46)
	Hearing	4084	3802 (93.1)	7 (0.17)	275 (6.73)
	Physical	16897	15532 (91.92)	34 (0.2)	1331 (7.88)
	Mental	5213	4775 (91.6)	17 (0.33)	421 (8.08)
	Autistic	2775	2567 (92.5)	10 (0.36)	198 (7.14)
Urban		6885	6487 (94.22)	51 (0.74)	347 (5.04)
	Speech	784	732 (93.37)	3 (0.38)	49 (6.25)
	Vision	1057	988 (93.47)	16 (1.51)	53 (5.01)
	Hearing	480	458 (95.42)	7 (1.46)	15 (3.13)
	Physical	2974	2798 (94.08)	21 (0.71)	155 (5.21)
	Mental	1058	1003 (94.8)	4 (0.38)	51 (4.82)
	Autistic	532	508 (95.49)	0 (0)	24 (4.51)

Table 4.2 indicate that most of the disable population follow general education and type of disability indicate that more than 93% of different type of disability such as speech, vision, hearing, physical, mental and autistic follow general education. For vocational and religious education the highest percentage is observed in case of vision disability. And this pattern is almost similar for all divisions.

4.3.2 Employment field of Disable population

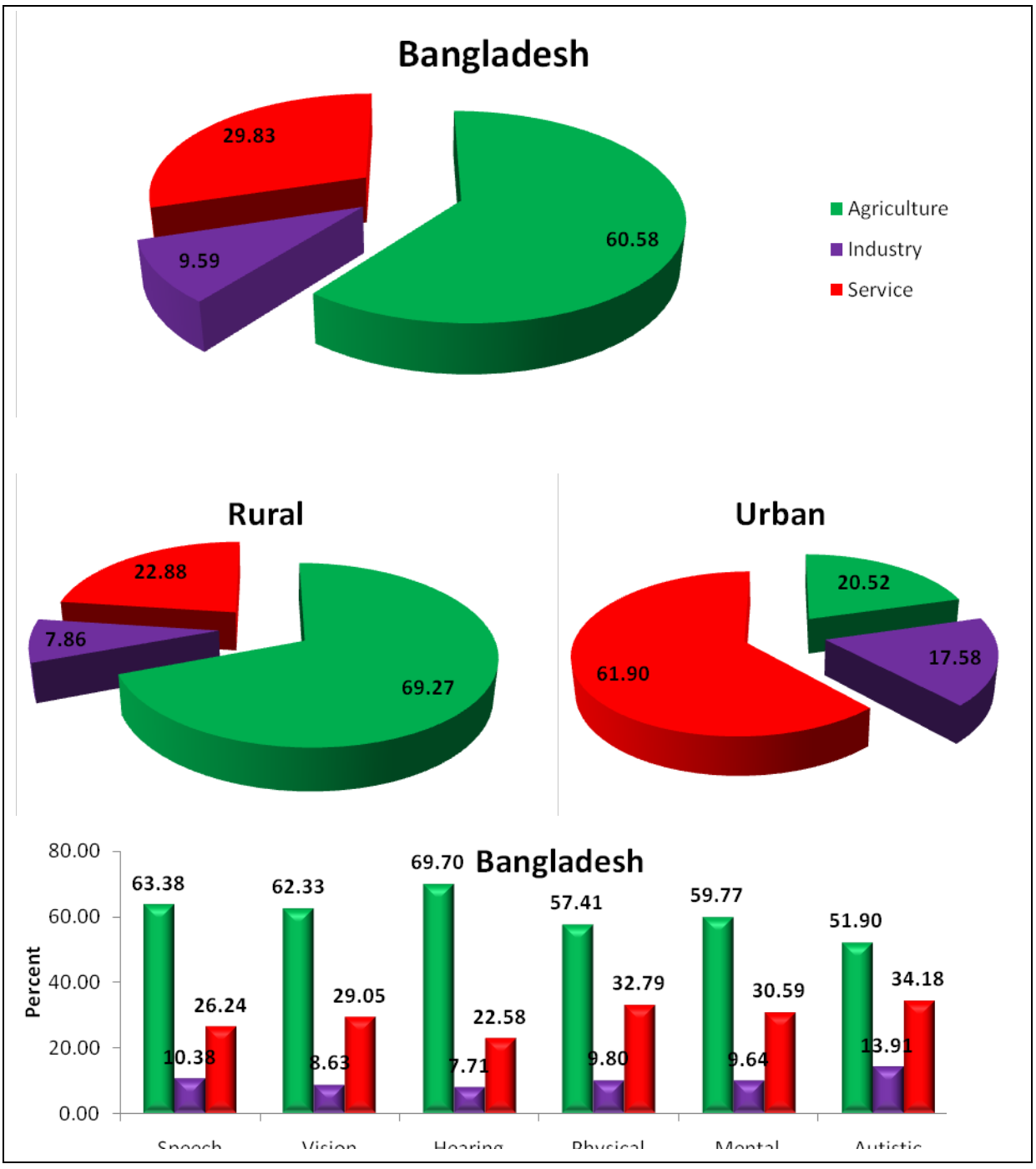


Figure 4.10: Distribution of employment field of disable population by type and residence

Persons with disabilities are ususlly excluded from existing governmental and non-governmental development programs. Although government imposes the policy to fix some quota for higher studies and job for disable, ethnic, female and freedom fighters but most of cases they are neglecting due to unfair selection and poor education. The employment field of disable population is given at Figure 4.10 and Table 4.3.

The Figure 4.10 identifies that in Bangladesh 60.58% disable population depend on agricultural where 9.59% depend on industry and 29.83% depend on service. This percentage is different in case of rural and urban. In rural area, most of disable person involved in agricultural where in urban area most of disable person involved in service. According to types of disability, for speech 63.38% agricultural, 10.38% industry, 26.24% service. For vision 62.33% agricultural, 10.38% industry, 29.05% service and so on.

Table 4.3 indicate that in Barisal division 67.75% disable population involve in agricultural, 7.29% in industry and 24.96% in service. In Chittagong division 53.23% disable population involved in agricultural, 9.53% in industry and 37.24% in service. And similar percentage is observed for other divisions.The percentage of hearing type disabie persons's envolvment higher in agricultural and the autistic type disabile person's engagement is higher both in industry and service.

Table 4.3: Distribution of disable population by type, employment filed, division and residence

	Disability Type	Employment Field						
		Total	Agriculture (%)		Industry (%)		Service (%)	
Bangladesh		518833	314301	(60.58)	49753	(9.59)	154779	(29.83)
	Speech	74319	47101	(63.38)	7715	(10.38)	19503	(26.24)
	Vision	109994	68555	(62.33)	9487	(8.63)	31952	(29.05)
	Hearing	56503	39383	(69.7)	4359	(7.71)	12761	(22.58)
	Physical	210448	120823	(57.41)	20620	(9.8)	69005	(32.79)
	Mental	42846	25607	(59.77)	4132	(9.64)	13107	(30.59)
	Autistic	24723	12832	(51.9)	3440	(13.91)	8451	(34.18)
Rural		**426358**	**295327**	**(69.27)**	**33496**	**(7.86)**	**97535**	**(22.88)**
	Speech	61406	44320	(72.18)	5280	(8.6)	11806	(19.23)
	Vision	90451	64488	(71.3)	6314	(6.98)	19649	(21.72)
	Hearing	49009	37210	(75.92)	3077	(6.28)	8722	(17.8)
	Physical	172822	113431	(65.63)	14194	(8.21)	45197	(26.15)
	Mental	33832	23889	(70.61)	2492	(7.37)	7451	(22.02)
	Autistic	18838	11989	(63.64)	2139	(11.35)	4710	(25)
Urban		**92475**	**18974**	**(20.52)**	**16257**	**(17.58)**	**57244**	**(61.9)**
	Speech	12913	2781	(21.54)	2435	(18.86)	7697	(59.61)
	Vision	19543	4067	(20.81)	3173	(16.24)	12303	(62.95)
	Hearing	7494	2173	(29)	1282	(17.11)	4039	(53.9)
	Physical	37626	7392	(19.65)	6426	(17.08)	23808	(63.28)
	Mental	9014	1718	(19.06)	1640	(18.19)	5656	(62.75)
	Autistic	5885	843	(14.32)	1301	(22.11)	3741	(63.57)
Barisal Division		34150	23137	(67.75)	2490	(7.29)	8523	(24.96)
	Speech	5087	3616	(71.08)	353	(6.94)	1118	(21.98)
	Vision	6955	4932	(70.91)	417	(6)	1606	(23.09)

	Disability Type	Employment Field						
		Total	Agriculture (%)		Industry (%)		Service (%)	
	Hearing	3516	2539	(72.21)	234	(6.66)	743	(21.13)
	Physical	14860	9658	(64.99)	1167	(7.85)	4035	(27.15)
	Mental	2241	1486	(66.31)	189	(8.43)	566	(25.26)
	Autistic	1491	906	(60.76)	130	(8.72)	455	(30.52)
Rural		**30350**	**22025**	**(72.57)**	**2056**	**(6.77)**	**6269**	**(20.66)**
	Speech	4479	3398	(75.87)	273	(6.1)	808	(18.04)
	Vision	6270	4694	(74.86)	347	(5.53)	1229	(19.6)
	Hearing	3194	2430	(76.08)	190	(5.95)	574	(17.97)
	Physical	13156	9235	(70.2)	974	(7.4)	2947	(22.4)
	Mental	1987	1409	(70.91)	168	(8.45)	410	(20.63)
	Autistic	1264	859	(67.96)	104	(8.23)	301	(23.81)
Urban		**3800**	**1112**	**(29.26)**	**434**	**(11.42)**	**2254**	**(59.32)**
	Speech	608	218	(35.86)	80	(13.16)	310	(50.99)
	Vision	685	238	(34.74)	70	(10.22)	377	(55.04)
	Hearing	322	109	(33.85)	44	(13.66)	169	(52.48)
	Physical	1704	423	(24.82)	193	(11.33)	1088	(63.85)
	Mental	254	77	(30.31)	21	(8.27)	156	(61.42)
	Autistic	227	47	(20.7)	26	(11.45)	154	(67.84)
Chittagong Division		87964	46824	(53.23)	8382	(9.53)	32758	(37.24)
	Speech	13244	7569	(57.15)	1250	(9.44)	4425	(33.41)
	Vision	17166	9635	(56.13)	1372	(7.99)	6159	(35.88)
	Hearing	8248	5215	(63.23)	698	(8.46)	2335	(28.31)
	Physical	36339	17987	(49.5)	3535	(9.73)	14817	(40.77)
	Mental	7665	4035	(52.64)	772	(10.07)	2858	(37.29)
	Autistic	5302	2383	(44.95)	755	(14.24)	2164	(40.81)
Rural		**70119**	**43033**	**(61.37)**	**5240**	**(7.47)**	**21846**	**(31.16)**
	Speech	10694	6979	(65.26)	793	(7.42)	2922	(27.32)
	Vision	13732	8848	(64.43)	872	(6.35)	4012	(29.22)
	Hearing	6953	4808	(69.15)	475	(6.83)	1670	(24.02)
	Physical	28883	16502	(57.13)	2270	(7.86)	10111	(35.01)
	Mental	5997	3712	(61.9)	453	(7.55)	1832	(30.55)
	Autistic	3860	2184	(56.58)	377	(9.77)	1299	(33.65)
Urban		**17845**	**3791**	**(21.24)**	**3142**	**(17.61)**	**10912**	**(61.15)**
	Speech	2550	590	(23.14)	457	(17.92)	1503	(58.94)
	Vision	3434	787	(22.92)	500	(14.56)	2147	(62.52)
	Hearing	1295	407	(31.43)	223	(17.22)	665	(51.35)
	Physical	7456	1485	(19.92)	1265	(16.97)	4706	(63.12)
	Mental	1668	323	(19.36)	319	(19.12)	1026	(61.51)
	Autistic	1442	199	(13.8)	378	(26.21)	865	(59.99)
Dhaka Division		151566	77840	(51.36)	21222	(14)	52504	(34.64)
	Speech	23641	12423	(52.55)	3927	(16.61)	7291	(30.84)
	Vision	32128	17138	(53.34)	3974	(12.37)	11016	(34.29)
	Hearing	16022	10050	(62.73)	1751	(10.93)	4221	(26.35)

	Disability Type	Employment Field						
		Total	Agriculture (%)		Industry (%)		Service (%)	
	Physical	58128	28273	(48.64)	7918	(13.62)	21937	(37.74)
	Mental	13115	6594	(50.28)	1819	(13.87)	4702	(35.85)
	Autistic	8532	3362	(39.4)	1833	(21.48)	3337	(39.11)
Rural		**112820**	**72902**	**(64.62)**	**12580**	**(11.15)**	**27338**	**(24.23)**
	Speech	17841	11758	(65.9)	2549	(14.29)	3534	(19.81)
	Vision	23563	15983	(67.83)	2171	(9.21)	5409	(22.96)
	Hearing	13033	9467	(72.64)	1093	(8.39)	2473	(18.97)
	Physical	43426	26441	(60.89)	4724	(10.88)	12261	(28.23)
	Mental	9342	6138	(65.7)	967	(10.35)	2237	(23.95)
	Autistic	5615	3115	(55.48)	1076	(19.16)	1424	(25.36)
Urban		**38746**	**4938**	**(12.74)**	**8642**	**(22.3)**	**25166**	**(64.95)**
	Speech	5800	665	(11.47)	1378	(23.76)	3757	(64.78)
	Vision	8565	1155	(13.49)	1803	(21.05)	5607	(65.46)
	Hearing	2989	583	(19.5)	658	(22.01)	1748	(58.48)
	Physical	14702	1832	(12.46)	3194	(21.72)	9676	(65.81)
	Mental	3773	456	(12.09)	852	(22.58)	2465	(65.33)
	Autistic	2917	247	(8.47)	757	(25.95)	1913	(65.58)
Khulna Division		62618	39985	(63.86)	4646	(7.42)	17987	(28.72)
	Speech	8292	5806	(70.02)	577	(6.96)	1909	(23.02)
	Vision	12792	8138	(63.62)	928	(7.25)	3726	(29.13)
	Hearing	6900	4977	(72.13)	436	(6.32)	1487	(21.55)
	Physical	27890	16650	(59.7)	2252	(8.07)	8988	(32.23)
	Mental	4517	3015	(66.75)	289	(6.4)	1213	(26.85)
	Autistic	2227	1399	(62.82)	164	(7.36)	664	(29.82)
Rural		**53042**	**37577**	**(70.84)**	**3545**	**(6.68)**	**11920**	**(22.47)**
	Speech	7184	5481	(76.29)	421	(5.86)	1282	(17.85)
	Vision	10609	7644	(72.05)	708	(6.67)	2257	(21.27)
	Hearing	6084	4711	(77.43)	331	(5.44)	1042	(17.13)
	Physical	23508	15605	(66.38)	1747	(7.43)	6156	(26.19)
	Mental	3768	2812	(74.63)	198	(5.25)	758	(20.12)
	Autistic	1889	1324	(70.09)	140	(7.41)	425	(22.5)
Urban		**9576**	**2408**	**(25.15)**	**1101**	**(11.5)**	**6067**	**(63.36)**
	Speech	1108	325	(29.33)	156	(14.08)	627	(56.59)
	Vision	2183	494	(22.63)	220	(10.08)	1469	(67.29)
	Hearing	816	266	(32.6)	105	(12.87)	445	(54.53)
	Physical	4382	1045	(23.85)	505	(11.52)	2832	(64.63)
	Mental	749	203	(27.1)	91	(12.15)	455	(60.75)
	Autistic	338	75	(22.19)	24	(7.1)	239	(70.71)
Rajshahi Division		77180	52026	(67.41)	7058	(9.14)	18096	(23.45)
	Speech	9743	7052	(72.38)	878	(9.01)	1813	(18.61)
	Vision	17366	11743	(67.62)	1625	(9.36)	3998	(23.02)
	Hearing	8486	6444	(75.94)	601	(7.08)	1441	(16.98)
	Physical	32295	20614	(63.83)	3136	(9.71)	8545	(26.46)

	Disability Type	Employment Field						
		Total	Agriculture (%)		Industry (%)		Service (%)	
	Mental	6624	4441	(67.04)	546	(8.24)	1637	(24.71)
	Autistic	2666	1732	(64.97)	272	(10.2)	662	(24.83)
Rural		**65918**	**48412**	**(73.44)**	**5422**	**(8.23)**	**12084**	**(18.33)**
	Speech	8411	6546	(77.83)	677	(8.05)	1188	(14.12)
	Vision	15038	11010	(73.21)	1313	(8.73)	2715	(18.05)
	Hearing	7530	6030	(80.08)	477	(6.33)	1023	(13.59)
	Physical	27474	19149	(69.7)	2398	(8.73)	5927	(21.57)
	Mental	5216	4069	(78.01)	347	(6.65)	800	(15.34)
	Autistic	2249	1608	(71.5)	210	(9.34)	431	(19.16)
Urban		**11262**	**3614**	**(32.09)**	**1636**	**(14.53)**	**6012**	**(53.38)**
	Speech	1332	506	(37.99)	201	(15.09)	625	(46.92)
	Vision	2328	733	(31.49)	312	(13.4)	1283	(55.11)
	Hearing	956	414	(43.31)	124	(12.97)	418	(43.72)
	Physical	4821	1465	(30.39)	738	(15.31)	2618	(54.3)
	Mental	1408	372	(26.42)	199	(14.13)	837	(59.45)
	Autistic	417	124	(29.74)	62	(14.87)	231	(55.4)
Rangpur Division		72072	53255	(73.89)	3247	(4.51)	15570	(21.6)
	Speech	9344	7306	(78.19)	352	(3.77)	1686	(18.04)
	Vision	16196	11963	(73.86)	661	(4.08)	3572	(22.05)
	Hearing	9344	7385	(79.03)	349	(3.74)	1610	(17.23)
	Physical	28919	20467	(70.77)	1533	(5.3)	6919	(23.93)
	Mental	5548	4135	(74.53)	228	(4.11)	1185	(21.36)
	Autistic	2721	1999	(73.47)	124	(4.56)	598	(21.98)
Rural		**64615**	**51088**	**(79.07)**	**2527**	**(3.91)**	**11000**	**(17.02)**
	Speech	8403	6979	(83.05)	270	(3.21)	1154	(13.73)
	Vision	14518	11512	(79.29)	496	(3.42)	2510	(17.29)
	Hearing	8577	7107	(82.86)	275	(3.21)	1195	(13.93)
	Physical	25865	19647	(75.96)	1222	(4.72)	4996	(19.32)
	Mental	4840	3939	(81.38)	160	(3.31)	741	(15.31)
	Autistic	2412	1904	(78.94)	104	(4.31)	404	(16.75)
Urban		**7457**	**2167**	**(29.06)**	**720**	**(9.66)**	**4570**	**(61.28)**
	Speech	941	327	(34.75)	82	(8.71)	532	(56.54)
	Vision	1678	451	(26.88)	165	(9.83)	1062	(63.29)
	Hearing	767	278	(36.25)	74	(9.65)	415	(54.11)
	Physical	3054	820	(26.85)	311	(10.18)	1923	(62.97)
	Mental	708	196	(27.68)	68	(9.6)	444	(62.71)
	Autistic	309	95	(30.74)	20	(6.47)	194	(62.78)
Sylhet Division		33283	21234	(63.8)	2708	(8.14)	9341	(28.07)
	Speech	4968	3329	(67.01)	378	(7.61)	1261	(25.38)
	Vision	7391	5006	(67.73)	510	(6.9)	1875	(25.37)
	Hearing	3987	2773	(69.55)	290	(7.27)	924	(23.18)
	Physical	12017	7174	(59.7)	1079	(8.98)	3764	(31.32)
	Mental	3136	1901	(60.62)	289	(9.22)	946	(30.17)

	Disability Type	Employment Field						
		Total	Agriculture (%)		Industry (%)		Service (%)	
	Autistic	1784	1051	(58.91)	162	(9.08)	571	(32.01)
Rural		**29494**	**20290**	**(68.79)**	**2126**	**(7.21)**	**7078**	**(24)**
	Speech	4394	3179	(72.35)	297	(6.76)	918	(20.89)
	Vision	6721	4797	(71.37)	407	(6.06)	1517	(22.57)
	Hearing	3638	2657	(73.03)	236	(6.49)	745	(20.48)
	Physical	10510	6852	(65.2)	859	(8.17)	2799	(26.63)
	Mental	2682	1810	(67.49)	199	(7.42)	673	(25.09)
	Autistic	1549	995	(64.23)	128	(8.26)	426	(27.5)
Urban		**3789**	**944**	**(24.91)**	**582**	**(15.36)**	**2263**	**(59.73)**
	Speech	574	150	(26.13)	81	(14.11)	343	(59.76)
	Vision	670	209	(31.19)	103	(15.37)	358	(53.43)
	Hearing	349	116	(33.24)	54	(15.47)	179	(51.29)
	Physical	1507	322	(21.37)	220	(14.6)	965	(64.03)
	Mental	454	91	(20.04)	90	(19.82)	273	(60.13)
	Autistic	235	56	(23.83)	34	(14.47)	145	(61.7)

4.4 Illiterate Population

Although country has achieved positive improvement in education but still illiteracy is the main problem of our country. Bangladesh is over populated and under developed country. The percentage of illiterate population by sex, residence and divisions is given at Figure 4.11 which indicates that the percentage of illiterate population is 32.22% (Census 2011). Illiteracy rate is higher in female compare to male. The overall illiteracy rate is higher in Rajshahi and Rangpur division. The illiteracy rate of Sylhet division is also remarkable and Barisal division present lowest illiteracy rate. For male, the illiteracy rate is higher in Barisal division where for female the illiteracy rate is higher in Rangpur division. To reduce the gender gap in education, some initiatives has been taken by the government and various NGO's have proved to be effective such as stipend, free tuition, national and international advocacy etc. This figure also indicates that the percentage of illiterate population is higher in rural area compare to urban areas. And similar results are obtaining for all the seven divisions. In rural area, the percentage of illiterate population is higher in Rajshahi and Rangpur division and for urban area the percentage is higher in Dhaka division because most of illiterate migrant workers are working at Dhaka.

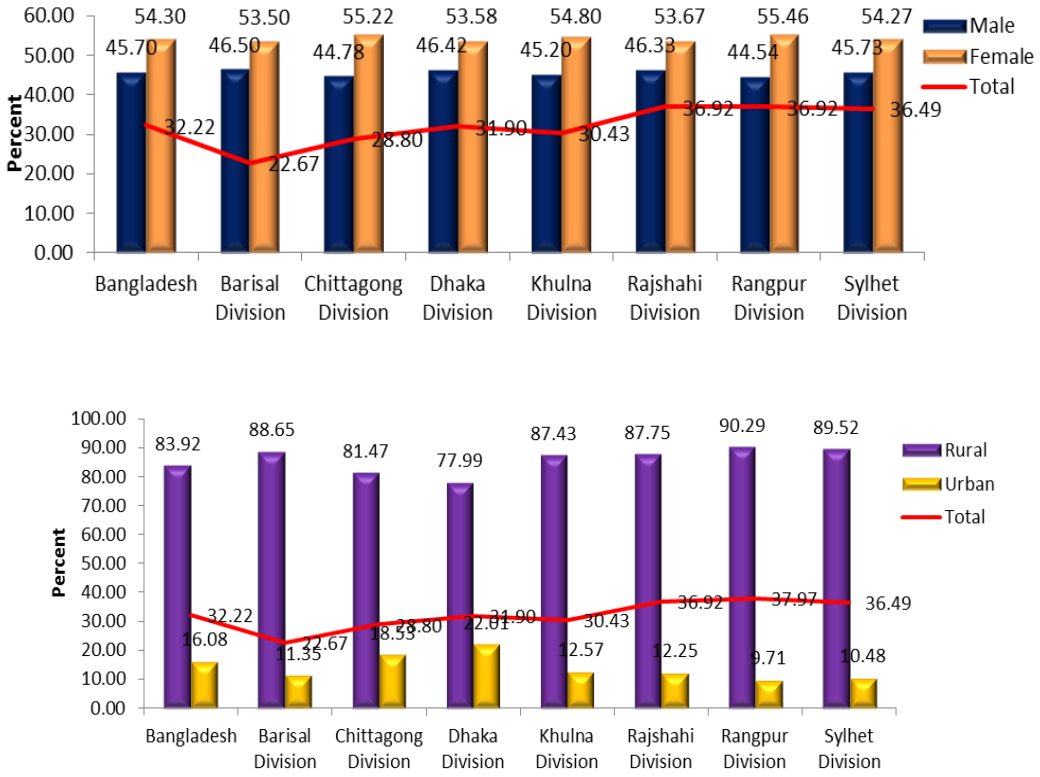


Figure 4.11: Distribution of illiterate population by division, sex and residence

4.4.1 Employment field of illiterate population

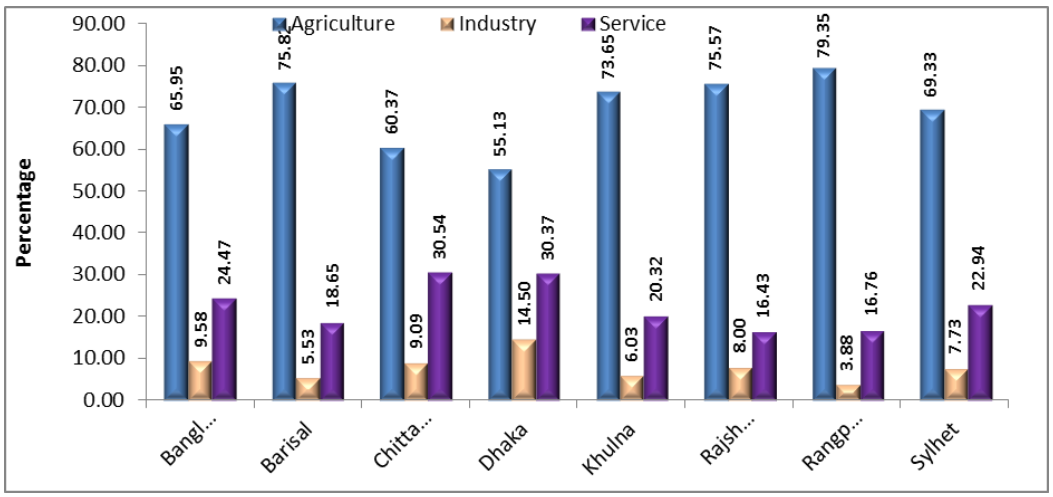


Figure 4.12: Distribution of employment field of illiterate population by division, 2011

Most of the illiterate population lived in the rural area, engaged in agriculture. Near about 70% illiterate population of Barisal, Khulna, Rajshahi, Rangpur and sylhet divisions depend on agriculture. And percentage of service and industry are higher in Dhaka and Chittagong division (Figure 4.12).

5. HOUSEHOLD VULNERABILITY

5.1 Introduction

Vulnerability assessment is required to understand the complex set of factors that contribute to adaptive capacity of the households. Vulnerability assessment describes a diverse set of methods used to systematically integrate and examine interactions between human and their physical and social surroundings. Managing climate risk is usually the responsibility of households of a region. Not only the structural strength of a house but also factors such as household size, availability of essential assets, water supply and sanitation system determines the adaptive capacity of a household to a disaster. In this chapter, the characteristics of households in different regions of Bangladesh are analyzed and finally a household vulnerability index is produced to assess the vulnerability posion of each region.

5.2 Household Characteristics

Distribution of number of household members is reported in Table 5.1. We observe that in Bangladesh, about 46.58% household has family members 3 to 4, 12.74% household has family members 1 to 2 and only 10.22% household has family members more than 6. Proportions of small size family is the maximum in Rajshahi division (15.37%) whereas large size family the maximum in Sylhet division (22.75%). Proportions of large size family in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 10.61%, 11.70%, 10.52%, 7.74%, 5.56% and 13.27% respectively. Of three earthquake zones, a maximum, 14.70% households of zone 1 consist of more than 6 members; among the coastal zones, this proportion is the highest in eastern zone (17.39%).

Table 5.1: Distribution of household members by divisions, natural disaster prone area, earthquake risk and coastal zone

	No. of Household Members			
	1-2	3-4	5-6	6+
Bangladesh	**12.74**	**46.58**	**30.46**	**10.22**
Barisal Division	11.58	44.63	34.54	9.25
Chittagong Division	9.01	39.99	35.40	15.60
Dhaka Division	13.95	45.73	30.68	9.64
Khulna Division	13.41	52.87	27.19	6.53
Rajshahi Division	15.37	54.06	24.45	6.12
Rangpur Division	14.92	50.98	27.87	6.23
Sylhet Division	9.17	33.64	34.43	22.75

Contd.

	No. of Household Members			
	1-2	3-4	5-6	6+
Natural disaster prone area				
Flood Prone Region	13.27	45.55	30.56	10.61
Cyclone Prone Region	10.09	44.79	33.42	11.70
River Erosion Region	12.33	44.34	32.82	10.52
Tornado Prone Region	15.80	48.69	27.77	7.74
Drought Prone Region	16.02	54.24	24.17	5.56
Earthquake Prone Region	11.73	44.33	30.67	13.27
Earthquake Zone				
Zone 1	12.93	40.71	31.66	14.70
Zone 2	13.08	47.57	29.65	9.70
Zone 3	12.29	48.03	30.82	8.86
Coastal Zone				
Eastern	7.50	39.36	35.75	17.39
Central	11.58	44.63	34.54	9.25
Western	11.58	51.36	29.34	7.72

Table 5.2 shows the distribution of number of household members who live in abroad. We observe that in Bangladesh, most of the households (80.50%) do not have any family member who lives in abroad. The maximum proportions (20.50%) of households Sylhet division has at least one member in abroad. This proportion for flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 17.53%, 6.79%, 21.71%, 16.02%, 2.03% and 16.90% respectively. Of three earthquake zones, a maximum, 14.74% households of zone 2 has at least one member in abroad; among the coastal zones, this proportion is the highest in eastern zone (17.86%).

Table 5.2: Distribution of household members living abroad by divisions, natural disaster prone area, earthquake risk and coastal zone

	No. of household member living abroad					
	0	1	2	3	4	4+
Bangladesh	**89.50**	**8.59**	**1.43**	**0.29**	**0.11**	**0.07**
Barisal Division	95.68	3.62	0.42	0.07	0.07	0.13
Chittagong Division	80.39	15.65	3.10	0.65	0.16	0.05
Dhaka Division	84.86	12.77	1.88	0.31	0.11	0.06
Khulna Division	95.47	3.90	0.45	0.10	0.05	0.03
Rajshahi Division	96.86	2.88	0.22	0.03	0.01	0.01
Rangpur Division	96.73	2.93	0.23	0.09	0.00	0.03
Sylhet Division	79.50	15.12	3.53	0.94	0.60	0.31

Contd.

	No. of household member living abroad					
	0	1	2	3	4	4+
Natural disaster prone area						
Flood Prone Region	82.37	14.72	2.35	0.33	0.17	0.05
Cyclone Prone Region	93.21	5.46	0.98	0.23	0.07	0.04
River Erosion Region	78.29	18.34	2.66	0.38	0.22	0.10
Tornado Prone Region	83.98	14.01	1.77	0.18	0.02	0.04
Drought Prone Region	96.97	2.82	0.16	0.04	0.01	0.00
Earthquake Prone Region	83.10	12.84	2.80	0.68	0.44	0.14
Earthquake Zone						
Zone 1	89.23	8.21	1.73	0.42	0.26	0.16
Zone 2	85.26	12.12	2.10	0.39	0.09	0.03
Zone 3	92.96	5.93	0.80	0.17	0.08	0.07
Coastal Zone						
Eastern	82.14	14.15	2.91	0.64	0.12	0.04
Central	95.68	3.62	0.42	0.07	0.07	0.13
Western	98.15	1.49	0.21	0.08	0.05	0.02

Distribution of number of dweling rooms is reported in Table 5.3. We observe that in Bangladesh, most of the households have only one (23.83%) to two rooms (31.26%). A maximum, 36.90% households of Dhaka division has only one room. Proportions of households with single room in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 27.18%, 13.33, 22.23%, 38.40%, 29.54% and 30.08% respectively. Of three earthquake zones, a maximum, 30.38% households of zone 1 has single room; among the coastal zones, this proportion is the highest in western zone (23.82%)

Table 5.3: Distribution of total number of dwelling rooms by divisions, natural disaster prone area, earthquake risk and coastal zone

	No. of Dweling Rooms						
	1	2	3	4	5	6	6+
Bangladesh	**23.83**	**31.26**	**23.27**	**12.96**	**5.06**	**2.21**	**1.41**
Barisal Division	5.06	18.55	33.80	25.37	11.04	4.02	2.17
Chittagong Division	9.20	29.06	28.38	20.48	7.21	3.72	1.94
Dhaka Division	36.90	31.60	18.23	8.22	3.11	1.17	0.76
Khulna Division	25.71	36.35	22.63	9.62	3.50	1.29	0.90

Contd.

	No. of Dweling Rooms						
	1	2	3	4	5	6	6+
Rajshahi Division	32.28	33.67	18.15	9.18	3.67	1.68	1.36
Rangpur Division	25.71	36.84	22.64	9.48	3.21	1.23	0.89
Sylhet Division	15.65	28.62	26.06	14.38	7.52	4.36	3.41
Natural disaster prone area							
Flood Prone Region	27.18	35.71	22.81	9.32	3.04	1.09	0.84
Cyclone Prone Region	13.33	27.16	27.42	18.97	8.05	3.26	1.81
River Erosion Region	22.23	32.44	25.80	13.05	4.12	1.46	0.90
Tornado Prone Region	38.40	33.65	17.00	7.04	2.43	0.88	0.59
Drought Prone Region	29.54	34.52	19.14	9.94	3.82	1.66	1.37
Earthquake Prone Region	30.08	25.08	19.84	12.43	6.76	3.53	2.27
Earthquake Zone							
Zone 1	30.38	32.10	19.80	9.48	4.25	2.21	1.77
Zone 2	25.39	31.89	22.61	12.04	4.73	2.04	1.30
Zone 3	19.36	30.23	25.46	15.43	5.77	2.39	1.37
Coastal Zone							
Eastern	11.53	25.84	26.97	20.53	8.56	4.49	2.08
Central	5.06	18.55	33.80	25.37	11.04	4.02	2.17
Western	23.82	37.23	22.78	10.20	3.84	1.27	0.87

Distribution of number of sleeping rooms is reported in Table 5.4. We observe that in Bangladesh, most of the households have only one (43.77%) to two sleeping rooms (37.39%). A maximum, 53.93% households of Dhaka division has only one room. Proportions of households with single sleeping room in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 47.82%, 37.21, 41.24%, 60.58%, 46.54% and 45.57% respectively. Of three earthquake zones, a maximum, 53.07% households of zone 1 has single sleeping room; among the coastal zones, this proportion is the highest in western zone (51.68%).

Table 5.4: Distribution of total number of sleeping rooms by divisions, natural disaster prone area, earthquake risk and coastal zone

	No. of Sleeping Rooms						
	1	2	3	4	5	6	6+
Bangladesh	**43.77**	**37.39**	**13.41**	**3.95**	**0.97**	**0.33**	**0.16**
Barisal Division	28.01	44.94	20.06	5.53	1.16	0.22	0.08
Chittagong Division	29.07	42.23	19.28	6.63	1.82	0.66	0.30
Dhaka Division	53.93	33.34	9.60	2.39	0.49	0.17	0.07
Khulna Division	46.75	36.73	12.20	3.19	0.79	0.22	0.12
Rajshahi Division	46.35	36.84	11.72	3.73	0.84	0.35	0.18
Rangpur Division	53.38	34.65	8.96	2.17	0.55	0.20	0.09
Sylhet Division	37.84	36.65	16.64	5.93	1.74	0.72	0.49
Natural disaster prone area							
Flood Prone Region	47.82	37.61	11.04	2.65	0.59	0.20	0.10
Cyclone Prone Region	37.21	39.84	16.17	5.01	1.20	0.41	0.15
River Erosion Region	41.24	39.54	14.59	3.68	0.65	0.21	0.08
Tornado Prone Region	60.58	29.76	7.28	1.76	0.47	0.13	0.04
Drought Prone Region	46.54	37.02	11.65	3.54	0.73	0.35	0.17
Earthquake Prone Region	45.57	34.48	13.74	4.27	1.08	0.58	0.28
Earthquake Zone							
Zone 1	53.07	31.42	10.60	3.43	0.88	0.37	0.22
Zone 2	45.11	37.45	12.26	3.66	0.98	0.36	0.18
Zone 3	38.36	39.88	15.85	4.49	1.01	0.29	0.12
Coastal Zone							
Eastern	29.91	42.22	18.36	6.70	1.76	0.78	0.27
Central	28.01	44.94	20.06	5.53	1.16	0.22	0.08
Western	51.68	33.06	11.21	3.10	0.64	0.23	0.08

Distribution of house ownership is reported in Table 5.5. We observe that in Bangladesh, most of the households (80.48%) have one member who owns a house; 14.95% of households do not own a house. A maximum, 19.87% households of Sylhet division do not own a house. Proportions of households with no house ownership in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 11.10%, 15.28%, 10.78%, 13.36%, 17.14% and 27.28% respectively. Of three earthquake zones, a maximum, 17.35% households of zone 2 has no house ownership; among the coastal zones, this proportion is the highest in western zone (20.64%).

Table 5.5: Distribution of total number of members own a house by divisions, natural disaster prone area, earthquake risk and coastal zone

	No. of Members Own a House		
	0	1	1+
Bangladesh	**14.95**	**80.48**	**4.57**
Barisal Division	9.97	84.93	5.10
Chittagong Division	12.31	80.97	6.72
Dhaka Division	17.96	77.92	4.12
Khulna Division	13.60	82.80	3.59
Rajshahi Division	16.32	79.24	4.43
Rangpur Division	13.75	84.28	1.97
Sylhet Division	19.87	73.24	6.89
Natural disaster prone area			
Flood Prone Region	11.10	85.31	3.59
Cyclone Prone Region	15.28	79.23	5.49
River Erosion Region	10.78	85.47	3.75
Tornado Prone Region	13.36	83.38	3.26
Drought Prone Region	17.14	79.48	3.38
Earthquake Prone Region	27.28	66.39	6.33
Earthquake Zone			
Zone 1	14.25	81.56	4.18
Zone 2	17.35	77.81	4.84
Zone 3	12.68	82.87	4.45
Coastal Zone			
Eastern	16.98	74.02	9.00
Central	9.97	84.93	5.10
Western	20.64	76.32	3.04

Distribution of land ownership is reported in Table 5.6. We observe that in Bangladesh, most of the households (51.69%) have one member who owns a house; 41.51% of households do not own a land. A maximum, 54.10% households of Sylhet division do not own a land. Proportions of households with no land ownership in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 39.78%, 39.83%, 36.09%, 41.33%, 45.16% and 53.99% respectively. Of three earthquake zones, a maximum, 46.03% households of zone 1 has no house ownership; among the coastal zones, this proportion is the highest in eastern zone (20.64%).

Table 5.6: Distribution of total number of members own land by divisions, natural disaster prone area, earthquake risk and coastal zone

	No. of Members Own a House		
	0	1	1+
Bangladesh	**41.51**	**51.69**	**6.80**
Barisal Division	28.69	64.10	7.21
Chittagong Division	44.88	48.93	6.19
Dhaka Division	42.73	51.53	5.74
Khulna Division	34.76	58.17	7.07
Rajshahi Division	46.96	44.22	8.81
Rangpur Division	40.31	52.63	7.06
Sylhet Division	54.10	39.05	6.85
Natural disaster prone area			
Flood Prone Region	39.78	54.36	5.86
Cyclone Prone Region	39.83	53.96	6.20
River Erosion Region	36.09	57.44	6.48
Tornado Prone Region	41.33	52.45	6.22
Drought Prone Region	45.16	45.81	9.04
Earthquake Prone Region	53.99	38.80	7.21
Earthquake Zone			
Zone 1	46.03	47.85	6.12
Zone 2	45.88	47.51	6.62
Zone 3	34.91	57.81	7.28
Coastal Zone			
Eastern	52.81	40.60	6.59
Central	28.69	64.10	7.21
Western	42.11	53.43	4.47

Distribution of dweling type is reported in Table 5.7. We observe that in Bangladesh, dweling type of most of the households (80.95%) is separate. A maximum, 87.87% households of Rangpur are separate type. Proportions of separate households in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 91.16%, 75.00%, 93.85%, 89.09%, 75.71% and 50.09% respectively. Of three earthquake zones, a maximum, 83.70% households of zone 3 is separate type; among the coastal zones, this proportion is the highest in central zone (84.28%).

Table 5.7: Distribution of dwelling type by divisions, natural disaster prone area, earthquake risk and coastal zone

	Dwelling Type		
	Separate	Apartment	Joint/Barrack House
Bangladesh	**80.95**	**4.84**	**14.21**
Barisal Division	84.28	4.58	11.14
Chittagong Division	79.32	5.92	14.76
Dhaka Division	81.58	6.38	12.03
Khulna Division	82.98	3.02	14.00
Rajshahi Division	77.05	5.05	17.90
Rangpur Division	87.87	0.96	11.17
Sylhet Division	69.31	6.96	23.73
Natural disaster prone area			
Flood Prone Region	91.16	1.38	7.45
Cyclone Prone Region	75.00	6.07	18.93
River Erosion Region	93.85	1.17	4.98
Tornado Prone Region	89.09	1.89	9.02
Drought Prone Region	75.71	4.84	19.45
Earthquake Prone Region	50.09	17.49	32.42
Earthquake Zone			
Zone 1	81.51	3.43	15.06
Zone 2	78.16	6.08	15.76
Zone 3	83.70	4.12	12.18
Coastal Zone			
Eastern	58.59	12.56	28.85
Central	84.28	4.58	11.14
Western	76.74	4.03	19.23

Distribution of households' wall material is reported in Table 5.8. We observe that in Bangladesh, higher proportion of the households' wall material is tin (38.87%) followed by brick-cement (24.75); proportion of households with straw made wall is 16.83%. A maximum, 33.83% households of Rangpur division have straw made wall. Proportions of households with straw made wall in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 14.80%, 16.49%, 10.24%, 11.99%, 15.70% and 13.67% respectively. Of three earthquake zones, a maximum, 20.41% households of zone 2 have straw made wall; among the coastal zones, this proportion is the highest in eastern zone (25.00%).

Table 5.8: Distribution of wall material by divisions, natural disaster prone area, earthquake risk and coastal zone

	Wall Material					
	Straw etc.	Mud/Unburnt Brick	Tin	Wood	Brick-Cement	Others
Bangladesh	**16.83**	**15.69**	**38.87**	**2.60**	**24.75**	**1.27**
Barisal Division	7.41	2.10	62.52	12.58	14.69	0.70
Chittagong Division	28.36	11.86	36.77	1.84	20.26	0.91
Dhaka Division	9.16	7.18	61.97	0.45	19.80	1.44
Khulna Division	14.86	22.94	15.76	5.44	38.38	2.61
Rajshahi Division	10.59	33.88	21.97	0.03	32.65	0.88
Rangpur Division	33.83	17.52	32.42	0.28	15.06	0.89
Sylhet Division	18.37	22.97	19.02	0.24	38.82	0.58
Natural disaster prone area						
Flood Prone Region	14.80	6.74	66.40	0.57	9.15	2.34
Cyclone Prone Region	16.49	14.02	33.49	8.94	25.74	1.33
River Erosion Region	10.24	4.33	74.12	0.78	8.61	1.93
Tornado Prone Region	11.99	10.32	65.05	0.03	11.87	0.74
Drought Prone Region	15.70	36.74	13.83	0.08	33.46	0.20
Earthquake Prone Region	13.67	12.00	22.60	0.85	50.63	0.25
Earthquake Zone						
Zone 1	18.90	14.16	45.29	0.14	20.86	0.66
Zone 2	20.41	18.52	35.62	0.72	23.94	0.79
Zone 3	12.11	13.31	39.61	5.66	27.28	2.03
Coastal Zone						
Eastern	25.00	16.50	22.02	2.75	32.90	0.83
Central	7.41	2.10	62.52	12.58	14.69	0.70
Western	15.39	22.94	9.44	12.09	37.74	2.41

Distribution of households' roof material is reported in Table 5.9. We observe that in Bangladesh, most of the households' roof material is tin (82.51%); proportion of households with straw made roof is 5.70%. A maximum, 15.37% households of Cittagong division have straw made roof. Proportions of households with straw made roof in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and

earthquake prone region are 2.48%, 12.00%, 2.17%, 2.69%, 2.29% and 4.37% respectively. Of three earthquake zones, a maximum, 7.41% households of zone 2 have straw made roof; among the coastal zones, this proportion is the highest in eastern zone (17.74%).

Table 5.9: Distribution of roof materials by divisions, natural disaster prone area, earthquake risk and coastal zone

	Roof Material				
	Straw etc.	Tin	Tally	Brick-Cement	Others
Bangladesh	**5.70**	**82.51**	**1.44**	**9.83**	**0.52**
Barisal Division	3.04	88.89	0.28	7.60	0.19
Chittagong Division	15.37	72.68	0.21	10.70	1.04
Dhaka Division	2.15	88.53	0.20	9.00	0.12
Khulna Division	5.86	72.03	7.15	13.73	1.24
Rajshahi Division	1.50	86.56	1.01	10.46	0.46
Rangpur Division	5.50	92.24	0.22	1.91	0.12
Sylhet Division	6.61	75.52	0.64	16.86	0.36
Natural disaster prone area					
Flood Prone Region	2.48	94.31	0.20	2.82	0.19
Cyclone Prone Region	12.00	70.18	4.42	12.15	1.25
River Erosion Region	2.17	94.81	0.19	2.69	0.14
Tornado Prone Region	2.69	93.58	0.13	3.50	0.10
Drought Prone Region	2.29	86.57	1.05	9.68	0.41
Earthquake Prone Region	4.37	67.78	0.49	27.15	0.20
Earthquake Zone					
Zone 1	5.47	85.98	0.41	7.91	0.23
Zone 2	7.41	82.18	0.23	9.68	0.50
Zone 3	3.97	81.37	3.18	10.81	0.67
Coastal Zone					
Eastern	17.74	63.67	0.22	18.18	0.20
Central	3.04	88.89	0.28	7.60	0.19
Western	13.48	54.52	12.76	15.94	3.29

Distribution of households' floor material is reported in Table 5.10. We observe that in Bangladesh, most of the households' floor material is mud (75.35%). A maximum, 88.85% households of Rangpur division have mud floor. Proportions of households with mud floor in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 87.49%, 75.01%, 87.58%, 82.62%, 78.76% and 47.52% respectively. Of three earthquake zones, a maximum, 81.30% households of zone 1 have mud floor; among the coastal zones, this proportion is the highest in central zone (82.32%).

Table 5.10: Distribution of floor materials by divisions, natural disaster prone area, earthquake risk and coastal zone

	Floor Material				
	Mud	Wood/Bamboo	Brick/Cement	Mosaic/Tiles	Others
Bangladesh	**75.35**	**2.08**	**21.25**	**1.26**	**0.07**
Barisal Division	82.32	0.89	16.03	0.72	0.05
Chittagong Division	70.24	7.83	20.43	1.29	0.22
Dhaka Division	71.43	2.09	24.81	1.64	0.03
Khulna Division	74.59	0.14	24.29	0.92	0.05
Rajshahi Division	77.79	0.06	21.03	1.09	0.03
Rangpur Division	88.65	0.30	10.93	0.10	0.02
Sylhet Division	67.88	0.60	27.95	3.47	0.09
Natural disaster prone area					
Flood Prone Region	87.49	0.89	11.44	0.13	0.05
Cyclone Prone Region	75.01	1.18	22.13	1.56	0.12
River Erosion Region	87.58	1.09	11.16	0.14	0.04
Tornado Prone Region	82.62	0.38	16.76	0.22	0.02
Drought Prone Region	78.76	0.17	20.05	1.00	0.02
Earthquake Prone Region	47.52	0.99	44.73	6.72	0.05
Earthquake Zone					
Zone 1	81.30	0.48	16.68	1.49	0.06
Zone 2	70.93	4.01	23.48	1.49	0.09
Zone 3	77.54	0.69	20.81	0.90	0.06
Coastal Zone					
Eastern	64.41	2.53	29.79	3.07	0.20
Central	82.32	0.89	16.03	0.72	0.05
Western	69.10	0.25	28.96	1.56	0.13

Distribution of slum dweling is reported in Table 5.11. We observe that in Bangladesh, proportion of slum dweling is 1.82%. A maximum, 4.90% households of Sylhet division are slum dwelers. Proportions of slum dwelers in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 0.38%, 3.44%, 0.49%, 0.53%, 1.71% and 5.69% respectively. Of three earthquake zones, a maximum, 2.31% households of zone 1 are slum dwelers; among the coastal zones, this proportion is the highest in eastern zone (4.87%).

Table 5.11: Distribution of slum dwelling by divisions, natural disaster prone area, earthquake risk and coastal zone

	Slum Dweling?	
	Yes	No
Bangladesh	**1.82**	**98.18**
Barisal Division	1.67	98.33
Chittagong Division	2.26	97.74
Dhaka Division	1.11	98.89
Khulna Division	1.96	98.04
Rajshahi Division	1.24	98.76
Rangpur Division	1.48	98.52
Sylhet Division	4.90	95.10
Natural disaster prone area		
Flood Prone Region	0.38	99.62
Cyclone Prone Region	3.44	96.56
River Erosion Region	0.49	99.51
Tornado Prone Region	0.53	99.47
Drought Prone Region	1.71	98.29
Earthquake Prone Region	5.69	94.31
Earthquake Zone		
Zone 1	2.31	97.69
Zone 2	1.87	98.13
Zone 3	1.56	98.44
Coastal Zone		
Eastern	4.87	95.13
Central	1.67	98.33
Western	4.53	95.47

Distribution of tenancy is reported in Table 5.12. We observe that in Bangladesh, most of the households (82.75%) live in own house; 10.65% live in rented house and 6.60% live in rent free house. A maximum, 16.42% households of Sylhet division live in rented house. Proportions of households living in rented house in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 3.34%, 14.38%, 3.33%, 8.39%, 5.55% and 36.77% respectively. Of three earthquake zones, a maximum, 13.84% households of zone 2 live in rented house; among the coastal zones, this proportion is the highest in eastern zone (21.92%).

Table 5.12: Distribution of tenancy of household by divisions, natural disaster prone area, earthquake risk and coastal zone

	Tenancy		
	Owned	Rented	Rent Free
Bangladesh	**82.75**	**10.65**	**6.60**
Barisal Division	86.55	10.11	3.34
Chittagong Division	84.94	11.54	3.53
Dhaka Division	79.99	15.59	4.43
Khulna Division	84.39	9.02	6.58
Rajshahi Division	81.18	6.40	12.42
Rangpur Division	86.67	2.14	11.19
Sylhet Division	75.07	16.42	8.52
Natural disaster prone area			
Flood Prone Region	90.93	3.34	5.72
Cyclone Prone Region	81.26	14.38	4.37
River Erosion Region	91.45	3.33	5.22
Tornado Prone Region	86.17	8.39	5.44
Drought Prone Region	80.65	5.55	13.79
Earthquake Prone Region	57.93	36.77	5.30
Earthquake Zone			
Zone 1	85.07	8.02	6.91
Zone 2	79.11	13.84	7.04
Zone 3	85.67	8.35	5.98
Coastal Zone			
Eastern	74.56	21.92	3.53
Central	86.55	10.11	3.34
Western	75.70	18.18	6.12

Distribution of source of water is reported in Table 5.13. We observe that in Bangladesh, most of the households (90.03%) use tubewell water; proportions of households using pond and river/ditch/canal water are 1.57% and 0.90%. Use of pond water is highest in Khulna division (5.67%) and use of river/ditch/canal water is highest in Chittagong division (3.89%). Proportions of households using pond water in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 0.14%, 7.09%, 0.47%, 0.01%, 0.04% and 1.52% respectively. Of three earthquake zones, a maximum, 3.21% households of zone 3 use pond water; among the coastal zones, this proportion is the highest in western zone (15.23%).

Table 5.13: Distribution of source of water by divisions, natural disaster prone area, earthquake risk and coastal zone

	Source of Water					
	Tap	Tubewell	Well	Pond	River/ditch/canal	Others
Bangladesh	**5.27**	**90.03**	**1.52**	**1.57**	**0.90**	**0.70**
Barisal Division	2.01	93.28	0.07	3.40	1.08	0.15
Chittagong Division	6.73	80.40	6.47	0.66	3.89	1.84
Dhaka Division	8.79	90.41	0.21	0.03	0.20	0.36
Khulna Division	2.71	90.67	0.11	5.67	0.13	0.71
Rajshahi Division	3.48	95.55	0.42	0.04	0.02	0.49
Rangpur Division	0.59	98.32	0.57	0.02	0.01	0.50
Sylhet Division	10.03	82.39	3.09	3.02	0.76	0.72
Natural disaster prone area						
Flood Prone Region	1.17	97.89	0.17	0.14	0.09	0.54
Cyclone Prone Region	6.52	84.65	0.32	7.09	0.65	0.76
River Erosion Region	1.26	97.15	0.05	0.47	0.43	0.64
Tornado Prone Region	2.70	96.35	0.16	0.01	0.34	0.43
Drought Prone Region	3.30	95.91	0.55	0.04	0.00	0.20
Earthquake Prone Region	26.26	71.23	0.36	1.52	0.32	0.31
Earthquake Zone						
Zone 1	4.46	91.77	1.54	1.27	0.51	0.44
Zone 2	7.70	86.76	2.81	0.17	1.56	1.00
Zone 3	3.01	92.77	0.14	3.21	0.37	0.50
Coastal Zone						
Eastern	13.09	85.00	0.64	0.66	0.07	0.53
Central	2.01	93.28	0.07	3.40	1.08	0.15
Western	4.43	78.27	0.22	15.23	0.32	1.53

Distribution of water distance is reported in Table 5.14. We observe that in Bangladesh, most of the households (57.53%) have water source inside dweling; proportion of households using water from long distance is 9.31%. Use of water from long distance is highest in Barisal division (24.04%). Proportions of households using long distance water source in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 5.60%, 19.34%, 8.97%, 3.63%, 4.17% and 5.93% respectively. Of three earthquake zones, a maximum, 13.00% households of zone 3 use pond water; among the coastal zones, this proportion is the highest in central zone (24.04%).

Table 5.14: Distribution of water distance by divisions, natural disaster prone area, earthquake risk and coastal zone

	Distance of Water Source		
	Inside Dwelling	Within 200 Metres	More Than 200 Metres
Bangladesh	**57.53**	**33.16**	**9.31**
Barisal Division	20.08	55.88	24.04
Chittagong Division	37.92	48.03	14.05
Dhaka Division	64.15	29.96	5.89
Khulna Division	60.99	29.69	9.31
Rajshahi Division	68.30	26.81	4.89
Rangpur Division	91.50	7.27	1.23
Sylhet Division	51.70	37.77	10.53
Natural disaster prone area			
Flood Prone Region	67.06	27.34	5.60
Cyclone Prone Region	30.22	50.44	19.34
River Erosion Region	55.25	35.78	8.97
Tornado Prone Region	77.34	19.03	3.63
Drought Prone Region	72.95	22.88	4.17
Earthquake Prone Region	62.01	32.06	5.93
Earthquake Zone			
Zone 1	60.73	31.37	7.90
Zone 2	66.37	27.21	6.42
Zone 3	46.70	40.29	13.00
Coastal Zone			
Eastern	42.74	47.20	10.06
Central	20.08	55.88	24.04
Western	34.56	46.26	19.18

Distribution of toilet facility is reported in Table 5.15. We observe that in Bangladesh, higher proportion of households (33.23%) use sanitary toilet without water seal; proportions of households using sanitary without water seal and open space toilets are 28.44%, 31.38% and 6.94% respectively. Use of open space toilet is highest in Rangpur division (18.71%). Proportions of households using open space toilet in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 7.41%, 4.55%, 7.02%, 9.56%, 13.46% and 5.79% respectively. Of three earthquake zones, a maximum, 9.90% households of zone 2 use open space toilet; among the coastal zones, this proportion is the highest in eastern zone (6.86%).

Table 5.15: Distribution of toilet facility by divisions, natural disaster prone area, earthquake risk and coastal zone

	Toilet Facility			
	Sanitary with Water Seal	Sanitary Without Water Seal	Non-sanitary/ Katcha	Open Space
Bangladesh	**28.44**	**33.23**	**31.38**	**6.94**
Barisal Division	31.18	41.39	23.87	3.56
Chittagong Division	21.79	38.02	32.44	7.75
Dhaka Division	28.07	40.01	27.51	4.41
Khulna Division	34.29	31.10	32.44	2.16
Rajshahi Division	31.77	23.69	35.66	8.89
Rangpur Division	28.30	17.85	35.14	18.71
Sylhet Division	23.25	32.36	37.32	7.07
Natural disaster prone area				
Flood Prone Region	25.68	33.95	32.96	7.41
Cyclone Prone Region	31.47	38.73	25.25	4.55
River Erosion Region	23.20	37.98	31.80	7.02
Tornado Prone Region	21.90	29.94	38.60	9.56
Drought Prone Region	33.29	19.08	34.17	13.46
Earthquake Prone Region	34.92	36.63	22.66	5.79
Earthquake Zone				
Zone 1	21.40	30.70	39.28	8.61
Zone 2	25.88	32.39	31.83	9.90
Zone 3	34.20	35.21	27.52	3.06
Coastal Zone				
Eastern	32.17	36.70	24.27	6.86
Central	31.18	41.39	23.87	3.56
Western	39.56	35.81	23.20	1.43

Distribution of toilet facility is reported in Table 5.16. We observe that in Bangladesh, most of the households do not maintain any procedure for waste management (52.09%); proportion of unmanaged dumping is the highest in Barisal division (63.34%). Proportions of unmanaged dumping in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 52.41%, 56.15%, 51.53%, 52.19%, 35.16% and 41.11% respectively. Of three earthquake zones, a maximum, 54.46% households of zone 2 use unmanaged dump site; among the coastal zones, this proportion is the highest in central zone (63.34%).

Table 5.16: Distribution of waste management by divisions, natural disaster prone area, earthquake risk and coastal zone

	Waste Management			
	Managed Dustbin	Unmanaged Dump Site	Bury/Inside Pit	Burn
Bangladesh	**18.88**	**52.09**	**28.24**	**0.80**
Barisal Division	18.52	63.34	17.20	0.94
Chittagong Division	17.58	62.48	17.49	2.44
Dhaka Division	20.02	58.06	21.45	0.47
Khulna Division	22.48	34.66	42.65	0.21
Rajshahi Division	16.32	45.69	37.86	0.13
Rangpur Division	10.46	40.84	47.94	0.76
Sylhet Division	28.65	57.84	13.15	0.35
Natural disaster prone area				
Flood Prone Region	12.14	52.41	34.90	0.54
Cyclone Prone Region	24.98	56.15	17.63	1.24
River Erosion Region	11.88	51.53	35.73	0.86
Tornado Prone Region	10.79	52.19	36.52	0.50
Drought Prone Region	17.33	35.16	47.32	0.20
Earthquake Prone Region	41.59	41.11	16.82	0.49
Earthquake Zone				
Zone 1	18.39	52.02	29.01	0.59
Zone 2	17.54	54.46	26.80	1.20
Zone 3	20.52	49.58	29.45	0.46
Coastal Zone				
Eastern	25.77	60.21	11.36	2.66
Central	18.52	63.34	17.20	0.94
Western	34.61	38.34	26.89	0.16

Distribution of source of light is reported in Table 5.17. We observe that in Bangladesh, most of the households have electricity (53.26%); proportion of households using kerosene is 42.32%. Use of electricity is the lowest in Rangpur division (32.41%). Proportions of households using electricity in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 39.94%, 48.76%, 41.67%, 47.27%, 51.44% and 75.72% respectively. Of three earthquake zones, a minimum, 43.16% households of zone 1 do not use electricity; among the coastal zones, this proportion is the lowest in central zone (42.23%).

Table 5.17: Distribution of source of light by divisions, natural disaster prone area, earthquake risk and coastal zone

	Source of Light				
	Electricity	Solar Energy	Kerosene	Biogas	Other
Bangladesh	**53.26**	**3.86**	**42.32**	**0.14**	**0.42**
Barisal Division	42.23	7.84	49.61	0.17	0.16
Chittagong Division	54.61	5.30	39.47	0.14	0.47
Dhaka Division	59.60	4.10	35.33	0.16	0.81
Khulna Division	57.99	2.55	39.05	0.11	0.30
Rajshahi Division	58.22	1.53	39.80	0.16	0.29
Rangpur Division	32.41	2.00	65.26	0.15	0.18
Sylhet Division	56.68	3.99	39.13	0.05	0.14
Natural disaster prone area					
Flood Prone Region	39.94	6.43	52.70	0.26	0.66
Cyclone Prone Region	48.76	6.64	44.24	0.15	0.21
River Erosion Region	41.67	6.94	50.29	0.22	0.88
Tornado Prone Region	47.27	3.78	48.04	0.24	0.66
Drought Prone Region	51.44	1.11	47.09	0.16	0.21
Earthquake Prone Region	75.72	1.23	22.61	0.07	0.38
Earthquake Zone					
Zone 1	43.16	3.88	52.07	0.10	0.79
Zone 2	57.85	3.05	38.57	0.16	0.37
Zone 3	52.66	4.72	42.17	0.14	0.32
Coastal Zone					
Eastern	64.52	3.17	31.67	0.18	0.46
Central	42.23	7.84	49.61	0.17	0.16
Western	54.50	5.98	39.41	0.06	0.04

Distribution of fuel use is reported in Table 5.18. We observe that in Bangladesh, higher proportion of households (50.29%) use straw/dried cow dung followed by wood (39.37%); Use of wood is highest in Barisal division (76.60%). Proportions of households using wood in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 20.30%, 66.13%, 31.22%, 22.42%, 20.68% and 37.05% respectively. Of three earthquake zones, a maximum, 45.52% households of zone 2 use wood; among the coastal zones, this proportion is the highest in central zone (76.60%).

Table 5.18: Distribution of fuel by divisions, natural disaster prone area, earthquake risk and coastal zone

	Fuel					
	Wood	Kerosene	Gas/LPG	Electricity	Straw/Dried Cow Dung	Bio-gas
Bangladesh	**39.37**	**1.10**	**8.84**	**0.34**	**50.29**	**0.07**
Barisal Division	76.60	1.41	3.68	0.08	18.20	0.03
Chittagong Division	59.77	1.18	11.77	0.37	26.86	0.06
Dhaka Division	27.99	0.86	15.77	0.45	54.87	0.06
Khulna Division	39.79	0.76	2.39	0.22	56.76	0.08
Rajshahi Division	14.28	1.49	4.25	0.36	79.50	0.12
Rangpur Division	26.27	1.48	0.71	0.30	71.22	0.03
Sylhet Division	44.62	0.75	19.68	0.53	34.33	0.09
Natural disaster prone area						
Flood Prone Region	20.30	1.03	1.38	0.30	76.95	0.03
Cyclone Prone Region	66.13	1.27	9.64	0.30	22.60	0.06
River Erosion Region	31.22	1.42	1.74	0.31	65.26	0.05
Tornado Prone Region	22.42	1.22	7.07	0.36	68.90	0.04
Drought Prone Region	20.68	1.80	3.21	0.39	73.79	0.13
Earthquake Prone Region	37.05	0.65	40.98	0.77	20.46	0.09
Earthquake Zone						
Zone 1	41.76	1.23	9.34	0.36	47.23	0.08
Zone 2	32.67	0.94	13.93	0.44	51.96	0.06
Zone 3	45.52	1.21	3.18	0.23	49.80	0.07
Coastal Zone						
Eastern	54.74	1.14	23.99	0.57	19.46	0.09
Central	76.60	1.41	3.68	0.08	18.20	0.03
Western	67.79	0.88	4.32	0.24	26.73	0.04

Distribution of different assets owned by households is displayed in Table 5.19 and the distribution of number of assets owned by households is reported in Table 5.20. It is found that in Bangladesh, 16.79% households do not own any asset and 29.53% household own only one asset; proportion of households that do not own any asset is highest in Rangpur division (24.05%). Proportions of households with no asset in flood prone region, cyclone prone region, river erosion region, tornedo prone region, drought prone region and earthquake prone region are 19.86%, 15.40%, 18.71%, 20.58%, 17.74% and 12.14% respectively. Of three earthquake zones, a maximum, 24.31% households of zone 2 do not own any asset; among the coastal zones, this proportion is the highest in central zone (15.40%).

Table 5.19: Distribution of asset owned by household by divisions, natural disaster prone area, earthquake risk and coastal zone

	Asset Own														
	Boat	Bull	Push Cart	Rick-shaw	Bicycle	Motor cycle	Motor Car	Scooter	Telephone	Mobile	Sewing Machine	Television	Dish Antenna	Computer	Freezer
Bangladesh	4.76	1.74	4.07	2.08	23.99	4.86	0.9	1.22	2.03	75.87	7.83	34.64	18.33	3.23	11.13
Barisal Division	8.61	1.86	1.89	2.85	9.93	3.72	0.66	1.09	1.95	79.01	8.3	29.02	15.41	2.67	10.46
Chittagong Division	4.46	1.2	1.47	2.53	8.63	2.78	0.82	1.31	1.93	78.21	8.43	35.45	15.65	3.08	12.47
Dhaka Division	7.56	1.37	3.51	2.37	16.85	3.86	1.37	1.21	2.27	78.21	7.96	37.02	22.19	3.99	14.51
Khulna Division	2.89	2.28	6.84	1.05	45.13	6.41	0.76	1.27	1.81	78.65	8.81	37.92	20.15	2.64	8.8
Rajshahi Division	1.84	1.59	6.31	1.42	35.12	7.05	0.58	1.39	2.06	75.43	8.75	39.27	25.84	3.58	9.73
Rangpur Division	0.52	1.95	6.23	2.36	44.4	6.77	0.5	0.87	0.87	61.5	4.47	22.75	7.75	1.33	2.88
Sylhet Division	6.21	2.87	1.75	1.83	6.87	4.62	1.19	1.41	3.75	75.15	6.91	35.46	14.31	5.37	17.53
Natural disaster prone area															
Flood Prone Region	8.2	2.01	3.95	2.13	22.35	3.94	0.51	1.01	1.08	72.58	5.35	23.77	11.77	1.38	5.74
Cyclone Prone Region	5.75	1.25	3.55	2.59	16.37	3.8	0.9	1.26	2.54	78.61	9.01	34.98	17.42	3.35	11.84
River Erosion Region	8.12	1.79	3.62	2.3	17.19	3.68	0.56	1.08	1.07	74.74	6.07	24.03	10.99	1.3	5.94
Tornado Prone Region	4.26	1.34	4.31	2.7	25.09	4.73	0.91	1.15	1.45	72.1	6.03	28.23	15.32	1.98	7.82
Drought Prone Region	0.75	2.01	6.62	1.89	42.02	7.76	0.59	1.26	1.97	71.6	7.74	37.05	21.96	3.29	8.39
Earthquake Prone Region	1.62	1.41	2.9	2.31	12.84	5.05	2.56	1.46	5.88	82.24	10.41	53.83	34.91	10.35	27.93
Earthquake Zone															
Zone 1	4.01	2.2	2.84	2.62	18.73	4.46	0.84	1.14	2.07	68.45	5.7	25.62	9.75	2.91	9.32
Zone 2	3.68	1.31	3.97	2	21.34	4.54	1.09	1.24	2.09	75.73	8.1	38.53	21.3	3.73	12.94
Zone 3	6.25	2	4.71	1.93	29.08	5.37	0.71	1.24	1.94	79.2	8.46	34.33	18.82	2.83	9.96
Coastal Zone															
Eastern	1.93	0.68	2.36	3.23	8.76	3.38	1.38	1.89	3.28	81.18	8.71	42.19	26.25	5.33	18.51
Central	8.61	1.86	1.89	2.85	9.93	3.72	0.66	1.09	1.95	79.01	8.3	29.02	15.41	2.67	10.46
Western	5.87	0.77	6.65	1.35	32.45	5.24	0.69	0.87	2.96	78.56	12.45	43.05	20.32	3.71	12.82

Table 5.20: Distribution of number of assets owned by household by divisions, natural disaster prone area, earthquake risk and coastal zone

	No. of Asset Owned by Household														
	0	1	2	3	4	5	6	7	8	9	10	11	12	14	15
Bangladesh	16.79	29.53	22.98	14.15	8.98	4.38	1.96	0.88	0.24	0.08	0.02	0.01	0.00	0.00	0.00
Barisal Division	15.40	39.90	20.90	10.35	6.64	4.01	1.86	0.75	0.16	0.02	0.01	0.01	0.00	0.00	0.00
Chittagong Division	17.33	35.91	20.33	13.10	7.58	3.52	1.39	0.56	0.18	0.08	0.01	0.00	0.00	0.00	0.00
Dhaka Division	15.56	29.50	21.96	14.88	9.91	4.71	2.07	0.98	0.24	0.10	0.06	0.02	0.00	0.00	0.00
Khulna Division	12.80	21.99	27.42	17.01	11.63	5.53	2.37	0.95	0.23	0.06	0.01	0.00	0.00	0.00	0.00
Rajshahi Division	16.29	24.05	22.20	15.73	11.36	5.89	2.65	1.30	0.42	0.11	0.01	0.00	0.00	0.00	0.00
Rangpur Division	24.05	25.47	27.26	13.61	5.93	2.19	0.95	0.39	0.11	0.03	0.01	0.00	0.00	0.00	0.00
Sylhet Division	19.97	32.75	20.63	11.11	7.05	4.01	2.53	1.35	0.37	0.19	0.03	0.01	0.00	0.00	0.00
Natural disaster prone area															
Flood Prone Region	19.86	33.53	24.27	11.94	6.09	2.91	0.94	0.35	0.07	0.02	0.01	0.00	0.00	0.00	0.00
Cyclone Prone Region	15.40	33.94	21.09	13.52	8.52	4.33	2.03	0.85	0.23	0.07	0.01	0.01	0.00	0.00	0.00
River Erosion Region	18.71	36.97	22.91	11.68	5.82	2.65	0.86	0.30	0.05	0.02	0.02	0.01	0.00	0.00	0.00
Tornado Prone Region	20.58	31.00	22.09	13.21	7.29	3.49	1.41	0.43	0.19	0.14	0.13	0.04	0.01	0.00	0.00
Drought Prone Region	17.74	22.20	23.86	16.05	10.71	5.20	2.46	1.22	0.41	0.13	0.02	0.00	0.00	0.00	0.00
Earthquake Prone Region	12.14	23.36	18.34	17.19	13.53	7.50	4.38	2.63	0.66	0.25	0.02	0.01	0.00	0.00	0.00
Earthquake Zone															
Zone 1	24.31	31.83	22.63	10.60	5.38	2.74	1.48	0.73	0.19	0.09	0.01	0.00	0.00	0.00	0.00
Zone 2	16.76	28.58	21.51	15.51	9.90	4.52	1.96	0.87	0.25	0.09	0.04	0.01	0.00	0.00	0.00
Zone 3	13.61	29.56	24.69	14.23	9.54	4.93	2.16	0.95	0.25	0.07	0.01	0.00	0.00	0.00	0.00
Coastal Zone															
Eastern	14.77	32.70	17.38	14.86	10.86	5.43	2.33	1.10	0.39	0.15	0.02	0.01	0.00	0.00	0.00
Central	15.40	39.90	20.90	10.35	6.64	4.01	1.86	0.75	0.16	0.02	0.01	0.01	0.00	0.00	0.00
Western	13.65	23.37	23.67	17.47	11.13	6.07	3.13	1.21	0.26	0.05	0.00	0.00	0.00	0.00	0.00

5.3 Household Vulnerability Index

Based on available information in the dataset, we used several indicators to assess vulnerability. The following major components are used: human, physical, financial, social and natural capitals. Each component has several sub-components. These sub-components are selected on the basis of their relevance to contribution to each major component. The Socio-economic variables and their impact on households vulnerability index is given in Table 5.21.

Table 5.21: Socio-economic variables and their impacts on HVI

	Variables	Values	Weight
Human Capital	Female Head	0=male, 1= female	1
	Female members		1
	Dependent members		1
Natural Capital	Drinking water	1=tubewell, 2=well, 3=tap, 4=pond/river/canal/others	2
	Distance to water	1=inside dweling, 2=within 200 meters, 3=more than 200 meters	2
	Toilet facility	1=sanitary with water seal, 2=sanitary without water seal, 3=non-sanitary, 4=open space	2
	Solid waste disposal	1=managed dustbin, 2=burry inside pit, 3=burn, 4=unmanaged dump side	1
	Source of light	1=electricity, 2=solar energy, 3=bio-gas, 4=kerosene/others	1
	Fuel	1=gas/LPG, 2=bio-gas, 3=electricity, 4=kerosene, 5=straw/cow-dung, 6=wood	1
Social Capital	Slum dwelling	0=no, 1=yes	1
	Ethnicity	0=not ethnic community, 1= ethnic community	1
	Head Marriage Disorder	1= widowed, Divorced or Separated, 0=otherwise	1
	Head Illiteracy	0=can read&write, 1=can read only, 2=can't read&write,	1
	Media access	1=no member has access to media, 0=at least one has access to media	1
Physical Capital	House wall	1=brick-cement, 2=tin, 3=mud, 2=wood, 4=straw/bamboo/polythene/others	2
	House roof	1=brick-cement, 2=tin, 3=tally, 4=straw/bamboo/polythene/others	2
	House floor	1=mosaic/tiles, 2=brick-cement, 3=wood/bamboo, 4= mud /others	1
	Tenancy	1=owned, 2=rent-free, 3=rented	1
	Members/sleeping room		1
Financial Capital	Own a house	0=yes, 1=no	1
	Own land	0=yes, 1=no	1
	HH asset		1
	Unemployed Head	0=employed, 1=unemployed	2

The HVI measures the vulnerability of households and communities in relation to the impact of different natural disasters, climate change, food security, diseases etc. The HVI achieves this by assessing a household's access to five livelihood capitals. For this purpose households will be disaggregated by residence (rural and urban), different administrative unit, AEZ regions, natural disaster porne area and earthquake risk area. Household vulnerability index by divisions is presented in Table 5.22 and histogram of the Household vulnerability index is given in Figure 5.1.

Table 5.22: Distribution of household vulnerability index by dwelling type, division and residence

	Mean	SD	Median	Minimum	Maximum	1st Quartile	3rd Quartile	N
Bangladesh	**29.42**	**10.52**	**28.74**	**0.96**	**80.79**	**22.27**	**35.84**	**165697**
Rural	30.67	9.94	29.78	0.96	80.79	23.89	36.57	132459
Urban	24.45	11.27	23.07	1.41	78.74	15.84	31.32	33238
Dwelling Type								
Separate	30.21	10.18	29.39	2.27	80.79	23.33	36.25	134186
Apartment	17.37	8.23	16.11	0.96	67.68	11.26	21.56	8031
Joint/ Barrack	29.04	10.63	28.14	2.68	77.97	21.51	35.83	23480
Division								
Barisal	30.15	9.65	30.10	2.25	80.38	23.88	36.12	16631
Chittagong	32.77	11.81	31.87	0.96	80.79	24.44	40.77	28351
Dhaka	28.11	9.25	27.53	2.25	76.13	21.90	33.69	42565
Khulna	27.30	10.32	26.61	1.77	76.88	20.14	33.33	26081
Rajshahi	27.61	10.16	27.18	1.71	78.74	20.66	33.83	21387
Rangpur	30.35	9.66	29.85	2.66	77.97	24.04	35.99	18942
Sylhet	31.61	12.35	32.00	2.93	77.65	22.50	40.26	11740

Table 5.22 indicates that total vulnerability in rural area of Bangladesh is much higher than the urban area. The key factor is health service, education facilities, sanitation, adverse of social and demographic profile. The rural households have more female members in the households and dependency ratio is also higher. The average age of urban household heads is lower. Dwelling type is important for vulnerability assessment. People living at separate houses are more vulnerable than joint or apartment type houses. There is a little variation in household vulnerability index among seven administrative divisions of the country. Household vulnerability is higher in Chittagong division and it is also higher in Barisal, Rangpur and Sylhet divisions.

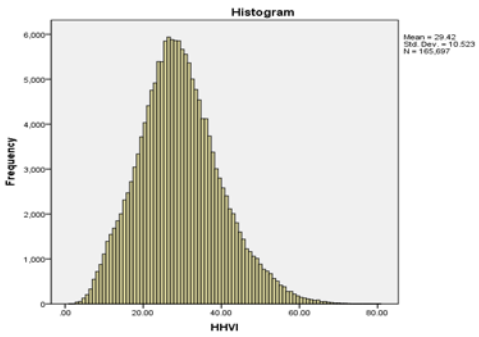
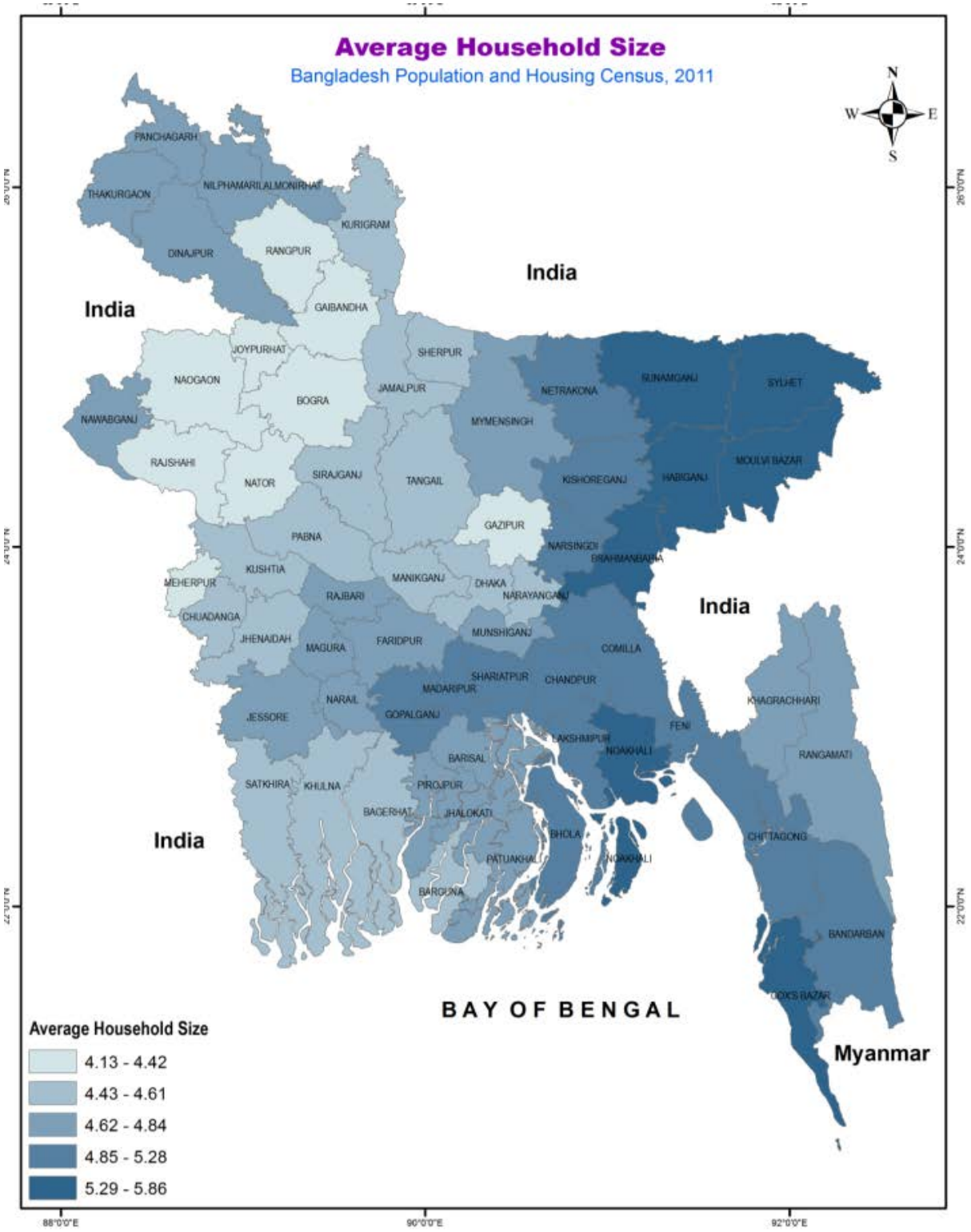


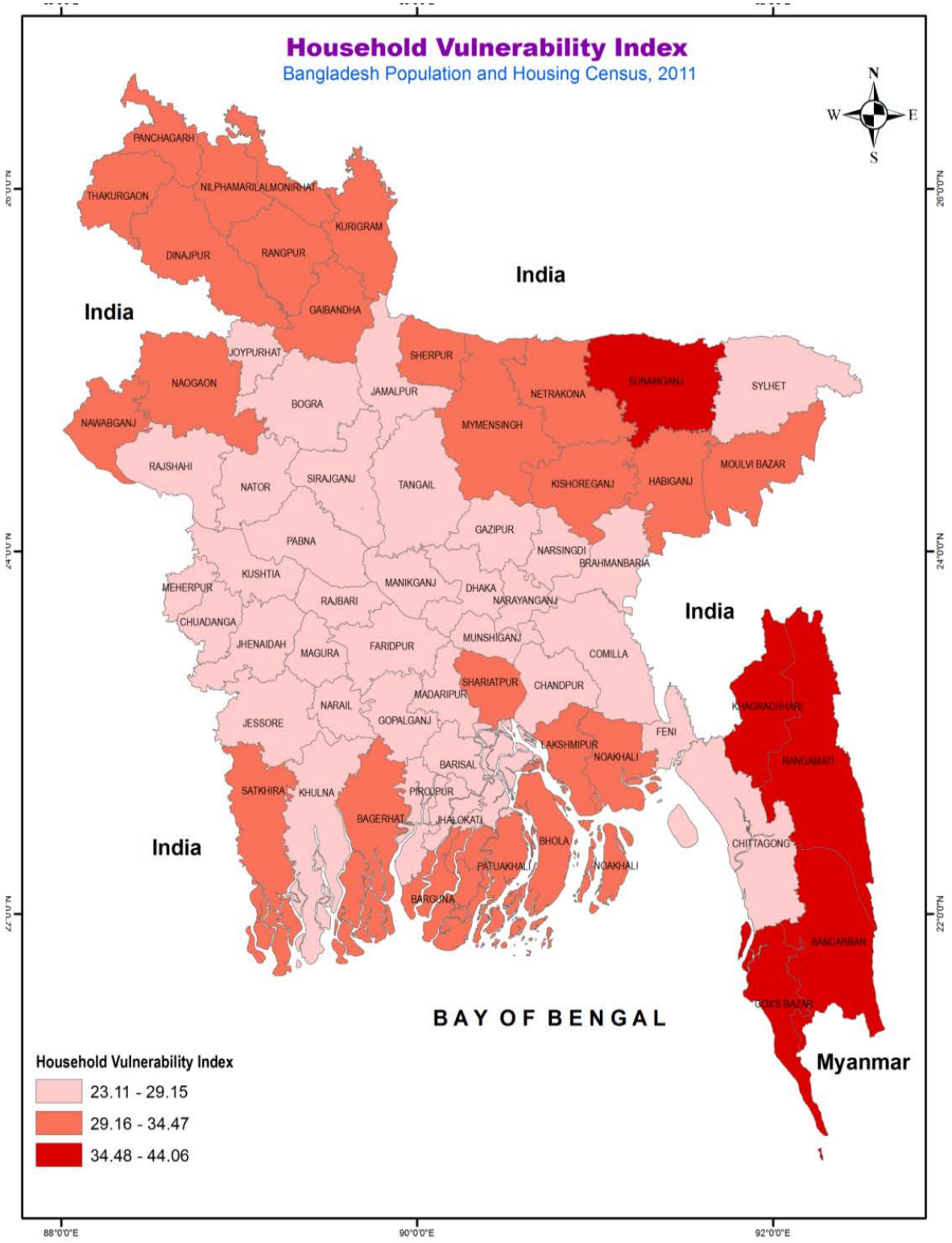
Figure 5.1: Distribution of household vulnerability index

Figure 5.1 indicate that the distribution of household vulnerability index is not normally distributed. It presents mean 29.41 and standard deviation 10.523. Average Households Size by districts is given in Map 5.1.



Map 5.1: Distribution of averge household size by district

Map 5.1 indicate that the household size is higher at Sunamganj, Sylhet, Habiganj, Moulvibazar and Brahmanbaria districts and is least at Gazipur, Rangpur, Gaibanda, Joypurhat, Bogra, Natore, Naogaon and Meherpur districts.



Map 5.2: Distribution of household vulnerability index by district

Map 5.2 indicates that most household vulnerable districts are Cox's Bazar, Bandarban, Rangamati, Khagrachhari and Sunamganj. Districts of the middle part of Bangladesh and the districts Sylhet, Chittagong, Khulna, Jalokati, Feni are least household vulnerable districts.

Table 5.23: Summary statistics of household vulnerability index by district

Districts	Mean	Median	Minimum	Maximum	1st Quartile	3rd Quartile
Bagerhat	32.7497	32.3534	5.68	74.90	25.8528	38.7633
Bandarban	44.0646	45.0735	8.30	80.79	37.8900	51.1897
Barguna	31.5538	31.0185	5.59	77.30	25.3803	37.0544
Barisal	27.4145	28.0311	2.25	71.50	19.9777	34.4083
Bhola	34.3356	33.8565	4.77	80.38	28.2939	39.2821
Bogra	28.0795	27.3704	4.32	64.83	21.6131	33.7492
Brahmanbaria	28.3547	28.2269	3.48	65.71	22.5078	33.7881
Chandpur	29.1474	28.5769	8.26	64.72	24.2842	33.3056
Chittagong	26.7353	26.1095	1.41	66.63	17.9395	34.8445
Chuadanga	24.0041	24.2076	5.44	55.54	18.0903	29.4391
Comilla	28.1974	27.6931	2.66	67.43	22.2447	33.5412
Cox's bazar	36.9673	37.4732	0.96	75.89	30.0986	44.3243
Dhaka	23.1080	22.1529	2.25	76.13	16.5507	28.5729
Dinajpur	29.5702	28.8919	4.43	77.97	22.3267	35.7275
Faridpur	28.7698	28.3427	4.97	68.22	23.2654	33.7740
Feni	26.3745	25.9734	4.30	63.25	20.4043	31.6821
Gaibandha	30.2792	29.4215	6.33	74.86	24.0652	35.4103
Gazipur	24.4549	24.3344	4.94	70.10	18.9593	29.4818
Gopalganj	27.2542	26.5643	5.49	66.36	21.8871	31.8017
Habiganj	32.1423	31.8064	3.22	72.84	25.1857	38.6838
Joypurhat	26.7527	25.8920	5.04	67.07	19.7576	32.7237
Jamalpur	28.0929	27.2835	2.34	59.64	22.7373	32.5337
Jessore	25.7577	25.2658	1.77	68.32	18.6284	31.8223
Jhalokati	28.0881	27.4585	6.06	65.37	22.4589	32.8006
Jhenaidah	25.1861	24.8852	4.02	65.12	18.7729	30.5825
Khagrachhari	41.6257	42.3427	8.13	77.42	34.1433	49.8750
Khulna	28.9376	28.1809	3.20	76.88	19.3249	37.2572
Kishoreganj	32.6704	32.2754	6.54	68.51	26.4635	38.6498
Kurigram	30.5503	29.5853	7.26	70.50	24.1681	36.1067
Kushtia	25.0184	24.6397	4.33	59.64	19.1324	29.7372
Lakshmipur	31.3815	31.2383	4.33	66.16	24.9510	37.4575
Lalmonirhat	29.5009	28.7198	6.56	73.37	23.2720	35.0586
Madaripur	27.0262	26.7346	3.82	57.72	22.0900	31.4234
Magura	26.9215	26.4872	4.05	68.24	20.6506	32.4480
Manikganj	27.2955	26.5064	8.02	64.68	21.8427	31.4848
Meherpur	24.8174	24.6491	3.19	61.17	19.0888	29.9025
Moulvibazar	33.9120	33.7678	4.33	77.65	24.7370	42.6229

Districts	Mean	Median	Minimum	Maximum	1st Quartile	3rd Quartile
Munshiganj	27.2408	26.5822	5.15	60.62	20.9064	32.8195
Mymensingh	32.4282	32.6093	4.87	70.00	26.3773	38.1099
Naogaon	30.2354	29.8892	4.33	75.66	23.5438	36.0184
Narail	28.2963	27.8437	4.88	66.74	21.5306	34.2074
Narayanganj	26.6437	26.1916	2.68	64.63	20.3391	32.4131
Narsingdi	26.2731	26.2470	4.19	71.26	21.2201	31.6828
Natore	27.0280	26.8986	4.87	65.06	20.3470	33.0544
Chapai Nawabganj	31.4380	31.1941	4.98	69.74	24.7502	38.0205
Netrokona	34.4731	34.2101	3.20	71.52	28.2842	40.6098
Nilphamari	31.7677	31.7401	2.66	72.04	26.1124	37.9217
Noakhali	32.3966	31.5973	5.31	73.64	25.4983	38.7189
Pabna	28.8860	28.5602	2.24	63.45	22.7391	34.4828
Panchagarh	30.7690	30.7347	5.05	76.93	25.0563	35.9071
Patuakhali	33.1992	32.8894	6.55	70.31	27.4855	38.0083
Pirojpur	29.0383	28.3562	7.35	65.02	23.2471	34.4064
Rajshahi	24.5687	23.5667	1.71	78.74	15.9940	31.4529
Rajbari	27.2692	26.6706	6.18	66.71	21.6221	32.1775
Rangamati	41.1400	42.0364	3.66	69.52	34.3159	48.7921
Rangpur	30.0961	29.4730	3.40	74.16	23.4055	35.7770
Shariatpur	30.6175	30.1213	8.07	73.00	25.0202	35.6629
Satkhira	29.4967	28.8555	5.23	73.19	22.4763	36.1781
Sirajganj	26.9704	26.1717	4.91	63.29	21.9592	31.3233
Sherpur	31.6246	30.7164	7.53	71.81	25.7010	36.8720
Sunamganj	36.9168	37.2797	4.71	74.26	30.9590	42.9754
Sylhet	27.5046	26.5399	2.93	75.95	17.0884	37.0461
Tangail	26.9507	26.4595	5.58	58.01	21.9858	31.3312
Thakurgaon	30.2904	30.1567	5.44	71.73	24.3860	35.6822

Summary measures of household vulnerability index by districts are given in Table 5.23. The average household vulnerability index is highest at Bandarban district. The average household vulnerability index is also higher at Khagrachhari, Rangamati, Sunamganj and Cox's bazaar districts and it is lower at Dhaka, Chuadanga, Gazipur and Rajshahi districts.

Table 5.24: Summary statistics of household vulnerability index by agro-ecological zone

AEZ	Mean	SD	Median	Minimum	Maximum	1st Quartile	3rd Quartile
HPTF	30.35	9.66	29.85	2.66	77.97	24.04	35.99
KFAB	27.52	10.51	27.16	1.71	78.74	20.15	34.11
BJF	31.05	9.43	30.36	2.34	71.81	24.75	36.76
HGRF	26.22	9.09	25.78	1.77	68.32	20.10	31.60
LGRF	28.19	8.27	27.60	3.82	73.00	22.67	33.13
GTF	30.11	10.43	29.91	2.25	80.38	23.19	36.53
SBSKF	31.61	12.35	32.00	2.93	77.65	22.50	40.26
MMRF	28.56	8.46	28.20	2.66	67.43	23.07	33.55
LMREF	30.06	9.83	29.51	4.30	73.64	23.44	36.20
CCPSI	30.14	12.28	30.20	0.96	75.89	20.92	38.79
EH	42.27	10.76	43.15	3.66	80.79	35.40	50.12
DHAKA	25.51	8.98	24.99	2.25	76.13	19.41	30.92

Household vulnerability index by agro-ecological zone is given in Table 5.24 which indicates that there is a remarkable difference in household vulnerabilities among these 12 regions. The median index of EH region is the highest and median indices of SBSKF and BJF are also higher. The household vulnerability median index is lowest at greater DHAKA region. The frequency distribution of household vulnerability by AEZ is given at Table 5.25.

Table 5.25: Class of household vulnerability for AEZ

AEZ zone	Class of Household Vulnerability				
	25.51-27.51	27.51-29.51	29.51-31.51	31.51-33.51	41.51-43.51
BJF			1		
CCPSI			1		
DHAKA	1				
EH					1
GTF			1		
HGRF	1				
HPTF			1		
KFAB		1			
LGRF		1			
LMREF			1		
MMRF		1			
SBSKF				1	
Grand Total	2	3	5	1	1

Table 5.25 indicates that the household vulnerability index is maximum at EH regions followed by SBSKF. Most of the regions fall on the medium vulnerable areas. Households Vulnerability Index by natural disaster prone areas is given in Table 5.26.

Table 5.26: Summary statistics of household vulnerability index by natural disaster prone area

Natural disaster	Mean	SD	Median	Minimum	Maximum	1st Quartile	3rd Quartile
Eastern coastal	30.70	11.81	30.65	0.96	75.89	22.25	38.78
Central coastal	30.15	9.65	30.10	2.25	80.38	23.88	30.12
Western coastal	30.03	11.65	29.56	3.20	76.88	21.84	37.44
Cyclone	31.25	10.45	30.97	0.96	80.38	24.27	37.76
Tornado	28.37	9.03	27.56	2.34	74.86	22.45	33.54
Flood	29.39	9.10	28.44	2.34	74.86	23.25	34.72
River Erosion	29.42	8.72	28.65	2.34	80.38	23.71	34.52
Drought	28.19	10.50	27.83	1.71	78.74	20.91	34.66
Earthquake	27.17	11.34	26.47	1.41	76.13	18.68	34.89

All most every year the country is affected by some form of natural disaster such as cyclone, tornado, flood, river erosion, drought, earthquake and others. The Table 5.26 indicates that the average household vulnerability index is higher at cyclone prone area. Cyclone hit the country several times in every year at our coastal area and flood and river erosion are fairly common events in Bangladesh. These natural disasters cause tremendous losses and damages of valuable resources which put poor rural households in a miserable situation. Among these coastal areas, the average household vulnerability index by natural disaster is higher at eastern coastal and least at western coastal but their differences is very less. The household vulnerability index by earthquake risk areas is given at Table 5.27.

Table 5.27: Summary statistics of household vulnerability index by earthquake risk area

Earthquake risky zone	Mean	SD	Median	Minimum	Maximum	1st Quartile	3rd Quartile
Zone 1	37.46	10.78	31.11	2.32	77.65	24.28	38.35
Zone 2	29.53	10.74	28.56	0.96	80.79	22.14	35.89
Zone 3	28.45	10.03	28.02	1.71	80.38	21.71	34.60

Table 5.27 indicates that the average household vulnerability is maximum at zone 1 and minimum at zone 3.

5.4 Monitoring Acute to Coping Level Vulnerability

Coping strategies that are pursued not only depend on but have a cumulative impact on, the assets upon which a household can draw and hence influence a household's future vulnerability (White and Robinson, 2000). These strategies can be short-term unsustainable or long-term sustainable coping strategies. Without development of human capital the

households will remain vulnerable in the long term. Also, the type of employment that the vulnerable gain access to during a crisis needs to be studied–for example, women entering prostitution to cope is not a desirable solution (Mani, 2001). Depending on the asset ownership and the subsequent coping strategies, vulnerability is expected to differ across households. Households fall into three different levels of vulnerability i.e., coping level household, acute level household and emergency level household.

Coping level Households: A household in a vulnerable situation is still able to cope. Much of the vulnerability of these households is arising from the effects of the epidemic on social capital and to a lesser extent financial capital. Little vulnerability is coming from the physical, natural and human capital aspects of the households. Besides these, it is also shown that within the social capital of these households vulnerability is coming from the impact of the epidemic on household access to social support services. Alleviation efforts for such households should be aimed at improving social support networks that will assist the households in building social relationalship within the community.

Acute level Households: A household that has been hit so that it badly needs assistance to the degree of an acute health care unit in a hospital. With some rapid-response type of assistance the family may be resuscitated. Financial, physical and human capitals of household falls in this group are affected by the epidemic. Vulnerability is coming from different impact areas.

Emergency level Households: This household is vulnerable in all the livelihoods aspects of its life, the degree to which the livelihood assets are affected is very high almost 100% effect. A considerable amount of effort is required to resuscitate this household because it requires assistance in almost every aspect of its livelihood.

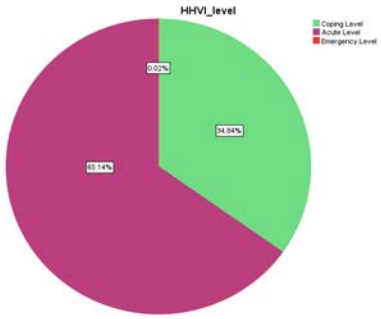


Figure 5.2: Distribution of level of household vulnerability index, 2011

Figure 5.2 and Table 5.28 present the percentage distribution of households for coping, acute and emergency level by division and residence. In Bangladesh 34.8% household are at coping level while majority, approximately 65.1% are at acute level and only 0% household (29 households out of 165697) are at emergency level.

Table 5.28: Distribution of level of household vulnerability index by dwelling type, division and residence

	Coping Level	Accute Level	Emergency Level
Bangladesh	34.84%	65.14%	0.02%
Rural	29.38%	70.60%	0.02%
Urban	56.58%	43.40%	0.02%
Dwelling Type			
Separate	31.36%	68.62%	0.02%
Apartment	84.72%	15.28%	0.00%
Joint/ Barrack	37.67%	62.31%	0.02%
Division			
Barisal	29.11%	70.87%	0.02%
Chittagong	26.75%	73.22%	0.03%
Dhaka	37.96%	62.04%	0.00%
Khulna	43.36%	56.62%	0.01%
Rajshahi	41.04%	58.94%	0.02%
Rangpur	28.66%	71.32%	0.03%
Sylhet	30.90%	69.06%	0.03%

Table 5.28 indicates that coping level of rural area is 29.4%, acute level is 70.6% and for urban coping level is 56.6% and acute level is 43.4 % and negligible emergency level for both rural and urban. The reason is that most of the poor people live in the rural area and they build their house with mud, straw, tin, bamboo where in urban area most of households are made by brick. The separate dwelling type present 31.4% coping level, 68.6% acute level and 0% emergency level. Apartment dwelling type has 84.7% coping level, 15.3% acute level and joint or barrack dwelling type house has 37.7% coping level, 62.3% acute level and 0.0% emergency level. The level of household index confirm that household type separate is most vulnerable and joint or barack type house is almost similar vulnerable where apartment type house is less vulnerable. In Barisal division 29.1% household are coping level, 70.9% household are acute level, 0% households (4 households out of 21387) are emergency level. In Chittagong division 26.7% household are coping level, 73.2% household are acute level, 0% households (9 households out of 28351) are emergency level and so on. Among these divisions Chittagong division present lowest coping level (26.7%) and highest acute level (73.2%) and Khulna division present highest coping level (43.4%) and lowest acute level (56.6%). Distribution of level of household vulnerability index by district is given in Table 5.29.

Table 5.29: Distribution of level of of household vulnerability index by district

Districts	Level of Households vulnerability Index		
	Coping Level	Acute Level	Emergency Level
Bagerhat	22.8%	77.1%	0.1%
Bandarban	5.0%	94.8%	0.2%
Barguna	23.5%	76.4%	0.1%
Barisal	39.5%	60.5%	0.0%
Bhola	14.3%	85.7%	0.0%
Bogra	38.4%	61.6%	0.0%
Brahmanbaria	35.6%	64.4%	0.0%
Chandpur	28.6%	71.4%	0.0%
Chittagong	46.0%	54.0%	0.0%
Chuadanga	53.9%	46.1%	0.0%
Comilla	37.2%	62.8%	0.0%
Cox's bazar	14.4%	85.5%	0.0%
Dhaka	63.1%	36.9%	0.0%
Dinajpur	34.5%	65.5%	0.0%
Faridpur	32.6%	67.4%	0.0%
Feni	45.4%	54.6%	0.0%
Gaibandha	28.8%	71.1%	0.1%
Gazipur	53.2%	46.8%	0.0%
Gopalganj	40.5%	59.5%	0.0%
Habiganj	24.5%	75.5%	0.0%
Joypurhat	46.5%	53.5%	0.0%
Jamalpur	35.7%	64.3%	0.0%
Jessore	49.4%	50.6%	0.0%
Jhalokati	37.4%	62.6%	0.0%
Jhenaidah	50.8%	49.2%	0.0%
Khagrachhari	7.4%	92.4%	0.2%
Khulna	39.9%	60.1%	0.0%
Kishoreganj	20.1%	79.9%	0.0%
Kurigram	28.1%	71.9%	0.0%
Kushtia	51.4%	48.6%	0.0%
Lakshmipur	25.4%	74.6%	0.0%
Lalmonirhat	32.5%	67.5%	0.0%
Madaripur	39.7%	60.3%	0.0%
Magura	43.3%	56.7%	0.0%
Manikganj	42.0%	58.0%	0.0%
Meherpur	52.7%	47.3%	0.0%
Moulvibazar	25.9%	74.0%	0.0%
Munshiganj	43.0%	57.0%	0.0%
Mymensingh	20.8%	79.2%	0.0%
Naogaon	30.4%	69.5%	0.0%
Narail	38.8%	61.2%	0.0%

Districts	Level of Households vulnerability Index		
	Coping Level	Acute Level	Emergency Level
Narayanganj	43.7%	56.3%	0.0%
Narsingdi	42.8%	57.2%	0.0%
Natore	42.5%	57.5%	0.0%
Chapai Nawabganj	25.7%	74.3%	0.0%
Netrokona	14.9%	85.1%	0.0%
Nilphamari	21.8%	78.2%	0.0%
Noakhali	22.9%	77.1%	0.0%
Pabna	34.4%	65.6%	0.0%
Panchagarh	24.7%	75.2%	0.0%
Patuakhali	16.3%	83.7%	0.0%
Pirojpur	33.4%	66.6%	0.0%
Rajshahi	54.5%	45.5%	0.1%
Rajbari	40.7%	59.3%	0.0%
Rangamati	7.3%	92.7%	0.0%
Rangpur	31.5%	68.5%	0.0%
Shariatpur	24.9%	75.1%	0.0%
Satkhira	34.6%	65.4%	0.0%
Sirajganj	42.5%	57.5%	0.0%
Sherpur	22.1%	77.9%	0.0%
Sunamganj	11.8%	88.2%	0.0%
Sylhet	46.3%	53.7%	0.0%
Tangail	41.6%	58.4%	0.0%
Thakurgaon	27.4%	72.6%	0.0%

Table 5.29 indicates that Bandarban district is shown lowest coping level (5.0%), highest acute level (94.8%) and 0.2% at emergency level. Almost similar percentage obtains for Khagrachhari district 7.4% coping level, 92.4% acute level and 0.2% emergency level. Dhaka district present the highest coping level 63.1% and lowest acute level 36.9%. The coping, acute and emergency level for AEZ region is given in Table 5.30.

Table 5.30: Distribution of level of household vulnerability index by AEZ region

AEZ Region	Coping Level	Accute Level	Emergency Level
HPTF	28.66%	71.32%	0.03%
KFAB	41.80%	58.18%	0.02%
BJF	25.81%	74.19%	0.00%
HGRF	46.32%	53.68%	0.00%
LGRF	35.66%	64.34%	0.00%
GTF	31.00%	68.97%	0.02%
SBSKF	30.90%	69.06%	0.03%
MMRF	33.84%	66.16%	0.00%
LMREF	31.19%	68.81%	0.00%
CCPSI	35.51%	64.47%	0.01%
EH	6.57%	93.32%	0.11%
DHAKA	50.07%	49.93%	0.01%

The Table 5.30 indicate that the coping level of EH regions is very low 6.6% and acute level is very high 93.3% and emergency level is 1% where the coping level of DHAKA is highest 50.1% and acute level is lowest 49.9% and emergency level is 0.0%. The natural disaster creates a vicious cycle for the poor of Bangladesh. Because the poor may not be able to afford safer housing, they have to live near the river which raises their risk of flooding and cyclones. This would result in greater damage suffered from the floods and cyclones, driving the poor into selling assets and pushing them further into poverty.

Table 5.31: Distribution of level of household vulnerability index by natural disaster

Natural Disaster Porne Areas	Coping Level	Accute Level	Emergency Level
Eastern coastal	32.37%	67.62%	0.01%
Central coastal	29.11%	70.87%	0.02%
Western coastal	34.30%	65.67%	0.03%
Cyclone	27.46%	72.52%	0.02%
Tornado	36.92%	63.07%	0.01%
Flood	32.63%	67.35%	0.01%
River Erosion	30.85%	69.13%	0.02%
Drought	39.19%	60.78%	0.03%
Earthquake	45.28%	54.70%	0.02%

The Table 5.31 indicates that the coping level by cyclone and floods 27.5% and 32.6%, the acute level by these two disasters 72.5% and 67.4% respectively. The highest coping level is obtained by earthquake risk regions and lowest coping level is obtained at cyclones affected regions. Among these coastal regions the coping level is highest at western coastal regions and central regions present the least coping level. Distribution of level of household vulnerability index by earthquake risk zone is reported in Table 5.32.

Table 5.32: Distribution of level of household vulnerability index by earthquake risk zone

Earthquake risk zone	Coping Level	Accute Level	Emergency Level
Zone 1	27.34%	72.64%	0.01%
Zone 2	35.60%	64.38%	0.02%
Zone 3	37.23%	62.76%	0.01%

Table 5.32 indicates the coping level is higher at zone 3 and zone 1 present the lowest coping level.

Bangladeshi people are familiar with climate induced hazards for a long time and as a result they have developed unique coping practices against such hazards.In the coastal areas of Bangladesh people are always aware of the fact that they might be affected by cyclone any time when the cyclone-prone period of the year approaches. As a result, they have naturally developed coping mechanisms to face cyclones.

5.5 Summary

The HVI measures the vulnerability of households and communities in relation to the impact of different natural disasters, climate change, food security, diseases etc. the total vulnerability in rural area of Bangladesh is much higher than the urban area. Household vulnerability in Chittagong division is higher than other division. For districts, the households of Cox's Bazar, Bandarban, Rangamati, Khagrachhari and Sunamganj are most vulnerable.The coping level of rural area is 29.4%, acute level is 70.6% and for urban the coping level is 56.6% and acute level is 43.4%, emergency level for both rural and urban are negligible.Ccoping level is highest in Dhaka district.

6. ECONOMIC VULNERABILITY

6.1 Wealth Index using Household Asset Indicators

Poverty is not the same as vulnerability, but they are strongly linked. They are mutually re-enforcing and brought about by similar processes. All poor people are vulnerable but not all vulnerable people are poor. Poverty is a core dimension of vulnerability. Poverty is not the only factor that leads to vulnerability; other factors like geographical location, communal conflict or social and ethnic association can make people vulnerable. Vulnerability pushes people into poverty, keeps them in poverty and stops them from coming out of poverty.

The asset index has been introduced by researchers since 1999 (Filmerand Prichett, 1999). This method employs data of household's assets such asdurable and semi-durable goods to describe household welfare instead of using household's income or expenditure data. Income and expenditure data are both expensive and difficult to collect, and many otherwise useful data sources lack direct measures of living standards (e.g. the Demographic and Health Surveys (DHS)). Rather than income or expenditure, data are collected for variables that capture living standards, such as household ownership of durable assets (e.g. TV, car) and infrastructure and housing characteristics (e.g. source of water, sanitation facility)(Seema and Lilani, 2006). On the face of it, this precludes the analysis of socioeconomic inequalities of health, as well as testing of hypotheses relating to the impact of living standards on health and health service outcomes. Moreover, the exclusion of living standards measures in multivariate analysis raises the possibility that other coefficient estimates are rendered biased. These concerns have prompted researchers to use data on household assets and other characteristics to construct alternative measures of welfare or living standards (Filmer and Pritchett, 1998; Montgomery et al. 2000; Sahn and Stifel 2000).The original list of assets and services used to calculate the Wealth Index. A variety of proxy measures of socioeconomic position have been developed. These have included shortened income or expenditure questionnaires, and measures of housing quality, education or nutritional status (Morris at al, 2000).Recently, researchers have used statistical techniques to combine multiple socioeconomic variables, usually including at least data on housing and ownership of fixed assets, into a measure of household wealth.Few studies have attempted to verify the extent to which the asset-based index approach is a good proxy for household economic wealth. Concerns include the handling of publicly provided goods and services, and the direct effects

of the indicator variables that make up indices, as well as ways of adjusting for household size and age-composition (Falkingham and Namazie 2002; and Houweling et al. 2003).

Principal Components Analysis (PCA) procedure was used to estimate the appropriate components or variables for inclusion in the index. Principal components analysis is an exploratory tool to uncover trends in data, a way to identify predominant variables in a large, multivariate dataset (SAS Institute 2008). The underlying assumption of PCA is that some of the variables are correlated and so there is redundancy in the information they provide. The procedure therefore helps to determine which of the variables best represent the structure of the data (Hatcher 1994). To accomplish this, PCA reduces the number of variables to a smaller number of variables or principalcomponents that account for most of the variance. Each variable contributes one unit to the total variance, so total variance is equal to the number of variables. Usually, the first component accounts for the largest variance, while subsequent components progressively account for smaller proportions. Generally, the first few components contribute most to the variance and are therefore the ones that are extracted for analysis (StatSoft 2007).

We will apply Principal Component Analysis (PCA) to construct wealth indexes (Equation 3). PCA works best when asset variables are correlated, but also when the distribution of variables varies across cases, or in this instance, households. It is the assets that are more unequally distributed between households that are given more weight in PCA (McKenzie 2003). With this consideration, eight binary household asset indicators are selected whose descriptive statistics and factor scores are displayed in Table 6.1.

Table 6.1: Results from principal components analysis

Asset Indicators	Mean (%)	SD	Factor Score
Has Brick Wall	24.75	0.43	0.80
Has Mosaic or Cement Floor	22.50	0.42	0.84
Has Brick-Cement Roof	9.83	0.30	0.72
Has Electricity	53.26	0.50	0.63
Has Sanitary Toilet with Water Seal	28.44	0.45	0.55
Has Television/ Radio	34.64	0.48	0.69
Has Freezer	11.13	0.31	0.71
Has Telephone/Mobile	76.00	0.43	0.40

Table 6.1 indicates that factor scores associated with all the indicators are large enough. However, the variable 'Has Mosaic or Cement Floor' gives highest scores followed by 'Has Brick Wall'. Total variation explained by the principal components analysis is given at Table 6.2.

Table 6.2: Total variation explained by the principal components

Component	Eigenvalues		
	Total	% of Variance	Cumulative %
1	3.699	46.231	46.231
2	1.055	13.183	59.414
3	0.772	9.656	69.07
4	0.715	8.94	78.01
5	0.611	7.643	85.653
6	0.467	5.832	91.485
7	0.432	5.399	96.884
8	0.249	3.116	100

It is revealed that the first principal component solely can explain a major amount (46.23%) of the total variation (see Table 6.2 and Figure 6.1). We, thus, select the first principal component to construct the desired.

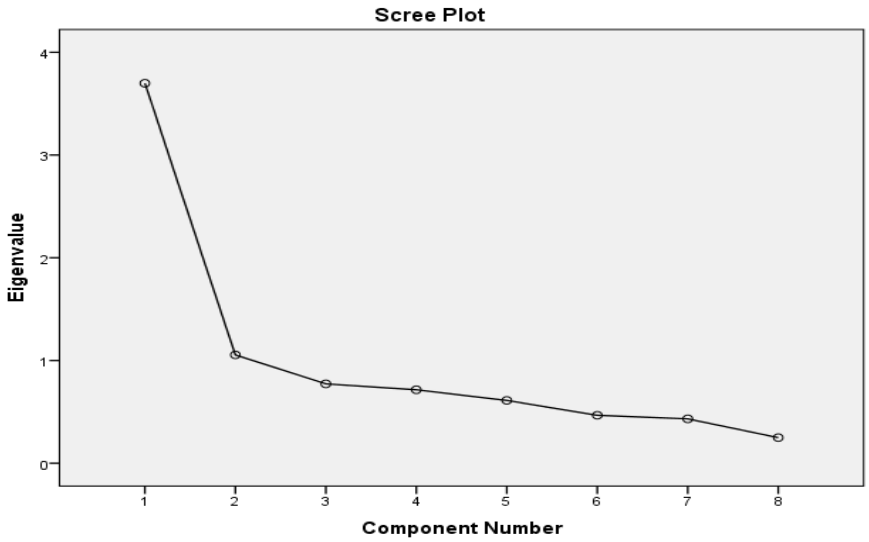


Figure 6.1: Scree plot of principal components analysis

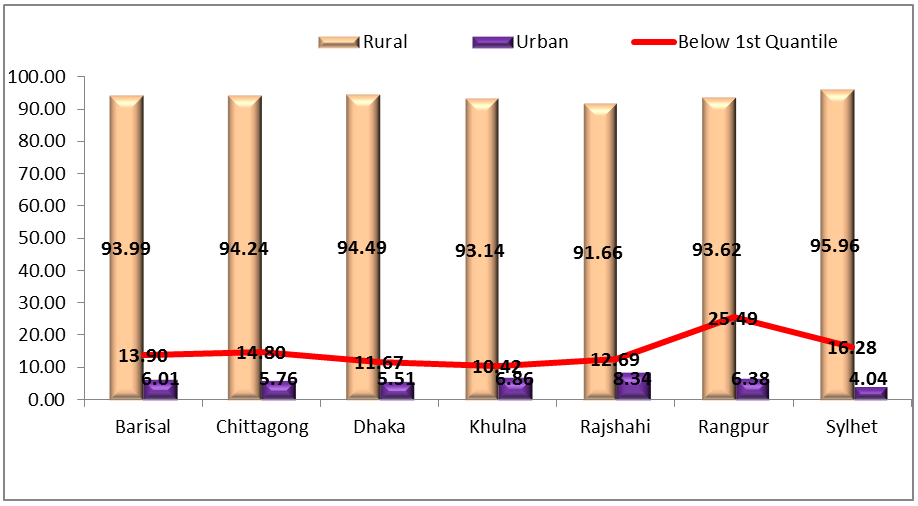


Figure 6.2: Distribution of population below the first quantiles of wealth index by division

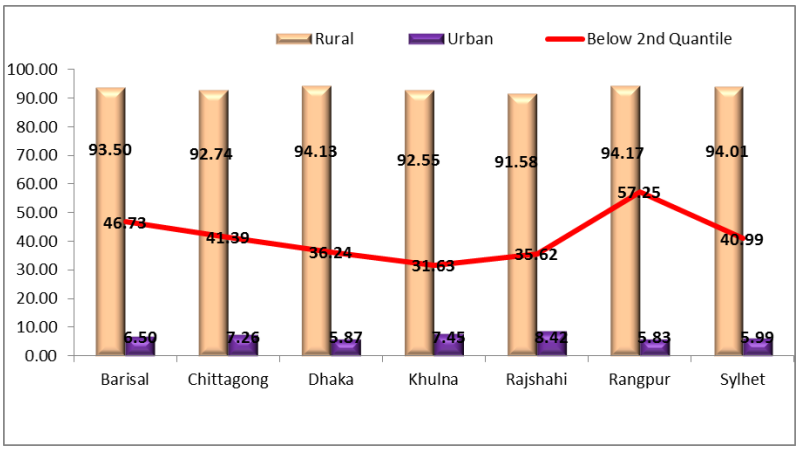


Figure 6.3: Distribution of population below the second quantiles of wealth index by division

The percentage of poorest population is highest at Rangpur division and lowest at Khulna division. On the other hand the percentage of richest population is higher at Sylhet division and lower at Rangpur division. And the percentage of poorest is higher at rural area and percentage of richest is higher at urban area (Figure 6.2 and 6.3). The mean difference is higher between the poorest and second poorest group for urban population in Chittagong division and for rural the difference is small in Barisal division.

Table 6.3 indicates that in Bangladesh the percentage of first quantile which identify poorest, is 14.27% and the fifth quantile which identify richest, is 20.11%. Methods for assessing household socio-economic status can be categorized into two major groups: money-metric measures and alternative approaches. The first category is traditionally used by the economists because it is easy to measure in a monetary definition and is widely well understood by the public. Its concept relies on the assumption that a person's material standard of living largely determines their well-being. Thus, the poor are defined as those who engage in a material

standard of living measured by income and expenditure below a certain level – the poverty line (Falkingham and Nmziel, 2001). Generally, poor people are considering as most vulnerable group of population.Internal coherence compares the mean value for each asset variable by socio-economic group in their example, quintiles. Filmer and Pritchett (2001) and McKenzie (2003) examined internal coherence of the asset-based index in their studies, and both found mean asset ownership differed by socio-economic groups.

Table 6.3: Descriptive statistics of wealth index by division and residence

		Mean	SD	Wealth Index Quantiles				
				Poorest 20%	2	3	4	Richest 20%
Bangladesh		**0.00**	**1.00**	**14.27%**	**25.84%**	**21.10%**	**18.68%**	**20.11%**
	Rural	-0.25	0.77	16.75%	30.06%	23.40%	18.65%	11.14%
	Urban	0.98	1.20	4.37%	9.00%	11.93%	18.78%	55.93%
Barisal		**-0.14**	**0.94**	**13.90%**	**32.82%**	**23.54%**	**14.86%**	**14.87%**
	Rural	-0.44	0.57	16.95%	39.73%	26.10%	12.50%	4.72%
	Urban	0.87	1.20	3.64%	9.61%	14.94%	22.78%	49.02%
Chittagong		**-0.02**	**1.02**	**14.80%**	**26.59%**	**21.44%**	**17.99%**	**19.18%**
	Rural	-0.26	0.80	17.68%	30.98%	23.10%	17.63%	10.61%
	Urban	0.88	1.22	4.03%	10.20%	15.22%	19.35%	51.20%
Dhaka		**0.05**	**1.00**	**11.67%**	**24.57%**	**22.72%**	**20.11%**	**20.93%**
	Rural	-0.18	0.79	13.50%	28.27%	25.31%	20.26%	12.65%
	Urban	1.05	1.18	3.51%	8.09%	11.16%	19.45%	57.79%
Khulna		**0.15**	**1.01**	**10.42%**	**21.21%**	**21.60%**	**21.85%**	**24.92%**
	Rural	-0.08	0.82	12.22%	24.66%	24.19%	22.41%	16.53%
	Urban	1.02	1.17	3.47%	7.97%	11.65%	19.69%	57.22%
Rajshahi		**0.08**	**1.01**	**12.69%**	**22.93%**	**20.25%**	**22.03%**	**22.09%**
	Rural	-0.24	0.69	15.22%	27.44%	23.75%	24.03%	9.56%
	Urban	1.11	1.18	4.50%	8.24%	8.89%	15.56%	62.81%
Rangpur		**-0.37**	**0.73**	**25.49%**	**31.77%**	**19.08%**	**13.86%**	**9.81%**
	Rural	-0.46	0.61	26.87%	33.84%	19.76%	13.28%	6.24%
	Urban	0.36	1.11	14.51%	15.31%	13.67%	18.43%	38.08%
Sylhet		**0.20**	**1.18**	**16.28%**	**24.71%**	**14.66%**	**15.19%**	**29.16%**
	Rural	-0.19	0.91	21.13%	30.99%	17.04%	15.31%	15.53%
	Urban	1.32	1.16	2.52%	6.89%	7.93%	14.85%	67.81%

Table 6.4: Internal validation of wealth index and correlation with other household variables

	Wealth Index Quantiles				
	Poorest 20%	2	3	4	Richest 20%
Wall Materials					
Brick-Cement	0.00%	1.45%	6.29%	25.56%	90.86%
Wood	2.45%	3.17%	3.89%	2.77%	0.45%
Tin	34.87%	47.42%	53.89%	46.33%	8.04%
Mud/Unburnt Brick	21.93%	21.14%	18.98%	16.10%	0.43%
Straw etc.	38.41%	24.83%	15.59%	8.62%	0.17%
Others	2.34%	2.00%	1.37%	0.63%	0.04%
Floor Materials					
Mosaic/Tiles	0.00%	0.00%	0.00%	0.06%	6.19%
Brick/Cement	0.00%	0.00%	1.54%	19.72%	85.71%
Wood/Bamboo	4.33%	2.70%	1.92%	1.71%	0.18%
Mud	95.61%	97.18%	96.48%	78.43%	7.90%
Others	0.05%	0.12%	0.06%	0.09%	0.03%
Roof Materials					
Brick-Cement	0.00%	0.00%	0.00%	0.73%	48.19%
Tin	81.43%	88.99%	93.80%	95.63%	50.91%
Tally	1.41%	1.62%	1.69%	1.77%	0.68%
Straw etc.	15.97%	8.61%	4.02%	1.68%	0.18%
Others	1.19%	0.78%	0.50%	0.20%	0.04%
Sources of Light					
Electricity	0.00%	13.87%	64.82%	87.66%	97.55%
Solar Energy	1.97%	5.67%	6.06%	3.38%	1.01%
Biogas	0.34%	0.23%	0.10%	0.04%	0.02%
Kerosene	97.00%	79.36%	28.72%	8.77%	1.37%
Other	0.69%	0.87%	0.29%	0.14%	0.05%
Sanitation					
Sanitary with Water Seal	0.00%	7.26%	33.83%	28.32%	70.30%
Sanitary Without Water Seal	26.58%	37.72%	32.39%	42.21%	24.72%
Non-sanitary/Kutcha	50.71%	44.83%	30.50%	27.55%	4.87%
Open Space	22.71%	10.18%	3.28%	1.92%	0.11%

	Wealth Index Quantiles				
	Poorest 20%	2	3	4	Richest 20%
Own Television/Radio					
Yes	0.00%	1.31%	13.84%	75.50%	85.91%
No	100.00%	98.69%	86.16%	24.50%	14.09%
Own Freezer					
Yes	0.00%	0.00%	0.07%	5.34%	50.29%
No	100.00%	100.00%	99.93%	94.66%	49.71%
Own Telephone/Mobile					
Yes	0.00%	75.91%	90.66%	94.94%	96.43%
No	100.00%	24.09%	9.34%	5.06%	3.57%
Own Computer					
Yes	0.15%	0.17%	0.44%	1.47%	13.90%
No	99.85%	99.83%	99.56%	98.53%	86.10%
Own Motor Bike					
Yes	0.29%	1.25%	2.35%	5.16%	15.09%
No	99.71%	98.75%	97.65%	94.84%	84.91%
Own Car					
Yes	0.15%	0.25%	0.41%	0.68%	2.96%
No	99.85%	99.75%	99.59%	99.32%	97.04%
No. of Dwelling Rooms					
1	66.10%	50.21%	43.70%	37.38%	25.66%
2	28.70%	37.46%	39.53%	40.25%	38.57%
3	4.44%	9.71%	13.05%	16.11%	22.41%
4+	0.77%	2.62%	3.71%	6.26%	13.35%
Water Source					
Tubewell	87.96%	92.11%	94.91%	94.66%	79.39%
Tap	0.69%	0.82%	1.44%	3.54%	19.86%
Well	4.47%	2.47%	0.86%	0.26%	0.09%
Pond	2.41%	2.17%	1.74%	1.15%	0.44%
River/ditch/canal	2.82%	1.43%	0.52%	0.09%	0.02%

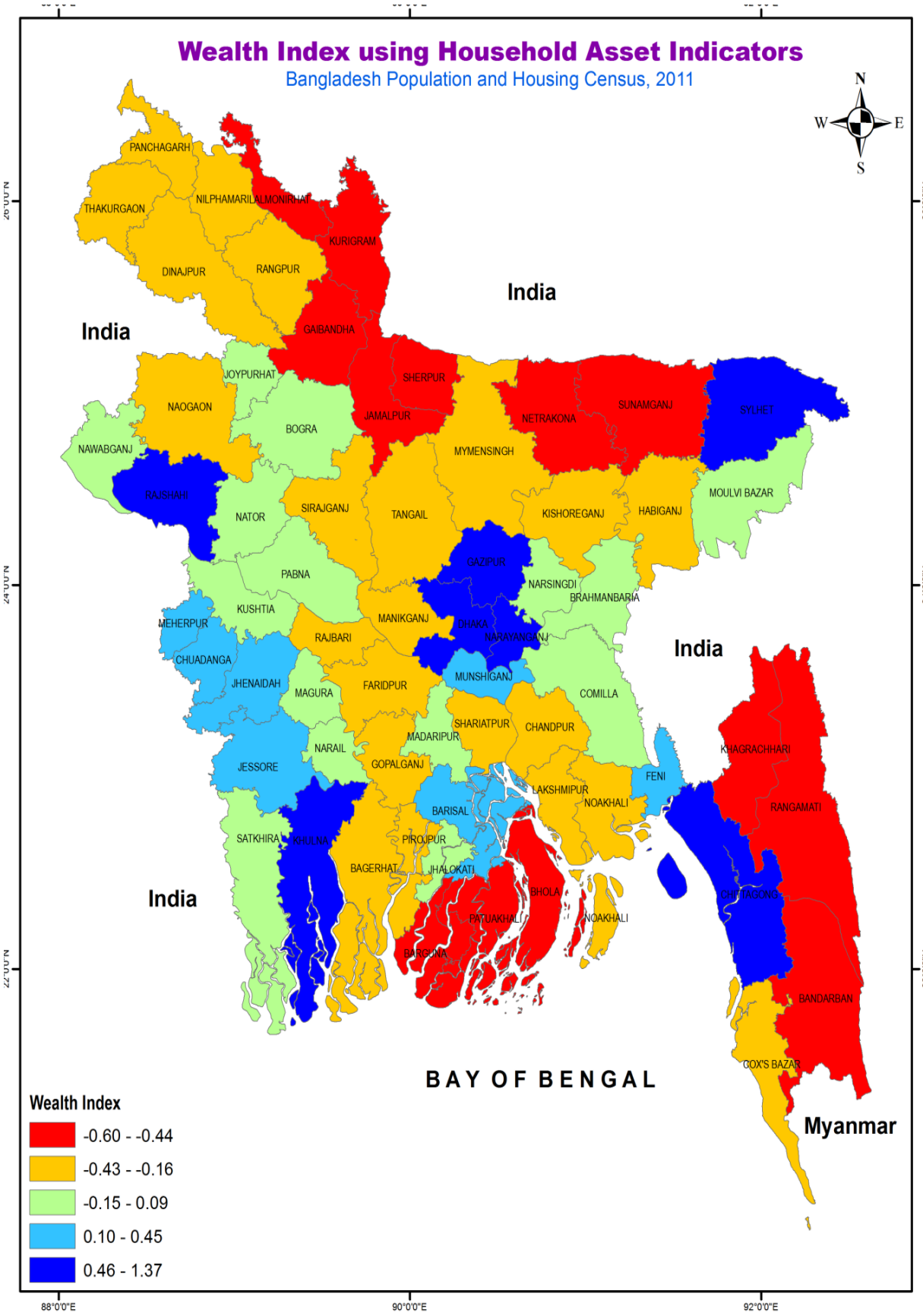
	Wealth Index Quantiles				
	Poorest 20%	2	3	4	Richest 20%
Others	1.65%	1.01%	0.54%	0.30%	0.19%
Water Distance					
Inside Dwelling	46.10%	48.76%	55.60%	61.06%	75.67%
Within 200 Meters	37.34%	38.10%	35.61%	32.88%	21.52%
More Than 200 Meters	16.56%	13.14%	8.79%	6.06%	2.81%
Drinking Bottles Water					
Yes	1.01%	1.49%	1.82%	2.93%	21.77%
No	98.99%	98.51%	98.18%	97.07%	78.23%
Fuel					
Gas/LPG	0.03%	0.34%	1.42%	6.28%	36.17%
Bio-gas	0.01%	0.03%	0.03%	0.05%	0.20%
Electricity	0.08%	0.10%	0.26%	0.33%	0.92%
Kerosene	1.80%	1.60%	0.79%	0.41%	0.92%
Wood	32.74%	37.26%	39.98%	43.66%	42.15%
Straw/Dried Cow Dung	65.34%	60.66%	57.52%	49.26%	19.64%
Waste Management					
Managed Dustbin	7.12%	9.59%	13.97%	16.30%	46.68%
Burn	1.26%	1.03%	0.77%	0.65%	0.32%
Bury/Inside Pit	29.43%	29.35%	30.91%	30.75%	20.80%
Unmanaged Dump Site	62.19%	60.02%	54.35%	52.29%	32.19%
Tenancy					
Owned	86.87%	89.98%	89.29%	83.19%	63.29%
Rented	1.44%	2.30%	4.79%	11.29%	33.46%
Rent Free	11.68%	7.72%	5.92%	5.51%	3.26%
Ethnic Community					
Yes	9.04%	5.92%	3.34%	2.01%	1.44%
No	90.96%	94.08%	96.66%	97.99%	98.56%

After categorizing the population households into 5 quintiles, from the poorest to the richest by using the asset index, the PCA can be used to measure household socio-economic status because the index produces significant differences among different socio-economic groups, especially in the assets with high factor scores such as Has Brick Wall, Has Mosaic or Cement Floor, Has Brick-Cement Roof, Has Electricity, Has Sanitary Toilet with Water Seal, Has Television/ Radio, Has Freezer and Has Telephone/Mobile. Households in the fourth and the fifth quintiles usually have the assets with high factor score while none or small percentage of households in the first and second quintiles would have such assets. In contrast, higher percentage of households in the first and the second quintiles would own assets with low factor scores such as having mud or unburnt brick, straw, floor material wood or bamboo (Table 6.5).

In our study ownership of wall materials brick-cement, floor materials mosaic/ tiles and brick-cement, roof materials brick-cement, electricity, have television/ radio, Freezer, telephone/ mobile phone, computer, motor bike, car, number of dwelling rooms more than 3, tap (water source) and inside dwelling, drinking bottle water, managed dustbin and rented house increased by socio-economic groups. Similarly, the ownership of wall materials mud or unburnt brick, straw, floor materials wood or bamboo, roof materials straw, sources of lilght biogas and kerosene, sanitation open space, no. of dwelling room one, source of water well, pond, river and others water distance more than 200 meters, fuel Straw/Dried Cow Dung, Waste Management Burn, Bury/Inside Pit, Unmanaged Dump Site and Tenancy Rent Free decreased by socio-economic groups.

In order to assess the internal validity of the wealth index, quintiles of wealth were computed based on the index to assess the characteristics of the poor and rich. Table 6.4 shows the percentage of the population that has access to each asset and the average wealth level across quintiles. As can be observed, the first Principal Component Analysis methodology discriminates well between the rich and poor. Individuals in the fifth quintile unambiguously show much higher levels of wealth than the rest of the population in both urban and rural areas. A comparison between using the asset index and Household/ individual expenditure to identify peoples above or below the poverty line.It is usually the poor who suffer the most because they lack the resources to overcome their financial losses. Their asset base and economic staying capacity is very low and therefore, cannot withstand the onslaught of such disaster making them utterly vulnerable. The wealth index by districts is given at Map 6.1.

Map 6.1 indicates that Bandarban, Rangamati, Khagrachhari, Bhola, Patuakhali, Barguna, Sunamganj, Netrakona, Sherpur, Jamalpur, Gaibandha, Kurigram, Lalmonirhat districts are most vulnerable based on Wealth index using household asset indicator.



Map 6.1: Distribution of wealth index using household asset indicators by dstrict

7. CONCLUSION AND POLICY RECOMMENDATION

7.1 Conclusion

According to the Global Climate Risk Index, Bangladesh is one of the most vulnerable countries. Vulnerability is related to an individual's circumstances particularly in social context. In this monograph, we observed vulnerability in different dimensions: population density, proxy vulnerability indicators, vulnerable groups, household vulnerability, economic vulnerability by residence, administrative unit, agro-ecological zone and natural disaster prone area and earthquake risk area as well.

Unplanned urbanization, low quality construction and inadequate urban management uplift the level of hazard risk and create human vulnerability. Generally, climate vulnerability is the maximum where population density is high. It is found that Dhaka division has the highest population density followed by Rajshahi, Rangpur, Chittagong, Sylhet, Khulna and Barisal divisions in order. Dhaka and Narayanganj are the most vulnerable districts due to their high population density. In AEZ, the most densely region is Greater Dhaka (DHAKA) followed by MMRF, CCPSI, BJF, HGRF, LMREF, HPTF, KFAB, LGRF, SBSKF, GTF and EH in order. The earthquake prone region that includes districts Dhaka, Chittagong, Sylhet, Rangpur and Mymensing is highly vulnerable because of its high density. Among three earthquake zones of Bangladesh zone 2 has the highest population density.

Most of the proxy vulnerability indicators indicate that vulnerability is more in rural area than urban area. Illiterate population, unsafe sanitation and vulnerable house decreased remarkably from 2001 to 2011. However, illiteracy and use of unsafe sanitation is still high in Bangladesh. Other indicators such as proportions of elderly, disable and divorced/widow/separated population increased in 2011 than 2001. Population over 65 year and disable population are maximum in Barisal division, whereas female population, ethnic population, vulnerable house are maximum in Chittagong division. Proportion of floating population is highest in Dhaka division, while proportion of illiterate population, divorced/widow/separated population and unsafe sanitation are highest in Rangpur division. Ethnic population is the maximum in EH AEZ region and female population in the maximum in LMREF AEZ region.

Illliteracy rate is higher in female than male. The overall illiteracy rate is highest in Rangpur division followed by Rajshahi and Sylhet divisions. Almost 70% illiterate population depends

on agriculture. Agricultural households again are more vulnerable than non-agricultural households.

The percentage of disable population is higher in rural than urban area. All of the divisions have same picture that disability is higher among male compared to female. The percentage of disable population is higher in Barisal and Rangpur divisions.

Vulnerability assessment is required to identify the complex set of factors that contribute to adaptive capacity of the households. The total vulnerability in rural area of Bangladesh is much higher than the urban area. People living in separate house are more vulnerable compare to people living in joint or apartment type of house. There is negligible variation in household vulnerability index among seven administrative divisions. Household vulnerability is the maximum in Chittagong division. The coping level is higher in urban area. Bandarban district is lowest in coping level whereas Dhaka district is the highest. Household vulnerability is maximum in EH region of AEZ.

The percentage of poorest population is maximum in Rangpur division followed by Sylhet, Chittagong, Barisal, Rajshahi, Dhaka and Khulna divisions in order. The percentage of poorest is higher at rural than urban area. The mean difference between the poorest and second poorest group for urban population is highest in Chittagong division and the difference is lowest for rural population in Barisal division.

Household asset indicator shows that living standard of population in Bandarban, Rangamati, Khagrachhari, Bhola, Patuakhali, Barguna, Sunamganj, Netrakona, Sherpur, Jamalpur, Gaibandha, Kurigram, Lalmonirhat districts is poor. Vulnerable districts by different measures are summarized in Table 7.1.

This study provides an in-depth analysis of variables associated with vulnerability and spatial pattern of vulnerability indicators which would help to achieve sustainable development goals such as Gender equality, Sustainable water and sanitation, Reduce inequality within countries, Safe, resilient and sustainable human settlement and Combat climate change and its impact.

Table 7.1: Most vulnerable regions by different measures

	Most Vulnerable Regions
High Population Density	
(Districts are in decending order of density)	Dhaka and Narayangang districts
	DHAKA AEZ: Dhaka, Narayanganj, Narshingdi, Gazipur, Munshiganj and Manikgonj districts
	Earthquake Prone Region: Dhaka, Chittagong, Rangpur, Mymensing and Sylhet districts
	Eastern Coastal Zone: Chittagong, Cox's Bazar and Noakhali districts
	Earthquake risky zone 2: Dhaka, Narayanganj, Narsingdi, Gazipur, Comilla, Brahmanbaria, Chandpur, Feni, Chittagong, Munshiganj, Sirajganj, Rangpur, Nilphamari, Bogra, Gaibandha, Pabna, Tangail, Manikganj, Cox's Bazar, Joypurhat, Natore, Dinajpur, Thakurgaon, Naogaon, Panchagarh, Khagrachhari, Rangamati and Bandarban districts
Proxy vulnerability indicators	
Female Population	Chandpur, Noakhali, Comilla, Lakshmipur, Brahmanbaria, Jhalokati, Feni and Shariatpur districts
Population under age 15	Cox's Bazar, Sunamganj, Brahmanbaria, Noakhali, Bhola, Habiganj, Kishoregonj, netrokona, Bandarban and Lakshmipur districs
Population over age 65	Jhalokati, Pirojpur, Bagerhat, Manikganj, Tangail, Barguna, Shariatpur, Narail, Chandpur, Rajbari and Barisal districts
Floating population	Cox's Bazar, Munshiganj and Dhaka districts
Ethnic population	Rangamati, Khagrachhari and Bandarban districts
Disable population	Gaibandha, Chandpur and Jhalokati districts
Vulnerable house	Cox's Babzar and Netrakona districts
Illiterate population	Jamalpur, Bandarban, Sherpur, Gaibandha, Kurigram, Netrakona, Sunamganj and Sirajganj districts
Divorced/ widowed/Seperated population	Naogaon, Joypurhat, Kurigram, Bogra and Narail districts
Unsafe sanitation	Gaibandha, Thakurgaon, Naogaon, Nilphamari, Bandarban, Rangpur, and Chapai Nawabganj districts
Households Vulnerability Index	Cox's Bazar, Bandarban, Rangamati, Khagrachhari and Sunamganj districts
Wealth Index	Bandarban, Rangamati, Khagrachhari, Bhola, Patuakhali, Barguna, Sunamganj, Netrakona, Sherpur, Jamalpur, Gaibandha, Kurigram, Lalmonirhat districts

7.2 Policy Recommendation

The high population density of Bangladesh with limited resources, lack of economic opportunities, illiteracy, poverty, physical or mental disability, vulnerable house, unsafe sanitation make the country vulnerable. Government should consider the following recommendations to reduce vulnerability.

1) The density of population is higher at Dhaka and Narayangang due to industrial area. People from different parts of the country come to these areas for better job opportunity, education and health facilities. Government should increase job opportunity, education and health facilities in different parts of the country to reduce the human pressure of Dhaka city. In long run, industrialization should be decentralized.
2) Government should impose proper mitigation plan and formulating adaptation policies to minimize the impacts of climate change, sea level rise, flood and cyclone on the country.
3) Imposing necessary regulation and running continuous awareness build-up programs could help reduce vulnerability in disaster prone areas. Information campaigns and training on food hygiene practices and sustainable management of residues and waste material should be launched to reduce the incidence of diseases that are transmissible through food and to educate the population to reduce anthropic impacts on the environment.
4) In order to improve the social security of people living in the coastal area, more amenities should be made such as establishment of cyclone shelter, fire service, health care center, school and market.
5) People in coastal area are more dependent on natural resources such as water and mangrove forest and they have limited set of livelihood options. Many households depend only on agriculture and fishing due to insufficient job opportunity. Government and NGO should create job opportunities for the coastal area.
6) The government should provide incentive and low-interest loan to reduce vulnerable houses in disaster prone areas and supervise all new constructions to assure earthquake-resistant buildings.
7) During natural clamities and disasters, access to safe drinking water is essential in rural area. To reduce vulnerability in rural and disaster prone areas, safe drinking water should be ensured. The government can take policy for using surface water. Steps can be taken for installing water purification plant, storing rain water, filtering sea water for drinking and supplying water purifying tablets in vulnerable regions.

8) High proportion of unsafe sanitation is identified in this study. The government should imvest on sanitation in marginal areas. More health centers and hospitals should be built in the rural areas to ensure immediate treatment.

9) About 50% of Bangladesh population is female and around 35% population is young. Government should invest more in education and creat more job opportunity for the young and female population.

10) Illiteracy is higher in female than male. To reduce the gender gap in education, some initiatives has been taken by the government and various NGO's have increased some effective program such as stipend, free tuition, national and international advocacy etc. Supervision of Government and NGO's is needed so that such initiatives are implemented properly.

11) Priority to extreme poor should be given to reduce consumption fluctuations through a combination of protective and promotional programme. For example, different GO or NGO should confirm the access to financial services so that poor people can market their products with good price and properly use their income to increase household assets.

12) Government should extend its SSNP program in economically poor districts and divisions.

13) Policy support to rural extreme-poverty reduction should be provided through sustainable urbanization. In order to mitigate climate change effects in rural areas, temporary migration opportunities can be enhanced by improving inter-city connectivity and within-city multi-modal transport, and by encouraging relocation of urban jobs to the affected areas.

14) Research initiatives should be taken for climate adaptive agriculture.

Annex-I

Abbreviations

ADB	Asian Development Bank
AEZ	Agro-Ecological Zones
BBS	Bangladesh Bureau of Statistics
BIDS	Bangladesh Institute of Development Studies
BJF	Brahmaputra-Jamuna Floodplain
BUET	Bangladesh University of Engineering and Technology
CCC	Climate Change Cell
CCPSI	Chittagong Coastal Plain & St.Martin's Coral Island
CDB	Caribbean Development Bank
CDP	Committee for Development Policy
CESP	Country Emergency Situation Profile
CREH	Cyclone Relief Effort Hampered
CS	Commonwealth Secretariat
CVAT	Community Vulnerability Assessment Tool
DF	Damaging Fluctuations
DHAKA	GraterDhaka
ESCAP	Economic and Social Commission for Asia and the Pacific
ETC CCA	European Topic Centre on Climate Change Impacts
EH	Eastern Hills
EM-DAT	Emergency Events Database
EU	European Union
FEWS	Famine Early Warning System
EVI	Economic Vulnerability Index
FAO	Foodand Agricultural Organization
IFPRI	International Food Policy Research Institute
IPCC	Inter governmental Panelon Climate Change
ITCZ	Inter –Tropical Convergence Zone
GBM	Ganges-Brahmputra-Meghna
GCRIO	Global Change Research Information Office
GECHS	Global Environmental Change and Human Security

GIS	Geographic Information System
GTF	GangesTidal Floodplain
HGRF	High Ganges River Flood plain
HPTF	Old Himalayan Piedmont Plainand Tista Flood plain
HSC	Higher Secondary Certificate
HVI	Households Vulnerability Index
KFAB	Karatoya Flood plain and Atrai Basin
LGRF	Low Ganges River Flood plain
LMREF	Lower Meghna River and Estuarine Flood plain
MMRF	Middle Meghna River Flood plain
MOEF	Ministry of Environment and Forest
NAPA	National Adaptation Program of Action
NGO	Non-Government Organization
PEC	Post Enumeration Check
SBSKF	Sylhet Basin and Surma-Kusiyara Flood plain
SIDs	Small Island Developing States
SOPAC	South Pacific Applied Geo-science Commission
SPCR	Strategic Program for Climate Resilience
SPSS	Statistical Package for Social Science
SSC	Secondary School Certificate
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNU/IAS	United Nations University Institute of Advanced Studies
UNDRO	United Nations Disaster Relief Organization
UNEP	United Nations Environment Programme
UNFCC	United Nation Framework Convention on Climate Change
UNFPA	United Nations Fund for Population
USGCRP	US Global Change Research Program
USAID	United States Agency for International Development
USCB	United States Census Bureau
USD	US Dollar
VAM	Vulnerability Analysis and Mapping
WFP	World Food Programme
WVR	World Vulnerability Report

Annex-II

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Annex-III

Government of the People's Republic of Bangladesh
Bangladesh Bureau of Statistics
Population and Housing Census - 2011 Project
Parishankhyan Bhaban, E-17/A, Agargaon, Dhaka-1207.

No: **52.01.0000.401.29.315.15-347** Date: **12-05-2015**

Subject: Selection of Expert Panel to Review Population Monographs

The following distinguished persons have been nominated as experts to review the Population Monographs being prepared under Population and Housing Census-2011 Project of Bangladesh Bureau of Statistics:

Expert Panel for Population Monographs

No	Broad Area	Monographs	Expert Panel
01	Reproductive Behavior of Population	1. Population Composition: age and sex 2. Fertility 3. Marriage & Family	Prof. M. Nurul Islam , Ex. Professor, DU Syeda Shahanara Huq, Prof. JNU Dr. Ahmed-Al-Sabbir, USAID Dr. Obidur Rob, Country Director, Population Council, Bangladesh
02	Special Protection Groups	1. Elderly Population 2. Disabled Population 3. Children and Youth 4.Population Density and Vulnerability	Dr. Nazma Ahmed, Social Protection Specialist Dr. Sharifa Begum, SRF BIDS Prof. Mahmuda Khatoon, DU Dr. A. J Faisal, Country Representative Engender Health Dr. Eshani Ruwan Pura, Program Specialist UNFPA
03	Household and Housing Characteristics, Education & Literacy	1. Housing Condition 2. Household Facilities 3. Education & Literacy	Prof. Kazi Saleh Ahmed, Ex. VC, JNU Mr. Abdur Rashid Sikder, Former DDG, BBS Dr. Anwara Begum, SRF BIDS
04	Economic and Social Aspects of Population	1. Urbanization 2. Labor Force Participation 3. Characteristics of International Migrant Households 4. Population Distribution and Internal Migration	Mr. Nichole MALPAS, Program Manager, Human and Social Development, Delegation to the European Union to Bangladesh. Prof. Kazi Saleh Ahmed, Ex. VC, JNU Dr. Sarwar Jahan, Prof., Department of URP, BUET Prof. Nurul lslam Najem, Dept. of Geography, DU

Terms of Reference:

i) The members of the panel will remain present in the presentation of the monographs and will act as a co-opt member of the Technical Committee;

ii) They will review the draft of the Monographs;

iii) They will provide guidance in improving the draft;

iv) They will get financial benefit as per provision in the AWP of the Population and Housing Census -2011 Project

12/5/15

Mohammad Abdul Wazed
(Additional Secretary)
Director General

Distribution:

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POPULATION DENSITY AND VULNERABILITY: A CHALLENGE FOR SUSTAINABLE DEVELOPMENT OF BANGLADESH

Population Monograph: Volume-7

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