Climate change, household amenities, and women's nutritional status in Bangladesh

By

Azmal Hossan, BSS, MSS

A Thesis

In

Sociology

Submitted to the Graduate Faculty
of Texas Tech University in
Partial Fulfillment of
the Requirements for
the Degree of

MASTER OF ARTS

Approved

Dr. Cristina Bradatan
Chair of Committee

Dr. Nadia Y. Flores–Yeffal
Co-chair of committee

Mark Sheridan
Dean of the Graduate School

May, 2018

ACKNOWLEDGMENTS

First of all, I would like to express my gratitude to the Department of Sociology, Anthropology and Social Work, Texas Tech University for giving me the opportunity to pursue my MA degree. The supportive environment I found here always helped me to overcome all the difficulties I have been confronted as an international student. I express my indebtedness to all the faculty members, staff, and my fellow students for their continuous support.

I would like to thank Dr. Bradatan for her patience in supervising me from the very beginning of the project. I am eternally thankful to her for the time and energy that she has invested in this research work. I would like to express my sincere gratitude to Dr. Flores who took supervising responsibility in absence of Dr. Bradatan at the later part of the project. I liked her thought provoking attitude and cordial mentality which has been so crucial for successful completion of the project.

It's my pleasure to express my indebtedness to DHS program for providing me the access to its dataset. In addition, the completion of the project would not have been possible if I wasn't able to gain access to the BDHS dataset. Finally, I express my gratitude to my family members, friends and well-wishers who have supported me along every step of this voyage of discovery.

TABLE OF CONTENTS

ABSTRACT

Although Bangladesh has achieved considerable success in most of its socio-economic indicators in the last couple of decades, women and children undernutrition is still among the highest in the world. Women in Bangladesh suffer from a three-dimensional obstacle in maintaining a standard nutritional status: climate change, poor household amenities, and gender inequality. Bangladesh's economy is predominantly rural agricultural where most people receive their dietary iron and/or zinc from C_3 grains and legumes susceptible to lose iron and zinc content due to elevated carbon concentration in the atmosphere. On the other hand, the Asian Enigma theory indicates that despite having better position in most of the indicators of human well-being, South Asian women and children are in backward position in terms of nutritional status than the sub-Saharan African countries. Poor household amenities and gender inequality are the responsible factors behind this paradox. The current study attempts to examine how the underlying connection between climate change and poor household amenities is negatively affecting women's body mass index (BMI). The study used both Bangladesh Demographic and Health Survey (BDHS), 2007 dataset and global positioning system (GPS) data to connect women's BMI with household amenities and climatic variabilities. Results of the study indicate that some climatic variabilities and poor household amenities have statistically significant negative consequences on women's body mass index. But when the predictor variables are combined together in the same model, individual factors and poor household amenities become more important than climatic variabilities in predicting women's nutritional status in Bangladesh.

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

"The Earth provides enough resources for everyone needs, but not for some people's greed."

(Mahatma Gandhi quoted in Shiva, 2005, p. 11)

Scientific bodies may have different measurements of climate change intensity, as for example, NASA declared 2017 as the 2nd warmest year since 1880 while NOAA found it 3rd warmest year, but there is no doubt climate change is happening. The major political parties may call it different names such as climate change or global warming. Some winter seasons may become cooler and snowy rather than hot and dry which may make lay persons to be more doubtful about it, but this is a real issue and a threat to humanity. While climate change is not a matter of belief but a scientifically established fact, personally, I believe that it is real also because it has been an integral part of my own daily life experiences since I was born. As somebody who was born in Bangladesh - the poster child of vulnerability because of its devastating effects on human lives and livelihoods which has taken place in this country – I feel like I have an obligation to understand the effects that climate change has on human societies. Yes, I am talking about the changing nature of global climate, one of the most daunting challenges human kind has ever faced.

The U.S. president Donald Trump, in his first State of the Union on January 30, 2018, declared the end of the so called 'War on American Energy' by bringing back coal, oil, and gas based 'America First Energy Policy'. At the same time, the global media covered the devastating news that the authority of Cape Town, the 2nd biggest city of South Africa with 4 million inhabitants, imposed a restriction on its residents not to use more than

50 liters of water daily, down from the current limit of 80 liters. This is because if appropriate actions are not taken immediately, the city is likely to face a "Day Zero" on April 12 when it might have to turn off most taps due to lack of water. Based on satellite image, NASA's Earth Observatory (2018) shows that the last three years of drought reduced the water level of Theewaterskloof Dam, the largest among the six major reservoirs of drinking water of Cape Town, at 13% of its capacity. Intergovernmental Panel on Climate Change (IPCC, 2014) predicted with medium confidence that droughts will intensify in the 21st century in East and Southern Africa due to reduced precipitation and/or increased evapotranspiration. This water crisis due to drought and other climatic events is not only South Africa's problem alone, it has become a problem of global human existence. Due to a five-year long drought, California, for example, has depleted its water reservoirs and already has imposed a restriction on wasteful water use.

Based on water deficit characterization, National Oceanic and Atmospheric Administration (NOAA) categorized drought into three types: 1. Meteorological drought caused by precipitation deficit; 2. Agricultural drought caused by soil moisture deficit; 3. Hydrological drought caused by deficit in runoff. Wehner et al. (2017) concluded with high confidence that all the three categories of droughts are consequences of anthropogenic climate change.

If drought is perceived as a natural event, then starvation and famine are its human consequences (Devereux, 1993, p. 38) and the poor are the most vulnerable sector of the population affected by it (Bush, 1985, p. 59). Drought directly hits the lives of affected people through four types of risks: water shortage, sanitation failures, infectious disease outbreaks, and anarchy due to competition for scarce resources. Water supply, hygiene and

sanitation are directly related to the infectious diseases, specifically diarrhea, and are also crucial for preventing malnutrition. Drought can also increase malnutrition by disrupting food security (Kumar et al. 2005). There is a popular equivalence with respect to the African continent: drought equals famine (Devereux, 1993, p. 35). Out of 27 million people, approximately 50,000 to 200,000 people died during the Ethiopian famine of 1972-74 (Sen, 1981, p. 86). Aykroyd (1974) rejected this estimation by claiming that "a death toll of perhaps over 100,000 is inexcusable at this stage in the history of famine" (p. 203). According to World Meteorological Organization, more than a million African Sahelian people died during the devastating droughts of 1972-1975 and 1984-1985 caused because of poor rainfall for 25 years in that region (Henson, 2014, p. 81). Famine due to drought and other extreme climatic variabilities is not the only problem for the African continent. More than 30 million Chinese died in the early twentieth century because of drought and related famine (Henson, 2014, p. 81). With the reference from the Report of the Famine Inquiry Commission and the Census of India (1951), Blyn (1966) said, "In 1942-43 cyclones and floods reduced the Bengal rice crop by about a third; this, coupled with the absence of exports from Japanese-controlled Burma, and inadequate relief, led to famines, epidemics (malaria, cholera, and smallpox), aggravated by widespread starvation" (p. 98). The official figure of death toll due to the Bangladesh Famine of 1974 is 26,000 (Alamgir, 1978, p. 2). Another estimation indicates that only in Rangpur district of Bangladesh 80 to 100 thousand persons died of starvation and malnutrition in the period of 2-3 months' during that year (Haque et al. 1975, p. 43). After the devastating famine in Bangladesh resulting from massive flooding along the Brahmaputra river, under the auspices of Food and Agricultural Organization (FAO), the United Nations (UN) organized the first World

Food Conference (1974) in Rome. Governments attended in the conference adopted Universal Declaration on the Eradication of Hunger and Malnutrition. The declaration proclaimed, "Every man, woman and child have the inalienable right to be free from hunger and malnutrition in order to develop fully and maintain their physical and mental faculties". However, more than forty years after the declaration, the residents of Cape Town city are likely to lose this inalienable right as it is located in the red heat zone and women, children and elder people are the first target of famine resulting from climate change-induced natural disasters.

Thinking of Bangladesh, the country is in an even more vulnerable position than Cape Town city. Along with climate change, Bangladesh has been struggling with other socio-economic difficulties such as high population density, agricultural economy, high poverty rate, corruption, extreme gender inequality etc. from the very beginning of its inception. In this study, I intend to investigate how climate change is negatively influencing women's nutritional status in Bangladesh and in the following sections I will continue to explain why this is an important study.

Climate is defined as long-term averages and variations in weather measured over a period of several decades (Walsh et al. 2014). IPCC dispelled the uncertainties regarding anthropogenic climate change through the periodic assessment reports. IPCC (2014) defines climate change, "a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer." Climate change may occur due to both natural (internal processes or external forcing such as modulations of the solar cycles, or volcanic eruptions) and human-induced ways (anthropogenic changes in

the composition of the atmosphere or in land use). But the climate change in the last 50 years is primarily due to human activities, especially due to burning of fossil fuels (coal, oil, and natural gas) and from deforestation (Walsh et al. 2014). Emphasizing human influences on climate change, article 1 of the United Nations Framework Convention on Climate Change (UNFCC) says, "Climate change is a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (p. 3). Land surface, atmosphere, oceans, and ice are major components of the Earth's climate system and warming of the planet is the most significant indicator of climate change (see figure 1). Scientists found more than 26,550 physical and biological evidences of warming planet around the world (Rosenzweig et al. 2008). Warming atmosphere and ocean, diminishing amounts of snow and ice specifically in the two poles, rising sea levels are the major physical evidences of warming planet (IPCC, 2014). Analyzing available data of last 136 (1880-2016) years, The National Aeronautics and Space Administration (NASA) declared 2014, 2015, and 2016 as the three consecutive warmest years in history. The global average mean sea level has been risen 0.1 meter from 1901 to 2010 (IPCC, 2014) and it continues to rise.

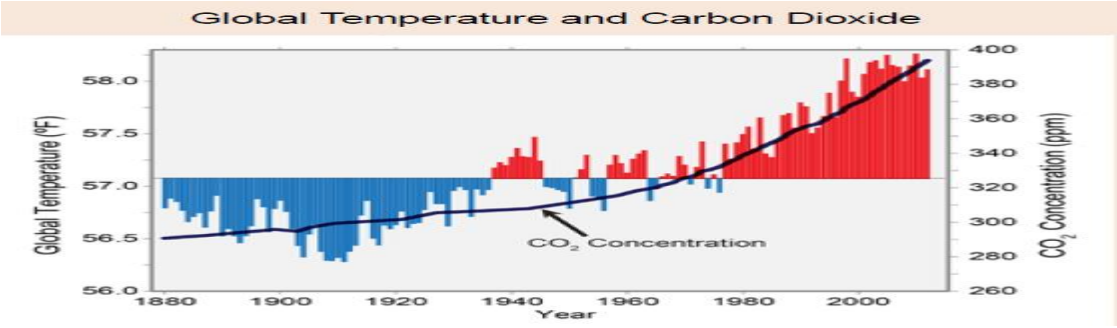

Figure 1: Atmospheric CO_2 concentration and global average temperature. Source: Karl et al. 2009 adapted from Walsh et al. 2014.

Global scientific communities have a consensus that climate change is real, and it is happening due to elevated concentration of Greenhouse Gases (GHG) in the atmosphere resulting primarily from burning of fossil fuels (see figure 2). GHGs absorb solar heat radiated by Earth, but they don't release all the absorbed heat to space which warms the atmosphere (Henson, 2014, p. 7). Population size, economic activity, lifestyle, energy use, land use patterns, technology and climate policy are the major contributing factors of GHG emission (IPCC, 2014). Among the GHG gases, CO_2 is the leading factor to the global warming process because it remains more than a century in the atmosphere. Over the last century, atmospheric concentrations of CO_2 have increased from a pre-industrial value of 278 parts per million (ppm) to 379 ppm in 2005 (IPCC, 2007). The threshold crossed 400 ppm in 2013 (Henson, 2014, p. 30) and it is expected to reach 550 ppm in the next 40–60 years, even if further actions are taken to stop emissions (Fisher et al. 2007 cited in Myers et al. 2014).

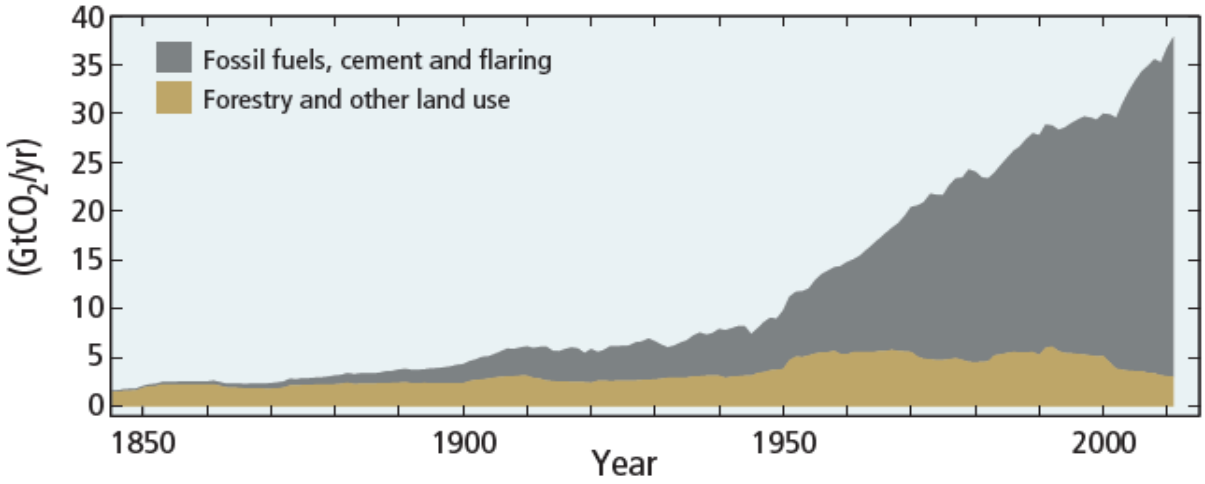

Figure 2: Global anthropogenic CO_2 emission. Source: IPCC, 2014.

Global climate change is not merely a scientific problem, rather it has become a major social justice issue. Although the industrialized developed countries in the global North are the major contributors to global warming, poor developing countries in the global

South are suffering the consequences of global warming the most. Among the victims, women and children specifically in developing countries are the most vulnerable groups because of their underprivileged social position and limited access to food and resources. But it is widely accepted that women are the primary managers of household food worldwide. The Rome Declaration on World Food Security and World Food Summit Plan of Action (1996) acknowledges the fundamental contribution of women particularly in rural areas of developing countries to food security. Women arrange food, water, health, and social security (Shiva, 2005, p. 116). They need to balance their reproductive, nurturing, educational and economic roles to ensure health and nutritional well-being of their household and the entire community (FAO & WHO, 1992). According to The Rome Declaration on World Food Security and the World Food Summit Plan of Action (1996), "Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life."

There are four dimensions of food security: food availability, stability of food supply, access to food, and food utilization (FAO, 2008). Food availability is determined by domestic production, import capacity, existence of food stocks and food aid. Stability of food supply is affected by weather, price fluctuations, human-induced disasters and other political and economic factors. Access to food is influenced by the level of poverty, household purchasing power, prices, transport and market infrastructures, and type of food distribution systems. Food utilization depends on care and feeding practices, food safety and quality, access to clean water, health and sanitation (FAO, 2008). The World Declaration and Plan of Action for Nutrition (1992) also expressed similar view stating

that there are three pre-conditions for food security: 1. Safe and nutritionally adequate food supply at national and household level. 2. Consistent stability in food supply. 3. Household's physical and economic access to enough food to meet its need (FAO & WHO, 1992).

Whatever the dimensions are, through its impacts on agriculture, climate change is likely to have negative impacts on food security (FAO, 2016). Availability of food is affected as climate change has an increasingly adverse impact on crop yields, fish stocks and animal health and productivity, especially in sub-Saharan Africa and South Asia, where most of the poor and food insecure live today. Stability of food supply is likely to be affected by changes in seasonality and intensified and frequent climate-induced natural disasters. Instable food supply will increase food prices that will severely affect urban and rural poor people because they spend maximum shares of their income on food. Climate change restricts access to food through negative impacts on rural incomes and livelihoods.

Food utilization is directly connected with human nutrition and changes in food utilization due to climate change are likely to impact the nutritional status of the poor and vulnerable. As pathogens develop because of higher temperatures, water quality and hygiene habits are affected by water scarcity, it is predicted that the burden of diarrhea will be increased up to 10 percent by 2030 in some regions because of climate change (FAO, 2016). From the above discussion, it can be said that along with climate change, poor household's physical and economic circumstances in which individual lives and other informal settlement patterns that happen due to forced migration as people get displaced from climate variabilities have significant negative implications on household members' especially women's nutritional status.

Although Bangladesh, a South Asian poor developing country which is primarily based on agriculture, it has little contribution to the global warming process, but still it is one of the most vulnerable countries to climate change impacts because of its geographical location and fragile socio-economic status. Bangladesh is the largest delta in the world, located in the northeastern part of South Asia which covers an area of 147,570 square kilometers. Bangladesh shares most of its border with India, except for a tiny southeastern part with Myanmar and a southern coastline on the Bay of Bengal. It is located between latitudes 20° 34' and 26° 38'north and longitudes 88° 01' and 92° 41' east, and it has a tropical climate (NIPORT et al. 2016). Seasonal monsoons are the dominating features of Bangladesh climate. It has a hot summer season with high humidity sustains from March to June; a cooler, but still hot and humid monsoon season from July through early October; and a cool, dry winter from November to the end of February (NIPORT et al. 2016). The land of Bangladesh is highly fertile but at the same time subject to frequent natural calamities, such as floods, cyclones, tidal bores and drought.

Since 2007, Bangladesh has topped the IPCC's risk index for climate change as it is low-lying, located on the Bay of Bengal in the delta of the Ganges, Brahmaputra and Meghna. Dominance of floodplains, low elevation from the sea, high population density, high levels of poverty and overwhelming dependence on natural resources also make Bangladesh most vulnerable which directly affects the lives and livelihoods of 36 million people in the southern coastal regions (Rahman, 2008). At current rate of CO_2 concentrations, Myers et al. (2014) found that the edible portions of many of the key crops for human nutrition have decreased nutritional value. Analysis of the United Nations' Food and Agriculture Organization food balance sheets reveals that in 2010 roughly 2.3 billion

people were living in countries whose populations received at least 60% of their dietary zinc and/or iron from C_3 grains and legumes and these are 72% and 88% respectively for Bangladesh population (Myers et al. 2014) (see table 1). That means even if an individual takes sufficient calories, this will not guarantee adequate intake of important micronutrients – vitamins, minerals and trace elements. This micronutrient deficiencies – often called hidden hunger- negatively affect far greater proportion of humanity than insufficient calorie intake (Thompson et al. 2012, p. 25).

Table 1: Countries whose population receive at least 60% of dietary iron and/zinc from C_3 grains and legumes.

Country	% Iron from C_3 grains & legumes	% Zinc from C_3 grains & legumes	Population (in thousands
Afghanistan	78%	78%	31,412
Algeria	76%	79%	35,468
Iraq	74%	83%	31,672
Bangladesh	72%	88%	148,692
Iran, Islamic Rep of	72%	77%	73,974
Pakistan	70%	72%	173,593
Tunisia	70%	77%	10,481
Jordan	69%	73%	6,187
Morocco	69%	78%	31,951
Syrian Arab Republic	67%	71%	20,411
Libya	67%	71%	6,355
Yemen	66%	75%	24,053
Myanmar	65%	81%	47,963
Tajikistan	62%	56%	6,879
India	59%	71%	1,224,614
Egypt	54%	65%	81,121
Indonesia	52%	65%	239,871
Sierra Leone	51%	70%	5,868
Cambodia	49%	68%	14,138
Sri Lanka	46%	69%	20,860
Laos	44%	66%	6,201
Viet Nam	43%	61%	87,848
Total			2,329,612

Source: United Nations' Food and Agriculture Organization Food Balance Sheet, 2010 adapted from Myers et al. 2014.

Globally one in four people has an iron deficient diet and children in preschool age and women are the most affected segments of population (Thompson, 2011). Half of the global prevalence of anemia is the result of iron deficiency and anemia is likely to affect work performance (Thompson et al. 2012, p. 25). At least 500 million women worldwide

are affected by anemia (UNSCN, 2010). 56% of pregnant women in developing countries suffer from anemia and for South and Southeast Asia, this rate is over three-quarters (Thompson et al. 2012, p. 25). Anemic mothers are more likely to give birth of pre-matured babies, or to deliver babies with low birthweights and to have babies who die as newborn babies (Thompson et al, 2012, p. 26). Because of iron deficiency in those who have anemia, 115,000 women die in childbirth each year which comprises 20% of global maternal mortality (Black et al. 2008). 63% of preschool children in South and Southeast Asia are affected by anemia and it is 39% for all developing countries (HarvestPlus, 2007). Anemic children suffer from impaired health and development, limited learning capacity and weak immune systems (Thompson et al, 2012, p. 26). Inadequate dietary zinc is the prime cause of stunting and susceptibility to infections. More than 60% of the developing world is likely to be at risk of low zinc intake, 70% in Southeast Asia and 90% in South Asia (de Benoist et al. 2007).

Despite experiencing some considerable socio-economic progress, the above statistics show that the South Asian people - especially women and children - are still suffering from extreme malnutrition. Ramalingaswami et al. (1996), through their 'The Asian Enigma' theory, explain this paradox. The Asian Enigma theory states that although the South Asian countries are in better position in terms of most of the indicators of human well-being i.e. access to safe water, school enrolment, food availability per person, income per person, degree of democratic governance as compared to other developing countries, they are surprisingly in backward position in terms of children nutritional status than the developing countries even more than Sub-Saharan Africa. Although their theory is built on the basis of children nutritional status, they concluded that it is women's malnutrition in

South Asian countries for which children of the region are more malnourished than Sub-Saharan Africa. They found the following factors which have a strong connection with women's malnutrition and their socio-economic status: low birth weight, feeding practices, diseases, breastfeeding, timing of other food, and child care. Low birth weight predicts nutritional status most significantly. Birth weight less than 2,500 grams has a strong connection with poor growth not just in infancy but throughout childhood (Ramalingaswami et al. 1996). They found that one third of all babies in India are born with low birth weight while it is one half in Bangladesh. On the other hand, the proportion is one sixth in sub-Saharan Africa. Low birth weight reflects the fact that the infant suffers from malnourishment in the womb and/or that the mother was suffering malnourishment during her own infancy, childhood, adolescence, and pregnancy (Ramalingaswami et al. 1996). Low birth weight rates therefore indicate women's status in the society particularly their health and nutrition in their whole life cycle.

Their findings also show that it is not the lack of food availability but weak feeding practices for which South Asia has a high rate of child malnutrition. A sound feeding practice is the indicator of whether the right food is given at the right time and in the right way- and by the frequency, severity, and duration of disease (Ramalingaswami et al. 1996). Frequency of disease depends on safe water and sanitation. Although South Asian households have more access to safe water supply than sub-Saharan Africa, but it stands behind sub-Saharan Africa in terms of sanitation especially in the rural areas where most of the population lives. They also found a strong correlation between income and hygiene. Overcrowded poor are less likely able to maintain personal hygiene (hand-washing, keeping food clean, latrine use, safe refuse disposal, cleanliness of clothes, or the overall

condition of the home). In terms of population density, on average, South Asia has 10 times more people per square kilometer than sub-Saharan Africa (Ramalingaswami et al. 1996).

Breastmilk is considered as the only food for children below six months of age. Breastmilk not only meets all a child's nutritional needs but also offers considerable protection against disease. Almost 50% of all babies in South Asia are exclusively breastfed for the first four months of life – as opposed to only about 25% in sub-Saharan Africa (Ramalingaswami et al. 1996). But conventional wisdom, well supported by research, says that breastfeeding meets all of the child's nutritional needs for the first six months. In Africa, this conventional wisdom holds good, and growth faltering (slow growth rate than expected one) is rare before the age of six months. But for many children in South Asia, growth faltering is common at four months. There are two reasons probably influence growth faltering: babies are not breastfed in the right way, and breastfeeding is inadequate. Timing for other foods is also important for children nutrition. In sub-Saharan Africa, the proportion of breastfed children aged six to nine months receiving complementary foods is almost two thirds. In Bangladesh, India, and Pakistan, it is less than one third (Ramalingaswami et al. 1996). This lack of child care is strongly connected with the lack of mother care because mother is the principal provider of child care. They finally summarize that the women in sub-Saharan Africa, and particularly poor women, have greater opportunities (doing paid job) and freedom (going outside of home) than the woman in South Asia. So, a root cause of children malnutrition in South Asia is gender inequality. Women in South Asia consume less food and have lower quality diets than men, mainly as a result of unequal food distribution within the households (Ahmed et al. 2007).

Bangladesh is the perfect example of The Asian Enigma. Despite some stunning achievements of Millennium Development Goals (reduction of infant and maternal mortality rate, reduction of total fertility rate, control of infectious disease through expanded program on immunization, maintenance of 100% school enrolment, reduction of gender gap in school enrolment, women empowerment through education and employment etc.), malnutrition in Bangladesh still is among the highest in the world and remains a serious public health problem. Approximately 9 million Bangladeshi children between six months and five years of age suffer from under-nutrition, with 41% of children stunted, 36% underweight, and 16% wasted. Anemia – still one of the major micronutrient issues in Bangladesh – is present among 51% of pre-school children and 42% of women which is higher than the World Health Organization (WHO)/Center for Disease Control and Prevention (CDC) threshold level (40%) and is considered a severe public health problem (FAO and WHO, 2014). About half of the Bangladeshi population already suffer iron and zinc deficiencies which cause serious harm, in particular to developing babies and pregnant women (FAO and WHO, 2014). Reductions in the zinc and iron content of the edible portion of these food crops due to climate change will increase the risk of zinc and iron deficiencies across these populations and will add to the already considerable burden of disease associated with them.

Given this situation, it is clear that Bangladeshi women are facing three-dimensional vulnerabilities in terms of their nutritional status: climate change, poor household amenities, and gender discrimination. This three-dimensional barrier towards a healthy population would be a major obstacle for Bangladesh to achieve the proposed Sustainable Development Goals (SDs) by 2030 because almost half of the Bangladeshi

population are women. So, it is crucial to explore whether there is any underlying connection among these three factors. No major work has been done yet to concentrate on this issue. Most of the studies on the impact of climate change, poor household amenities, and gender gap on women's poor health outcomes in Bangladesh have concentrated on the predictor variables separately. Even there are no significant studies which have focused on impact of climate change on women malnutrition in Bangladesh. Studies related to climate change and health outcomes have focused mainly on infectious diseases (Rahman, 2008; Hasib & Chathoth, 2016). Using Bangladesh Demographic and Health Survey (2017) dataset, this study attempts to explore the impact of underlying connection between climate change and household characteristics on women's body mass index (BMI). The study does not focus on gender inequality as the dataset have only women and children nutritional information.

CHAPTER II

LITERATURE REVIEW

Climate Change, Undernutrition, and Bangladesh

Although both WHO and IPCC identified malnutrition as one of the five major negative health consequences of climate change, there is a lack of systematic evidence to quantify the impacts. After a systematic review of 15 scientific and peer reviewed articles, Phalkey et al. (2015) found that 80% of them show a significant but variable link between weather variables, e.g., rainfall, extreme weather events (floods/droughts), seasonality, and temperature, and childhood stunting at the subsistence farming household level of low and middle-income countries. In addition, agricultural, socio-economic, and demographic factors at the household and individual levels also have significant roles in mediating the nutritional impacts.

Monsson has been playing a significant role in South Asian agriculture-based economy as well as food production. Monsson and tropical cyclones influenced by climate change in South Asia are the two contributing factors for floods and Douglas (2009) found a strong correlation between flood and food insecurity in Bangladesh. Rice is the mostly affected crop by floods and droughts which contributes 93.96% of the total cereal production in Bangladesh, followed by wheat (5.8%) and other crops (0.23%) (Karim et al. 1996). As a coping strategy, most family members reduce their food intake during floods. Many women after the 1998 floods admitted that they reduced their consumption of rice from twice a day to once a day or even less frequently (Rashid, 2000). As a result of less access to food, vulnerable populations, who spend major portion of their income on food, rationed consumption to prefer calorie-rich but nutritionally poor foods. Hidden

hunger is the ultimate result of this unsustainable coping mechanism and its negative impacts remain during the whole life cycle of the victims (Bloem et al. 2010). Analyzing data on household expenditure on rice and non-rice foods in Bangladesh, Campbell et al. (2010) found that households that spent more on non-rice foods and less on rice had a lower prevalence of maternal and child malnutrition and vice versa. Sari et al. (2010) also found similar findings in Indonesia.

Climate Change and Migration

Although migration is considered as one of the coping strategies to global climate change, it is still a matter of debate whether climate change has any impact on human migration. This is because migration process is not solely determined by a single factor. A large variety of social factors i.e. culture, gender, income, migration networks and population structure play a significant role in this process (Bradatan, 2013). Black et al. (2011) identified five drivers of migration: social, political, economic, environmental and demographic. According to Islam and Shamsuddoha (2017), environmental driver (climate change) influences the economic driver by affecting employment opportunities, income, wages and well-being. For them, both sudden and slow onset climate-related hazards combined with rapid urbanization, population growth and pre-existing social vulnerabilities and poverty are likely to increase displacement and migration. Short-term migration follows sudden climatic events while routine economic migration follows slow onset disasters. Similarly, Martin (2009) proposed four possible pathways through which climate change affects human migration: 1. Intensification of natural disasters; 2. Increased warming and drought that affects agricultural production and access to clean water; 3. Sea level rise, which makes coastal areas and some islands states increasingly uninhabitable;

4. Competition over natural resources, which leads to conflict and displacement of inhabitants. The climate-induced migrants often live in degraded environmentally locations characterized by poor sanitation, safe water scarcity, food shortage and lack of livelihoods (Islam and Shamsuddoha, 2017).

On the other hand, Gray and Mueller (2012) suggests that natural disasters can reduce migration as they remove necessary resources or increase labor demands in the origin area. Massey et al. (1993) also found negative relationship between climate change and migration as significant moving and start-up costs, the need to access to social networks in destination area, the loss of origin-area resources (land), and uncertainty on economic success often prohibit people to migrate. Despite the above debate, the recent climate change scenario indicates that Bangladesh is struggling with mass external and internal migration specifically from rural and coastal regions.

Morton et al. (2008) identified three different ways through which climate change-induced hydro-meteorological events affect displacement in Bangladesh: First, warming temperature reduces agricultural production and disturbs ecosystem services such as the availability of clean water and fertile soil. Second, increasing precipitation promotes flash or river floods in tropical regions. Third, sea-level rise destroys extensive and highly productive low-lying coastal areas that are the sources of livelihoods for millions of people who have to relocate permanently. The disaster (floods) induced migration in Bangladesh are often temporary, of short-distance, and of smaller magnitude. This supports the IPCC's (2014) idea that the spatial-dimension of climate induced migration is often internal to nations. Long distance migration only takes place due to crop failure (Gray and Mueller, 2012). Adjacent river islands or embankments are the suitable destination for short to

medium-term migration and it happens when basic services are no longer available in the origin place (Paul and Islam, 2015) while urban slums or other urban poverty pockets are the common destinations for long-term and long-distance migration which lack basic human services (UN Habitat, 2015). The rich and educated people follow a planned migration while the poor rely on natural ecosystem services and experience insecurity when moving to a new place where they have no social networks or suitable livelihood opportunities. The poorest of the poor, particularly women, children, elderly and disabled people are less able to migrate. For example, water salinity in coastal region in Bangladesh leads to migration not only for economic purposes, but also for social reasons. Coastal people are suffering from several health consequences (hypertension and miscarriage among pregnant women, skin diseases, acute respiratory infection and diarrheal diseases) related to water salinity through drinking, cooking, and bathing. These health problems are constraint for young women to get married. These women are also socially marginalized because of their lower social status. This situation encourages the family to migrate to a distant place where they are not known so that the daughter can get married (Islam and Shamsuddoha, 2017).

Flood and Health (Diarrhea)

Flood is the most common natural disaster and its frequency and intensity is likely to increase due to climate change. During the last 30 years, more than 2.80 billion people were affected and more than 200,000 were killed worldwide by flood (Center for Research on the Epidemiology of Disasters, 2011). Floods affect water sources and supply systems, sewerage and waste-disposal systems which promotes enteric pathogen transmission (Parker and Thompson, 2000). Diarrheal diseases (especially among children in low-

income countries) and acute respiratory infection in children (particularly less than 5 years of age) are the major two health outcomes of flood. Diarrheal diseases are the leading causes of morbidity and mortality among children in low-income countries (Kosek, Bern, & Guerrant, 2003). while acute respiratory infections in children is the major cause of illness and death among displaced people due to natural disasters (Watson, Gayer, & Connolly, 2007). However, the impact of floods on diarrheal diseases varies according to the times and places. For example, Bangladesh has completely different experience during the 1998 flood and 2004 flood respectively. On one hand, examining the 1998 flood situation in Dhaka (capital city of Bangladesh), Hashizume et al. (2008) found that both cholera and non-cholera diarrheal cases are likely to have been higher at the beginning of the flood and peaked during the middle of the flood period. During floods, people who use tape water are more susceptible to cholera induced diarrhea than those who use tube wells. Low educated people are more susceptible to non-cholera diarrhea than those who have higher education level. In the post-flood period, people with lower education and household with a non-concrete roof are more prone to non-cholera diarrhea than their counterparts. In contrast, this is not the case for cholera. During this period, people who use tube wells and unsanitary toilets are significantly susceptible to both cholera and non-cholera diarrhea. For non-cholera diarrhea, the rate is also higher among those who collect water from distant sources. Hashizume et al. (2008) found that there are no major differences between men and women in terms of susceptibility to diarrheal diseases in either the flood or post-flood period, but Rashid (2000) argued that during flooding, women in Bangladesh are likely to have less exposure to hygiene and sanitation facilities due to socio-cultural norms.

On the other hand, Milojevice et al. (2012) did not find any substantial evidence of flood-related increases in mortality or diarrhea (cholera, non-cholera, and rotavirus infections) either during the 2004 flood period itself or afterwards in Matlab (a sub district in Bangladesh).

One reason behind the difference in findings of the two studies would be that the former study is based on an analysis of diarrheal cases from a region where individuals are not usually exposed to flood, and it does not consider the seasonal differences in terms of effects of flood between who are exposed to flood and who are not. Geographical settings would be another reason (particularly regarding urban or rural locations). It is assumed that people living in crowded areas (urban) are more affected by problems related to water sources, sewerage, and waste disposal systems (Milojevice et al. 2012).

Local environment, disaster management and adaptation strategies have significant influences on the prevalence of diarrheal diseases in post-flood period. Regions that are exposed to flood and have well-prepared health systems to treat infectious disease outbreaks can easily return back to baseline levels of disease than the regions not exposed to flood and health systems not adequately prepared (Milojevice et at. 2012). Malnutrition among the flood-affected population may also lead to post-flood diarrheal disease exposure (Hashizume et al. 2008). Chronic diarrhea may become secondary to other infection for the acute malnourished people (Thapar & Sanderson, 2004). Del Ninno and Lundber (2005) found chronic malnutrition among flooded households' children as compared to non-flooded households in Bangladesh after the 1998 flood.

Determinants of Mother and Children Undernutrition in Bangladesh

Undernutrition is the outcome of the complex interplay of social, economic, and political determinants coming from the substantial inequalities between population subgroups (Black et. al. 2013). Maternal and children undernutrition are mutually interdependent. Mother's undernutrition influences children's nutrition negatively. On the other hand, undernourished girls are the future undernourished mothers. So, analysis of the dynamics of child undernutrition also gives insights for the analysis of mother undernutrition. Rabbani, Khan, Yusuf, & Adams (2016) found a massive reduction of under five children stunting in Bangladesh from 1996/97 to 2014, but the reduction was relatively greater among the richest quintile compared to the poorest. These differences were increased in the course of time. They identified household wealth index (ownership of televisions and bicycles, materials used for housing construction, and types of water access and sanitation facilities) and maternal factors (years of schooling, chronic energy deficiency, short stature, antenatal doctor visits, birth at a health facility, and early breastfeeding), birth order, age and squared age of the child as well as paternal schooling as the responsible factors for socioeconomic inequities of under five children stunting. Other studies also found quite similar determining factors of child malnutrition: economic development (Headey, 2012); household wealth inequality, social deprivation, multiple birth (Ahmed, 2013); rural-urban disparities, gender, household income, mother's education, women empowerment, knowledge (Islam and Biswas, 2015); individual, household, and community level factors (Chowdhury et al. 2016). There are also opposite narratives. Vollmer et al. (2014) challenges the assumption that economic growth will automatically lead to reductions in child undernutrition. Islam et al. (2013) indicates that

the relationship between economic disparity and malnutrition at the national level is not straightforward, because better economy at the national level does not necessarily mean better health care for all. For them, macroeconomic growth in the form of per-head GDP has no association with children undernutrition. Subramanyam et al. (2011) also reported that there is no consistent evidence that economic growth is associated with a reduction in childhood malnutrition.

Geography has been received significant importance in literature relating to nutritional determinants, as regions with poor nutrition tend to pull down the overall nutritional status of the country. Consequently, reducing the regional gap can alone reduce overall undernutrition significantly, especially when regional gaps are high (Mohsena, Goto, & Nicholas Mascie-Taylor, 2015). The administration of Bangladesh is currently divided into eight major divisions. As each division has different characteristics in terms of geography, economy and social structure, it tends to offer different opportunity structures for people living there (Mohsena et al., 2015). Opportunity structure, in social science, refers to the societal structure that provides opportunities such as quality education, transportation, community well-being, and income generation for its people to live a successful life (Merton, 1995). Biswakarma (2011) found interregional inequality in undernutrition as one of the outcomes of such differential opportunity structures.

Cooking Fuels and Respiratory Diseases

One of the most common causes of morbidity and mortality in preschool children worldwide is respiratory disease (Lancet, 1985). Developing countries are more exposed to respiratory diseases than their counterparts. In India, respiratory diseases are responsible for 23% of the deaths in preschool children (Collings, 1990) and 30% of all childhood

deaths (Honicky, 1985), and associated with chronic respiratory disease in adults (Awasthi et al. 1996). Women and children in developing countries are exposed to respiratory diseases due to air pollution caused by smoky fuels (Clearly and Blackburn, 1986). Use of biomass fuels for cooking is the primary source of domestic smoke in developing countries. 30% of urban and 90% of rural households use biomass fuels for cooking (Berman, 1991). Biomass fuels emit high levels of suspended particulate matter (Smith, 1993). Ellegard (1996) found high particulate matter emission for wood, coal, and kerosene, intermediate for charcoal, and low for electricity and LPG gas in Maputo, Mozambique. But in India, it is animal dung cake that produces the highest level of indoor air pollution, followed by wood and charcoal (Smith, 1993). Along with smoky fuels, household features are also responsible for respiratory problems. For Mozambique, having a well-ventilated kitchen is associated with less cough symptoms while using a pit latrine and finding fuel expensive is associated with more (Ellegard, 1996) while in India, use of dung cakes and overcrowding defined as the number of people sharing a bedroom is associated with respiratory diseases. Nutrition plays a significant role in fighting against respiratory diseases. From the above analysis, it is expected that wood or animal dung cake users are exposed to more indoor air pollution as well as more respiratory problems. But Ellegard (1996) found a surprising result: the longer a woman cooks, the less she suffers. One possible reason might be that those who cook longer should have more food as well as better nutritional status that would offset some of the effects of indoor air pollution.

CHAPTER III

THEORETICAL FRAMEWORK

Sociology of Nutrition

Sociological analysis of nutrition derives from the sociological analysis of food. Because people eat food, not nutrients (McIntosh, 1996, p. 4). Although nutrition is purely a biological notion, food production and consumption are purely social. Sociological perspective of food concentrates on social appetite – the social patterns of food consumption (Germov & Williams, 1999, p. 2). Social appetite focuses on the link between social organization and individual behavior in exploring the nature of food production and consumption. Social appetite argues that food habits are not universal and people's food choice is heavily determined by their sociocultural contexts. This is social appetite for which cow is sacred in India, alcohol and pork is profane to Muslims, kosher eating is important to Jewish community, animals such as dogs, horses, and kangaroos are part of menus in some regions while they are considered as pets in another, some cultures have gender division of food production and consumption.

Sociological analysis of food and nutrition as a subdiscipline of sociology has been originated as the overlap with medical sociology. However, it encompasses some topics that were overlooked in medical sociology. Straus (as cited in McIntosh, 1996, p. 10) divided medical sociology into two parts: sociology in medicine and sociology of medicine. The sociology in medicine (also refers to the sociology of health) refers social epidemiology - the social causes of health (McIntosh, 1996, p. 10). It tries to involve the sociological tools (theories, concepts, and research methods) in explaining how social groups and their attributes influence morbidity and mortality. Every social status has its

own opportunities and limitations. For example, people with higher education have access to occupation with higher payment and less stress than their counterparts. This privilege allows them to have quality food items and better medical treatment. The sociology in nutrition is a part of sociology in medicine that focuses on the social epidemiology of inadequate diets, lower BMI, stunted growth, obesity, and poor nutritional health as the result of many of the status differences: class, gender, and ethnicity (Harris as cited in McIntosh, 1996, p. 11). For example, women, minorities, and the poor are more likely to suffer obesity than their counterparts (Sobal and Stunkard as cited in McIntosh, 1996, p. 11). Social relationships whether formal (doctor-patient) or informal (spousal) resulting from real (e.g., person becomes ill) or anticipated changes (e.g., a person is exposed to a virus) in health status are also focus of interests of the sociology in medicine. For sociology in nutrition, we can imagine these relationships between dietitians and their patients, dietitians and physicians, dietitians and the food industry in general, and dietitians with the public. On the other hand, the sociology of medicine examines social relations within both formal and informal health care settings. The sociology of nutrition as part of the sociology of medicine thus focuses on the formal and informal relations within dietetics and nutrition fields (McIntosh, 1996, p. 12). For example, the status and research priorities of dietitians and nutritionists are influenced by their working location; the role expectations, professional autonomy, and role strain are varied among dietitians who work in different settings e.g., hospital, group practice, and independent practice; the research priorities of a nutritionists working in a college of home economics are likely to vary from who works in college of agriculture, particularly in department of animal science.

Table 2: The Sociology *of* Health and *in* Health contrasted with the Sociology *of* Food and Nutrition and *in* Food and Nutrition

Sociology *in* health	Sociology *in* nutrition
A. Ecology and etiology of disease	A. Ecology and etiology of under-and-over-nutrition, hunger.
B. Variations in attitudes and behavior regarding health and illness. 1. Sociological continuities (e.g., social class differences). 2. Reorientation of sociological concerns: deviance, stigma.	B. Variations in attitudes and behaviors regarding hunger, eating habits, nutritional status. 1. Sociological continuities (e.g., social class differences). 2. Reorientation of sociological concerns: deviance (certain forms of vegetarianism, stigma associated with obesity).
Sociology *of* health	Sociology *of* nutrition
A. Recruitment and training of physicians.	A. Recruitment and training of dietitians.
B. Relations of physicians to others in the role set.	B. Relations of consumers (or dietitians) to others in the role set.
C. Effect of the changing political economy on distribution of health care.	C. Effects of changing political economy on access to food and nutritional services.

Source: Wolinsky (1980) adapted from McIntosh (1996, p. 14).

Pierre Bourdieu and His Concept of 'Distinction'

A sociological explanation of food habits examines the role played by the underlying social environment in which food is produced and consumed (Germov and Willliams, 1999, p. 2). Pierre Bourdieu (2014) used this social environment in the analysis of the distinctive distribution of food and nutrition among the social members. According to him, the position in the social environment is determined by position of two classes: those who are best provided with both economic and cultural capital (dominant class) and those who are most deprived in both respects (working class). Bourdieu (2014) used occupation as a key marker of class position but argued that the construction and maintenance of occupational status depend on both economic and cultural capital. There is a sharp distinction in the attainment of economic and cultural capital. While economic capital is predominantly ascribed, cultural one is achieved.

This distinction exists through the relationship between two capacities: 1) habitus – the capacity to produce classifiable practices and works; 2) taste – the capacity to differentiate and appreciate these practices and products that the represented social world is constituted. It is habitus that makes the relationship between the pertinent characteristics of economic and social condition and the distinctive features associated with the corresponding position in the universe of life-styles. Thus, each class condition is defined by its intrinsic properties and by the relational properties which it derives from its position in the system of class conditions. The habitus is necessity internalized and converted into a disposition that generates meaningful practices and meaning-giving perceptions of the necessity inherent in the learning conditions. So, the most fundamental oppositions in the structure (high/low, rich/poor etc.) tend to establish themselves as the fundamental

structuring principles of practices and the perception of practices. On the other hand, taste is a system of classificatory schemes that is the basis of mutual adjustment of all the features associated with a person. Taste is thus the source of the system of distinctive features which cannot fail to be perceived as a systematic expression of a particular class of conditions of existence, i.e., as distinctive life style by anyone who possesses practical knowledge of the relationships between distinctive signs and position.

If we want to know how habitus and taste are interlinked, we can concentrate on the expenditure that people spend for food. For Bourdieu, as one rises in the social hierarchy (teachers, clerk as compared to manual workers), the proportion spent on heavy, fatty, fattening foods, which are also cheap – pasta, potatoes, beans, bacon, pork – declines, whereas an increasing proportion is spent on leaner, lighter (more digestible), non-fattening foods (beef, veal, mutton, lamb, and especially fresh fruits and vegetables). These changes in the structure of spending on food are accompanied by increasing spending on health and beauty care and clothing, and a slight increase in spending on cultural and leisure activities. So, we can categorize taste (in food, clothes etc.) into two groups: 1) taste of luxury (or freedom)- leaner foods with cultural activities, formal dress in the domestic world; 2) taste of necessity – heavy, fatty, and fattening foods, functional and long-lasting clothes. We can find this similar distinction in capitalistic (taste of luxury for bourgeoisie vs taste of necessity for proletariat) and patriarchal (taste of luxury for men vs taste of necessity for women) societies.

Amartya Sen and The Entitlement Approach

"Starvation is the characteristic of some people not *having* enough food to eat. It is not the characteristics of there *being* not enough food to eat. While the latter can be a

cause of the former, it is but one of many *possible* causes" (Sen, 1981, p. 1). In order to understand poverty in general and mass starvation or famine specifically, Sen's (1981) Entitlement Approach is prominent. Sen's entitlement approach is a criticism of Malthusian notion of Food Availability Decline (FAD) that sees famine is a natural disaster resulting from shortage of food as population exceeds food production. Sen argues that famine is not caused by shortage of food or a failure of food availability rather it is a breakdown in food entitlement. He moved the focus from food supply to food distribution and the social, political, and legal system through which this distribution is organized. According to Sen (1981), "A person starves *either* because he does not have the ability to command enough food, *or* because he does not use this ability to avoid starvation" (p. 45). For Sen, food ownership is a legitimate primitive right and an individual must have entitlement to commodity bundle including enough food in order to avoid starvation. Thus, starvation is a function of entitlements and not a food availability (Sen, 1981, p. 7). An individual starves if exchange entitlement fails to arrange enough food. Exchange entitlement is influenced by the following factors:

1. Employment (duration and wage);
2. Non-labor assets and their market value;
3. Own labor power, purchasing power and managerial capacity.
4. Price of the purchasing resources and selling products;

In a private ownership economy, this entitlement depends on two parameters: 1. the endowment of the person (the ownership bundle), and 2. the exchange entitlement mapping (the set of alternative commodity bundle on which an individual has command). In this regard, the nature of modes of production and economic class structure and their

interrelations should be taken into consideration. For Sen (1981), ownership relations conform entitlement relations which connects one set of ownerships with each other in a legitimate way. In a market economy, exchange is an individual choice. One can exchange what s/he owns with another collection of commodities either through trading or production or through a combination of the two. This is called exchange entitlement. The relation that specifies the set of exchange entitlements for each ownership bundle is called 'exchange entitlement mapping' that depends on the legal, political, economic and social circumstances and the person's position in them. This entitlement relation is a recursive one in which the process of connection repeats. In a private ownership market economy, fundamentally there are four types of entitlement relations which vary according to the economic systems:

1. Trade-based entitlement: One's entitlement is established through a trade with willing parties.
2. Production-based entitlement: One's entitlement is established through production using either own's resources or resources hired from willing parties.
3. Own-labor entitlement: One's entitlement is established through one's own labor power. Trade-based and production-based entitlements are related to one's labor power.
4. Inheritance and transfer entitlement: One's entitlement is established through what is willingly given to one by a legitimate owner, usually owned after the owner's death.
5. Social security and taxes.

Sen (1981) presented an illustration of his entitlement approach through the diagram presented below. There are only two commodities that are produced and exchanged: food and non-food. OA represents minimum food requirements for an

individual to survive. If an individual has food endowment equal to OA or more (DAE region), then s/he is able to avoid starvation. The vertical axis represents the non-food endowments (cash income and savings, consumer durables, livestock etc.) that illustrate exchange entitlement. The total price of both food and non-food endowments determine the amount of food that can be exchanged through trade. The price ratio p indicates that the 'starvation set' of an individual is OAB and AB is the combination of all food and non-food endowments which combinedly fulfil the minimum food requirement. An individual who belongs to the food secure position of x in the diagram can be 'plunged into starvation' in two ways: 1. 'if his endowment collapses into the starvation set' (a move from x to x* perhaps because of drought or animal disease), 2. 'through an unfavorable shift in the exchange entitlement mapping' (an increase of price ratio p to price ratio p* because of price hike). The 'starvation set' moves from OAB to OAC and the individual suffers from starvation.

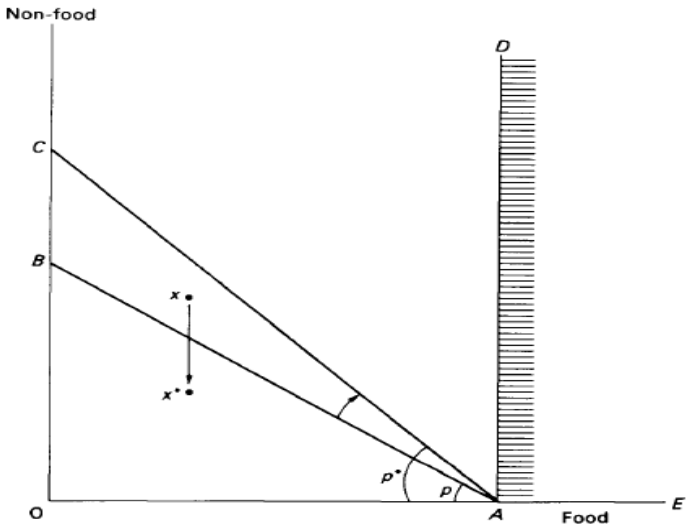

Figure 3: Illustration of endowment and entitlement.
Source: Amartya Sen, 1981, p. 48

CHAPTER IV

METHODOLOGY

Bangladesh Demographic and Health Survey

The current study attempts to examine the impact of underlying connection between climatic variabilities and household amenities on the nutritional status of women in Bangladesh. For this, Bangladesh Demographic and Health Survey (BDHS) data set of 2007 is used which is a nationally representative sample survey designed to collect information on basic national indicators of social advancements including fertility, childhood mortality, family planning, HIV/AIDS awareness, domestic violence and maternal and child health with special focus on anthropometric measurements of nutritional status (body mass index (BMI) for women; stunting, wasting, and underweight for children). This survey is periodically conducted every three to four years. BDHS (2007) is the fifth of this kind of survey in Bangladesh and is part of the worldwide Demographic and Health Surveys program conducted under the authority of the National Institute for Population Research and Training (NIPORT), Ministry of Health and Family Welfare. It is implemented by Mitra and Associates, a Bangladesh private research firm with the financial and technical assistance from Macro International Inc. through United States Agency for International Development (USAID), Bangladesh. Although there are two more rounds of BDHS after 2007, but this current study is the only one that contains migration information of the respondents. Migration is one of the significant predictor variables of women's nutrition status in this study.

The BDHS (2007) is based on a nationally representative sample that covers the entire population living in private households in Bangladesh. The sampling frame used in

this survey comes from the list of census enumeration areas (EAs) with population and household information from 2001 national population census. Currently, Bangladesh is divided into eight administrative divisions: Dhaka, Chittagong, Rajshahi, Khulna, Barisal, Sylhet, Rangpur, and Mymensingh. But in 2007, there were six administrative divisions that exclude the last two. Each division is composed of several *zilas* (districts), and each zila is composed of several *upzilas* (subdistricts). Upzilas located in rural areas are composed of several *union parishads* (Ups), and Ups are further composed of *mouzas*. Upzilas located in urban areas are composed of wards, and wards are further composed of *mahallas.* These compositions permit the country as a whole to be divided into rural and urban areas. The Primary Sampling Units (PSUs) for the survey are the enumeration areas (EAs) of the census. This is because they could be easily located with exact geographical areas and sketch maps are available for each EA. On an average, each EA consists of 100 households that is equivalent to a rural *mouza* and to an urban *mahalla*.

A two-stage stratified sampling procedure was adopted to conduct the survey. 361 PSUs were selected at the first stage of sampling. The PSUs were selected independently for each stratum and with probability proportional to PSU size, in terms of number of households. The sample distribution was not proportional over different parts of the country, because Barisal and Sylhet were the two smallest divisions. The samples of these two divisions were too small for statistical precision. Since most of the people of Bangladesh live in rural areas, urban areas were also needed to be over-sampled to achieve statistical precision as compared to rural areas. Therefore, the country was needed to be divided into strata, with varied probabilities of selection calculated for the various strata. The achievement of sample stratification was confirmed by separating the sample into

divisions, and within divisions, into urban and rural areas. There were three strata in each urban area: statistical metropolitan areas (SMAs), municipality areas, and other urban areas. In total, there were 22 strata where Barisal and Sylhet had no SMAs.

There were 227 rural PSUs and 134 urban PSUs in the first stage of sampling. From January to March 2007, a household listing operation was conducted in all selected PSUs. A sampling frame was formed on the basis of the household listing through which the households were selected in the second stage sampling. Based on equal probability systematic sampling technique, 30 households, on average, were selected from each PSUs. 10,819 households were selected for the sample. Some of the PSUs were large with more than 300 households. Large PSUs were segmented and only one segment was selected for the survey, with probability proportional to size of the portion. Before finalizing the selection, households in the selected segments were then listed. So, we can say that a 2007 BDHS sample cluster refers either an EA or a segment of an EA.

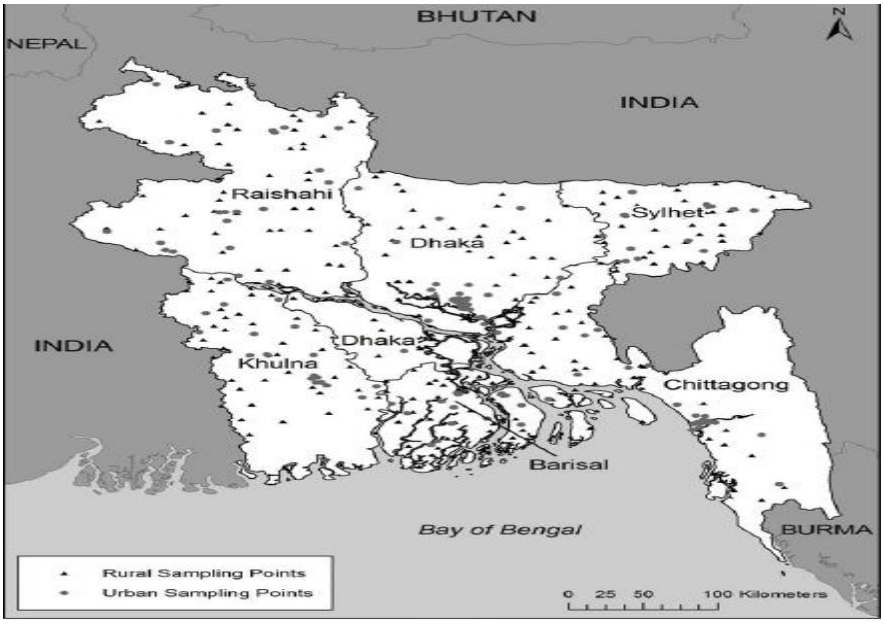

Figure 4: Map of 2007 Bangladesh urban and rural sampling points.
Source: NIPORT et al. (2009).

Out of 10,819 households selected for the survey, 10,461 were found to be occupied. Interviews were successfully completed in 10,400 households, or 99.4% of households. The number of eligible women age 10-49 was 11,233, of whom 11,051 were interviewed for a response rate of 98.4%. However, there were very few ever-married women aged 10-14 (55 unweighted cases or less than 1%). These women have been removed from the data set and weights recalculated for the 15-49 age group. Finally, a total of 11,178 eligible women aged 15-49 were identified in these households and 10,996 were interviewed, for a response rate of 98.4%. But I think this data is misleading for my research objectives. I want to show whether the combination of climate variabilities and household characteristics has any significant influence on women's BMI. That's why I need to make a comparison between undernourished (BMI of <18.5) women and well-nourished (although the range for standard BMI is from 18.5 to 24.9, I still consider BMI of ≤ 29 as standard) women. However, this data set has not adjusted BMI for pregnant women and obese women who are supposed to be over-nourished. Inclusion of pregnant and obese women is likely to play the role of outliers in the data set. To avoid this discrepancy, I excluded pregnant and obese women from my analysis. For both normal and pregnant women, having BMI more than 29 is considered obese. Out of 10,996 women, the number of women who are obese is 489 and who are pregnant is 718. So, the final number of respondents in my analysis is 9789 {10996 – (489+718)}.

My analysis aims to examine how the underlying connection of climatic variabilities and household amenities is influencing women's BMI. This survey includes respondents' demographic variables (current age, religion, current marital status, educational level, migration status, geographical location, residence), wealth index, and

Table 3: Results of the household and individual interviews with adjusted number of women for analysis.

Result	Residence				Total	
	Urban		Rural			
	Number	Percent	Number	Percent	Number	Percent
Households selected	3,993	100.0	6,825	100.0	10,819	100.0
Households occupied	3,849	96.4	6,612	96.9	10,461	96.7
Households absent for extended period	78	2.0	121	1.8	199	1.8
Dwelling vacant or destroyed	59	1.5	73	1.1	132	1.2
Other	7	0.2	20	0.3	27	0.2
Household Interviews						
Households occupied	3,849	96.4	6,612	96.9	10,461	96.7
Households interviewed	3,821	95.7	6,579	96.4	10,400	96.1
Households response rate		99.3		99.5		99.4
Interviews with women age 15-49						
Number of eligible women	4,230	100.0	6,948	100.0	11,178	100.0
Number of eligible women interviewed	4,151	98.1	6,845	98.5	10,996	98.4
Eligible women response rate		98.1		98.5		98.4
Adjusted number of women for analysis (excluding women who are pregnant and who have BMI more than 29.00)	3597	100.0	6192	100.0	9,789	100.0

Source: NIPORT et al. (2009).

household amenities (floor materials, source of drinking water, types of toilet, usage of toilet, cooking fuel). This survey also includes GPS household data which helps me to connect climate information to the dataset. The benefits of GPS data are substantial. For example, GPS data recorded at each sample cluster can be linked to all of the household and individual level attributes contained in the full DHS dataset (ICF International, 2013). Data were analyzed by using SPSS software (IBM SPSS Statistics 24).

At first, I run multiple linear regression models by using individual level variables and household amenities to predict women's BMI. In the second step, I run hierarchical linear modeling (HLM) by using GPS data to link women's BMI outcomes to individual level variables, household amenities, and climate variabilities (rainfall, aridity, temperature, drought episodes) from the gridded climate data where the respondents' households are located. There were some missing cases in the temperature variable and I replaced these missing cases with the average or mean temperature. Hierarchical Linear Modeling (HLM) is a complex form of ordinary least squares (OLS) regression that is used to analyze variance in the outcome variables when the predictor variables are at varying hierarchical levels (Woltman et al. 2012). Researchers use hierarchical linear modeling when nested data is required. Nested data is possible when groups of units are clustered together in an organized fashion. For example, a rural woman respondent in BDHS are nested within households within *mouza* within union parishad (UP) within *upzila* (subdistrict) within *zila* (district) and finally within division.

Two correlation matrixes were constructed in order to test for multicollinearity among the independent variables. If two or more predictors in a regression model are strongly correlated, we can say that there is a multicollinearity. Multicollinearity is a

problem for multiple regression as it requires two or more predictors. So, what is the measurement of strong correlation? According to Field (2005), if the correlation value is <.80, we can consider it free from multicollinearity. First correlation matrix was based on individual level variables and household amenities and there is no multicollinearity. The second correlation matrix was based on climatic variabilities (rainfall, aridity, temperature, and drought episodes) and multicollinearity is found in the correlation between rainfall_2000 and rainfall_2005, rainfall_2000 and aridity, rainfall_2005 and aridity. This is the major limitation of hierarchical linear models used in this study since these variables are included in the models.

Independent Variables

Current Age: Age is a significant indicator for individuals' health outcomes. Current age in completed years calculated from the century month code of the date of birth of the respondent and the century month code of the date of interview. In a few cases the age in the data file are different from that reported by the respondent when the respondent's birthday was in the month of interview, but she had not yet had her birthday. If the respondent correctly reported her age at her last birthday (and not her age at her next birthday) then the calculated age was rounded up from the reported age, to avoid inconsistencies between the age and the century month code for the birth.

Religion: Bangladesh is a Muslim dominant country. According to the 2011 national census, 90% of the population are Muslim, 9.5% are Hindu. The rest of the population belongs to Christianity, Buddhism and other indigenous communities. Although the constitution of Bangladesh recognizes Islam as the state religion, it also states that the nation is a secular state that "shall ensure equal status and equal rights in the

practice of the Hindu, Buddhist, Christian, and other religions." However, in practice, Muslims enjoy a better socio-economic status than their counterparts. Keeping this issue in mind, the current study aims to explore whether religious identity has any implication for women's nutritional outcomes. For this, a dummy variable was created by recoding Religion variable (Muslim = 1, Others = 0).

Current Marital Status: Marriage is universal in Bangladesh and that almost all women marry before age 30 (NIPORT et al. 2009). The prime cause of disruption to marriage is widowhood, followed by marital separation. Aged women are more likely to be widowed than young women. Although divorce and separation are unusual in Bangladesh, the proportions of divorced and separated women are higher than the proportion of divorced and separated men. Divorced women in Bangladesh suffer from social exclusion and stigma, harassment in working place, difficulties in a second marriage, downswing changes in lifestyle in the face of social expectations, and psychological and physiological disturbance (Parvez, 2011). Women other than married face difficulties in getting socio-economic and health benefits in a patriarchal society like Bangladesh. In order to examine the connection between women's current marital status and their BMI, a dummy variable was created for current marital status (currently married = 1, previously married = 0).

Education Level: Education is one of the major socioeconomic factors that influences a person's behavior and attitude (NIPORT et al. 2009). Generally, the higher the education an individual can attain, the more he/she becomes knowledgeable about the use of health services, healthy food, health care of children. The study focused on women's educational level by incorporating their highest education level. This is a standardized

variable providing level of education in the following categories: No education, Primary, Secondary, and Higher.

Migration: In Bangladesh, both international and internal migration increased significantly since its independence, but policy makers pay little attention to the latter. This is because remittance from international migration is one of the foundation of Bangladesh economy. Due to rapid urbanization, internal migration especially from rural to urban has become dominant migration pattern also. In 2007, 4.5 million individuals migrated internally, of which 75 percent moved within rural or urban areas. Over 840,000 people moved from rural to urban areas that year (MFDM, 2008). Migration is the double-edged variable for climate change vulnerable people. In the one hand, people migrate from one place to another because of displacement from their place of origin. On the other hand, people use migration to place of destination as an adaptation. Both aspects of migration have important health implications. The current study wants to examine whether migration has any impact on women's BMI by recoding migration variable (migrant = 1, non-migrant = 0).

Division: Although Bangladesh has achieved tremendous success in socio-economic advancement, regional social inequality still a major gray concern for its development. This inequality is extreme in health sector. Among the eight divisions, Khulna, with 58 percent, has the highest coverage of skilled birth attendance while Sylhet, with 27 percent, has the lowest. The difference between these two divisions is 2.1 times. On the other hand, Rajshahi, with 60 percent, has the highest coverage of post-natal care (PNC) for newborns (within 2 days after birth) while Sylhet, with 42 percent, has the lowest coverage. The difference is 1.4 times (UNICEF, 2015). Given this situation, the current

study intends to examine the regional differences of women's nutritional status. Considering Sylhet as the reference division, five dummy variables were created in the following way: (Dhaka = 1, Others = 0), (Chittagong = 1, Others = 0), (Rajshahi = 1, Others = 0), (Khulna = 1, Others = 0), (Barisal = 1, Others = 0).

Age at First Marriage: All of the United Nations' Conventions and Resolutions consider "child, early, and forced marriage" as a fundamental human rights violation (UN, 2014). Early marriage (before 18 years of age) is considered to be a harmful practice as it denies girls the right to the highest attainable standard of general, sexual, and reproductive health, and to a life free from violence (UN, 1948). Early marriage also restricts to physical, emotional, and personal maturity required to safe and sound transition to adulthood (UN, 1989). The Child Marriage Restraint Act (2016) also supports the UN's principles in terms of girls' marriage in Bangladesh. However, the law is not properly enforced. Early marriage especially for girls is highly prevalent in Bangladesh. Marriage is the only socially acceptable system for women to have children in Bangladesh. The current study considers age at first marriage is a significant predictor of women's nutritional outcomes. For this, a dummy variable was created for age at first marriage {early marriage (<18 years) = 1, perfect marriage (>18 years) = 0}.

Residence: Globally, there is a sharp distinction between rural and urban areas in terms of health care benefits. This difference is extreme in developing countries. Globally, 56 per cent of the rural population lacks health coverage, while it is only 22 per cent for the urban population (ILO, 2015). This scenario is almost same for Bangladesh. The reason behind this difference is the lack of accessibility, availability, affordability and quality of

services in rural areas (ILO, 2015). The current study used individuals' *De facto* type of place of residence: where the respondent was interviewed as either urban or rural.

Wealth Index: The study used wealth index that was developed and tested in several countries to measure household income inequalities, access to health services, and health outcomes (Rutstein et al. 2000). It indicates households' level of wealth consistent with expenditure and income (Rutstein, 1999). In this study, the wealth index is constructed based on household assets including ownership of durable goods (televisions, bicycles) and household amenities (sources of drinking water, sanitation facilities, and construction materials). To create wealth index, a weight was assigned for each asset (factor score) which is generated through principal component analysis. The resulting asset scores were standardized in relation to a normal distribution with a mean of zero and standard deviation of one (Gwatkin et al. 2000). After assigning a score for each asset, the scores were summed for each household. The ranking of individuals was determined according to the total score of the household in which they resided. The sample was then divided into quantiles from one (Poorest) to five (Richest).

Main Material of the Floor: Housing materials especially floor materials have a significant health implication for household members. Households with dirt flooring are likely to have the least favorable health outcomes, with the highest prevalence of child cough, diarrhea, and infant mortality (Bradatan et al. 2017). In order to explore the connection between floor materials and women's nutritional status, a dummy variable was created for floor material (Dirt floor = 1, Others = 0).

Sources of Drinking Water: Access to an improved source of drinking water is universal in Bangladesh (NIPORT et al. 2009). But half of the drinking water consumed

does not satisfy water safety standard (World Bank, 2016). Tube wells are the most commonly used source of drinking water in both rural and urban areas in Bangladesh. But presence of arsenic in the tube wells since 1990s has become a major public health concern in Bangladesh. Drinking water rich in arsenic for a long period of time leads to arsenic poisoning or arsenicosis which causes cancer and skin lesions. It also causes cardiovascular diseases and diabetes. Arsenic exposure in utero and early childhood may have negative impacts on cognitive development and increased deaths in young adults. Malnutrition may aggravate the effects of arsenic in blood vessels (WHO, 2017). According to WHO Guideline, the acceptable value for arsenic in drinking water is 0.01 mg /liter. 27 % of shallow tube-wells in Bangladesh are contaminated with high level of arsenic (above 0.05mg/l). It has been estimated that 35 - 77 million of the total population of 125 million of Bangladesh are at risk of drinking contaminated water (WHO, 2017). Piped water is available only in urban areas. Water treatment before drinking is rare in Bangladesh. Only urban people slightly use boiled water. Given this situation, a dummy variable was created by recoding sources of drinking water (tube well = 1, others = 0).

Sanitation Facilities (types and sharing): Households without proper sanitation facilities are more exposed to infectious diseases of diarrhea, dysentery, and typhoid than households with sound sanitation facilities (NIPORT et al. 2009). Bangladesh has made significant improvement in reducing open defecation, from 34% in 1990 to 1% in 2015. However, the current rate of improved sanitation is 61%, growing at only 1.1% annually. Bangladesh also lacks systematic sewer disposal and treatment system. Only Dhaka, the capital city of Bangladesh, has a sewer system which covers only 18% of the entire city (World Bank, 2016). Consequently, waterborne diseases are widespread in Bangladesh

which are responsible for rapid transmission of gastrointestinal pathogens which can have a significant negative impact on health and nutrition. Keeping this issue in mind, two dummy variables were created covering the sanitation facilities: types of sanitation (flush toilet = 1, others = 0); whether toilet is shared or not (shared = 1, not shared = 0).

Type of Cooking Fuel: Exposure to indoor pollution has significant health implications for household members. The type of fuel used for household cooking is one of the main determinants of indoor pollution. Women in developing countries are more exposed to indoor pollution and consequently respiratory infections and other related diseases because they usually organize and manage household cooking. The risk of indoor pollution from cooking is limited in Bangladesh because more than four in five households use separate building or outdoors for cooking. However, about nine in ten households use solid fuels in Bangladesh (NIPORT et al. 2009). Animal dung is one of the dominant solid fuels used in cooking in South Asia. In India, animal dung cake is the major source of indoor air pollution, followed by wood and charcoal (Smith, 1993). Animal dung is also widely used in Bangladesh especially in rural areas as a source of cooking fuel. A dummy variable was created by recoding types of cooking fuels (animal dung = 1, others = 0).

Rainfall Year: Rainfall was measured millimeters per year. The average rainfall of the cells whose centroid falls within a radius of 10 km (for rural points) or 2 km (for urban points) (NIPORT et al. 2009).

Aridity: Aridity refers as a generalized function of precipitation, temperature, and/or potential evapo-transpiration (PET). Aridity index is between 0.01 (Hyper Arid) and 0.99 (Humid). The study uses average aridity index of the cells whose centroid falls within a radius of 10 km (for rural points) or 2 km (for urban points). Aridity is calculated by

dividing the actual evapotranspiration by the potential evapotranspiration. The closer the number is to 1.0, the more humid the environment. Both the actual and potential evapotranspiration values were calculated using the WorldClim Global Climate Data (NIPORT et al. 2009). The Aridity Index values reported within the *Global-Aridity* geodataset have been multiplied by a factor of 10,000 to derive and distribute the data as integers (with 4 decimal accuracy). This multiplier has been used to increase the precision of the variable values without using decimals. Global-Aridity values need to be multiplied by 0.0001 to retrieve the values in the correct units (CGIAR-CSI, 2012).

Temperature Month: Temperature was measured as average temperature for months January to December in degrees Celsius. The average temperature of the cells whose centroid falls within a radius of 10 km (for rural points) or 2 km (for urban points) (NIPORT et al. 2009).

Drought Episodes: Drought events are identified when the magnitude of a monthly precipitation deficit is less than or equal to 50 percent of its long term median value for three or more consecutive months (CHRR et al. 2005). Drought episodes were measured in this study as individual classes between 1 (Low Drought) and 10 (High Drought). The average of the drought episodes indices of the cells whose centroid falls within a radius of 10 km (for rural points) or 2 km (for urban points) (NIPORT et al. 2009).

Dependent Variable

Body Mass Index (BMI): The 2007 BDHS measured the height and weight of all ever-married women age 15-49. The BMI is used to measure thinness or obesity. BMI of a women is defined as her weight in kilograms divided by the square of her height in meters (W/H^2). The main advantage of the BMI is that it does not require a reference table from a

well-nourished population. A cutoff point in the BMI of 18.5 is used to define thinness or acute undernutrition. A BMI of 25 or above usually indicates overweight, and 30 or above indicates obesity (NIPORT et al. 2009). There are two implied decimal places in the BMI (decimal points are not included in the data file).

Hypotheses

From the literature review and theoretical analysis, it is assumed that human nutrition is socially distributed. Position in the socio-economic hierarchy is the determining factor of one's nutritional status. Extreme climatic events create extra pressure in deteriorating nutritional status of people with faulty marital status, lower education, lower wealth quantiles, poor household amenities. Given this situation, the following hypotheses are constructed in this study:

H_1: Women who are currently married and married at perfect age enjoy better nutritional status than women who are previously married and married at early age.

H_2: The higher the education level, the better the nutritional status for a woman.

H_3: Migrant women are in better position in terms of nutritional status than non -migrant women.

H_4: Rural women are more vulnerable than urban women for nutritional status.

H_5: Women belong to upper wealth index are in better position in terms of nutritional status than women belong to lower wealth index.

H_6: Women living in poor household amenities are more undernourished than women living in good household amenities.

H_7: Climatic variabilities (rainfall, aridity, temperature, and drought episodes) have negative influences on women's nutrition.

H_8: The underlying connection between climate change and poor household amenities influences women's nutritional status negatively.

CHAPTER V

RESULTS OF THE STUDY

Descriptive Statistics

Descriptive statistics of the continuous variables used in the study are presented in table 4. Body mass index is the only dependent variable. A standard BMI value for female is 18.5 to 24.9. There are two implied decimal places in the BMI (decimal points are not included in the data file). As I excluded women who are pregnant and have BMI more than 29.00 from the analysis, then the maximum BMI value must be 2900 while the minimum BMI value is 1214. The mean value of 2050.64 implies that women in Bangladesh, on average, maintain standard level in terms of nutritional status. The standard deviation of 3.15 implies that women's BMI values are spread above and below of 3.15 than the mean value of 2050.64 The study only incorporates ever-married women of age between 15 to 49. The mean age of the respondents is 31.03 that indicates a young cohort while the ages are spread above and below of 9.320 than the mean age. The rainfall is measured as the millimeter per year. In 2000, the minimum rainfall is 1342 millimeters and the maximum is 5730 millimeters while in 2005, these are 1512 and 4874 respectively. The average rainfall in both 2000 and 2005 were 2575 millimeters and 2233 millimeters respectively.

The Global-Aridity values need to be multiplied for 0.0001 to retrieve the values in the correct units. So, the minimum aridity index is .850 (8502.400*0.0001) while the maximum aridity index is 3.015. The average aridity index is 1.530 which is above the normal aridity index range between 0.01 (Hyper Arid) and 0.99 (Humid) that proofs Bangladesh's weather is extremely humid. In terms of temperature, I used the coldest (January belongs to Winter season) and the warmest (May belongs to Summer season)

months in order to check whether temperature variation has any significance on women's BMI. The temperature is expressed in Celsius. The lowest temperature in winter season is 16.63˚ C while it is 25.76˚ C in summer. On the other hand, the maximum temperature in winter is 20.57˚ C while it is 30.41˚ C. The average temperature in both winter and summer season is 18.36˚ C and 28.56˚ C respectively. The minimum number of drought episodes is 4 while the maximum number is 10. The average number of drought episodes is 6 that belongs to higher middle drought class.

Table 4: Descriptive statistics of continuous variables

Variables	Total (N)	Minimum	Maximum	Mean	Std. Deviation
Body Mass Index	9789	1214	2900	2050.64	315.899
Current Age	9789	15	49	31.03	9.320
Rainfall_2000	9789	1342.000	5730.364	2575.171	866.072
Rainfall_2005	9789	1512.000	4875.000	2232.735	655.905
Aridity	9789	8502.400	30147.995	15296.669	4226.244
Temperature_January	9789	16.63	20.57	18.359	.779
Temperature_May	9789	25.76	30.41	28.598	.846
Drought Episode	9761	4.00	10.00	6.311	2.539

Table 5 presents the descriptive statistics of categorical and ordinal level variables. Bangladesh is a Muslim dominant country having 90% of the population as Muslim. Only 10% of the population belong to other religious groups i.e. Hinduism, Christianity, Buddhism, and indigenous communities. Marriage is one of the important indicators for women's socio-economic and health status in Bangladesh as marriage is the socially recognized way to form a family. Usually married women are more secured from any social or natural vulnerabilities as she belongs to strong social networks than any other groups. Almost 92% women are currently married and the rest of them are previously married but now either divorced or separated or widowed. During the last couple of decades, Bangladesh has achieved significant success in gender parity in school enrollment through

The Female Secondary School Stipend Project (FSP) established in 1982. The goals of the project were to increase the enrollment of girls in secondary schools, and thereby delaying marriage and childbearing. But the current study shows that only 29% of women completed secondary education. The rate for higher education enrollment is almost negligible (7%). Most of the women either did not get any education (34%) or only completed primary education (30%). Bangladesh is a popular country of origin for migration especially for international migration to Middle Eastern region which has attracted much attention in academic and development discussion. However, it is also essential to take internal migration into account as the study shows that majority portion of the respondents (77%) are migrant. This data indicates that there is a huge internal migration flow in Bangladesh. Among the regional distribution, Dhaka division has the highest number of respondents (21%) while Sylhet has the lowest number (13%).

Early marriage has a negative consequence for both physical and mental health of women. Although it is not legal in Bangladesh, but early marriage (<18 years of age) is highly prevalent. The current study shows that most of the women (88%) are early married while only 12% are married in a perfect age. Bangladesh is a country of villages and majority portion of Bangladesh population live in rural areas. In this study, 63% of the respondents are rural women while only 37% live in urban area. Position in wealth index always have an influence on access to basic human needs. The current study uses five quantiles for measuring wealth index: poorest, poorer, middle, richer, richest. Highest number of women belong to richest quantile (25%) and the lowest number of women belong to poorest quantile (17%). In terms of household amenities, most of the women live in households with dirt floor (69%), use tube well for drinking water (81%), use non-flush

toilet (82%), shared toilet with other households (54%), and use sources for cooking fuel other than animal dung (92%).

Table 5: Descriptive statistics of categorical and ordinal level variables

Variables	Category	Frequency	Percent	Total (N)
Religion	Islam	8818	90.1	9789
	Others	971	9.9	
Marital Status	Currently Married	8988	91.8	9789
	Previously Married	801	8.2	
Level of Education	No Education	3282	33.5	9786
	Primary	2449	30.1	
	Secondary	2836	29.0	
	Higher Education	719	7.3	
Migration Status	Migrant	7532	76.9	9053
	Non-migrant	1521	15.5	
Division	Dhaka	2086	21.3	9789
	Chittagong	1705	17.4	
	Rajshahi	1858	19.0	
	Khulna	1549	15.8	
	Barisal	1299	13.3	
	Sylhet	1292	13.2	
Age at First Marriage	Early Married	8644	88.3	9789
	Perfectly Married	1145	11.7	
Residence	Rural	6192	63.3	9789
	Urban	3597	36.7	
Wealth Index	Poorest	1628	16.6	
	Poorer	1817	18.6	
	Middle	1887	19.3	
	Richer	1999	20.4	
	Richest	2458	25.1	
Floor	Dirt	6792	69.4	9789
	Others	2997	30.6	
Sources of Drinking Water	Tube Well	7994	81.7	9789
	Others	17.95	18.3	
Type of Toilet	Flush	1764	18	9789
	Other	8025	82	
Toilet Sharing	Shared	3251	53.5	8486
	Not Shared	5235	33.2	
Cooking Fuel	Animal Dung	761	7.8	
	Others	9028	92.2	

Multiple Linear Regression Models Predicting Women's Body Mass Index

Table 6 shows the results from four multiple linear regression models predicting women's body mass index. The models use demographic features (current age, religion, marital status, educational level, migration status, division where the respondents live, age at first marriage, residential status in terms of rural/urban), wealth index, and household characteristics (floor materials, sources of drinking water, type of toilet, sharing status of toilet facility, and cooking fuel) as independent variables. There are some valid logics for which I used four multiple linear regression models. The first two models predict women's BMI in relation to demographic variables where the first model excludes the variables of age at marriage and residence in terms of rural/urban. This is because, in Bangladesh, although the legal age for marriage is 18 years which is coherent to the United Nations' conventions and resolutions, marriage before 18 years is highly prevalent especially among the girls from rural areas. On the other hand, the majority portion of Bangladesh population live in rural areas who are living in worse position in terms of access to quality food and health services. That's why it is significant to know whether early marriage and living in rural areas have any significant impacts on women's BMI.

Current age is a continuous variable used to observe changes in women's BMI according to the change of age (increase). Educational level is measured by the highest educational achievement through four ordinal categories: no education, primary, secondary, higher. Literatures suggest that people with higher education are more knowledgeable and aware about food preference and healthy life. So, they are in better nutritional status. In order to identify region where the respondents live, keeping Sylhet as the reference category, five dummy variables were created for other five divisions: Dhaka, Chittagong, Rajshahi, Khulna, Barisal. This is because each and every division differ from

each other in terms of geographical location, climate, population composition, socioeconomic well-beings. For example, the capital of Bangladesh lies in the Dhaka division which is composed of plain lands and most of the socioeconomic and administrative facilities are centralized here. On the other hand, although Sylhet division is the richest in terms of migrant people living in United Kingdom, but this division is the worst in terms of socioeconomic advancement including health outcomes of women and children. One reason for the backwardness of Sylhet division would be its geographical composition. The whole division is composed of two geographical characteristics: mountains, and *haor* (wetland ecosystem). The *haor* basin is a remote area that is flooded in every year during monsoon season. Water transport is the only way of communication during most of the times of the year. Fishing is the major livelihood as agriculture is not possible in maximum times of the year. Keeping this mind, Sylhet division was considered as reference category to compare women's BMI among the divisions. All other predictor variables were used as dichotomous dummy variables having two categories (Muslim vs others, currently married vs previously married, migrant vs non-migrant, early married vs perfectly married, rural resident vs urban resident).

Wealth index and household amenities are the most significant determining factors of household members' health outcomes. Generally, position in upper wealth quantiles and access to better household amenities have a positive correlation with household members' health outcomes. This is more significant for women's BMI. Because individual's nutritional intake is heavily dependent on food security and women are considered the chief managers of household food security. Literatures suggest that along with favorable climatic condition, economic solvency and access to clean water and sanitation are the

preconditions for the fulfilment of four dimensions of food security: availability, stability, access, and utilization. The third and fourth multiple regression models focused on these two factors. The third model attempts to examine whether wealth index has any implication for women's BMI in addition to demographic factors. In order to trace women's position in wealth index, they were classified into five categories - poorest, poorer, middle, richer, richest – and checked whether their position in any of the category has significance to their BMI or not. Although the wealth index is constructed by combining household assets including ownership of durable goods (televisions, bicycles) and household amenities (sources of drinking water, sanitation facilities, and construction materials), the fourth model included it partially by adding only household amenities: floor materials, sources of drinking water, types of toilet, whether toilet is shared or not, and types of cooking fuels. This is because literatures suggest that household's amenities significantly affect household members health outcomes. Keeping this in mind, five dummy variables were created in order to indicate the implications of household amenities to women's BMI: floor materials (dirt floor vs others), sources of drinking water (tube well vs others), types of toilet (flush vs others), sharing of toilet (shared vs not shared), and cooking fuel (animal dung vs others). All models have equal sample size (N = 9,789). When we predict BMI value, we should keep in mind that decimal point is not included in the BMI value.

Model 1 in Table 6 explains 11.2% of the variance in women's body mass index. Migration has a statistically significant positive association with women's BMI controlling for all of the individual level variables used in this study except age at first marriage and residence in terms of rural/urban. Among the individual level variables, current age, religion, marital status, education level have statistically significant positive influence on

women's nutritional outcome. With one-year increase of women's age, there are 6.641 unit increase of their BMI. Muslim women are in favorable position in terms of their nutritional status than other religious groups. Currently married women are in better position in terms of their nutritional status than previously married (widowed + divorced + separated). Educational level has four categories: No education, primary, secondary, and higher education. The model shows that a woman's BMI is increased by 105.863 if she advances one level of education from no education to higher education. That means the more education a woman can attain, the better position she holds in terms of her nutritional status. Among the divisions, living in all other divisions (Dhaka, Chittagong, Rajshahi, Khulna) other than Barisal has a statistically significant positive influence on women's BMI as compared to living in Sylhet (reference division). Living in Khulna has the highest positive impact while living in Rajshahi has the lowest one. Living in Barisal has a negative consequence, but this is not statistically significant.

Incorporation of age at first marriage and residence in terms of rural/urban in the model 2 has a significance in determining women's BMI as the model explains 14.2% of the variance predicting women's body mass index which is exactly 3% larger than the model 1. Although migrant women are still in better position than non-migrant women, but it is not statistically significant. That means migration status loses its impact on women's BMI. Both age at first marriage and residence in terms of rural/urban have statistically significant negative association with women's body mass index. Early married (child marriage as it is <18 years of age) women are in vulnerable position than perfectly married (>18 years of age) women. Rural women are more malnourished than urban women. All other individual level variables, as like as model 1, positively correlated with

women's BMI and they are statistically significant. As it was the case with model 1, except living in Barisal, living in Dhaka, Chittagong, Rajshahi, and Khulna has a positive association. Like model 1, living in Khulna has the highest positive impact and Chittagong has the lowest (in model 1 it was Rajshahi) compared to living in Sylhet. Living in Barisal, as compared to living in Sylhet, still has a statistically insignificant negative association.

Along with all variables used in model 1 and 2, Model 3 incorporates wealth index that explains 18% of the variance which is almost 4% higher than the model 2. Migration has no significance on women's BMI. Wealth index is positively associated with women's BMI which is statistically significant. The BMI increases 55.22 units if a woman advances one steps in terms of wealth index from the poorest to the richest. The inclusion of wealth index in the model significantly affects BMI's relationship with living in Barisal division. Like all other divisions, now Barisal also has a statistically significant positive relationship. All other variables remain the same. In the model 4, wealth index is omitted, and household amenities (floor materials, sources of drinking water, type of toilet, toilet facilities sharing status, and cooking fuel) are added. This model explains 18.2 % of the variance which is slightly larger than the model 3. That means household amenities have more significant impact than wealth index on women's BMI. The results show that migration has no significance for women's BMI. Having flush toilet in the household has a positive relationship with women's nutritional outcome than other types of toilet and it is statistically significant. Except using animal dung as cooking fuel, all other household amenities (dirt floor, tube well as source of drinking water, shared toilet facilities) have negative influences on women's BMI and among them, only tube well is not statistically significant in predicting women's BMI.

Table 6: Multiple linear regression models predicting women's body mass index.

	Model 1	Model 2	Model 3	Model 4
Current Age	6.641*** (.359)	5.995*** (.356)	4.705*** (.354)	4.709*** (.371)
Muslim	32.016** (10.470)	27.329** (10.351)	28.178** (10.117)	30.283** (10.621)
Currently Married	36.011** (11.556)	43.326*** (11.372)	44.275*** (11.114)	50.322*** (11.755)
Educational Level	105.863*** (3.523)	88.118*** (3.728)	53.537*** (4.011)	55.151*** (4.103)
Migrant	18.796* (8.445)	12.464 (8.319)	8.128 (8.133)	3.554 (8.532)
Division (Sylhet=ref)				
Dhaka	62.575*** (11.022)	54.312*** (10.905)	59.494*** (10.661)	62.140*** (11.124)
Chittagong	43.308*** (11.488)	42.376*** (11.324)	42.426*** (11.067)	61.593*** (11.455)
Rajshahi	37.699** (11.260)	44.587*** (11.135)	67.989*** (10.942)	63.811*** (11.437)
Khulna	65.879*** (11.702)	70.460*** (11.570)	78.553*** (11.314)	86.045*** (11.696)
Barisal	-8.391 (12.263)	-2.571 (12.119)	34.699** (11.981)	26.347* (12.224)
Early Married		-51.511*** (10.606)	-44.258*** (10.371)	-30.909** (10.701)
Rural residence		-107.998*** (6.608)	-48.992*** (7.064)	-48.387*** (7.440)
Wealth Index			55.220*** (2.678)	
Dirt Floor				-115.659*** (9.815)
Drinking Water (Tube well)				-13.168 (10.500)
Flush Toilet				83.547*** (9.710)
Toilet Facilities Shared				-36.106*** (6.729)
Cooking Fuel (Animal Dung)				13.389 (11.678)
Constant	1614.159*** (22.176)	1769.424*** (24.638)	1618.606*** (25.166)	1871.354*** (27.776)
R Square	.112	.142	.180	.182
N = 9,789				
*p ≤ 0.05, **p ≤ 0.01, ***p ≤ 0.001				

Hierarchical Linear Models Predicting Women's Body Mass Index

Hierarchical linear models (HLM) predicting women's body mass index by combining individual level variables and household amenities with the climatic variabilities are presented in table 7. Among six different models, first five models predict women's BMI considering different combinations of climatic variabilities while the last one predicts by takin into account of the individual level variables and household amenities. Model 2 indicates a positive correlation between temperature in January and women's BMI controlling for aridity and temperature in May. This relationship is statistically significant. January is the coldest month in Bangladesh. That means winter season is more favorable than summer season for women's nutrition in Bangladesh. Inclusion of drought episodes in the model 3 significantly changes seasonal implications.

Although temperature in January is still positively correlated but it loses statistical significance while temperature in May is positively correlated with statistical significance. May is the warmest month in Bangladesh. That means, if we take drought episodes into account, summer season influences women's BMI more positively than winter season. But if we take all the climatic variabilities (rainfall in 2000, rainfall in 2005, aridity, temperature in January, temperature in May, drought episodes) into account (model 4), then winter season gains statistical significance again while summer season loses significance in influencing women's nutrition positively. Drought episodes are negatively associated, and it is statistically significant. Exclusion of rainfall in 2000 brings a significant change in the model 5. Although temperature in both January and May has statistically significant positive relationship with women's BMI, but both aridity and drought episodes have a negative influence on women's BMI and they are statistically

significant. But when we combine all the individual level variables and household amenities with climatic variabilities (excluding rainfall in 2000) in model 6, all of the climatic variabilities lose their statistical significance in influencing women's BMI either positively or negatively. On the other hand, it is found that the older a woman, the better the nutritional status than a younger woman. Muslim women enjoy better nutritional status than any other religious groups. Currently married women are in better position than previously married women. The higher the education level, the better the nutritional status for a woman. The upper the position in wealth index, the better the nutritional position of a women.

Having flush toilet in the household also favors women in keeping their nutritional status sound than having any other type of toilet. Early marriage, rural residency, dirt floor, and shared toilet predict women's BMI negatively and they are statistically significant. That means, early married women compared to perfectly married women, women living in rural area compared to women living in urban area, women who live in a household with dirt floor compared to women who live in a household with other floor types, and women who share a toilet with other households compared to women who do not share are in disadvantaged position in terms of their nutritional status. Although being migrant and using animal dung as cooking fuel are positively associated with women's BMI but they are not statistically significant. On the other hand, using tube well as the source of drinking water has a negative implication but it is not statistically significant. These findings indicate that some climatic variabilities (aridity, drought episodes) are influencing women's BMI in Bangladesh negatively, but their influences are weaker than the individual level variables, wealth index and household amenities.

Table 7: Hierarchical linear models predicting women's body mass index.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Rainfall_2000	-.033 (.031)			-.046 (.057)		
Rainfall_2005	.004 (.040)			.953 (.059)	.053 (.029)	-.003 (.018)
Aridity		-.004 (.003)	-.003 (.003)	-.010 (.006)	-.011* (.005)	-.003 (.003)
Temperature_January		23.115* (11.937)	14.838 (12.793)	35.040* (11.673)	31.147* (15.492)	7.723 (9.493)
Temperature_May		19.325 (13.902)	34.303* (16.613)	28.834 (18.427)	35.736* (16.382)	5.719 (9.894)
Drought Episode			-5.768 (3.487)	-8.612* (3.794)	-7.714* (3.631)	2.702 (2.235)
Currently Married						49.374*** (11.657)
Education Level						45.160*** (4.224)
Migrant						4.322 (8.487)
Early Married						-27.518** (10.669)
Rural Residence						-38.194*** (9.230)
Wealth Index						35.054*** (3.506)
Dirt Floor						-63.085*** (11.207)
Tube Well Water						-8.070 (12.020)
Flush Toilet						58.534*** (10.086)
Shared Toilet						-30.171*** (6.772)
Cooking Fuel (Animal Dung)						6.203 (11.923)
Intercept	2128.545*** (24.999)	1133.414*** (318.603)	885.010** (352.533)	691.471 (422.524)	562.797 (392.097)	1502.910*** (242.920)
N = 9,789						
*p ≤ 0.05, **p ≤ 0.01, ***p ≤ 0.001						

CHAPTER VI

DISCUSSION AND CONCLUSION

Discussion

Malnutrition is not only the result of a lack of access to sufficient, nutritious and safe food. It also derives from a series of interlinked factors related to inadequate access to resources and services, such as quality healthcare, education, drinking-water, sanitation and hygiene. Poor women often face additional hurdles to access resources and services (FAO, IFAD, UNICEF, WFP, and WHO, 2017). These underlying causes of undernutrition are determined by environmental, economic, and socio-political contextual factors, with poverty having a central role (Met Office Hadley Centre & WFP, 2012). Climate change can exacerbate undernutrition by reducing calorie intake due to lower food availability. Inadequate care practices could be exacerbated due to difficulty in accessing clean drinking water. Potential increases in food prices due to climate change could reduce dietary diversity and hence reduce nutritional value of the diet, which impacts on nutritional status (Met Office Hadley Centre & WFP, 2012).

In the last century, Bangladesh has faced two major famines that took lives of millions of starved people. The first one is the Great Bengal Famine, 1943, and the second one is the Bangladesh Famine, 1974. Following Malthusian notion of food availability decline (FAD) approach, the official documents on both incidences tried to establish that food crisis due to extreme climatic events (cyclones, floods, and droughts) are the responsible factors behind these mass starvations. But Sen (1981) challenged this PAD approach. Analyzing the official documents, he claimed that both in 1943 and 1974, the Bangladesh region produced more food than the preceding years. Referencing Report of

the Famine Inquiry Commission (1945) and Alamgir (1980) respectively, Sen (1981) showed that, in Bengal, there was 13 percent higher rice production in 1943 than in 1941, and there was .6 oz. higher per capita food availability in 1974 than in 1973. According to him, extreme climatic events obviously played a significant role in the starvation process, but it was not unavailability of food due to natural disaster but unequal distribution of food among the population that was the main culprit of such misery. For him, policy failure in terms of social, economic, political and legal systems during both famine periods hinder people with lower socio-economic status to get entitlement to the available food.

If we look at the time period of both famines, we will find some common characteristics. Both famines are the byproduct of war economy, a man-made disaster. Both were taken place during political turmoil situation in that region. In 1947, just four years later of the first famine, India and Pakistan got independence from two hundred years long British colonial rule which was fighting against Japanese army as part of the Second World War during the famine period by using the resources of that region. Massive inflation due to war economy and restriction on rice import from Burma as it was occupied by Japan pushed a price hike of rice. As rice was the main staple food of Bengali people especially in rural areas, the rural people living in the lower wealth index lost their command over food and started to starve due to this price hike. Cyclone and flood created just a double burden on this starvation process. According to Sen (1981), "The Bengal Famine was essentially a rural phenomenon" (p. 63) and the largest group of destitute is agricultural laborers (p. 141). Referencing census report of India, 1951, Sen (1981) also argued that, "The male population exceeded the female population in Bengal, and the recorded death

rate per unit of population was higher for women in every year during the decade I94I-50 through the famine" (p. 211).

It was almost the same situation during 1974 famine. In 1971, just three years earlier of the famine, Bangladesh got independence from Pakistan after a nine months long Liberation War. It is now widely established that the separation of Pakistan was nothing but the result of extreme socio-economic exploitation and domination of East Pakistan (now Bangladesh) by the West Pakistan (now Pakistan). Three million Bangladeshi people were killed, and two hundred thousand Bangladeshi women were raped by the Pakistani army during this war. The socio-economic infrastructures were totally collapsed. While Bangladesh was trying to recover the damage mainly with the foreign assistance, The United States (US) suddenly stopped food assistance by demanding that Bangladesh should cut business relation with Cuba, one of the major enemies of the US. At that time, Bangladesh was exporting jute in Cuba. Along with these multidimensional problems, a massive flooding along the Brahmaputra river, created a barrier for poor people specifically in rural areas to get enough food to avoid starvation. Despite achieving significant socio-economic advancements in the last couples of decades, Bangladesh is still struggling with the above mentioned nutritional crises. FAO & WHO (2014) acknowledged this as, "In Bangladesh, malnutrition is caused by a combination of factors including faulty food consumption, food utilization owing to poor sanitation, illness and inadequate health care" (p. 19).

The findings of the current study are consistent with the above analysis. The current study concentrates on how climate change, women's demographic characteristics, their position in wealth quantiles, and their own household amenities are influencing women's

nutritional status in Bangladesh. In order to examine the relationship between predictor variables and outcome variables, both multiple linear regression (prediction of women's body mass index by their demographic features, position in wealth quantiles, and household amenities) and hierarchical linear models (prediction of women's body mass index by the underlying connection between climatic variabilities and demographic features, position in wealth index, and household amenities) were run. The study hypothesized ($H_{1)}$ that women who are currently married and married at perfect age enjoy better nutritional status than women who are previously married and married at early age. The models show that current marital status has a statistically significant positive relationship with women's BMI while early marriage has statistically significant negative relationship. That means a woman living with her family especially with her husband is in secured position and a woman who is married earlier is in unsecured position in terms of nutritional status. This is usual in Bangladesh as it is extremely patriarchal society where divorced, separated, widowed often face social exclusion. This exclusion hinders them in getting socio-economic capital through which they could manage their means of subsistence. On the other hand, most of the women in Bangladesh are early married (88.3% in this study) which has negative consequences for their physical and mental well-beings. This study is consistent with this scenario. So, I failed to reject hypothesis 1.

The study hypothesized (H_2), the higher the education level, the better the nutritional status for a woman. Every regression model used in the study indicates a positive relationship between educational level and women's BMI that supports the respective hypothesis. Hypothesis 3 was constructed on the relationship between rural to urban migration status and BMI: migrant women are in better position in terms of

nutritional status than non-migrant women. Maximum number of women participated in this study are migrant (77%). This is because only internal migration is considered in this study and most of the urban household members are migrated from rural areas in Bangladesh. The study shows that migration has a statistically significant positive relationship with women's BMI controlling for respondents' current age, Muslim, currently married, educational level, and division. But if all the variables are taken into consideration, then migration is not significant. Consequently, hypothesis 3 (H_3) is rejected. Bangladesh is a country of village and major portion of Bangladeshi population live in rural areas with less access to socio-economic and health opportunities as compared to urban areas. This rural-urban population distribution is also prevalent in this study (63% percent are from rural areas). Considering this situation, the study hypothesized (H_4) that rural women are more vulnerable than urban women for nutritional status. All the models predicting women's BMI in relation to rural residency shows negative relationships and they are statistically significant. So, hypothesis 4 is accepted.

Exposure to economic capital is treated one of the major indicator of human well-being. Bangladesh's economy is agricultural, and people exposed to higher wealth index are likely to have better position in terms of food and other daily subsistence. I found a positive relationship between wealth index and women's BMI. That means rich women are in better position in terms of their nutritional status than the poor women in Bangladesh. This finding allows me to accept the hypothesis 5 (H_5): women belong to upper wealth index are in better position in terms of nutritional status than women belong to lower wealth index. Wealth index is composed of household durable assets (television, furniture etc.) and household amenities (floor materials, sources of drinking water, type and sharing status

of toilet, and cooking fuel items etc.). Since examination of the relationship between household amenities and women's BMI is one of the major objectives of this study, I used household amenities separately to predict women's BMI in this study and constructed hypothesis 6 (H_6): women living in poor household amenities are more undernourished than women living in good household amenities. The regression models support me to accept hypothesis 6 only for floor materials, type and sharing status of toilet. The models indicate that dirt floor and shared toilet facilities are negatively correlated with women's BMI, while flush toilet is positively correlated, and their correlations are statistically significant. The relationship between tube well as source of drinking water, animal dung as cooking fuel with women's BMI is not statistically significant.

The literature suggests that climate change creates negative pressure on human nutrition by disrupting each and every dimension of food security. As Bangladesh is one of the major victim countries of climate change around the world, it is assumed that Bangladeshi people are in a vulnerable situation in terms of their food and nutrition security. Moreover, it is also well documented that rice as a C_3 grain is likely to lose zinc and iron content due to elevated carbon concentration in the atmosphere and rice is the main staple food in Bangladeshi households. As the first manager of food security but the last consumer of food in the household, women in Bangladesh are likely to be more vulnerable than any other members of the households in terms of food and nutrition security due to climate change. Keeping this issue in mind, it is hypothesized that (H_7) climatic variabilities (rainfall, aridity, temperature, drought episodes) have negative influences on women's BMI. The hierarchical linear model (model 5) indicates that aridity, temperature, and drought episodes, not rainfall, have significant influences on women's

BMI. While aridity and drought episodes have statistically significant negative impact on women's BMI, temperature (both in January and May) have statistically significant positive impact. So, hypothesis 7 (H_7) is partially accepted. But these climatic variabilities lose statistical significance if individual level variables, and household amenities are taken into account (model 6). This finding allows me to conclude that climatic variabilities are significant, but they are less significant than individual level variables, and household amenities in predicting women's BMI in Bangladesh. As a result, hypothesis 8 ($H_{8:}$ The underlying connection between climate change and poor household amenities influences women's nutritional status negatively) is rejected.

As we discussed earlier that sociological analysis of nutrition is derived from the sociological analysis of food, and dimension of food security – availability, access, utilization, stability- depend on natural and man-made disaster, position in economic and market structure, access to safe drinking water and sanitation. Although Sen (1981) acknowledged both natural disasters and unequal distribution of food and other socio-economic opportunities in explaining mass starvation, he emphasized on unequal distribution of food and other socio-economic opportunities rather than climatic events. Sen's (1981) entitlement approach of starvation and famine is coherent with Bourdieu's concept of distinction. Both approaches concentrate on socio-economic inequality and injustice in explaining mass starvation and undernutrition rather than environmental factors. Results of the study support the idea of Sen and Bourdieu as women's individual characteristics, their position in wealth quantile, and household amenities play more significant role than climatic variabilities on their nutritional status in Bangladesh.

Conclusion

Achieving a world without hunger and malnutrition by 2030 is one of the major goals set by the 2030 Agenda for Sustainable Development. In achieving this goal, the United Nations also set some other supplementary goals: poverty alleviation, good health and well-being, quality education, gender equality, access to clean water and sanitation, reduction of inequalities, tackling climate change. Considering the importance of nutrition for human well-being as well as sustainable development, the United Nations also declared the Decade of Action on Nutrition (2016-2025) that is a commitment of member states to undertake ten years of sustained and coherent implementation of policies and programs by following the recommendations and commitments of the 2030 Agenda for Sustainable Development. Although Bangladesh has achieved some considerable success in Millennium Development Goals (MDGs), but still a significant number of Bangladeshi population especially women and children in rural areas are living with under-nutrition and fragile socio-economic conditions. Poor household amenities are the major socio-economic vulnerabilities for its populations especially for rural women. These vulnerabilities become worse during frequent climatic events (floods, cyclones, and drought episodes). Under-nourished women reproduce under-nourished generations. Moreover, women consist almost half of the Bangladeshi population. So, women's food and nutritional security is a significant determining factor for a nourished and healthy Bangladesh. The study shows that women with lower socio-economic status (in terms of marital status, education, residency in terms of rural/urban, household amenities etc.) are more vulnerable in terms of their nutritional status than women living with upper socio-economic status. This situation will create obstacles in achieving the most of the sustainable development goals.

This is because, if we look at the 17 goals set by the Agenda 2030, we will find that most of the goals either directly or indirectly are related to human nutrition and well-being. So, in order to have a well-nourished and healthy population, along with tackling climate change, Bangladesh should be concerned in reducing the socio-economic inequality among its population.

CHAPTER VII

POLICY RECOMMENDATIONS

Food security and nutrition is the inalienable human rights. The Constitution of Bangladesh recognized these two rights with full importance. Article 15 of the Constitution proclaims that "it shall be a fundamental responsibility of the State to attain, through planned economic growth……the provision of the basic necessities of life, including food, clothing, shelter, education and medical care." The constitution further proclaims in Article 18 (1), "The State shall regard the raising of the level of nutrition and the improvement of public health as among its primary duties." When Bangladesh got independence in 1971, it was named 'bottomless basket' by the international communities because of poverty and extreme food deficiency. Until 1990s, Bangladesh was considered to a part of "Asian Enigma" as it's child undernutrition situation was worse than sub-Saharan African countries where people were both poorer and less educated than Bangladesh.

However, during the last 40 years, Bangladesh has achieved a considerable success in food security and reducing child undernutrition. Considering Bangladesh as "The Other Asian Enigma", Headay et al. (2015) states that "from 1997 to the 2007 Bangladesh recorded one of the fastest prolonged reductions in child underweight and stunting prevalence in recorded history" (p. 749). But surprisingly, they argued that this success has been achieved without any significant contribution from national nutritional programs. Although Bangladesh has adopted multiple policies to improve food security and nutritional status: 1. The National Food and Nutrition Policy, 1997; 2. National Nutrition Policy, 2015. According to Headay et al. (2015), "Assessments of Bangladesh's Integrated

Nutrition Program 1995-2004 (BINP) and the subsequent National Nutrition Program suggest, at best, a modest impact on nutrition outcomes" (p. 749). Instead, they identified the following factors that played significant role in reducing child undernutrition in Bangladesh: household wealth accumulation, rapid expansion of education especially women's education, women empowerment, community-based service delivery, improvement in sanitation, improvement in demographic outcomes, rapid growth in agriculture.

The current study findings are also consistent with analysis of Headay et al. (2015). Education, marital status, wealth index, rural-urban residency, household amenities play more significant roles than climatic events in determining women's nutritional status in Bangladesh. However, we should not ignore climate change as it also influences women's nutrition. Given this situation, the current study proposes the following policy recommendations on which Bangladesh should focus in order to improve women's nutritional status:

1. Attention of international communities for climate vulnerabilities so that it gets sufficient assistance to adapt with climate change.
2. Extension of agriculture with crop diversification.
3. Innovation of climate sensitive crops.
4. Enhancement of population control programs.
5. Establishment of gender equality with special focus on the household food distribution.
6. Women education with especial focus on higher education. Extension of Female Secondary School Assistance Program to higher level.

7. Proper enforcement of The Child Marriage Restraint Act, 2017.
8. Development of rural infrastructure and health services.
9. Expansion of skilled employment opportunities for women.
10. Promotion of international migration as it is one of the foundation of Bangladesh economy.
11. Improvement of pure drinking water supply and sanitation facilities.

REFERENCES

Ahmed, A., Hill, R. V., Smith, L., & Wiesmann, D. (2007). *The world's most deprived: characteristics and causes of extreme poverty and hunger*. *Food Policy*. https://doi.org/10.2499/0896297705

Ahmmed, M. (2013). Impact of wealth inequality on child nutrition in Bangladesh. *Paediatrica Indonesiana*, *53*(6), 299–304. https://doi.org/10.14238/pi53.6.2013.299-304

Alamgir, M. (1978). *Bangladesh: A case of below poverty level equilibrium trap*. Dhaka: Bangladesh Institute of Development Studies.

Awasthi, S., Glick, H. A., & Fletcher, R. H. (1996). Effects of cooking fuels on respiratory diseases in preschool children in Lucknow, India. *The American Journal of Tropical Medicine and Hygiene*, *55*(1), 48–51. https://doi.org/https://doi.org/10.4269/ajtmh.1996.55.48

Aykroyd, W. R. (1974). *The conquest of famine*. London: Chatto and Windus.

Berman, S. (1991). Epidemiology of acute respiratory infections in children of developing countries. *Rev Infect Dis, 3 (suppl)*, 5454–5462.

Bishwakarma, R., & Vanneman, R. D. (2011). Spatial inequality in child nutrition : Implications of regional context and individual/household composition. *(*Unpublished doctoral dissertation*).University of Maryland, College Park,*. Retrieved from http://drum.lib.umd.edu/bitstream/handle/1903/11683/Bishwakarma_umd_0117E_12081.pdf?sequence=1&isAllowed=y

Black, R., Bennett, S. R. G., Thomas, S. M., & Beddington, J. R. (2011). Climate change: Migration as adaptation. *Nature*, *478*(7370), 447–449. https://doi.org/10.1038/478477a

Black, R. E., Allen, L. H., Bhutta, Z. A., Caulfield, L. E., de Onis, M., Ezzati, M., … Rivera, J. (2008). Maternal and child undernutrition: global and regional exposures and health consequences. *The Lancet*, *371*(9608), 243–260. https://doi.org/10.1016/S0140-6736(07)61690-0

Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., De Onis, M., … Uauy, R. (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet*, *382*(9890), 427–451. https://doi.org/10.1016/S0140-6736(13)60937-X

Bloem, M. W., Semba, R. D., & Kraemer, K. (2010). Castel Gandolfo Workshop: An introduction to the impact of climate change, the economic crisis, and the increase in the food prices on malnutrition. *Journal of Nutrition*, *140*(1), 132S–135S. https://doi.org/10.3945/jn.109.112094

Blyn, G. (1966). *Agricultural trends in India 1891-1947: Output, availability and production*. Philadelphia: University of Pennsylvania Press.

Bourdieu, P. (2014). Distinction: A social critique of the judgement of the taste. In D. B.

Grusky & K. R. Weisshaar (Eds.), *Social stratification: Class, race, and gender in sociological perspective* (Fourth, pp. 982–1003). Boulder: Westview Press.

Bradatan, C., Dennis, J. A., Flores-Yeffal, N., & Swain, S. (2017). Climate variability, child health and household environment in Honduras. An unpublished paper.

Bradatan, C. (2013). Where do we go from here? Climate change as a human affair. *International Sociology*, *28*(5), 496–501. https://doi.org/10.1177/0268580913496914

Bush, R. (1985). Briefing: Drought and famines. *Review of African Political Economy*, *33*.

Campbell, A. A., de Pee, S., Sun, K., Kraemer, K., Thorne-Lyman, A., Moench-Pfanner, R., … Semba, R. D. (2010). Household rice expenditure and maternal and child nutritional status in Bangladesh. *Journal of Nutrition*, *140*(1), 189S–194S. https://doi.org/10.3945/jn.109.110718.

Center for Hazards and Risk Research (CHRR) - Columbia University, Center for International Earth Science Information Network - Columbia University, and International Research Institute for Climate and Society - Columbia University. (2005). "Global Drought Hazard Frequency and Distribution." Accessed March 20, 2018. http://sedac.ciesin.columbia.edu/data/set/ndh-drought-hazard-frequency-distribution.

CGIAR-CSI (2012). Global geospatial potential evapotranspiration & aridity index methodology and dataset description. Accessed March 20, 2018. http://www.cgiar csi.org/wp-content/uploads/2012/11/Global-Aridity-and-Global-PET-Methodology.pdf

Chowdhury, M. R. K., Rahman, M. S., Khan, M. M. H., Mondal, M. N. I., Rahman, M. M., & Billah, B. (2016). Risk factors for child malnutrition in Bangladesh: A multilevel analysis of a nationwide population-based survey. *Journal of Pediatrics*, *172*, 194–201e1. https://doi.org/10.1016/j.jpeds.2016.01.023.

Clearly, G., & Blackburn, C. R. (1968). Air pollution in native huts in the highlands of New Guinea. *Arch Environ Health*, *17*, 785–794.

Collins, D. A., Sithole, S. D., & Martin, K. S. (1990). Indoor woodsmoke pollution causing lower respiratory disease in chidlren. *Trop Doct*, *20*, 151–155.

de Benoist, B., Darnton-Hill, I., Davidsson, L., Fontaine, O., & Hotz, C. (2007). Conclusions of the joint WHO/UNICEF/IAEA/IZiNCG interagency meeting on zinc status indicators. *Food and Nutrition Bulletin*, *28*(3 SUPPL.), 480–486. https://doi.org/10.1177/15648265070283S306

Declaration, R. (2011). Rome declaration on world food security, 1–29.

del Ninno, C., & Lundberg, M. (2005). Treading water: The long-term impact of the 1998 flood on nutrition in Bangladesh. *Economics and Human Biology*, *3*(1), 67–96. https://doi.org/https://doi.org/10.1016/j.ehb.2004.12.002

Devereux, S. (1993). *Theories of famine*. Hertfordshire: Harvester Wheatsheaf.

Douglas, I. (2009). Climate change, flooding and food security in south Asia. *Food Security*, *1*(2), 127–136. https://doi.org/10.1007/s12571-009-0015-1

Ellegård, A. (1996). Cooking fuel smoke and respiratory symptoms among women in low-income areas in Maputo. *Environmental Health Perspectives*, *104*(9), 980–985. https://doi.org/10.1289/ehp.96104980

FAO. (2008). *The state of food and agriculture*. *Food and Agriculture Organization of United Nations*.

FAO. (2016). *The state of food and agriculture*. *Food and Agriculture Organization of United Nations*. https://doi.org/ISBN: 978-92-5-107671-2 I

FAO/WHO. (1992). World declaration and plan of action for nutrition. *International Conference on Nutrition*, (December), 1–42. https://doi.org/?

FAO, IFAD, UNICEF, WFP, & WHO. (2017). *The state of food security and nutrition in the world 2017. building resislience for peace and food security*. FAO. Retrieved from http://www.fao.org/3/a-I7695e.pdf

FAO & WHO. (2014). Country Nutrition Paper Bangladesh.

Field, A. (2005). *Discovering statistics using SPSS*. London: SAGE Publications Ltd.

Germov, J., & Williams, L. (1999). Introducing the social appetite: Why do we need a sociology of food and nutrition. In J. Germove & L. Williams (Eds.), *A sociology of food and nutrtion: The social appetite* (pp. 1–10). Victoria: Oxford University Press.

Gray, C. L., & Mueller, V. (2012). Natural disasters and population mobility in Bangladesh. *Proceedings of the National Academy of Sciences*, *109*(16), 6000–6005. https://doi.org/10.1073/pnas.1115944109

Gwatkin, D.R., Rutstein, S., Johnson, K., Pande, R.P., & Wagstaff, A. (2000). *Socio-economic differences in health, nutrition and poverty.* HNP/Poverty Thematic Group of The World Bank. Washington, D.C.: The World Bank.

Haque, W., Mehta, N., Rahman, A., & Wignaraja, P. (1975). *Towards a theory of rural development*. Bangkok: UN Asian Development Institute.

HarvestPlus. (2007). *Micronutrient malnutrition*. Washington, DC: HarvestPLus.

Hashizume, M., Wagatsuma, Y., Faruque, A. S. G., Hayashi, T., Hunter, P. R., Armstrong, B., & Sack, D. A. (2008). Factors determining vulnerability to diarrhoea during and after severe floods in Bangladesh. *Journal of Water and Health*, *6*(3), 323–332. https://doi.org/10.2166/wh.2008.062

Hasib, E., & Chathoth, P. (2016). Health impact of climate change in Bangladesh: A summary. *Current Urban Studies*, *4*(March), 1–8. https://doi.org/10.4236/cus.2016.41001

Headey, D., Hoddinott, J., Ali, D., Tesfaye, R., & Dereje, M. (2015). The Other Asian Enigma: Explaining the Rapid Reduction of Undernutrition in Bangladesh. *World Development*, *66*, 749–761. https://doi.org/10.1016/j.worlddev.2014.09.022

Headey, D. D. (2013). Developmental drivers of nutritional change: A cross-country analysis. *World Development*, *42*(1), 76–88. https://doi.org/10.1016/j.worlddev.2012.07.002

Henson, R. (2014). *The thinking person's guide to climate change*. Boston: American Meteorological Society.

Honicky, R. E., Osborne, J. S., & Akpom, C. A. (1985). Symptoms of respiratory illness in young children and the use of wood-burning stoves for indoor heating. *Pediatrics*, *75*, 587–593.

ICF International. (2013). *Incorporating Geographic Information into Demographic and Health Surveys: A Field Guide to GPS Data Collection.* Calverton, Maryland, USA: ICF International.

ILO. (2015). *Global evidence on inequities in rural health protection: New data on rural deficits in health coverage for 174 countries*.

IPCC. (2014). Climate change 2014: Synthesis report. Contribution of working groups I, II, and III to the fifth assesment report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland.

Islam, A., & Biswas, T. (2015). Chronic stunting among under-5 children in Bangladesh: A situation analysis. *Advances in Pediatric Research*, 2–9. https://doi.org/10.12715/apr.2015.2.18

Islam, M. M., Alam, M., Tariquzaman, M., Kabir, M. A., Pervin, R., Begum, M., & Khan, M. M. H. (2013). Predictors of the number of under-five malnourished children in Bangladesh: Application of the generalized poisson regression model. *BMC Public Health*, *13*(1), 1. https://doi.org/10.1186/1471-2458-13-11

Islam, M. R., & Shamsuddhoha, M. (2017). Socioeconomic consequences of climate induced human displacement and migration in Bangladesh. *International Sociology*, *32*(3), 277–298.

Karim, Z., Hussain, S. G., & Ahmed, M. (1996). Assessing impacts of climatic variations on foodgrain prpduction in Bangladesh. *Water, Air, and Soil Pollution*, *92*(1–2), 53–62. https://doi.org/10.1007/BF00175552

Kosek, M., Bern, C., & Guerrant, R. L. (2003). The global burden of diarrhoeal disease, as estimated from studies published between 1992 and 2000. *Bulletin of the World Health Organization*, *81*(3), 197–204. https://doi.org/S0042-96862003000300010 [pii]

Krishnamurthy, P. K., Lewis, K., & Choularton, R. J. C. F. (2012). Climate impacts on food security and nutrition. *Met Office and WFP's Office for Climate Change*, 1–23.

Kumar, R.H., Venkaiah, K., Arlappa, N., Kumar, S., Brahmam, G., Vijayaraghavan, K. (2005). Diet and nutritional situation of the population in the severely drought affected areas of Gujarat. *Journal of Human Ecology*, *18*, 319–326.

Lancet. (1985). Editorial: Accute respiratory infections in under-fives: 15 million deaths a year. *Lancet, ii*, 699–701.

Martin, S. F. (2009). Managing environmentally induced migration. In F. Laczko & C. Aghazarm (Eds.) (pp. 353–384). Geneva: International Organization for Migration.

Massey, D. S., Arango, J., Hugo, G., Kouaouci, A., Pellegrino, A., & Taylor, J. E. (1993). Theories of international migration: A review and appraisal. *Population and Development Review*, *19*(3), 431–466.

McIntosh, W. A. (1996). *Sociologies of food and nutrition*. New York: Plenum Press.

Merton, R. K. (1995). Opportunity structure: The emergence, diffusion, and differentiation of a sociological concept, 1930s to 1950s. In F. Adler & W. S. Laufer (Eds.), *Advances in criminologial theory: The legacy of anomie theory* (pp. 3–78). New Brunswick: Transaction Publishers.

Milojevice, A., Armstrong, B., Hashizume, M., McAllister, K., Faruque, A., Yunus, M., … Wilkinson, P. (2012). Health effects of flooding in rural Bangladesh. *Epidemiology*, *23*(1), 107–115.

MFDM (2008). *Rural-urban migration and its implications for food security in Bangladesh*. Ministry of Food and Disaster Management

Mohsena, M., Goto, R., & Nicholas Mascie-Taylor, C. (2015). Regional variation in maternal and childhood undernutrition in Bangladesh: evidence from demographic and health surveys. *WHO South-East Asia Journal of Public Health*, *4*(2), 139. https://doi.org/10.4103/2224-3151.206683

Morton, A., Boncour, P., & Laczko, F. (2008). Human security policy challenges. *Fmr*, *31*, 5–7. Retrieved from http://www.fmreview.org/sites/fmr/files/FMRdownloads/en/FMRpdfs/FMR31/0507.pdf?v=1392752313000/_/jcr:system/jcr:versionStorage/d0/86/05/d086055f-19be-4d5d-8286 5c97a55e8bcf/1.3/jcr:frozenNode

Myers, S. S., Zanobetti, A., Kloog, I., Huybers, P., Leakey, A. D. B., Bloom, A. J., … Usui, Y. (2014). Increasing CO_2 threatens human nutrition. *Nature*, *510*(7503), 139–142. https://doi.org/10.1038/nature13179.

National Institute of Population Research and Training (NIPORT), Mitra and Associates, & ICF International. (2016). *Bangladesh Demographic and Health Survey 2014*. Dhaka, Bangladesh, and Rockville, Maryland, USA: NIPORT, Mitra and Associates, and ICF International.

National Institute of Population Research and Training (NIPORT), Mitra and Associates, & ICF International. (2009). Bangladesh Demographic and Health Survey 2007. Dhaka, Bangladesh, and Rockville, Maryland, USA: NIPORT, Mitra and Associates, and ICF International

NOAA. (2008): Drought: public fact sheet. National Oceanic and Atmospheric Administration, National Weather Service, Washington, D.C. http://www.nws.noaa.gov/os/brochures/climate/DroughtPublic2.pdf

Parker, D. J., & Thompson, P. M. (2000). *Floods in Africa: Vulnerability, impacts and mitigation*. London: Routledge.

Parvez, K. N. (2011). *Social changes and women-initiated divorce in Dhaka, Bangladesh: Gaining or loosing power?* University of Bergen, Norway.

Paul, S., & Islam, M. R. (2015). Ultra-poor char people's rights to development and accessibility to public services: A case of Bangaldesh. *Habitat International*, *48*, 113–121.

Phalkey, R. K., Aranda-Jan, C., Marx, S., Höfle, B., & Sauerborn, R. (2015). Systematic review of current efforts to quantify the impacts of climate change on undernutrition. *Proceedings of the National Academy of Sciences*, *112*(33), E4522–E4529. https://doi.org/10.1073/pnas.1409769112

Rabbani, A., Khan, A., Yusuf, S., & Adams, A. (2016). Trends and determinants of inequities in childhood stunting in Bangladesh from 1996/7 to 2014. *International Journal for Equity in Health*, *15*(1), 1–14. https://doi.org/10.1186/s12939-016-0477-7

Rahman, A. (2008). Climate change and its impact on health in Bangladesh. *Regional Health Forum*, *12*(1), 16–26.

Ramalingaswami, V., Jonsson, U., & Rohde, J. (1996). Commentary: the Asian enigma, 11–17. Retrieved from http://www.sef.org.pk/ecdpak/old/Gilgit-Conference/articles/day2/The Asian Enigma.pdf

Rashid, S. F. (2000). The urban poor in Dhaka city: Their struggle and coping strategies during the floods of 1998. *Disasters*, *24*(3), 240–253.

Rosenzweig, C., Karoly, D., Vicarelli, M., Neofotis, P., Wu, Q., Casassa, G., … Imeson, A. (2008). Attributing physical and biological impacts to anthropogenic climate change. *Nature*, *453*(7193), 353–357. https://doi.org/10.1038/nature06937.

Rutstein, S., Johnson, K., & Gwatkin, D. (2000). Poverty, health inequality, and its health and demographic effects. Paper presented at the 2000 Annual Meeting of the Population Association of America, Los Angeles, California.

Rutstein, S. (1999). *Wealth versus expenditure: Comparison between the DHS wealth index and household expenditures in four departments of Guatemala.* Calverton, Maryland: ORC Macro.

Sari, M., de Pee, S., Bloem, M. W., Sun, K., Thorne-Lyman, A. L., Moench-Pfanner, R., … Semba, R. D. (2010). Higher household expenditure on animal-source and nongrain foods lowers the risk of stunting among children 0-59 months old in Indonesia: Implications of rising food prices. *Journal of Nutrition*, *140*(1), 195S–200S. https://doi.org/10.3945/jn.109.110858.

Sen, A. (1981). *Poverty and famines: An essay on entitlement and deprivation*. Oxford: Clarendon Press.

Shiva, V. (2015). *Earth democracy: Justice, sustainability, and peace*. Berkeley: North Atlantic Books.

Smith, K. R. (1993). Fuel combustion, air pollution exposure, and health: The situation in developing countries. *Annu Rev Energy Environment*, *58*, 529–566.

Subramanyam, M. A., Kawachi, I., Berkman, L. F., & Subramanian, S. V. (2011). Is economic growth associated with reduction in child undernutrition in India. *Plos Medicine*, *8*(3). https://doi.org/https://doi.org/10.1371/journal.pmed.1000424.

Thapar, N., & Sanderson, I. R. (2004). Diarrhoea in children: An interface between developing and developed countries. *The Lancet*, *363*(9409), 641–653. https://doi.org/https://doi.org/10.1016/S0140-6736(04)15599-2.

The World Bank (2016). Bangladesh: Improving water supply and sanitation. http://www.worldbank.org/en/results/2016/10/07/bangladesh-improving-water-supply-and-sanitation

Thompson, B., Cohen, M. J., & Meerman, J. (2012). World food insecurity and malnutrition: Scope, trends, causes and consequences. In B. & Thompson & M. J. Cohen (Eds.), *The impact of climate change and bioenergy on nutrition* (pp. 21–41). Rome: FAO & Springer.

Thompson, B. (2011). Combating iron deficiency: Food-based approaches. In B. Thompson & L. Amoroso (Eds.), *Combating micronutrient deficiencies: Food-based approaches* (pp. 268–288). Rome: CAB International and FAO.

UN Habitat. (2015). *Informal settlement*. New York.

UNICEF. (2015). *Maternal and newborn health disparities: Bangladesh*.

United Nations. (2014). Resolution on Early, Child and Forced Marriage. New York, USA: UN General Assembly Report No.: 68/148.

United Nations. (1992). United nations framework convention on climate change. *Fccc/Informal/84*. https://doi.org/10.1111/j.1467-9388.1992.tb00046.x.

United Nations. (1989). Convention on the Rights of the Child. New York, USA: UN General Assembly.

United Nation. (1948). Universal Declaration of Human Rights. 217 A (III) New York, USA: UN General Assembly.

UNSCN. (2010). *6th report on the world nutrition situation: Progress in nutrition*. Geneva. https://doi.org/10.1111/j.1753-4887.1947.tb04238.x.

Vollmer, S., Harttgen, K., Subramanyam, M. A., Finlay, J., Klasen, S., & Subramanian, S. V. (2014). Association between economic growth and early childhood undernutrition: Evidence from 121 Demographic and Health Surveys from 36 low-income and middle-income countries. *The Lancet Global Health*, *2*(4), e225–e234. https://doi.org/10.1016/S2214-109X(14)70025-7

Walsh, J., Wuebbles, D., Hayhoe, K., Kossin, J., Kunkel, K., Stephens, G., … Somerville, R. (2014). Chapter 2: Our changing climate. *Climate change impacts in the United States: The third national climate assessment*, 19–67. https://doi.org/10.7930/J0KW5CXT.On

Watson, J. T., Gayer, M., & Connolly, M. A. (2007). Epidemics after natural disasters Yeeyan.pdf, *13*(1), 1–5. https://doi.org/https://dx.doi.org/10.3201/eid1301.060779.

Wehner, M.F., Arnold, J.R., Knutson,T., Kunkel, K.E., & LeGrande, A.N. (2017). Droughts, floods, and wildfires. In: *Climate Science Special Report: Fourth National Climate Assessment, Volume I* [Wuebbles, D.J., Fahey, D.W., Hibbard, K.A., Dokken, D.J., Stewart, B.C. & Maycock, T.K. (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 231-256 doi: 10.7930/J0CJ8BNN.

WHO. (2017). Arsenic fact sheet. Retrieved from http://www.who.int/mediacentre/factsheets/fs372/en/

Woltman, H., Feldstain, A., MacKay, J.C., & Rocchi, M. (2012). An Introduction to Hierarchical Linear Modeling. *Tutorials in Quantitative Methods for Psychology*, *8*(1), 52-69.

Appendixes

A. Correlation among the individual level variables

	Age	Islam	Married	Education	Migrant	Dhaka	Chittagong	Rajshahi	Khulna	Barisal	Early Married	Rural	Wealth Index	Dirt Floor	Tubewell	Flush Toilet	Toilet Shared	Animal Dung
Age		-.019	-.169**	-.326**	-.002	-.013	-.016	-.005	.009	-.012	.004	-.025*	.028**	.052**	.106**	.054**	-.124**	.002
Islam			-.023*	-.024*	-.062**	.052**	.005	-.006	.022*	-.021*	.087**	-.042**	-.004	-.011	-.002	.005	.016	-.079**
Married				.145**	.094**	.014	.004	.009	-.009	.033**	-.029**	.015	.021*	-.006	.009	-.005	-.014	.013
Education					.054**	-.014	.009	.017	.046**	.055**	-.312**	-.177**	.431**	-.363**	-.138**	.319**	-.126**	-.055**
Migrant						.015	.011	-.008	-.011	-.014	-.005	-.058**	.067**	-.064**	-.028**	.060**	.003	.005
Dhaka							-.239**	-.252**	-.226**	-.204**	.009	-.089**	.071**	-.117**	-.136**	.010	.093**	-.064**
Chittagong								-.222**	-.199**	-.180**	-.020	-.004	.069**	-.016	-.002	-.004	-.009	-.090**
Rajshahi									-.210**	-.189**	.036**	.041**	-.080**	.032**	.052**	.001	.031**	-.003
Khulna										-.170**	.026**	.006	.030**	.010	.038**	-.010	.013	.214**
Barisal											.020	.016	-.110**	.089**	.060**	-.056**	-.109**	-.073**
Early Married												.153**	-.222**	.233**	.126**	-.204**	.078**	.036**
Rural													-.448**	.396**	.163**	-.325**	-.065**	.096**
Wealth Index														-.628**	-.248**	.513**	-.102**	-.096**
Dirt Floor															.480**	-.445**	.096**	.132**
Tube Well																-.048**	-.044**	.094**

Appendix A, Con't

	Age	Islam	Married	Education	Migrant	Dhaka	Chittagong	Rajshahi	Khulna	Barisal	Early married	Rural	Wealth Index	Dirt Floor	Tub Ewell	Flush Toilet	Toilet Shared	Animal Dung
Fush Toilet																	-.115**	-.085**
Toilet Shared																		.014
Animal Dung																		

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

B. Correlation Among the Climatic Variabilities

	Rainfall_2000	Rainfall_2005	Aridity	Temperate_ January	Temperature_ May	Drought Episode
Rainfall_2000		.967**	.924**	-.028**	-.765**	-.476**
Rainfall_2005			.857**	-.146**	-.710**	-.339**
Aridity				.239**	-.636**	-.485**
Temperature_ January					.365**	-.036**
Temperature_ May						.610**
Drought Episode						

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).