Food Policy and Food Security: A Potential Impact of Food Policy on Household Food Security in Rural Bangladesh

Final Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Environmental Policy – Memorial University of Newfoundland, Canada.

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December, 2020

Acknowledgement

First and foremost, I record my best regards, profound gratitude, and indebtedness to my respected as well as beloved Graduate supervisor and committee review member, Dr. Gabriela Sabau, Professor, Environment and Sustainability, Grenfell Campus, Memorial University of Newfoundland, Canada for her sincere supervision, inspiring attitude, encouragements and wise advice throughout the entire period of my Graduate program. I feel very lucky and grateful to have her as my supervisor for giving me such an opportunity to work in close association with her. She has always supported me and helped me to develop my thesis work more concisely.

I would like to give thanks to Dr. Garrett Richards, Ph.D. Assistant Professor, Environmental Policy Institute, Environment & Sustainability Program as I have learned a lot from the course ENVP-6002, Research Design and Methods from him. The content of this course helped me a lot to develop my research proposal as well as the writing of the thesis main body. I have to extend my thanks to Dr. Andreas Klinke and Dr. Stephen Decker too. I completed two courses under Professor Andreas Klinke and learned a lot about the critical writing system. Dr. Stephen Decker helped me a lot to seek permission for collecting data in Bangladesh and also managing funds for my internship program.

I am also especially thankful to Dr. Daniel Nadolny and Ms. Lan Ma the members of Grenfell Campus Research Ethics Board, as they reviewed my research questionnaire and approved it very quickly. My heartiest greetings to all faculty members and staff of the Environmental Policy Institute, Grenfell Campus for their endless patience and co-operation and collaboration.

This study is based on primary data and I express my deep appreciation to the households of three sub-districts in the Rajshahi district who were my respondents during the periods of data collection. As I feel that without their co-operation and helpful attitude this research would not have been possible.

Last but not the least I would like to give my heartiest thanks to my parents, sister, my son Wasiq Ahnaf and my husband Md. Selim Reza for giving me encouragement and support to complete this work. Their love and helpful attitude always encouraged me to keep going and I am truly grateful to them.

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List of Abbreviations and Acronyms

ASA	Association for Social Advancement
BRAC	Bangladesh rural advancement Committee
CFSVA	Comprehensive Food Security & Vulnerability Analysis
EIU	Economist Intelligence Unit
FAO	Food and Agricultural Organization
FCS	Food consumption score
GHI	Global Hunger Index
HFIAS	Household Food Insecurity Access Scale
HHS	Household Hunger Scale
HLPE	High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security
HSC	Higher Secondary Certificate
IFPRI	International Food Policy Research Institute
IPC	Integrated food security phase classification
OLS	Ordinary Least Square
SSC	Secondary School Certificate
TMSS	Thengamara (a place name in Bangladesh) Mohila (Female) Sabaj (Green) Sangha (Community)
USAID	United States Agency for International Development
WB	World Bank
WFP	World Food Programme
WTO	World Trade Organization

Abstract

Food policy is a strategy that any government should pursue as part of their public policy. Food policy includes aspects such as food production, distribution, consumption, availability, purchasing procedures, and techniques of food processing and marketing. For developing the necessary level of food security, the food policy is working as an initiative at the domestic level which is also helpful to ensure a safe and adequate supply of food for the general public. In this research we study the impact of food support, which is part of the food policy, on the household's daily calorie intake, as well as food security index, by using telephone interview survey data from three sub-districts of the Rajshahi district (Puthia, Paba and Charghat) in Bangladesh. The survey was conducted using 160 households from these three sub-districts, and among them 67 households (41.9 percent) were food support receivers while the rest, i.e. 93 households (58.1 percent) were food support non-receivers. In this research, the daily mean calorie intake, head count ratio, shortfall or surplus index and food security index are calculated to identify the extent of food insecurity among the respondents. The PSM (propensity score matching technique) is used to assess the effects of food policy on rural household's food security. Results have shown that, dissimilarities exist in unobserved characteristics between the groups of food support receivers and non-receivers, as food prices and agricultural production may influence the household's decision to receive government food support. This influenced both the calorie intake and food security index of the sample respondents. A comparison of the means of the matched sample, showed that the two groups did not differ in food expenditure. Therefore, the impact of government food support on the calorie intake or food security index in the present study may not be underestimated, due to the likely heterogeneity in agricultural

production. The results also suggest that natural disasters like floods, cyclone, drought, and improper distribution of food which are unobserved characteristics for the sample may influence food support received. Descriptive statistics suggested that the age of the household head and income earning member did not differ in the matched sample. Therefore, households' monthly income did not likely differ between the two groups. The results also indicate that there is no proper distribution of food supplied by the government among the rural households in the study area as well as food support is insufficient compared to necessity and, thus, food support receivers and non-receivers were unlikely to differ in this regard. Finally, the researcher generated some policy suggestions which might be useful to policy makers as well as decision-makers of the relevant authorities. The study recommended that government should keep an updated database including necessary information about the poor and marginalized people; should take measures to reduce corruption in the case of food distribution, and extend the food coverage to cover more poor people in order to implement the food support program effectively. Food policy can be efficiently implemented in a well-functioning socio-economic system. The study concludes that measures such as employment generation, control of food prices, support for producing more food locally and increasing the amount of subsidy for the agricultural sector could contribute to solving the problem of food insecurity at the level of rural households in thestudyarea.

Chapter One

Introduction

1.1 Background of the Study

Worldwide, the total production of food is enough to meet the food demand for around nine billion people; however, every year almost one billion people all over the world are suffering from scarcity of food or food insecurity (Altieri, Nicholls and Funes, 2012), while significant amounts of food are wasted in some countries, such as Canada. Many people in the poorer or developing countries are passing their days without any food; at the same time, numerous people from developed countries are suffering from various diseases like obesity and degenerative diseases which result from overconsumption of food (Friel and Lichacz, 2010; Popkin, 1993, 2008). Possible reasons of this unequal distribution of food worldwide is most countries' focus on unchecked economic growth and the failure to develop sustainable food systems (Lawrence, Lyons and Wallington, 2010; Lawrence, Richards and Lyons, 2013) and policies for dealing with food security.

Food policy is a strategy that any government should pursue as a part of their public policy. Food policy includes the procedures of food production, distribution, consumption, availability, purchasing procedures, and techniques of food processing and marketing (Drake university report, 2011). For developing the necessary level of food security, the food policy is working as an initiative at the domestic level which is also helpful to ensure a safe and adequate supply of food for the general public (Fischer, Frohberg, Keyzer, and Parikh, 1988). In more advanced countries, like the USA, the food and nutrition policy is developed around regional and national economic concerns about environmental pressures, maintaining a social safety net and

encouraging private enterprises and innovation (Wilde and Parke, 2013). Pinstrup-Andersen, Watson, Frandsen, Kuyvenhoven, and Von Braun, (2011) states that, for developing countries, an appropriate food and agriculture policy is essential, as in these countries nutritious food is not available for all the people residing within the country and also because of rural poverty which affects the rural people who cannot afford nutritious food. The situation is different for a higher income country where subsidies for agriculture and trade policies play an important role in policy-making (Pinstrup-Andersen, Watson, Frandsen, Kuyvenhoven, and Von Braun 2011).

Food security exists when "all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 2002). According to the report of the World Food Summit (1996), food security has four dimensions, i.e. food availability, utilization, accessibility and stability. Most of the countries are both food producers and food consumers. When food production is also considered in the equation of food security, the causes of food insecurity appear to be more complex and intricate. The major sources of food insecurity are unequal distribution of food, lack of access to land for growing food, the influence of mega corporations who control bureaucracies and governments, free trade, year-to-year variations in international food prices, foreign exchange earnings, size of population, domestic food production and household incomes (WB, 1986). These sources are often related to temporary sharp reductions in a population's ability to produce or purchase food and other essentials, which undermines the long term development of a country and causes loss of human capital from which it takes years to recover (WB, 1986). At the national level, food security may also be associated with agricultural liberalization, which is often the source of increased volatility in production and prices, as well as climate change which can affect the agricultural performance (FAO, 2002). In addition, national and international

agricultural and food policies also play an important role in fluctuations of food production and food security (Ninno, Dorosh and Smith, 2003).

According to a relatively recent report on global food policy 2017, about 63 percent people are "dissatisfied" with the global food policies, while 73 percent are "not satisfied" with the food policies existing in their own countries. If we consider the progress of global food policies and of food policies in people's own countries, then about 60 percent and 66 percent of the people are "not satisfied" respectively (Global food policy report, 2017). Additionally, 36 percent of the surveyed people thought that by 2025 the world hunger and under nutrition can be eliminated, while 46 percent believed that hunger and malnutrition can be removed from their own country by 2025. The report also referred to rapid urbanization (the expansion of cities and urban populations) that will make it harder to ensure nutritious food for everyone. 73 percent of the respondents believed this, while 61 percent thought that policies and investment are needed for supporting the development of links that bring food products from rural producers to urban consumers (Global food policy report, 2017). As it is known, the world population is growing and rapid urbanization takes place everywhere of the world. This creates pressure on the global food supply as well as on agricultural production. The increasing population is responsible for environmental degradation, change in global climate, extreme weather conditions and limited availability of land for food production. The world is attempting to build momentum through global initiatives, such as the Habitat III summit and the Milan urban food policy pact (Global food policy report, 2017).

The report also mentions that developing countries, can improve the food security and nutrition in both rural and urban areas by creating linkages between smallholder agricultural producers and urban consumers. Urbanization will be a blessing for the rural producers as they could

supply nutritious food to urban markets and earn a larger profit. According to Muzzini, Puig, Anapolsky, Lonnberg, and Mora (2016), rapid urbanization creates more new cities which have the potential for economic growth as in most cities there exist educated middle class people, and cities have a long history of making public policies and industrial development, a very strong, skilled and highly creative workforce etc. In addition, cities are full of supply of the abundant natural resource and a vibrant culture and art scene (Muzzini, Puig, Anapolsky, Lonnberg, and Mora, (2016). All of these incentives are helpful to reduce malnutrition and ending hunger and besides this, co-ordinations of policies, can strengthen the value chains; investment in rural areas is also needed to remove the problem of food security in developing countries (Global food policy report, (2017).

Climate change affects the world economy at a great extent and agriculture sector is the main victim of this existential threat (Lenton et. al., 2019; NSAC, 2019). Recently, the agriculture resilience act (2020) is trying to mitigate the effects of climate change through various techniques such as removing carbon as well as decreasing other greenhouse gases, increasing soil health etc. According to Lenton et al., (2019), many people believe that, nothing can be done to reduce the effect of climate change on human life but Wright, (2020) reported that in China, the greenhouse gas emission (GHG) is reduced to 25 percent in a very short time. The reasons behind this reduction of GHG is the recent response of people to the COVID-19 virus. The amount of nitrogen oxides, CO_2 has also reduced in Caifornia, China, and in Italy due to recent stop of travelling by car or airplane as well as the locked down of peoples' movement (Gohd, 2020; Ghosh, 2020 and Nasralla, Volcovici and Green, 2020). Many researchers, who work on resilience, predict that the reduction of GHGs will continued but it is unpredictable too. The Air Resources Board in California encourages to hire more workers to work from home after the

COVID-19 crisis ends and the objectives of these steps is to continuing the reduction of GHGs emissions (Gohd, 2020). The COVID-19 crisis provides an opportunity to examine the eight qualities of ecologically resilient food system such as the connectivity, local self-organization, innovation, maintenance, accumulation of value added infrastructure, transformation, ecological integration and diversity (Worstell, 2017). The specific resilience of Corona virus is to invent a vaccine but the virus will not disappear. In fact, it could mutate to another form of virus. From this point of view, the grocery store seems to be a general resilience and in this sector, the amount of employment is rising and besides this, the restaurateurs, consumers and grocers earned more dollars in this crisis period (Redman, 2020). The consumers are more likely to eat homemade food instead of eating food prepared at the restaurants and they won't like to go back to restaurant for eating foods as it is risky and harmful for their health (Varadarajan, 2020). Online business, resilient societies, communities, farms as well as online food businesses, new jobs in home delivery and local food delivery businesses (such as the Instacart, Grubhub and DoorDash) will take the advantage of the opportunities of increasing employment arises by the disturbance of COVID-19 (Worstell,2020). The country which was fully dependent on outside sources of food or imported food are now become more conscious about self as well as independent production system (Fink, 2019; Worstell, 2020). This led to a increase in sales as well as jobs in plant nurseries and seeds providers (Marantos, 2020). The local ecosystems also developed by producing food locally. Due to the recent pandemic, the farmers are now delivering products directly to their customers and increases the benefits of the farmers as they get the right price of their products. The consumers did not need to go to the grocery shop for buying products instead they can order from home to multiple farmers. Besides social distancing, the COVID-19 crisis has also increasing the social bridging by voluntary works, non-profit initiatives from the

farmers as well as delivering food to the aged peoples staying at home (Grillo, 2020). Investment in on-farm storage, processing, packaging as well as distributing locally will robust the response in similar disruptions and this will add more value for the farm. The procedure of storage, farm processing and transportation infrastructure will rule the after COVID-19 situation (Worstell, 2020).

In Bangladesh, the main challenge to attaining sustainable food security is the increasing rate of population growth (Mahbub Hossain and Bayes, 2010). Although rice production has been increasing faster than in previous times, the overall domestic production is difficult to increase due to the negative influence of supply side factors such as the lack of diversification (producing a variety of rice) in domestic production (Mahbub Hossain and Bayes, 2010). According to the latest Worldometer elaboration of the United Nations data, the current population of Bangladesh is 163,906,226 (Worldometer, 2020). Among these, 39.4 percent is urban population (64,814,953 people), and the approximate number of rural population in Bangladesh is 99,874,430 people (60.6 percent) (Worldometer, 2020). Agriculture is the backbone of Bangladesh's economy. In Bangladesh, the agriculture sector is contributing around 17 percent of the total GDP and provides employment to 45 percent of the workforce (BBS, 2018). In rural areas, about 84 percent of the people are directly or indirectly involved with agriculture for their livelihood. This sector also contributes to earn foreign currency by supplying raw materials to the food industry exports (BBS, 2018). The major agricultural products of Bangladesh are rice, wheat, legumes, fruits, vegetables, fish, chicken meat and seafood. At the same time, Bangladesh is a major importer of agricultural food items. In FY 2014-2015, about 5.27 million metric tons of food grain was imported, of which 1.49 million metric tons was rice and 3.78 million metric tons was wheat (FPMU, 2015). Bangladesh is also a producer of food. It exports some fish items (shrimp)

and vegetables to Middle East countries and United Kingdom. Despite progress in food production and the improved availability of food due to increased national production, 40 million people – which represent one quarter of the country's population – remain food insecure, and 11 million suffer from acute hunger in Bangladesh (WFP, 2017).

Moreover, in Bangladesh, day by day, the area of agricultural land is decreasing to satisfy the increasing demand of housing, industries and infrastructure for the growing population. In addition, river erosion due to floods, deforestation, and heavy rainfalls, strong river currents and silt deposition are other causes of the loss of arable land (Munna, 2018). To produce more food on a limited land area, the farmers are now using chemical fertilizers and insecticides heavily, which leads to declining soil fertility and increases the risks of low productivity. The effect of climate change and global warming is another reason of agricultural land loss, as the rising of sea levels is decreasing the area of agricultural land (Mahbub Hossain and Bayes, 2010). To counter this situation, since 2006, there is a national food security policy in Bangladesh with main provisions concerning the households. The objectives of the food policy are to ensure an adequate and stable supply of safe and nutritious food, to increase the farmers' incomes purchasing power, to secure access to food for everyone and to ensure adequate nutrition for all individuals, especially for women and children (NFP, 2006).

To overcome the food shortage problem, the Bangladesh government has also implemented an Action Plan (2008-2015) which included trade liberalization policies, such as decreasing import tariffs on some food items, for example rice (Dorosh, 2001; Del Ninno, Dorosh and Smith, 2003). The concepts of rice fish farming (dual farming system, which indicates rice as the main crops and fishes as the source of additional income) and aquaculture are also a part of recent food policy (Ahmed and Lorica, 2002; Ahmed and Garnett, 2011). For the increasing population

of Bangladesh, rice fish farming fulfills the lack of carbohydrates and proteins in diets. It is assumed that the rural population of Bangladesh will benefit from rice fish farming as their incomes will be increasing (Akter and Basher, 2014). To increase food security, it is necessary to involve more female workers into the rural workforce and research centers. Adoptive agriculture innovative technology will also be helpful in eradicating the food shortage problems (Feder, Just and Zilberman, 1985). "The process of adoption is a mental process an individual passes from first hearing about an innovation to final adoption" (Rogers, 1962, p. 17). Adoptive agriculture innovative technology means the use of new technology in farming practices, for example high yielding varieties (HYV), fertilizers and corresponding land preparation practices. Nowadays, adoption of technological innovation in farming is very popular to the development economists as the use of new technology will create an opportunity to increase the production as well as the income of the poor people (Feder, Just and Zilberman, 1985). Most of the people from developing or least developed countries (LDCs) are directly or indirectly engaged with agricultural activities and earn their livelihoods from agricultural production. According to Feder, Just and Zilberman, (1985), introduction of new technologies has recorded limited success because there are some limitations of this process such as the lack of credit facilities or loans, limited access to new information, risk aversion, limited number of farm as well as farm area scarcity of human capital, insufficient land tenure systems, absence of modern equipment, shortage of labor, lack of supply of the complementary inputs (such as seeds, chemicals and water) and inappropriate communication and transportation systems. To encourage the introduction of better technologies and good farming practices, the government of Bangladesh provides agricultural credit and has established new policies and programs. These programs are benefitting especially the "better off" farmers, while smallholder farmers are basically deprived

of it. Considering this, it is necessary to pay attention to the smallholder farmers (Osmani, Ahmed, Ahmed, Hossain, Huq and Shahan, 2016).

Bangladesh is the first country in the world to have developed a rice variety which is biologically enriched with zinc (a type of micronutrient) and helps reduce the rate of child mortality, prevalence of diarrhea, pneumonia etc. Bangladesh Government released the world's first zinc enriched rice variety since 2013 (Osmani, Ahmed, Ahmed, Hossain, Huq and Shahan, 2016). In addition, more recently, the government of Bangladesh has been focusing on women empowerment and has proven that this helps to develop a nutrition sensitive agricultural system, as if more women would be self-dependent, a greater amount of more diversified production will be encouraged. This might indicate that the farmers who produce a variety of agricultural and food products will also consume a diversified diet rather than selling the products at a higher price (Osmani, Ahmed, Ahmed, Hossain, Huq and Shahan, 2016). A transformation of income sources, credit programs for the rural households and other preliminary initiatives during crisis moments will be appropriate to reduce poverty and improve the condition of food security in Bangladesh.

The Rajshahi district is located in the northern part of Bangladesh, and like in other rural areas poverty is a common problem in the rural areas of the Rajshahi district, as most of the people living in the rural areas of the district are dependent on agriculture for their livelihoods. They are deprived of modern clothing, healthcare, education, housing, sanitation facilities, pure drinking water and other basic human rights, although they are producing a variety of food like cereals, fruits and vegetables. Most of the food they produce is sold in the urban market in the hope to earn a large revenue, so no food is left for the household. Besides, for getting higher incomes, the

food producers in rural areas of Bangladesh use a huge amount of chemicals and pesticides to get a higher yield. The government of Bangladesh gives a huge amount of food support for the rural poor people in Rajshahi to increase their food security condition. For all of the above reasons, the Rajshahi district has been selected as research and data collection area for this thesis.

1.2 Research Questions

The researcher will try to find answers to the following questions: i) What is the food insecurity issue in rural Bangladesh and what are its main causes? ii) What are some indicators of household food insecurity? iii) What is the current food policy in Bangladesh and how has it impacted the rural household food insecurity? and iv) What can be done to bring a sustainable solution to the problem of rural household food insecurity?

1.3 Objectives of the Research

The rural household food security in Bangladesh basically depends on the country's agriculture production, on international market food prices and on the food policy. In addition, the national food production of Bangladesh fluctuates due to natural disasters like floods, cyclones, and drought, and is impacted by social risk factors such as shortage of capital for farmers. Based on the above research questions, the specific objectives of the study are as follows:

i) Firstly, to examine the food security issue in rural Bangladesh and causes of food insecurity, with a special focus on household food insecurity;

ii) Secondly, to assess whether the different food policies that exist in the country (short term and long term), can solve the households' food security issues in a sustainable way;

iii) Finally, to make some policy recommendations for further development of the existing food policies.

1.4 Thesis Statement

Sustainable food security is a great concern all over the world, especially for the developing countries. In Bangladesh, a large number of people are deprived of nutritious food in their daily life. The economy of Bangladesh is mainly dependent on agriculture; however most of the people spend a huge portion of their incomes to provide food for their families. Bangladesh is a developing country and currently the production of food is growing across the country but still there is a lack of sustainable food security (namely access to food, and the quality of food available), especially in the rural areas of Bangladesh. In the off season (when no crops are produced) there is a lack of employment opportunities and the poor people cannot afford nutritious food for their families. In addition, most of the people spend a huge portion of their incomes to provide food for their families. In this situation, to ensure an adequate supply of food for all the people at all time, the government of Bangladesh has developed a national food policy in 2006. The goal of this food policy is to secure a supply of adequate nutritious and safe food for everybody, especially for women and children, by increasing the purchasing power of their incomes, food production, efficiency of food marketing and price stabilization. Recently, self-employment opportunities, training for the poor, education, government intervention in the agricultural sector and other related food security policies and programs have helped to improve the condition of food security in rural Bangladesh. This research will demonstrate, by using data related to food insecurity of rural households that the Bangladesh government's food policies and related programs have not addressed in a sustainable way the problem of households' food security in rural Bangladesh and more needs to be done in order to achieve this objective.

1.5 Organization of the Thesis

This thesis is organized in seven chapters. Chapter two provides a review of relevant literature covering major topics, concepts and policy issues surrounding the relationship between food policy and food security at the level of rural households. Chapter three discusses the conceptual framework used in this research and Chapter four is a description of the research methodology used in this research. It includes the research technique, sample selection, data collection procedure, data analysis techniques etc. The fifth Chapter presents the socio-demographic features of the sample households and it also presents the model estimation results. The result of the logistic regression model and the propensity score matching (PSM), as well as the extent of food security in the study area are presented in Chapter six. Chapter seven contains the major findings, a conclusion and policy implications derived from these findings.

Chapter Two

Review of Literature

2.1 Introduction

This literature review provides an overview of earlier studies related to food policy, food security and their impact on rural households over the last 10 to 15 years period. The reviewed literature is helpful to fulfill the objectives of the present research by bringing forward the findings of earlier studies, which is helpful to identify the limitations of the previous research, and solve the present research problem. This literature review includes peer reviewed articles from printed and online publications and a few books as well as public/government reports. They cover the relevant literature discussed globally, and some literature of the Asian and developing countries, as well as literature related to food security in Bangladesh. The researcher identified some main themes which are relevant to this research, such as: the conceptual framework for food studies, food insecurity, global food security and agriculture intensification, climate change and global food security, world population growth and food security, food security in Bangladesh and the impact of microcredit on food security in Bangladesh. The chapter also presents some limitations of the literature and some topics for further research.

This chapter is divided into nine main sections. Section 2.1 describes the main themes of the literature reviewed in this chapter; section 2.2 focuses on the conceptual framework for food studies; the meaning and condition of food insecurity around the globe is discussed in section 2.3; the relationship of agriculture intensification with global food security is presented in section 2.4; section 2.5 shows the impact of climate change on global food security; the relationship

between world population growth and food security is presented in section 2.6; section 2.7 describes the trends of food security in Bangladesh; and the impact of microcredit on rural households' food security is analyzed in section 2.8. Finally, the gaps in the reviewed literature are identified in section 2.9.

2.2 Conceptual Framework for Food Studies

The concept of *food security* refers to four ideas which are significant mostly to food consumers such as food availability, accessibility, utility and stability (FAO, 2008). The availability of food indicates the "supply side" of food security and depends on the amount of food production, food stocks levels and net trade (FAO, 2008). Food accessibility is the financial and physical ability of acquiring foods for a balanced diet, while utilization of food is related to the state of nutritional well-being of the people through an adequate diet, access to clean water, sanitation and health facilities. By the concept of food utilization it is clear that the concept of food security is not only dependent on food items but also nonfood items are included with it (FAO, 2006). The concept of stability means both the availability and accessibility of food, i.e. the households must have access to sufficient, safe food all the time. Any kind of sudden shocks such as economic or climatic crisis, cyclical shocks (seasonal food security) will not affect the household's access to food (FAO, 2006).

The Nobel prize laureate A. Sen (1981) stated that to remove hunger and the impact of the famine that occurred in 1974 in Bangladesh, the concept of accessibility to food is not too helpful. The concept of food sovereignty first emerged in 1990s as a prerequisite of gaining food security for all the people, including food producers (Lawrence and McMichael, 2012; Patel,

2009, 2010; Rosset, 2006). There are six pillars of the *food sovereignty* framework, namely: food as a basic need for people, agricultural reformation, sustainable use of land, water and seeds, self-sufficiency in case of food production, and government intervention in the case of food production to increase social welfare (Silva, 2016).

According to Lang (2009), the picture of the food systems differs from developed countries to the developing ones. The peoples of the developing countries are struggling to feed an increasing number of people (Regmi and Weber, 2000), while the developed countries need to cut off consumption as well as their CO_2 emissions and help the developing countries to achieve food security (Silva, 2016). When food and agricultural development policies are implemented in a sustainable ways by following environmental policy rules and regulations as well as observe the ecosystems' limits then this will be called sustainable development (Silva, 2016). Bangladesh is a small country with a large population and it is a challenge for the country to feed the growing number of people. In this situation, it is necessary for the country to implement some new food policies for the improvement of food security as well as increasing food production by using the limited land and modern technology.

Havas and Salman (2011) relate the concept of food security directly to food nutrition and health. The availability of and access to food is considered an important part of food security. The threats to food security are related to rapid urbanization, discrimination of income, overpopulation, environmental degradation, animal health and freshness of food which is an important aspect of food nutrition (Havas and Salman 2011). According to the definition of the World Food Summit 1996, "food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their

dietary needs and food preferences for a healthy life" (Barrett, 2010). This definition includes food availability, food access and also the requirement that the food be safe, nutritious and culturally appropriate.

At present, the global production of food is enough to feed the world's population, but a problem exists due to food distribution. The food is not distributed equitably and also all food is not appropriate for all people around the world (Hazell and Wood, 2008). There is a huge difference in local food access between the developed and developing countries and the reasons behind this is the unequal distribution of income among the populations (Hazell and Wood, 2008). Hazell and Wood (2008) mention that hunger exists in every country (both developed and developing) and this often falls along social and economic lines.

Hunger is a psychological feeling; everyone feels hungry in their daily life and can fulfill their need for food within a short period of time. But this is not the definition of hunger; hunger is that phenomenon in which the lack of meal/bread is involved. In most cases, the people who suffer from hunger were deprived of food to eat and they don't have any option to eat. These people are always trying to feed themselves and their families at present as well as in the future. Generally, hunger is a lack of food supply which causes short term physical discomfort which in turn could be a threat for life (National Research Council, 2006). From this definition, it is clear that the concept of hunger is related to access and availability of food not only to a shortage or limited supply of food. The definition of hunger varies from country to country. In some countries, hunger occurs due to food shortages, especially in the developing countries. In some areas, the reason is that people have no ability to buy enough food, some countries such as Bangladesh

have a “hunger season” occurring every year; this is the season in which the previous harvest is gone and the future harvest is not ready to consume. This situation exists only for three to four months. In US or Canada this types of hunger season does not exist, but in these countries many people such as low wage workers, retirees, people with disabilities and their families, seniors, rural communities and urban communities pass some weeks hungrier than others. The reasons behind this are that, at the end of the month, these families/people run short of food due to low incomes and they can’t spend less on rent but they can spent less on food if needed. The possible factors that cause hunger in US as well as in Canada and abroad are poverty, job instability, food shortages and waste, poor infrastructure, unstable markets, climate change, war and conflict, nutritional quality, and discrimination. According to the estimation of the United Nations Food and Agriculture Organization (FAO), in 2016, about 815 million people (10.7 percent) of the total 7.6 billion people in the world were suffering from under nutrition caused by hunger. Among these, most of the hungry people live in lower-middle-income countries and 11 million live in developed countries (FAO, 2015; for individual country estimates, IFPRI, 2016 and Rosen et al. 2016). In developing countries, like Bangladesh, hunger is one of the most significant problems and the main reason behind this is poverty. The rural farmers, women and children are the most visible victims of under nutrition caused by hunger.

2.3 Food Insecurity

Mohamed (2017) indicates that the concept of *food security* is changes to new dimensions and analysis over the years. According to Mohamed (2017), Ethiopia was affected by the strongest droughts in 2015 and due to this the people of the country suffered from food insecurity and in 2016 food assistance was needed to overcome this problem. This author has identified some sources of food insecurity in Ethiopia, i.e. natural calamities, like drought and land degradation,

huge population growth, policy inconsistency and armed conflict etc. To solve these problems, the people living in Ethiopia have sold their livestock, have lost their agricultural employment, migrated to other areas, were forced to take loans on food grain, for selling wood and charcoal, or to open small-scale businesses and to limit the size and frequency of their daily meals as part of the major strategy (Mohamed, 2017).

Magadoff and Tokar (2009) referred to some factors indicating *food scarcity*, like decrease of food production, increasing food prices, growth of bio-fuels production etc., and mentioned that globally about 36 million people suffer from hunger and live without secure access to food. The main reasons behind the scarcity of food is the decrease of agricultural production which is caused by a changing climate, and increasing temperatures around the globe, as well as loss of crop diversification etc. (Magadoff and Tokar 2009).

Kendall and Pimentell (1994) noted that worldwide the per capita production of food grain has been decreasing and the situation is worse mainly in Africa. To avoid this problem, the only way was to restrict the growth of population (Ehrlich, 2009). Hopfenberg (2003), another neo-Malthusian scholar, asserted that if the production of food is restricted, then the growth of population can be controlled. In 1798, Thomas Malthus identified scarcity of food as a social issue of concern all over the world, and Paul Ehrlich extended the Malthusian theory on population growth, arguing that there will be a war between humans and hunger and maybe the humans are going to fail in the battle (Ehrlich, 2009).

According to Gonzalez (1985), the land has an impact on Latin America's agricultural production and it is an important factor of production. Kendall and Pimentell (1994) also predicted that, due to unsustainable agricultural practices, 30 percent of the total world soil will be damaged by 2050 and the total arable land will also have to increase by around 500 million hectares by 2050. To overcome this situation, new economic and technological development will be helpful which supports sustainable agricultural systems (Boongarts, 1996). Kellogg, Whiteford, Turner, Cahill, and Mertens (2013) postulate that increased exports of agriculture goods will hinder the self-sufficiency of any country and will make it hard to meet their basic needs of food. In developed countries, the export of food products is higher compared to the least developed countries. The least developed countries import most of the food items.

Lio and Liu (2008), have found that political outcomes and democracy can influence the agricultural production, and that democracy is the reasons for lower production in agriculture. Jenkins and Scanlan (2001) have suggested that agricultural production is affected by economic growth. If the economy is growing rapidly this will indicate an increase in GDP and this has a positive impact on the consumption pattern of daily calories intake of the children living in the developing countries.

2.4 Global Food Security and Agricultural Intensification

Conserving biodiversity is a global challenge because of increasing depletion of biodiversity as well as due to changes in land and natural resource use (Tscharntke et al. 2012). Green, Cornell, Scharlemann and Balmford (2005) and Phalan, Balmford, Green and Scharlemann (2011a) discuss whether land for nature and land for production should be separated, in categories such

as “land sparing” or “land sharing” through wildlife-friendly farming. In some recent analyses, it is postulated that it is necessary to protect the wilderness because many wild species failed to survive in the wildlife-friendly farming systems (Maas, Dwi Putra, Waltert, Clough, Tscharntke and Schulze, 2009 and Kleijn et al., 2011). Although most of the recent studies give importance to agricultural intensification, Tscharntke et al. (2012) mention that agricultural intensification fails to solve the complications of the real-world and secure the prospects for agricultural landscapes. According to Schönhart, Schauppenlehner, Schmid, & Muhar, (2011), agriculture intensification is the process of introducing new varieties of crops, using of chemicals and fertilizers and this has a positive impact on agricultural production as well as the wealth of the consumer. The increased yield from agricultural intensification could be used as a policy to control human requirement for land, as well as to reduce impinging on natural habitats (Phalan, Balmford, Green and Scharlemann, 2011a).

Tscharntke et al. (2012) make it clear that in most of the developing world, agriculture practiced under smallholder farmers is the pillar of the world food security. They give less importance to large scale farming, since large scale agricultural production could not reduce the hunger of people. Small and diversified farms, rather than large single crop farms, show greater productivity per area, which is a phenomenon referred to as the ‘paradox of the scale’ or the ‘inverse farm size-productivity relationship’ (Barrett, Bellemare and Hou, 2009; Cornia, 1985; De Schutter, 2011; Halweil, 2006; Horlings and Marsden, 2011). Tscharntke et al. (2012) also have found that the true value of functional biodiversity on the small-scale farm is often ineffectively recognized or assumed, while conventional intensification tends to disrupt the beneficial functions of biodiversity. Functional biodiversity means “*the part of total biodiversity*

composed of clusters of elements (at the gene, species or habitat level) providing the same agro ecosystem service that is driven by within-cluster diversity" (Moonen, and Barberi, 2008, p. 7). The world agriculture lies between conventional and agro-ecological agriculture practices. The conventional agriculture practice means the traditional smallholders with heavy use of pesticide or large-scale organic farms (Wanger, et. al., 2010). To produce sufficient amounts of food, agro ecological practices are the best way as these practices not only depend on traditional agricultural techniques such as using of chemical fertilizer and pesticides or technological solutions, for example genetically modified organisms. The agro-ecological practices improve the sustainability of agricultural systems depending on different ecosystem services such as nutrient cycling, biological N fixation, natural regulation of pests, soil as well as water conservation, biodiversity conservation and carbon sequestration (Wezel, 2014). According to Wezel (2014), among these, some practices were being applied for decades and some still have a limited rate of application.

Another study, by Phalan, Balmford, Green and Scharlemann (2011a) concluded that linking agricultural intensification with biodiversity conservation and hunger reduction is a great challenge for the future, as it requires well-informed regional and targeted solutions. Godfray and Garnett (2014) have argued that to produce more food, improving governance, reducing waste and moderating demand throughout the food system, proper action and taking of the challenge are needed. If sustainable intensification strategies, such as agro-ecology (intercropping), organic farming (i.e. integration of crop and livestock farming), using of biotechnology (i.e., genetic modification) etc., are used, then the production of food will increase (FCRN, 2018). Godfray and Garnett (2014) have also investigated the interaction between food

policy agendas and sustainable intensification, in short, by use of land and biodiversity, animal welfare and human nutrition. These authors have concluded that if the demand for food was increasing, then the pressure to produce more food will also be increasing. As a result, the land will have to be converted and the environment will be damaged, which will lead to an unsustainable intensification that is harmful for the planet (Godfray and Garnett 2014). The real problem is that the amount of land available for agriculture globally is limited (has become scarce), as most of the good/fertile lands are already under agriculture cultivation. In Africa, most of the less fertile lands are now brought under cultivation such as in Southern Nigeria; the demand for palm oil helps to fuel the British style industrial revolution in Algeria. For this reason, the poor French farmers were resettled without compensating the remaining population (Batterburry and Ndi., 2018). In Kenya, the British created large tea plantations on the best land, among these some still exist. Before the first World War, agro-industrial development had been started by the German colonial administration in Cameroon (Bederman, 1996; Mope Simo, 2011). According to Peluso and Lund (2011) and White et al., (2012), the Africans were forced to meet production targets for crops such as cotton and cocoa in their own land due to the increasing demand for taxation and the variation between the out grower and contractor relationship.

2.5 Climate Change and Global Food Security

According to the report by Kloeke (2014), the effects of climate change will be more acute in poor countries, especially for the small-scale producers. By 2030, food and farming systems of the developing countries will be affected by global warming. In many places, the crops and pasture yields are going to decline, for example, in North-East Brazil, Central America, East

Africa and New Zealand. In humans' daily lives, the global climate change has a destructive effect, although not all the effects are negatively impacting the planet, but agriculture and the food sector are at high risk (Kloeke, 2014). To mitigate the impact of climate change on food and agriculture, Kloeke (2014) has identified the crop management adaptation policy, which includes development of new crop varieties, tolerant to drought, heat and salt, irrigation and fertilizer optimization, adjustment of planting date etc. In addition, changes should also be needed in case of livestock and fish farming practices, like if the mangrove forests could be restored then this will help to create sustainable breeding sites for fish populations.

Campbell et al. (2016) asserted that the impact of climate change is very harmful for the production of crops, livestock as well as for fisheries, and the impact is measurable. The changing of climate is a serious threat to food security and in order to reduce the risks, Campbell et al. (2016), have identified four key challenges. Firstly, the culture of research has to change. That means that incentives are given on climate related research and rewards are given to those researchers or publications of papers which give solutions for solving climate change problems and help to achieve outcomes (Knight et al., 2008). Secondly, to keep some options for farmers, communities and countries, what actions should be taken to reduce the effect of climate change from farm to national levels? As the resources are limited, the best of them should be used on the basis of prioritization to get actual benefits (Campbell et al., 2016). Thirdly, make sure that the adaptation actions are relevant and able to reduce the risks of climate change. As Sudgen et al., (2020) have shown, climate change vulnerability depends on economic, social, geographic, ecological and political factors. These factors determine the ability of households to purchase food. Participation of women is also considered here. Finally, a combination of adaptation and

mitigation measures by reducing global warming and increasing food production with the help of an environmental friendly technology (Campbell., et. al., 2016) should also be considered.

Porter et al. (2014) projected that, as a result of global climate change, the total production of world crops will be decreasing. Due to per degree of warming, the average yields of rice, wheat and maize will see reductions between 3 percent to 10 percent (Challinor, et al., 2014b). Moreover, Asseng, et al. (2014) have estimated that the global production of wheat will be decreasing by 6 percent per each degree of warming. Most of the evidence suggests that the reasons behind this reduction are due to increasing the CO_2 in the atmosphere and the warmer climate (DaMatta, et al., 2010). The climate change has an impact on livestock and fisheries too. In the case of livestock, the production, both as the quality and the quantity, of feed will be reduced due to diseases and physiological stress. Also, the quality of meat, milk and eggs will be decreased (Thornton and Gerber, 2010). A dramatic development is seen in the production of marine fisheries and aquaculture sectors. In 1950, the total amount of fish production was 19,3 million tonnes which has risen up to 163 million tonnes in 2009 (FAO, 2011). In the late 1950s and 1960s and between 1983 and 1989 the fisheries sectors developed rapidly and the reasons behind this development was the expansion of post-war shipbuilding expansion and the invention of new technologies such as the steam engine and motor trawlers in 1960s. The extension of jurisdictions from 12 to 200 nautical miles and the establishment of exclusive economic zones following UNCLOS were the reasons for the rapid expansion of fish production in the 1980s (Sanchirico and Willen, 2007). This global increase of fish production has begun to decrease gradually after 1996, and in 2009 about 10 percent of the total production has fallen (FAO, 2011). In 2010, Brander (2010) predicted that the catch of global marine fisheries will be

decreasing by 5 percent to 10 percent by 2050 and the possible reasons behind this were the change in ocean temperatures, ice thickness, wind, pH and nutrient supply.

Consistent with this, Bebber et al. (2013) have also identified climate change as the greater risks for the 21st century as this will affect the ability of people to purchase food and affordability of food for the people for their daily consumption (Nelson, et. al., 2014a). Due to the change in climate, the food production will be lower; as a result, the price of food is projected to become higher (Nelson, et. al., 2014b). White, et. al. (2010) have also concluded that the purchasing power of households determines affordability of food for the people and this may be affected by climate. The other things the climate change can affect is in the production area, i.e. shifts in the production area, flows of trade and access to food etc. (Havlik, et. al., 2014).

The quality and diversification of food is also affected by climate change. The effects of a changing climate on utilization of food have two dimensions. Firstly, through climate change, the safety of the food is hampered and the health is damaged due to lack of nutrition in food. The reasons behind this are that due to a changing climate the world temperature is increasing and this higher temperature is responsible for micro bacterial growth especially on fresh fruits, vegetables and in the fisheries (Hammond, et. al., 2015; Liu, et. al., 2013). Macdonald, et. al., (2011) and Uyttendaele, et al., (2014) have identified some water related impacts of climate change. Due to climate change, the supply of fresh water is decreasing; there is also lack of pure drinking water and fresh water for sanitation, and severe floods will occur and the contamination in water will be increasing which is very harmful for the human health. Despite all of this, climate change has some direct and indirect effects too. Due to increasing temperatures, the

agricultural productivity will be lower and in order to increase the productivity to fulfill the demand of the increasing population, chemicals and pesticides will be used in the agricultural land. This overuse of chemicals is very harmful for human health. Additionally, veterinary medicines which are used in fisheries sector, are responsible for increasing human diseases (Campbell., et. al., 2016). Among the indirect effects are that people become jobless, or migrate to other regions; public health services are damaged or insufficient; and the lack of food among poor and Indigenous peoples becomes more frequent (Costello, et. al., 2009; Ford, 2012).

According to the Millennium Ecosystem Assessment report (MEA, 2005), climate change is responsible for damaging the ecosystems, and food security is linked with ecosystem health through services such as provisioning of food, water, timber, genetic resources; regulating of climate; controlling floods, disease, and pollination; and helping with soil formation, water and nutrient cycling.

2.6 World Population Growth and Food Security

The world population is increasing and it has become a challenge to ensure 'food security' and doubling the global food production by 2150 (Tomlinson, 2013). The food security issue has got importance at international and national policy levels due to the contributory factor called 'food crisis' that left many of the poorest people in the global South unable to afford basic foodstuffs (Lawrence, Lyons and Wallington, 2009). Tomlinson (2013) has criticized the specific claim that "we need to increase global food production by 70% to 100% in order to feed the world in 2050, and thus has challenged the dominant framing of the problem of food security in the UK, and its resolution" (p. 82). This author has also claimed that the doubling of food production was never

intended as a normative goal of policy and it has exacerbated many of the existing problems within the current global food system (Tomlinson, 2013). His paper also argued about the social movement activities and institutional scientific and political challenges that are beginning to merge together, and discussed an alternative set of discourses around the concepts of ecological food provision, food sovereignty and agro-ecology (Tomlinson, 2013).

Hunter's (2016) study identified advanced maternity and healthcare services as the factors of rapid population growth in recent years. The increased population will create a number of challenges regarding sustainability around the globe, including the need for more food. In addition, in the developing world, 100 percent of the food needs to be processed; that means increasing the supply of related products to fulfill the food demand; for the developed countries, the percentage is almost 70 percent (Hunter, 2016). Hunter (2016) also argued that it was necessary to secure a balance between the quantity and quality of food, and in order to achieve this balance, investment is needed. Investment extends to technology which has a very important role in helping the industry to increase the production of food without compromising the quality. New innovations are also needed to maintain the balance between food production and distribution (Hunter, 2016).

Olimar, and Maisonet-Guzman, (2011) have reviewed the current literature related to the Malthusian theory of population and scarcity of agricultural production and have examined the relationship between economic growth and agriculture production in different countries of Africa, Asia, Europe, North America, Latin America and Oceania. They used data from 1981 to 2008, and finished their report with a discussion of the results of an ordinary least squares (OLS)

regression on agricultural production. Malthus (1809) had argued that population growth is a primary determinant of a country's agricultural production. On the other hand, modern scholars, such as Jenkins and Scanlan, 2001; Lio and Liu, 2008, argue that political and economic policies play an important role in determining agricultural production. Moreover, Olimar and Maisonet-Guzman, (2011) have found that population growth has a positive impact on the agricultural production of a country, while the neo-Malthusians assume a negative relationship between these two. Olimar, and Maisonet-Guzman, (2011) have also found that the relationship between an increasing population and agricultural production differs from region to region. The total area of agricultural land and urbanization will play a significant role in determining any country's agricultural production. If the population is growing rapidly, it will be responsible for rapid urbanization which is a threat for a country's agricultural production (Olimar, and Maisonet-Guzman, 2011). In 1996, Boongarts (1996) identified technology as an important factor to determine agricultural production. Finally, Olimar, and Maisonet-Guzman, (2011) concluded that to feed the projected 9 billion global population in 2050, sustainable agriculture practices will be helpful and cooperation will need to increase for implementing this.

Bricker D. and John Ibbitson (2019) postulate that, according to the forecasts of the United Nations, the world's population will grow from seven billion to eleven billion in this century, before leveling off after 2100. But an increasing number of demographers around the world believe that the UN estimates are far too high. More likely, they say, the planet's population will peak at around nine billion sometime between 2040 and 2060, and then will start to decline (Bricker and Ibbitson, 2019, p. 2).

2.7 Food Security in Bangladesh

Begum, Hossain and D'Haese (2013) have focused on the recent trends and patterns of food consumption and micro-nutrients intake in Bangladesh, which, in their opinion, basically depend on food availability, food accessibility and mode of food utilization. The authors explained that besides these three interrelated elements of the food security, an exogenous dimension for Bangladesh is represented by the natural disasters which affect all the three dimensions of food security (Begum, Hossain and D'Haese, 2013). According to the Government of Bangladesh (GoB, 2000), "the normal diet of Bangladeshi people is seriously imbalanced, with inadequate shares of fat, oil and protein" (p. 264). This reflects an insufficient domestic production of non-cereal foods (pulses, oilseeds, fruits, meat, milk and eggs), low incomes, specific food preferences and people's lack of knowledge. It has been found that young children, pregnant and lactating women and adolescent girls are mostly affected by the imbalanced diet, as they need nutrients for growth; at the same time, urban people eat a more balanced diet compared to people in the rural areas. For this reason, the authors suggested that improving the purchasing power and strengthening formal and non-formal education programs can popularize the idea of a balanced diet (Begum, Hossain and D'Haese, 2013).

Another study, (Dorosh, 2001), pointed out a certain theoretical framework of price stabilization and trade liberalization and articulated that trade liberalization in the early 1990s between India and Bangladesh added a significant new height to food security and food policy in Bangladesh. The major benefit of price stabilization was increasing households' investments in productive activities rather than in stockholding, and helping the government to overcome the risk of food shortages (Timmer, 1989). "Both theory and empirical modeling suggest that allowing export

and import parity to set floor and ceiling prices, and relying on international trade to help stabilize prices can reduce the need for large government stocks and reduce costs" (Goletti, 1994, pp. 673-674; Pinckney, 1998). The major argument is that trade liberalization had a positive contribution to the short-run food security in Bangladesh in recent years, but widespread concerns remain regarding possible adverse effects on the long-run food security (Dorosh, 2001). Therefore, Dorosh (2001) also suggested that the success of trade liberalization in stabilizing food prices and increasing supplies in recent years does not mean that less attention should be devoted to encouraging domestic food production through appropriate price incentives and public investments, ensuring supplies of inputs, and agricultural research and extension.

Another article (Zezza and Tasciotti, 2010) postulate that urban agriculture can play a significant role in reducing urban food insecurity problems which are important due to secular trends towards urban poverty and to general population increase in developing regions. Another research has found that one-quarter of the poor people in the developing world live in urban areas and poverty is becoming more acute in urban areas and the poor are urbanizing faster than the population as a whole (Ravallion, Chen, Sangraula, 2007). The major objective of the Zezza and Tasciotti (2010) study was to attempt a rigorous quantification of the magnitude of urban agriculture in a reasonably large cross-section of countries (Ellis and Sumberg, 1998; Nugent, 2001). The households' access to food can be increased through alternative measures like promotion of different income generation activities and employment opportunities, or by improving the efficiency of the urban markets the poor rely on (Zezza and Tasciotti, 2010).

In Bangladesh, 63 percent of the total population are employed in the agriculture sector, and the most common crop produced in Bangladesh is rice (Ismail, 2016). The production of rice will differ due to seasonal changes and to supply of water, as in Bangladesh rice is produced two times annually. In addition, the farmers also grow vegetables, lentils, peanuts, oilseeds etc. According to Ismail (2016), more recently, considerable progress is seen in the case of rice production in Bangladesh as during the last few decades the production of rice surpassed the growth of population. The reasons behind this are the invention and use of modern technology in agricultural production, development of irrigation policies and innovation of new crops varieties etc. Additionally, the per unit cost of production has also decreased for this rice which is more available and affordable too (Ismail, 2016). Ismail (2016) also argued that, in the long term, using high-tech technology is not sustainable at all, as the ground water is declining day by day due to rapid growth of population and increasing pollution. As the world temperature is increasing, the salinity of river water is increasing as well. Although the production of rice is increasing, the people of Bangladesh are still food insecure, as most of the people consume less daily calories intake than recommended. There is a lack of nutritious food too, which has a negative impact on the public health, especially for the children health. The children are suffering from malnutrition and various diseases (Ismail, 2016). This study suggests that different policies should be developed for increasing the nutrition levels, such as crop diversification, increased imports of more nutritional alternative foods by exporting rice etc. Finally, Ismail (2016) recommended implementing sustainable agriculture practices for increasing the agricultural productivity in Bangladesh.

Another study, by Regmi, and Paudel (2015), identified that in Bangladesh remittance (i.e. transfer of money from foreign countries) plays an important role in household food security.

Based on the Integrated Household Survey data 2011/12, the authors assessed the status of food security in Bangladesh. To conduct this research, two commonly measured food security indicators, a Food Consumption score (FCS) and a Households Hunger scale (HHS), were used. This study calculated a categorical variable which indicates the level of food security obtained by the above two indicators (Regmi, and Paudel, 2015). The data were analyzed by using ordered probit regression models. The findings of the research show that to improve the condition of food security at household level, remittance plays an important role, and the coefficient of this variable is significant. The coefficients of other variables, i.e. the farm's outside income, literacy rate, male operated households etc., are also significant. Regmi, and Paudel (2015) have also found that if the household's income from the nonagricultural sector is increasing, that will increase the probability of the household being food secure. Finally, Regmi, and Paudel (2015) recommended that if the Government of Bangladesh takes proper initiatives, such as improving the agricultural sector, creating incentives for income generating activities for the rural households, increasing non-farm activities for the poor, and diversifying the sources of income for farmers, these initiatives will contribute to achieving food security in Bangladesh.

2.8 The Impact of Microcredit on Food Security in Bangladesh

The microcredit program was developed by Muhammad Yunus and was introduced in Bangladesh since 1976. At the beginning, the objective of this program was to give loans to a group of working women for financing their own businesses through Grameen Bank. After (2009), BRAC (i.e. Bangladesh rural advancement Committee) launched a customized microcredit program named 'Borgachi Unnayan Prakalpa (BCUP)" to help the poor tenant farmers as well as those farmers who have limited access to credit facilities (Hossain, Malek, Hossain, Reza, Shakil and Ahmed, 2019).

Based on a randomized control trial, Hossain, Malek, Hossain, Reza, Shakil and Ahmed (2019), studied the impact of the microcredit program on the livelihoods of landless, tenants, small and marginal farmers in Bangladesh. The study found that this program helps to increase the rice production, as well as that access to credit has an impact of introducing modern varieties of rice. The microcredit programs increased the farm income but have had limited contribution on increasing the total income. The reason behind this is that providing credit facilities for the poor tenants can improve their output but do not have any significant impacts on the overall economic outcomes. Finally, Hossain, Malek, Hossain, Reza, Shakil and Ahmed (2019) suggested that besides credit facilities it was necessary to consider others factors such as diversified sources of income, education, new investment etc. for increasing the profit as well as the livelihood status of the tenant farmers.

Mazziotta, Muro, Grigoletto, Scafetti and Lochetti (2016) conducted a survey in three districts of Bangladesh (Satkhira, Netrokona and Rajshahi) and used a methodology to calculate a multidimensional index (a newly developed index) based on four basic dimensions of food security (availability, access, utilization and stability). In addition, this study also assessed the impact of microcredit on households' food security. A regression model was used to describe the main variables that affected households' food security (Mazziotta, Muro, Grigoletto, Scafetti, and Lochetti, 2016). This study has found that in order to improve the food security condition at the household level, access to microcredit has had a little impact, i.e. the effect was very weak. Finally, the Mazziotta, et al. (2016) study has identified some weaknesses of this methodology and have shown that other factors, such as poverty, unemployment, illness, low income, health

status and the number of production sources have a stronger impact on the rural households' food security.

According to another research, by Islam, Pakrashi, Maitra, and Smyth (2016), in most of the developing countries, like Bangladesh, the poor households can't get credit facilities properly. The reason for this is that they are not able to diversify their sources of income, nor to save themselves from uncertainty, shocks and seasonality. For these reasons, although there is an adequate supply of aggregate food, the rural poor people do not have access to it (Islam, Pakrashi, Maitra, and Smyth, 2016). These authors postulate that in order to improve the food security condition of these rural households the microcredit programs are very helpful, as they help to accelerate the financial capital of the rural people. Islam, Pakrashi, Maitra, and Smyth (2016) have also examined the effects of microcredit on different measures of food security, namely household calorie availability, dietary diversity, anthropometric status of women of reproductive age (15-49) and of children under the age of five. The findings show that the calorie availability of the rural people will increase with the microcredit program participation, but the dietary diversity does not improve, and this has mixed effects on the anthropometric measures (Islam, Pakrashi, Maitra, and Smyth, 2016). Finally, the results indicate that, initially, the access to microcredit has had no positive effect on household's food security (Islam, Pakrashi, Maitra and Smyth, 2016).

Wadud (2013) has also studied the impact of microcredit on agriculture farm performance, production and household food security. Wadud (2013) has collected primary data from four districts (Rangpur, Dinajpur, Bogura and Rajshahi) of the Northern part of Bangladesh, by conducting a survey of 682 farms. Among these, 450 farms were microcredit receivers and 232

were microcredit non-receivers. To assess the effect of microcredit on agricultural production and food security, Wadud (2013) applied a Cobb-Douglas stochastic frontier and data envelopment analysis (DEA) along with an inefficiency effects model and propensity score matching (PSM) techniques. This study found that microcredit helped the rural farmers to utilize the agricultural inputs efficiently, which increased the supply of food and also increased the purchasing power of the rural households. As a result, food security was strengthened. Wadud (2013) has also highlighted that the average income of microcredit receiving farms was higher than that of microcredit non-receiving farms. Finally, Wadud (2013) suggested that fair and availability of microcredit could lead to the improvement of farm performance and production capacity, factors that indicate the betterment of households' food security.

2.9 Gaps in the Literature

Most of the literature discussed above mainly focused on the availability of food but it did not analyse the issue of sustainable development of food systems. In addition, most of the studies have analyzed data using a quantitative method and have tried to find out the extent of food security in different nations. Although Dorosh (2001) suggested that trade liberalization was an effective food policy, his study did not consider the food sufficiency. Several studies, such as Tomlinson (2013), Lawrence, Lyons and Wallington (2009) and Mooney and Hunt (2009), have focused on the conditions for doubling food production, but they did not consider the sustainable utilization of land and other natural resources related to food production. Besides, there was no discussion about the price of food which is also related to a sustainable food policy. A significant number of studies, such as Kloeke, (2014), Campbell., et. al., (2016), Knight, et. al., (2008), Sudgen, et. al., (2020), Porter., et., al., (2014), Challinor, et. al., (2014b), DaMatta, et.al., (2010),

Thornton and Gerber, (2010), Brander, (2010), Bebber, et. al., (2013), Hammond, et. al., (2015), Liu, et. al., (2013), Macdonald, et. al., (2011) and Uyttendaele, et, al., (2014), discussed the effects of climate change on food security, but the authors did not identify specific food policies to solve the problem.

In most of the literature reviewed above, there is no specific discussion about the condition of food sovereignty in Bangladesh. In addition, the previous researchers only referred to the condition of food security in Bangladesh, and limited research has been done on the impact of the national food policy on households' food security. The Bangladesh Government has adopted a food policy in 2006; depending on the food policy framework in this study, the researcher intends to find out the effectiveness of this national food policy. Some authors, such as Regmi, and Paudel, (2015), Mazziotta, Muro, Grigoletto, Scafetti and Lochetti, (2016), Islam, Pakrashi, Maitra, and Smyth, (2016) and Wadud, (2013), have tried to find out the impact of microcredit on rural households' food security, as the microcredit policy is indeed a policy that could remove the food insecurity problem.

Chapter Three

Conceptual Framework

3.1 Introduction

This chapter is an overview of the concept of food security and the methods to measure food security. The purpose of this chapter is to analyze relevant concepts, theories, and the theoretical linkages concerning food security and related aspects. The four dimensions of food security, availability, affordability, accessibility and utilization (FAO, 2002) are presented in this chapter. With these four dimensions, a new and more recent dimension named sustainability by Berry, et al., (2015), is also discussed here. The meaning of food security from the global level to household level is described in this chapter. Finally, the relationship between the concepts of food security and sustainability is also presented in this chapter.

The chapter is organized into six main sections. Section 3.2 discusses the concept of food security, where the definition of all components of food security is provided. The concept of food insecurity with its components/characteristics is presented in section 3.3. Section 3.4 discusses different matrices of food security measurement, and section 3.5 describes the relationship between food security and sustainability. Finally, section 3.6 provides brief concluding remarks of the overall chapter.

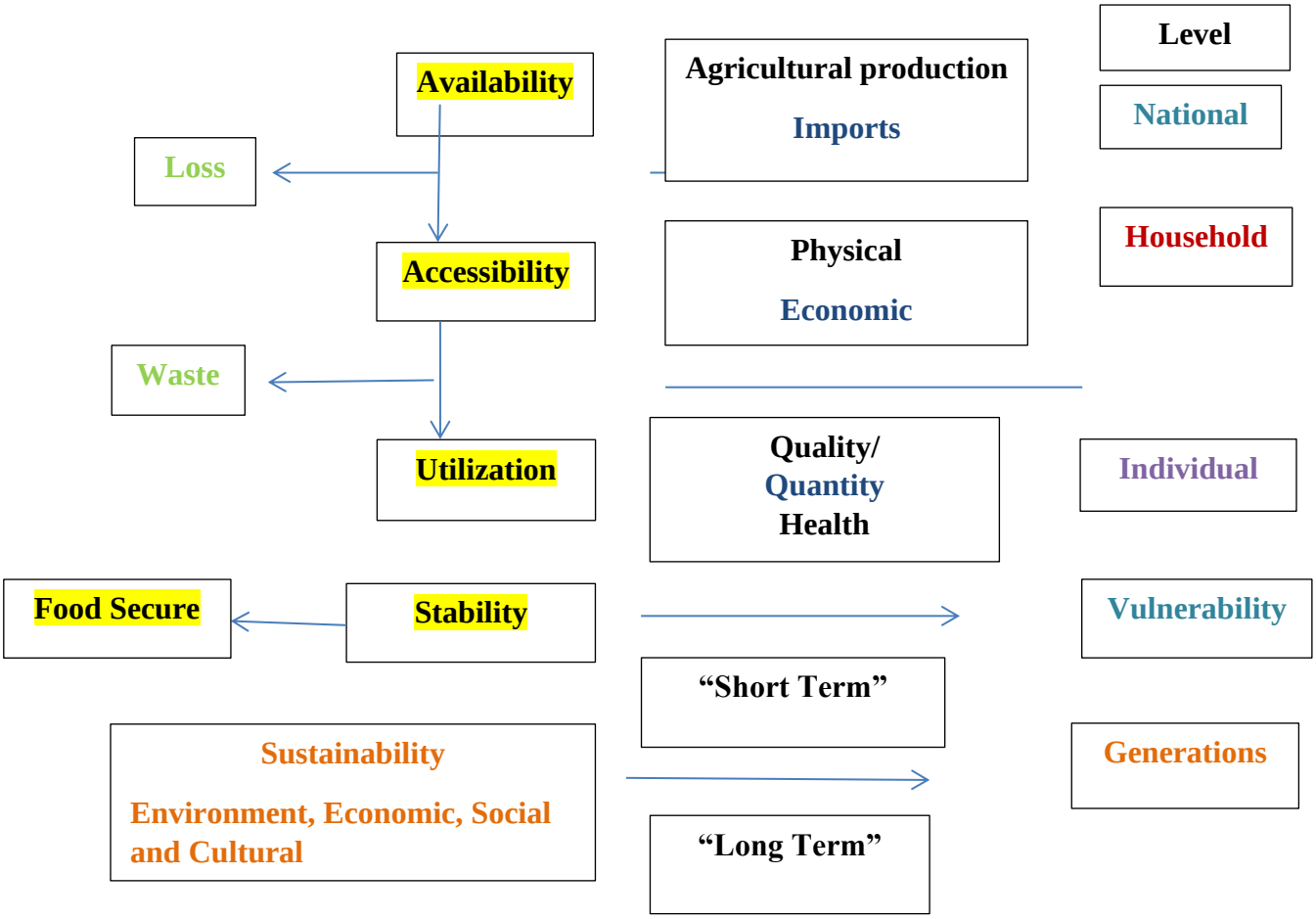
3.2 The Concept of Food Security

In the 1970s, around fifty years ago, due to a global food crisis, the concept of food security first emerged, and there were numerous definitions of the concept of food security, according to Maxwell and Smith (1992). The reasons behind the global food crisis were the fluctuations of

food and commodity prices, and market inefficiencies, especially in the currency and energy markets (Berry et al., 2015). Depending on the state of the world food insecurity, in 2001, the UN Food and Agriculture Organization (FAO) defined food security as "A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2002). After that, in 2009, at the World Summit on Food Security, the FAO added a fourth dimensions to the previous definition i.e., stability. According to the FAO, stability is a short-term indicator of food security (FAO, 2009). The other three indicators are availability, accessibility and utilization, where availability means the local production of food and the import of the rest of the food which is not available within the country. Accessibility means making sure that the food can easily reach the consumers. That indicates better transportation facilities, a reasonable price of food and assurance that the consumer has sufficient money to purchase food (FAO, 2008). FAO, (2008), also added the economic and physical accessibility to ensure the food is acceptable by all, as the food habits vary from country to country. Thirdly, to ensure a better, healthier and safer life, the quality and also the quantity of food must be considered. The quality of food indicates pure and safe drinking water and nutritious food, as well as sanitation systems, and the quantity of food means sufficient or adequate water and food. This is known as utilization (Peng and Berry, 2018). The concept of food availability consists of three elements: production, distribution and exchange, while the concept of food accessibility can be described by affordability, allocation of food and food preferences. The nutritional value, and the social value of food, as well as food safety are the three elements of food utilization (Ericksen, 2008). All of the above discussed indicators of food security exist at a number of levels i.e., availability is for the national level, accessibility is for the household level and utilization refers to the

individual. Fourthly, the stability affects all of the three levels, as stability of food deals with the ability of a nation, household and individual person to fight against shocks to the food chain system that are caused by natural disasters (flood, drought, earthquake) or by man-made disasters (war, economic-crisis, political inconsistency) etc. (Peng and Berry, 2018). Recently, Berry, et al., (2015), suggested sustainability as a fifth dimension of food security, to encompass the long-term time dimension, which involves indicators at the national and regional levels, such as biodiversity and climate change, as well as socio-cultural and economic factors. The climate change will affect the future generations' food security (Berry, et al., 2015). The dimensions of the food security concept are summarized in flow chart 3.1. which exhibits the pathway of the dimensions of food security. An important insight from the flow chart 3.1 is that the food can be lost from processes in agriculture, post-harvest and distribution. In addition, food waste also happens from processing and consumption of food by the households as well as the community (Peng and Berry, 2018). According to the report of High Level Panel of Experts on food security and nutrition of the committee on world food security, HLPE, (2014), worldwide, the amount of wasted food may be one-third of the total available food, which indicates an obvious target for improving global food security. To reduce the amount of food waste is a major challenge for world food security and food availability in the future. Peng and Berry, (2018), also identified obesity as a type of food waste, as obesity is a consequence of overconsumption of food.

Flow Chart 3.1: The Pathway of the Dimensions of Food Security



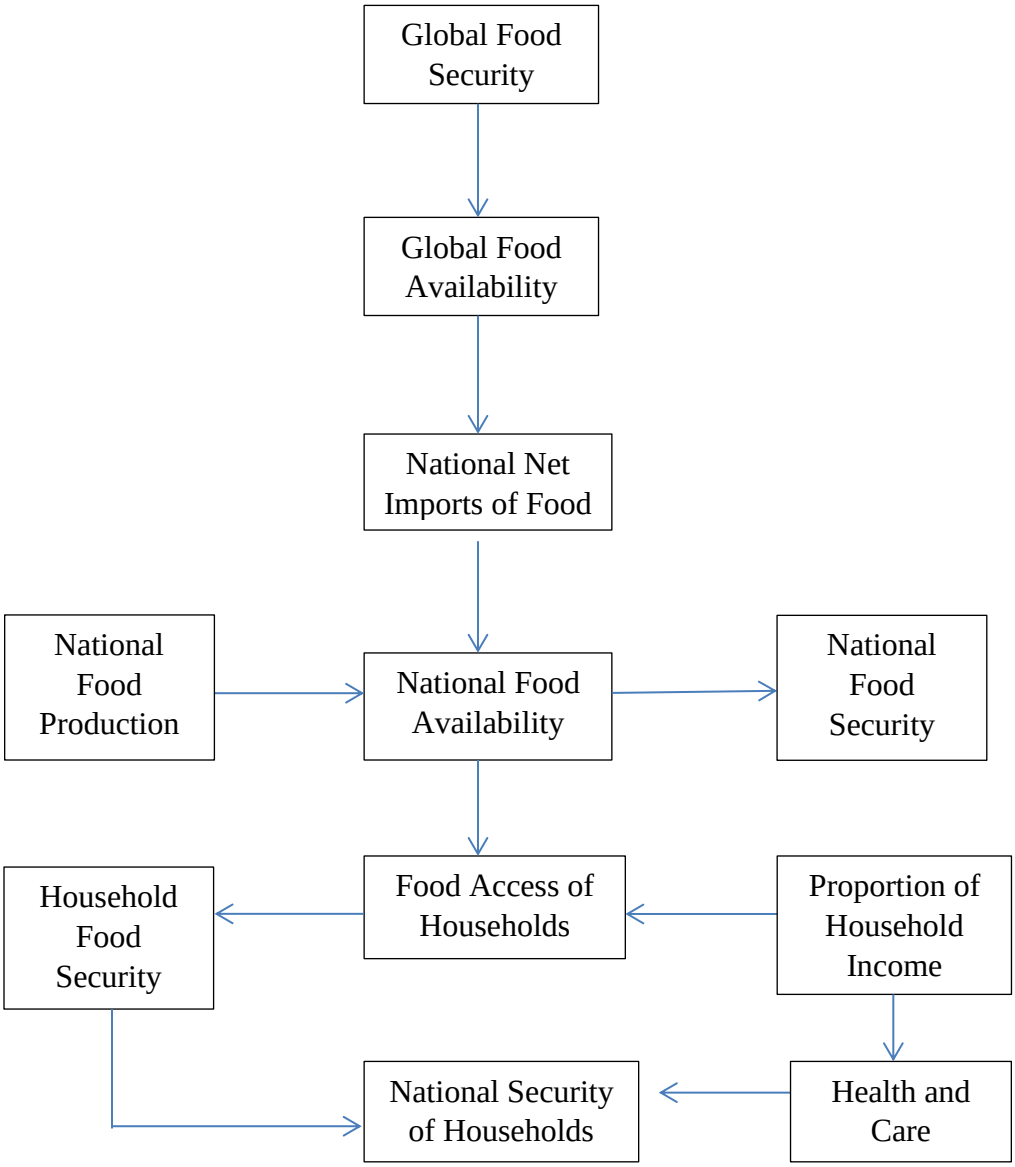
Source: Berry, et. al., (2015).

Food security can be defined at the individual, household, national and global levels (Amiti, 1982). According to IFAD (1991), the individual level of food security means access to healthy and nutritious food to fulfill the minimum necessities of all members of the society. The food can be produced by the person him/herself or can be obtained either from the market or from the public food distribution system (Clay, et. al., 1988). Ballenger and Mabbs-Zeno (1990), postulate that the individual should have sufficient income to fulfill the demand. The household food security is related to the term availability which ensures enough food is available to fulfill the minimum needs (depending on the household's size, as well as the body size, weight, sex and

nature of work, especially for women with pregnancy or lactation status) of all members (Alamgir, 1991; Jacobs, 2009). The household food security also depends on accessibility to food production, cash income, food reserves and government assistance programs to maintain seasonal and annual fluctuations of the food stock (Benson, et. al., (1986). At the national level, food security means the national availability of sufficient food stocks from harvests or imports to meet current national demand during a certain period of time, say three months (Alamgir, 1991; Clay et al., 1988). According to Ballenger and Mabbs-Zeno (1990), if there is enough food to feed the world's population, then this is known as global food security. It is the access to and assurance of adequate food supply for all, which includes food security in individual countries (Alamgir, 1991).

As shown in Flow chart 3.2, there is a competition between households' expenditure of income for food and other basic needs to achieve food security. The other expenditures are for health care, housing and basic education, as well as for luxuries. Nutrition security is another important aspect of defining food security. In the absence of nutrition security, food security will not indicate a healthy and active life. According to Frankenberger et al. (1997), the definition of food security is 'An individual is nutritionally secure when he or she has secure access to a nutritionally adequate diet and the food consumed is biologically utilized, such that adequate performance is maintained in growth, resisting or recovering from disease, pregnancy, lactation, and physical work'

Flow Chart 3.2: Conceptual Framework for Food Security



Source: Smith, et al., (1999)

As can be seen from Flow chart 3.2, the concept of food and nutrition security, at the national level, has two other dimensions i.e., care and health. Care means "the provision in the household and the community of time, attention and support to meet the physical, mental and social needs of the growing child and other household members" (ICN, 1992). For example, important child care behaviors are the timing and frequency of breastfeeding, the degree of stimulation and

interaction with parents, investments in disease prevention and domestic hygiene, the use of health services and regular growth monitoring. The second non-food determinant of nutrition security is health. Poor health, or illness, affects nutrition security by depressing appetite, inhibiting the absorption of the nutrients in food and consuming calories and other nutrients while fighting off and recovering from illness, leaving less energy and nutrients available for growth and weight maintenance (ICN, 1992).

3.3 Food Insecurity

According to Moharjan and Chhetri (2006), if the households as well as the individuals fail to meet their necessary level of consumption due to the fluctuation of income, food price and production, this will be referred to as food insecurity. Food insecurity is mainly the absence of food security due to famine or periodic hunger produced by inadequate supply of food (Kuwornu et al., 2013). The people suffering from food insecurity are unable to live a healthy and productive life. A country's development opportunity will be hampered due to food insecurity which also has a devastating impact on families' nutrition level (Bokeloh et al., 2009). Smith et al. (1999) identified among the causes of food insecurity political instability, war and civil strife, natural disasters, macroeconomic imbalances and trade dislocations due to environmental degradation, poverty, population growth, gender inequality, inadequate education and poor health etc. Reutlinger, S. (1987) postulates two types of food insecurity i.e., the lack of sufficient and nutritious food that can be either chronic or transitory. In some cases, food insecurity can be chronic and sometimes it can be transitory. But the food insecurity may be both transitory and chronic too.

3.3.1 Chronic Food Insecurity

Reutlinger (1985), defines chronic food insecurity as the continuous inadequate choice of diet due to lower production of enough food. The reasons behind the low production is the lack of adequate resources. Those people who are the victims of continuous inadequate diet are suffering from various diseases and parasites which are creating risks for their health. The victims also are deprived of schooling and receiving educational training, as they are not physically fit (lack of vigor, alertness and vitality required) for the jobs. For these reasons, the victims are unable to become human capital and this is responsible for the low level of productivity. This low output and income are the reasons of the poverty cycle (Reutlinger, 1985). For example, chronic food insecurity took place in Ethiopia, Somalia and Sudan in 2011 and also in 2018. According to the report of (FAO, 2009), Chronic food insecurity is the long term or persistent food insecurity. Further, continuous inadequate diet is also one of the main obstacles to human and overall economic development identified for Bangladesh (Muzafar, 2009).

3.3.2 Transitory Food Insecurity

FAO, (2009), identified transitory food insecurity as short term and temporary food insecurity. The temporary decreasing of a consumer's access to sufficient food, due to the fluctuation of incomes, high food prices, losses of foodstuffs and disruption of food production due to war, natural disasters (floods, cyclones, droughts and earthquakes), changing national human capital and political inconsistency, is known as transitory food insecurity **(**Muzafar, 2009). The lack of entitlements to enough food among the households and unequal distribution of food are other reasons for transitory food insecurity. Nowadays, the growth rate of food production was faster than the growth of population when the Malthusian theory postulated that food production is slower than the growth of population. This growth of food production cannot help to eliminate

hunger **(**Muzafar, 2009) which is due to inequality in access to food. Natural calamities like famines are one of the reasons for the severe shortage of food during transitory food insecurity, when the victims cannot acquire any food items of their own choice. The reason behind that is the lack of money and low purchasing power, lack of sufficient food aid from the government, non-governmental organizations or from anywhere. Muzafar (2009) reveals that, according to the report of the world's worst famines, instability and high variation of the production of food and the increasing price of domestic food are responsible for reducing the income of the general public, especially the daily laborers' purchasing power was decreased and most of the people lost their jobs. For example, the great Bengal famines (of 1770 and 1943), the Bangladesh famines (of 1974) and the Hidden Hunger (2008). In 2007, Bangladesh had a very bad year as in this year various natural calamities such as a flood and the cyclone Sidr have occurred and due to this the rice production was fallen. In addition, there was a new government which did not have the experience to manage the worst situation. Due to the shortage of supply, the price of products was increased inside the country, as well as with the given pressure of the IMF and World Bank the government controlled food distribution centers were abolished. In this situation, the purchasing power of the people was reduced due to the rising prices of food items especially rice and this caused political instability inside the country. The reasons behind this political instability was that not only the poor but also the middle class people could not afford their daily food needs as the poorer as well as the middle income households spent almost 80 percent of their total income on food. This situation was known as the hidden hunger of 2008 (Ground report, 2008).

For this study, transitory food insecurity is relevant, as in Bangladesh the food production is sufficient enough to feed the total population. The food insecurity problem is a temporary

problem arisen due to income inequality, natural calamities, high food prices and instability in the case of food production.

3.4 Measuring Food Security

The matrix of food security measurement focuses on the combination of the four dimensions (food availability, access, utilization and stability of food) of the food security over time (Jones, Ngure, Pelto and Young, 2013). Jones, Ngure, Pelto and Young (2013) state that the measures of food security depend on hypothesized data related to the determinants of food security, for example the price of commodities, and the consequences of food security, for example child malnutrition. A brief description of the common food security metrics used is provided below.

3.4.1 National-level Estimates of Food Security and Undernourishment

This measure has been developed by FAO to measure food availability at the country level. It includes food balance sheets which have traditionally been drawn from nationally aggregated data on food supply. The data include the amount of total food production, imports, exports, food used as feed for livestock, seed, processed for food and non-food uses and waste of food during storage and transportation. All these data are being used by the FAO to measure the core food security and the degree of undernourishment (FAO, 2001).

3.4.2 Global Hunger Index

International food policy research institute (IFPRI) developed the Global Hunger Index (GHI) in between 2006 to 2007 to measure the aspects of food security at the country level. The aim of this institution is to measure the amount of "hunger" by using some weighted indicators and ranked those countries on a 100-point scale, then categorized them as "low" to "extremely alarming" hunger. Undernourishment (the proportion of undernourished people compared to the percentage of total population), child underweight (the proportion of children younger than five

years old who have a low weight compared to their age) and child mortality (the child mortality rate for children under the age of five years) are the weighted indicators of this index (IFPRI, 2012).

3.4.3 Global Food Security Index

This index is the first to examine food security depending on three dimensions such as affordability, availability, and quality. Moreover, the study looks beyond hunger to the underlying factors affecting food insecurity. The GFSI now includes an adjustment factor on natural resources and resilience. This category assesses a country's exposure to the impacts of a changing climate; its susceptibility to natural resource risks; and how the country is adapting to these risks. The Economist Intelligence Unit designed another multidimensional tool named Global Food Security Index (GFSI) to assess the food security trends within the countries. This index is sponsored by DuPont. The GFSI metrics not only rank the performance of the countries but also use both a qualitative and a quantitative approach. Besides food availability, the GFSI reflects food accessibility too and is calculated quarterly based on the shifts in food price data. The GFSI relies upon the academic, nonprofit and public sectors, expert panels and analysts for the data. This method also depends on the data from the World Bank (WB), Food and agricultural organization (FAO), World Food Programme (WFP), World Trade Organization (WTO) and the Economist Intelligence Unit (EIU) (EIU, 2012).

In contrast to the above metrics, which are used for making national level estimates of food security, the measurement tools discussed below are used to monitor food security in areas of high risk for severe food insecurity.

3.4.3.1 Famine Early Warning System Network

The Famine early warning system network provides information for supporting the decision makers to mitigate food insecurity, as well as gives the updates of food security monthly for 25 countries (Funk and Verdin, 2010). The network has a regional team monitor who analyzes the information and data related to food insecurity, such as rainfall records, vegetation index, temperature, agricultural production, prices, trade, economic shocks, political instability and local livelihoods (Funk and Verdin, 2010).

3.4.3.2 Integrated Food Security Phase Classification (IPC)

The IPC is assigned for measuring food security in a region, and the IPC draws from the food security matrix depending on a wide range of data from specific contexts. To identify the severity and the purpose of the IPC, then, is to identify the extent of severity of food insecurity as the main objective of the IPC (Haan, 2012). This system classify food security/insecurity into five different phases such as generally food secure, moderately or borderline food insecure, acute food and livelihood crisis, humanitarian emergency and famine/humanitarian catastrophe. These five phases is identified by analyzing crude mortality rate, acute malnutrition, disease, food access/availability, dietary diversity, water access/availability, destitution and displacement, civil security, coping and livelihood assets (Haan, 2012).

3.4.3.3 Vulnerability Analysis and Mapping Methodology

The vulnerability analysis and mapping methodology use different types of assessments like the Comprehensive Food Security & Vulnerability Analysis (CFSVAs) to conduct food security analyses and also examine the causes of vulnerability using both primary and secondary data

(WFP, 2009). The food security assessment modules used by them are the patterns of food consumption, the patterns of expenditures, households assets, compositions and education, sources of water, sanitation system, materials of housing, credit facilities, sources of earnings, agriculture, livestock, external assistance, shocks and coping strategies (WFP, 2009). To reduce hunger and analyze vulnerability, the World Food Program, WFP used a food security monitoring system, emergency assessments of food security, crop and food security assessment missions, and market assessment which strengthen the countries' capacity to improve the condition of food security (WFP, 2009).

3.4.4 Measuring Households' Food Access

The food security measurement tools described above are only measures of the availability of food at national or country levels but do not consider the access to food at household level or household level food security. The access to food is the acquisition of food per household (Jones, Ngure, Pelto and Young, 2013).

3.4.5 Household Consumption and Expenditure Surveys

The household consumption and expenditure surveys (HCESs) and living standard measurement surveys are used by the FAO to calculate the national level estimates of the prevalence of undernourishment (World Food Security, 2011). Under the HCESs, poverty, consumer price index, patterns of food and non-food consumption and household socio- economic status i.e., education, housing status, assets amount, health condition, income etc., are measured (Fiedler, Carletto, Dupriez, 2012).

3.4.6 Food Consumption Score (FCS)

To identify the food insecure regions, the FCS monitors the changes in the level of food security by targeting different programs worldwide and also determines the amount of food needs. This indicator is used by the WFP and this index creates a link between household food access and dietary diversity (World Food Program, 2007). The Food Consumption Score (FCS) represents households' dietary diversity and nutrient intake. The FCS is calculated by inspecting how often households consume food items from the different food groups during a 7-day reference period (World Food Program, 2007).

3.4.7 The Dietary Diversity Score

The dietary diversity framework was developed by the United States Agency for International Development (USAID) food and technical assistance project (Swindale and Bilinsky, 2006). The dietary diversity score is calculated by using the data on the consumption of cereal grain staples, roots and tubers, vegetables, fruits, meat, eggs, fish, pulses and nuts, dairy products, oils and fats, sugar and condiments. For collecting data, the individuals were asked about their consumption patterns i.e., if any of them consumed any item from the above list within 24 hours (Swindale and Bilinsky 2006).

3.4.8 Household Hunger Scale (HHS)

The HHS was recommended in 2010, by the authors of the Household Food Insecurity Access Scale, (HFIAS), and in this procedure three questions were asked to the households for measuring food security (Deitchler Ballard, Swindale and Coates, 2010). Firstly, was there insufficiency of food or no food in the household due to lack of adequate resources? Secondly, did any of the household slept without food due to food shortage or lack of food? Thirdly, due to lack of enough food did any of the family members passed a day or night without food?

3.4.9 Measuring Food Utilization: Anthropometry

The third dimension of the food security concept was utilization of food. This indicates the allocation of sufficient food within the household. The food must be sufficient in amount and nutritious, and the bioavailability in the nutritious level is expected (Haddad and Kanbur, 1990). To understand the distribution of food among the households, it is necessary to measure the utilization of food, as although there is sufficient food but there can be deficiency in the level of nutrition (Haddad and Kanbur, 1990). The traditional proxy measure for measuring food utilization is anthropometry, which is a measurement of body dimension, the nutritional status of the body that is also linked to the mortality rates (Pelletier, Frongillo, Schroeder and Habicht, 1995).

Among the above measures, the dietary diversity score is relevant for the present thesis as through dietary diversity we can measure the food security level of rural households. To identify the extent of diversity in households' food habits, such as consumption of cereals, roots and tubers, vegetables, fruits, meats, eggs, fish and other seafood, pulses/legumes/nuts, milk and milk products, oils and fats, sugar and honey and miscellaneous (Islam, Maitra, Pakrashi and Smyth, 2016), this matrix is used in this study.

3.5 Food Security and Sustainability

In this study, sustainable agriculture practices such as agriculture intensification and better nutrition facilities are considered as indicators of sustainability. Sustainable agricultural intensification is the combination of sustainability and increasing productivity as well as improving the condition of natural capital (Garnett, Dodfray et al., 2012; Pretty. 2008). For attaining sustainability in the food system, it is necessary to ensure the right food for all as well

as increasing the demand and acceptability of nutritious food for the poor (HLPE, 2017). There is a strong relationship between food security and sustainability as it is known that, worldwide, the demand for food is increasing rapidly. The reasons behind the increase in food demand are the changing pattern of food consumption and population growth (Capone, Bilali, Debs, Cardone, and Drioech, 2014). At present, the food and agricultural sectors' main concern is to ensure sufficient and nutritious food for everyone. To meet the food needs of the increasing world population it is necessary to produce more food by maintaining sustainability (environmentally, economically and socio-culturally) (Capone, Bilali, Debs, Cardone, and Drioech, 2014). The meaning of sustainable development also indicates the necessity to keep some resources for future generations and produce agricultural goods without hampering the environment. Searchinger et al. (2013) suggested that the approximate world population will be around 9.6 billion, and to feed this population, i.e to meet the global human food needs by 2050, the world agricultural system must be changed to produce more food in a sustainable way (without increasing greenhouse gas emissions and by protecting the ecosystems). According to Capone, Bilali, Debs, Cardone, and Drioech (2014), the physical availability of food is essential to reduce hunger, but only increasing the production of food is not sufficient to achieve the food as well as nutritional security. It has been assessed recently, that the world is producing enough food in aggregate terms, but the problems of food insecurity and malnutrition are increasing day by day due to improper distribution of food and this has adverse effects on society, economy and the environment (Capone, Bilali, Debs, Cardone, and Drioech, 2014) (Goodman, 1997). In the area of food production, the food system overlaps with the agricultural systems and governs the system of food processing, marketing, transportation system, access and consumption. Besides the consumption of food, other factors, such as the people who are able to eat food, the nutrition

level of their food and food acquisition, the system of agriculture i.e., the management and production process of both food and non-food products, are also influenced by the food system. For instance, fuel and fibre which are produced from different sources (crops, livestock, fisheries and forestry) are impacted by the food system (FAO, 2012d). Ericksen, Ingram and Liverman, (2009), have described that the concept of food system helps to identify the whole process of production of food, for example, those who are involved with it, their roles and the interactions among them. Ericksen (2008) categorized the food system into four main groups: production, processing, distribution and retailing, and consumption of food. The concept of sustainability as defined by the Sustainable food production and consumption project states that, "Sustainability is a food system that supports the food security, makes optimal use of natural and human resources and respects biodiversity and ecosystems for present and future generations, is culturally acceptable and accessible, environmentally sound and economically fair and viable, and provides the consumer with nutritionally adequate, safe, healthy and affordable food" SUSFOOD, (2013). Capone, Bilali, Debs, Cardone, and Drioech (2014) emphasized that the reduction of food waste and food losses helps to achieve food and nutrition security as well as improving the sustainability of the food system worldwide.

The Foresight Global Food and Farming Future project (2011) highlighted that to provide sufficient food for the predicted 9 billion people by 2050 it is necessary to change different elements of the existing food system. For example, sustainable production of food can be ensured by implementing existing knowledge, modern environmental friendly technology and best practice. Investment in new research and improving social infrastructure helps the food producer to obtain the benefit. Limiting the demand for resource-intensive types of food and

improving the political and economic governance of the food system in order to raise the food productivity and sustainability is also needed (Capone, Bilali, Debs, Cardone, and Drioech, 2014). Foresight (2011) also identified that, for future global food security, a sustainable balance between food demand and supply is necessary, also making sure that the supplied foods are affordable to all. Achieving global access to food, ensuring sufficient food stability, managing the contribution of the food system, mitigating climate change and maintaining the biodiversity and ecosystems' health, while feeding the world, is some other criterion for making global food security sustainable (Foresight, 2011). APHA, (2007) also linked food to health and sustainable development. If the food is nutritious and healthy, then it will indicate sustainable development. Guyomard (2011) identified the patterns of consumption as important factors in agriculture production and in 1987, Brundtland report (WCED, 1987), mentioned that, a reversal is needed in the pattern of global food consumption and the developed countries need to reduce consumption and the developing countries need to increase consumption. The consumption of food is affected by food availability, food accessibility and food choice. These factors are influenced by geography, demography, disposable income, socio-economic status, urbanization, trade liberalization, religions, culture, food corporations, food industry marketing, attitude of the consumer etc. The society, the economy, health and the environment are affected by these factors, i.e. the biodiversity may be lost, creating social inequalities, changing the climate, depletion of the aggregate fish stocks, all these are consequences of the changing patterns of consumption (Kearney, 2010). Kearney (2010) postulated that to achieve food and nutrition security some requirements were needed, for example, firstly, consistency in the availability and accessibility to sustainably produced food. Secondly, reduction as well as elimination of food losses and waste during the periods of food production, processing and consumption. Thirdly, the

amount of food production must be increased following an environmentally, socially and economically sustainable way, such as agro ecology, local knowledge and innovation, using human capital, control over agricultural technology and agro biodiversity use.

UN-HLTF, Food and Nutrition Security (2011) suggested a comprehensive approach to describe the requirements of food and nutrition security. These are:

- Interaction is necessary among the five dimensions (availability, access, utilization, stability and sustainability) of food and nutrition security;
- Addressing the food production, sourcing and distribution;
- Integrating the different stages of the food policy cycle, for example, gender equality, management of nature and ecosystems, climate change mitigation and adaptation etc.;
- Co-ordination among different sectoral policies (i.e., agriculture, trade, health, education and nutrition).

FAO (2012d), pointed out that in order to end hunger and achieve food security it is necessary to produce more with less effort, which encourages to foster sustainable intensification of the production of food, as well as sustainable food consumption. The reduction of food waste and food losses is also necessary. In addition, the zero hunger challenge also indicated that there is a strong relationship between the food system (food and nutrition security) and sustainability. To free the future generations from hunger, the UN's Secretary General in 2013 has set five objectives: i) 100 percent supply of food around the whole year; ii) The number of stunted children (children under 2 years old) will be zero; iii) The system of food production, distribution and consumption will be sustainable; iv) ensure 100 percent growth in productivity as well as in income and v) zero food lost or wasted (UN, Zero hunger challenge, 2013).

For the governance of a future sustainable food system, nutritional health, cultural acceptance, affordability and environmental protection are needed, and to assure food security, sustainable food is the key element (FAO and Bioversity International, 2010). Sustainable food refers to safe and healthy food produced without hazardous pesticides and chemicals, non-essential antibiotics or growth promotion supplements. Without food security or in the absence of food security, sustainable food production cannot be pursued (Buttriss, and Riley, 2013). From this discussion, it is clear that the concepts of sustainability and food security are strongly correlated. To achieve sustainable food security, investment in human resources, access to productive resources, access to market, adequate infrastructure, research knowledge, advanced technology, managing the natural resources sustainably, and good governance are needed (Capone, Bilali, Debs, Cardone, and Drioech, 2014).

Sustainable development is not possible without a food secure world. A major challenge in achieving sustainable food systems is to implement sustainable food policies, such as producing organic food, adopting a sustainable diet, reducing food waste, using renewable energy sources, reducing population growth etc. (Berry, Elliot, 2015). In Bangladesh, if these policies could be implemented, then the problem of food insecurity will disappear.

3.6 Conclusion

In this chapter, food security concepts have been discussed in detail, as well as the measuring matrices used by different organizations. In addition, the concept of food insecurity and the levels of food security have also been discussed. From the overall discussion of several significant concepts, it is clear that food and nutrition security is an important component of a

sustainable food system. To ensure households' food security it is necessary to maintain sustainability of food production, distribution and consumption.

Chapter Four

Methodology

4.1Introduction

This chapter provides a guideline of the techniques of data collection and analysis and the empirical model used in this research. It includes the explanation of the econometric model that is used to estimate the effect of food policy on rural household's food security, a description of the dependent and explanatory variables, and the ways of analyzing the collected data.

This chapter includes seven principal sections; section 4.2 describes the research techniques which include selecting the study area and sample size, data collection method, and data analysis. The empirical approach of analyzing food security is described in section 4.3 and section 4.4 describes the econometric theories related to model estimation. The ethical considerations and the dissemination plan for this research are presented in sections 4.5 and 4.6 respectively. Finally, this chapter ends with a conclusion provided in section 4.7.

4.2 Research Technique

This research uses quantitative as well as qualitative data analysis techniques. The goal of this study is to compare the food security condition of the households who received government food support under the existing food policy (National Food Policy, 2006), and of the households who didn't receive any food support from the government, by using primary data. This study also uses secondary data explaining the concepts of food security, government food policy, condition of food insecurity and the causes of the households' food insecurity in Bangladesh. In addition,

this study reviews literatures in order to analyze the impacts of food policy on the level of national food security in Bangladesh.

The primary data was collected with the goals of identifying the indicators of rural household food insecurity, to measure the impact of food policy on rural household food security and to recommend some policy options based on respondents' answers about reducing the problem of rural household food insecurity in the country. The primary data also contained information related to food consumption patterns of the household, the reasons of food shortage, the role of micro credit and of the government food policy in increasing food security etc. The study by Islam, A., Chandana, M., Debayan, P. and Russell, S. (2016), which calculated a composite index, is used to measure the food security level of the household, i.e. the absolute level of calories intake and the households dietary diversity. According to Lancaster (1966) and Becker (1965), the demand of calories is measured with the help of consumer demand theory. In this research, the daily calorie intake and households dietary diversity is used to measure the food security level of the households.

4.2.1 Selection of the Study Area

The researcher has selected the study area and the respondents carefully, and has taken into account all the difficulties and complexities inherent in conducting an empirical research work. The Rajshahi district has been selected from the northern part of Bangladesh, as it is an agricultural area and most of the rural people of this district depend on agricultural activities for their livelihood. Due to the lack of large industries and services sectors as earning sources, the per capita income and living standard are very low in the Rajshahi district, as well as in the north-west part of Bangladesh. Government food support and food policies and microcredit provided by the government and by non-government banks and NGOs play a vital role in

increasing the income and food security of the rural households. The Rajshahi district includes nine sub-districts named Paba, Tanore, Mohonpur, Godagari, Baghmara, Durgapur, Puthia, Charghat and Bagha. Three sub-districts, namely Puthia, Charghat and Paba, have been selected randomly for collecting primary data from the rural households. The inhabitants of these three sub-districts are different on the basis of income, consumption expenditure, land ownership, possession of wealth and other socio-economic characteristics, which open an opportunity to investigate the impact of food policy on the level of food security of the different households.

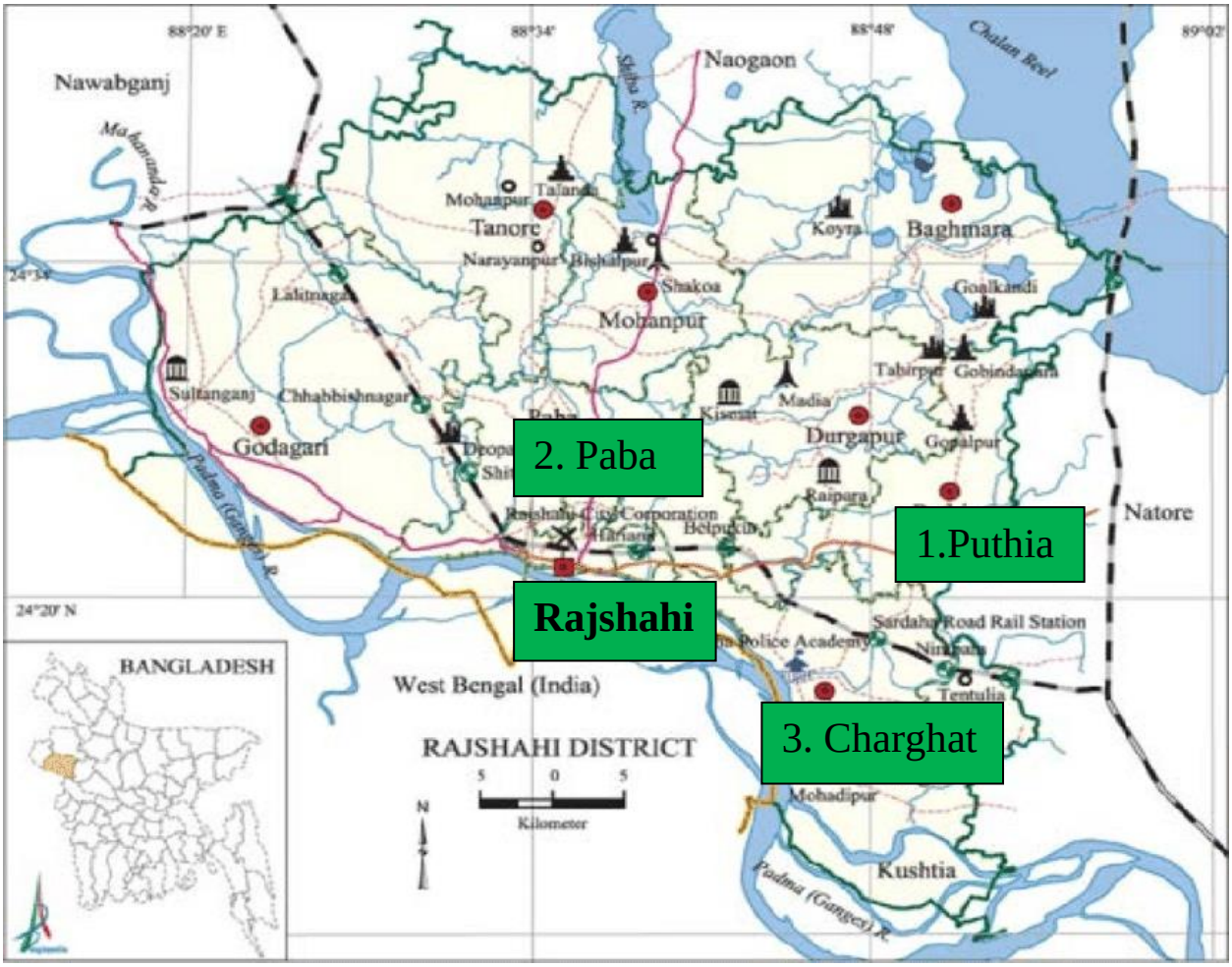


Figure 4.1 The Rajshahi district map with the study area:1. Puthia, 2. Paba and 3. Charghat sub-districts.

4.2.2 Population and Sample Size

According to the report of the Bangladesh Population and Housing Census (2011), the Puthia sub-district has a population of 207,490, the Charghat sub-district has a population of 206,788 and the Paba sub-district has a population of 314,196 (BBS, 2011). The total number of households of all three sub-districts is approximately 165,562.27 (728,474/4.4 where 4.4 indicate number of persons per household) (BBS, 2011). The respondents of the study area are living in rural households and they were selected by using the technique of simple random sampling. Using the simple random sampling technique, 52 and 58 households have been selected from the two sub-districts Puthia and Paba, and from the Charghat sub-district, 50 households have been selected making up the total number of the respondents 160, which is around 0.026 percent of the total households.

4.2.3 Method of Data Collection

This research basically depends on both primary as well as secondary data. Primary data was collected through a well-structured and pre-tested questionnaire by using the interview method over the phone. For collecting the phone or mobile numbers of the respondents, the researcher contacted the three sub-districts offices and collected the list of phone or mobile numbers of the household's heads. The respondents were selected randomly from the list provided by the three sub-district offices (Puthia, Charghat and Paba) under the Rajshahi district located in the northern part of Bangladesh. The secondary data was collected from reviewed literature including peer-reviewed published journal articles, reports of government departments and international organizations, periodicals, unpublished theses, newspapers and conference articles. The key words that provided guidelines for collection of secondary data included "food security and insecurity conditions in Bangladesh", "food policy in Bangladesh" and "agricultural policy

in Bangladesh". The Bangladesh Bureau of Statistics (BBS), the Food and Agriculture Organization (FAO), and the World Bank (WB) were the major important and reliable sources of secondary data for this research.

4.2.4 Interview Method

For collecting primary data in social science research, a principal tool for quantitative research is face-to-face interviews. In this interview process, there is a sequence of questions and the respondents can answer the questions according to their own language (Lewis-Beck, Bryman and Liao, 2004). Yin (2003, p. 92) also pointed out that "interviews were an essential method of data collection in a case study approach, as social researchers were dealing with human issues." The questionnaire for interviews has been prepared based on the review of literature and the research objectives. The researcher sought ethical clearance for the research tools questionnaire according to the MUN ethical research requirements. The researcher restricted participation in the interview to the head of the households whose age is 20 years or older. The reason for choosing household heads as respondents is that, in Bangladesh, the household head mainly controls the whole family and they have the full information related to household's total income, food habits and other issues relevant to this research. The higher the age of the household head, the more he/she is experienced and the more information can be collected from him/her. The questionnaire included the following elements: Firstly, there are questions related to personal information, such as the name of the respondent, address, sex, age, marital status, education, profession etc. Secondly, the questions referred to household's characteristics, like the number of people in the household, their ages, highest education level of the members, earning members, monthly household income, and percentage of income expended for food consumption etc. Then, the questions referred to the amount of food consumption, caloric intake, food diversity, and how

much of the food consumed came from the household's food production. Finally, the respondents were asked about the impact of microcredit on household income and food security, problems related to accessing microcredit, the effects of existing government food policy on the household food security and the role of the government and non-governmental organizations in reducing the food insecurity problem.

The questionnaire (converted to Bengali version), the informed consent form, the letter of invitation and a return envelope were sent to the particular households, before the phone calls, through the Bangladesh postal service. The respondents were invited to participate in the interview through a cover letter and asked to sign the informed consent when the researcher contacted them for the interview. When starting the interview, a short briefing about the research has been provided to the particular respondent. The permission of the respondent has been sought to record the interview and some respondents did not agree to record the interview, then the important points of the interview have been noted down.

4.2.5 Structure of Questionnaire

A well-structured questionnaire was prepared to conduct this research. The questionnaire consisted of a total of 51 open and close-ended questions.

Question No.	**Related to**
Question 1-11	Demographic and socio-economic information
Question 12-29	Food consumption pattern related information
Question 30-50	Microcredit and food policy and their impact on household food security

Source: Authors Own Design, 2020

4.3 Empirical Approach of Analyzing Food Security

This study analyzed the impact of government food policy on households food security in Bangladesh. After completing the collection of primary data through the field interview, the researcher used SPSS (SPSS V27), Stata (V16) and Microsoft Office Excel (MS Excel) softwares to analyze the data. For analyzing primary data, a fixed effect regression model has been used to analyze the impact of food policies on household food security. For example, how does the food policy in Bangladesh affect the different measures of food security i.e., household calories intake and dietary diversity? To measure the food security status at household level, some statistical techniques such as the adult equivalent unit, food security index, head count index and shortage and surplus index were applied. To determine the food security status of each household based on the recommended daily calorie approach, Okwudilio et al. (2006) have used the Food Security Index (FSI). The Food Security Index method was also used by other researchers such as Omonona and Agoi (2007); Babatunde et al. (2007); Babatunde et al. (2010); Kuwornu et al. (2013); Adeniyi and Ojo (2013); Iorlamen et al. (2013); Ahungwa et al. (2013) and Iorlamen et al. (2014). The Microsoft Office Excel spreadsheet (MS Excel) was used to calculate average, maximum and minimum values, to draw figures, charts and tables etc. The results of the study were presented through tables, figures and graphs and used the map and the GIS system. The SPSS software was used to convert the weekly calorie intake per household to per capita calorie intake per day, to draw cross tables etc. To run the logistic regression model, to find out the propensity score and the average treatment effects on outcome variable, Stata 16 software has been used.

4.3.1 Food Security Index

For measuring the food security status at household level, two methods have been widely used in different studies (Maxwell, 1996). The first method was used by Omonona and Agoi (2007), which is expressed as: Food security = (food expenditure of i^{th} household ÷ two-third of the mean per capita food expenditure of all study households). The second method was used by Fakiyesi (2001) and Olayemi (1998), where food security can be measured into two ways. The first one is based on calorie consumption per equivalent male adult, and the second one is based on age and sex without converting to equivalent adult by calorie consumption (Dev, 2014). The daily calorie intake method is better than the food expenditure method, because the daily calorie intake method represents the actual food consumption pattern of the households, and due to this reason, this study used the daily calorie intake method.

This study collected detailed data from the respondents about the quantity and value of food items purchased and consumed by households over the seven days preceding the date of the interview (Islam, Pakrashi, Maitra and Smyth, 2016). The quantities were converted to grams (G) and the calorie content was estimated by using the nutrient composition table of commonly eaten foods in Bangladesh (GoB, 2005; BIDS, 1997). Due to similar food habits in Bangladesh and India, this study also used the Gopalan et al. (1981) nutrition chart to convert the food items consumed by a household to calorie availability by applying conversion factors, which is routinely used in large-scale nutrition surveys, such as India's National Survey Organization (NSSO, 2012). The calorie chart used in this study is justified by the calorie chart used by the Bangladesh Institute of Labour Studies. The total calorie equivalent of all food items consumed by the household during the reference period was derived by aggregating calories over different food groups. Finally, this study calculated the equalized calorie availability, expressed as

kilocalories per day, by dividing the aggregate calorie figure at the household level by the OECD (Organization of Economic Co-operation and Development) equivalence scale, following Haagenars et al. (1994), which assigns a value of 1 to the first adult, 0.7 to each additional adult member and 0.5 to each child under the age of 15 (Islam, Pakrashi, Maitra and Smyth, 2016). It is important to take into account the equalized calorie availability as consumption needs may differ across households based on their composition, like a household consisting of only working age adults and a household with one or more children. The measure of the food security status of each household is based on the food security line using the daily calorie intake recommended by FAO (2005). The average daily calorie requirement for a moderately active adult is 2850 kcal and a safe minimum daily intake should not fall below 80% of the above calorie requirement, which means that the minimum intake should be about 2280 kcal per adult equivalent per day (Dev, 2014). According to the FAO (2005) recommendation, households whose daily per capita calorie intake is at least 2280 kcal are regarded as food secure, while those with less than 2280 kcal are food insecure.

Barrett (2002) defined that an appropriate threshold level may vary depending on the health status, nutrition requirement, activity level and genetics etc. As the calorie level varies with climate, age, gender, activity status, irrespective of the level at which it is set, so the minimum calorie requirements are developed by the Bangladesh Bureau of Statistics (BBS). To measure the incidence of poverty, BBS used two thresholds of measuring poverty, namely the absolute poverty as indicated by 2122 Kcal per person per day and the hard core poverty indicated by 1805 kcal per day (Islam, Pakrashi, Maitra and Smyth, 2016). This is known as the daily calorie intake (DCI) method of measuring the incidence of poverty (BBS, 2000). Fakiyesi (2001) defined a food security index as follows:

$$F_i = \frac{Y_i}{R}$$

where,

$F_i = Food\ Security\ index = Food\ security\ status\ of\ ith\ household$

$Y_i = Daily\ per\ capita\ calorie\ intake\ of\ the\ ith\ household$

$R = Recommended\ per\ capita\ daily\ calorie\ intake$

$(2280\ kcal\ per\ day\ per\ adult\ equivalent).$

When, $F_i \geq 1$, the i^{th} household will be food secure [$Y_i \geq R$]

$F_i < 1$, the i^{th} household will be food insecure [$Y_i < R$]

Based on F_i, other related measures are calculated and these are the HCR (Head Count Ratio), the Shortfall/Surplus Index (P), and the food insecurity gap (FAO, 2005; Fakiyesi, 2001; Olayemi, 1998).

4.3.2 The Headcount Ratio (HCR) Index

The head count ratio shows the ratio of the total number of food insecure (secure) households to the total number of household studied, which is calculated by using the following formula:

$$HCR = \frac{M}{N}$$

where,

HCR = Head count ratio

M = Total number of food insecure/secure households

N = Total households studied

4.3.3 The Shortfall or Surplus Index

A household may consume more or less compared to recommended calories depending on household income, household size or other factors. The shortfall or surplus index measures the extent to which households are above or below the food security line, and the index can be measured by using the following formula:

$$P = \frac{1}{M}\sum_{i=1}^{m} G_i$$

And $G_i = (FS_i - Th)/Th$

where, P shows the shortfall/surplus index

M= the number of food insecure (for shortfall index) or secure (for surplus index) households

G_i is the deficiency or surplus faced by i^{th} household and

FS_i is the average daily calorie available to the i^{th} household

Th= stands for the threshold level (per capita 2280 kcal/day)

For example, the shortfall and surplus indexes are 0.0700 and 0.066 which show that the food insecure households fall below the food security line by about 7% and the food secure households lie above the food security line by 6.6%.

4.4 Estimation Methodology: Propensity Score Matching (PSM) Technique

This study estimates the casual impact of government food policy or food support programme participation on rural household level food security. Therefore, it necessitates addressing non-random programme placement and the self-selection of households into food support programmes (Islam, Pakrashi, Maitra and Smyth, 2016). To assess or compare the impact of government food policy or food support programmes, it is required to consider a treatment group affected by the programme, such as a government food support intervention, and a control group (not receiving government food support). Then, the difference between the two groups is defined as the impact of the programme. To address the concern regarding the comparability of participants and comparison groups, this study estimates a regression model using a strategy that builds on the propensity score matching (PSM) method proposed by Rosenbaum and Rubin (1983). This study combines the regression method with the PSM method, and uses a regression-adjusted PSM (Heckman et al. 1998) that addresses a selection based on observables and unobservables (Islam, Pakrashi, Maitra and Smyth, 2016). The main purpose of using the PSM technique is to compare the calorie intake of individuals as well as the food security index of rural households who received government food supports to that of control groups (who did not receive food support). In order to match groups of receivers and non-receivers of food support, this study estimates propensity scores of each household using a standard logit model that regresses participation status of the households surveyed on their initial set of household and village-level observable characteristics (Alauddin, Tisdell, Sarker and Islam, 2020; Islam, et al, 2016; Wadud, 2013).

Evaluation studies attempt to estimate the mean effect of participating in a programme (treatment), which requires making an inference about the outcome that would have been

observed for the treated (treatment) group, if they had not been treated (control group) (Wadud, 2013). Experimental studies have a key advantage (over non-experimental methods), which is the ability to generate a control group that has the same distribution of characteristics as the treatment group. In this case, the calculation of the treatment effect is the difference of mean outcomes. On the other hand, in non-experimental studies, subjects usually self-select into treatment groups. Wadud (2013) and Alauddin, Tisdell, Sarker and Islam (2020) refer that treated and control groups differ with respect to their participation status, but also with respect to many other unobservable characteristics. Calculating the treatment effect as the difference of mean outcomes between the two groups would yield biased results (selection bias).

This study tries to overcome the fundamental evaluation problem and address the possible occurrence of selection bias. The first problem arises because this study knows the difference between the participants' outcome with and without treatment. It is also clear that it is not possible to observe both outcomes for the same individual at the same time (Wadud, 2013). It is not suggested to take the mean outcome of non-participants as an approximation, since participants and non-participants usually differ even in the absence of treatment. This problem is known as selection bias and is a good example in the case where high-skilled individuals have a higher probability of entering training programmes and also have a higher probability of finding a job. Matching 'treatment' and 'control' groups of similar observed characteristics using the PSM technique can reduce biases associated with confounding factors (Becker and Ichino, 2002). Matching is a widely applied approach to estimate casual treatment effects, such as evaluating labour market policies (Heckman et al. 1997 and 1998; Dehejia and Wahba, 1999), as well as other empirical examples in very diverse fields of study. It is applied for all situations

where one has an intervention with a group of treated individuals and a group of untreated individuals (Wadud, 2013). For instance, Perkins et al. (2000) applied matching in pharmaco-epidemiologic research, Hitt and Frei (2002) analyzed the effect of online banking on the profitability of customers.

The basic idea is to find in a large group of non-participants who are similar to the participants in all relevant pre-treatment characteristics X. The underlying identifying assumption is known as confoundedness, or selection on observables or conditional independence. It should be mentioned that matching is no 'magic bullet' that will solve the evaluation problem in any case, but if there is rich information of the data and detailed understanding of the institutional set-up by which selection into treatment takes place, then matching should be applied under the underlying identifying assumption.

Since conditioning on all covariates is limited in the case of a dimensional vector X ('course of dimensionality'), Rosenbaum and Rubin (1983) suggested the use of so-called balancing b(X), i.e. functions of the relevant observed covariates X such that the conditional distribution of X given is independent of assignment into treatment. One possible balancing score is the propensity score, i.e. the probability of participating in a program given observed characteristics X. Matching procedures based on this balancing score are known as propensity score matching (PSM) (Wadud, 2013).

Let Y_1 be the outcome that would be the result if an individual received government food support and Y_0 the outcome that would result if the individual did not receive support. Let D = {0,1} denote the binary indicator of food support (D = 1 food support, 0 otherwise). For a given individual, the observed household income is then $Y_1 = Y_{0i} + Di\ (Y_{1i} - Y_{0i})$. According to Heckman

et al. (1997 and 1998) and Sianesi (2001), we can attempt to identify the effects of government food support given in the following:

a) The average treatment effect: $E(Y_1-Y_0)$ is the average calorie intake difference between the two groups.
b) The average treatment effect on the treated is $E(Y_1-Y_0 \mid D=1)$. This parameter is the one receiving most attention in the evaluation literature and measures the average calorie intake difference between the households who received food support and the calories that they would intake if they had not received food support.
c) The average treatment effect on the non-treated: $E(Y_1-Y_0 \mid D=0)$ is the average calorie intake difference between the potential or expected calorie that the households who did not receive food support $(D=0)$ would intake if they had $(E(Y_1))$ and the real calorie that they intake (Y_0).

To estimate the mean effect of a particular program, matching is a commonly used non-experimental method of evaluation. This method compares the outcomes of program participants with those of matched non-participant, where matches are chosen on the basis of similarity in observed characteristics (Wadud, 2013). Suppose there are two groups of farmers indexed by participation status $P = 0/1$, where 1(0) indicates farms that did (not) participate in a program. Denote by Y_1 the outcome (performance of farm) conditional on participation $(P=1)$ and by Y_0 the outcome conditional on non-participation $(P=0)$.

The most common evaluation parameter of interest is the mean impact of treatment on the treated, $ATT = (Y_1-Y_0 \mid p=1) = E[(Y_1 \mid p=1) - E[(Y_0 \mid p=1]$, which answers the following question: 'How much did households participating in the program benefited compared to what they would have experienced without participating in the program?

Data on $E[(Y_1 \mid p=1)]$ are available from the programme participants. An evaluator's classic problem is to find $E[Y_0 \mid p=1]$, since data on non-participants enables one to identify $E[Y_0 \mid p=0]$. So the difference between $E[(Y_1 \mid p=1)]$ and $E[Y_0 \mid p=1]$ cannot be observed for the same household.

Rubin (1977) provided a solution based on the assumption that has given a set of observable covariates X, potential (non-treatment) outcomes are independent of the participation status (conditional independence assumption – CIA): $Y_0 \perp S \mid X$. Hence, after adjusting for observable differences, the mean of the potential outcome is the same for P=1 and P=0; this is $[E(Y_0 \mid p=1, X) = E(Y_0 \mid p=0, X)]$. This permits the use of matched non-participating households to measure how the group of participating households would have performed, had they not participated.

4.4.1 Analytical Framework:

Alauddin, Tisdell, Sarker and Islam, (2020) used three analytical frameworks into three different stages in their research. **At the first stage,** the logistic regression model is used to estimate the probability of receiving food support based on selected predictors. A logistic regression model analyzes the influence of different independent variables on a dichotomous outcome by examining the probability of the occurrence of the event. Due to a change in the predictor variables, the probability of changing in the dependent variables is also explained by the logit model. The specified logit model is shown in equation 1 below:

$L_i = l_n \left({}^{p_i}/_{1-p_i}\right) = \beta_0 + \beta_1 x_i$, where X_i is the vector of household characteristics.

In details the model is:

$$L_i = l_n \left({}^{p_i}/_{1-p_i}\right) = \beta_0 + \beta_1 AHH + \beta_2 EHH + \beta_3 HS + \beta_4 EM + \beta_5 MI + \beta_6 AL + \beta_7 OC + \beta_8 FE + \beta_9 RM + u_i \quad (1)$$

where,

L_i is the log of ith household

AHH = Age of the household head

EHH = Education level of the household head

HS = Household size

EM = Earning member

MI = Monthly income

AL = Arable land ownership

OC = Ownership of cattle

FE = Food expenditure weekly and

RM = Receiving microcredit

β_0 is the constant and β_1, β_2 ..... β_9 are the regression coefficients and u_i is the random error term.

Equation (2) specifies the marginal effects (ME).

$$\text{ME} = \frac{\partial p_i\ (y=1x)}{\partial x_k} \qquad (2)$$

Marginal effects estimated from the logit model (Equation 2) demonstrated which and how the selected household characteristics influenced the household to accept food support. With binary independent variables, marginal effects measure discrete change, i.e. how do predicted probabilities change as the binary independent variable changes from 0 to 1? Marginal effects for continuous variables measure the instantaneous rate of change. ∂ indicates the amount of

changes. They often provide a good approximation to the amount of change in y that will be produced by a 1- unit change in X_k (Williams, 2020).

4.4.2 Measurement of dependent and explanatory variables

In this section, the units of the variables and their measurement procedure are discussed. The dependent variable was dichotomized with a value. The present analysis included all the households having access to any sources of food support and the selected variables were based on an in-depth review of the relevant literature. Table 4.1 presents definitions of the selected variables.

Table 4.1: Description of Variables Using the Logit Model

Variable		Type	Measurement
Dependent variable	Food Support	Dummy	1 if received food support and 0 for not receiving food support
Explanatory Variables	Age	Continuous	Age of the household head
	Education	Continuous	Education level of the household head
	Household size	Continuous	Total number of members in the household
	Earning member	Continuous	Total number of earning members in the family
	Monthly income	Continuous	Total monthly income of the household's head
	Arable land	Continuous	Total pieces of arable land owned by the household head
	Ownership of cattle	Dummy	1 if the household has cattle and 0 for otherwise
	Food expenditure	Continuous	Total amount of weekly food expenditure of the household
	Receiving microcredit	Dummy	1 if the household received microcredit and 0 for otherwise

Source: Author's Own Design, 2020.

Age

The age of the household head is expected to have positive impact on receiving food support. The household heads having a higher age may lead to receiving more food support compared to people of younger age. The expected effect of age could have negative impacts on receiving food support. The reason behind this is that some household heads who are young may have large family size and not sufficient income sources. Due to these reasons, these households need more government food support.

Household head education

Education increases household's knowledge as well as experience. Educated household heads are more efficient and the household heads with higher level of education have more job opportunities due to the high level of efficiency performance (Wadud, 2013). Besides, the household heads with more education are being able to use their wealth and knowledge in an efficient way; that's why they did not need any food support to improve the condition of their food security level. They are sufficient enough to fulfill the demand of their family food needs. Depending on the findings of Wadud, (2013), it is assumed that the education level is negatively related with the dependent variable, i.e. receiving food support. The higher the level of education, the lower the percentage of households receiving food support. In contrast, the lower the level of education, the higher the percentage of households that will receive food support.

Household size

Islam, Pakrashi, Maitra and Smyth (2016) used household size as an explanatory variable to identify the impact of microcredit program participation on household food security. Following their study, the present study is using household size as an independent variable and has identified that household size has a positive impact on receiving food support, as the household

with numerous family members needs more food compared to the household with less family members. Sometimes, due to other factors such as low income, bad harvest and high food prices it is not possible to bear the food cost of a large household and that's why large families need to receive food support to improve their food security condition.

Earning member

Like household size, the number of earning members is an important variable. Receiving food support and the number of income earning members of the family are negatively related with each other. It is assumed that the higher the number of income earning members of the family indicates the lower need to receive food support and the lower the number of income earning members indicates the family needs more food support. Islam, Pakrashi, Maitra and Smyth (2016) used the number of working people as an explanatory variable to find out the impact of microcredit participation to improve the household food security level. But the relationship between income earning members and receiving food support could be positive too, if the amount of income is very low, no matter how many income earning members existed in the family (expressed in labour days).

Monthly income

The monthly income of the respondents is expected to have a negative impact on receiving food support. The household with a higher monthly income did not need any food support, while the household with low income needed to receive food support for a healthy life.

Arable land

Arable land ownership is inversely related with receiving food support, as large amount of land ownership indicates a higher amount of wealth. The household with a huge land can cultivate their own land or rent their land which is a great source of income. As their income was sufficient, they needed not receive any food support. In contrast, the landless or poor households needed to receive food support to maintain their livelihoods.

Ownership of cattle

Ownership of cattle or livestock has a negative impact on receiving food support. A household with huge ownership of cattle/livestock indicates that the household has diversified sources of income as well as that livestock is one kind of asset. This study assumes a negative relationship between cattle ownership and receiving food support, as the household with more cattle indicates ownership of more assets and for this reason these households do not need to receive any food support. On the other hand, less or no ownership of cattle indicates no diversification in the sources of income and ownership of less assets. For this reason, these households need to receive food support.

Food expenditure

The household's expenditure on food is another important determinant of receiving food support. Food expenditure depends on the market price of food and on the family size. If the market price of food is higher due to inflation or food shortage in the economy, then the households have to pay more money to buy food, which increases their food expenditure. When the food expenditure is high, the household is pushed to asking and receiving food support to meet their daily calorie intake. If the food price remains stable, then the food expenditure becomes constant and the

households do not need to receive any food support. From this explanation, we assume that the relationship between food expenditure and receiving food support is positive.

Receive microcredit

In general, the households who receive microcredit do not need to receive government food support, as they are already engaged in income generating activities and business to improve their income and food security level. Besides, from the findings of Wadud (2013) and Islam, Pakrashi, Maitra and Smyth (2016) it is found that the households who receive microcredit can improve their economic condition as well as their food security level. So from their findings, it is assumed that the relationship between microcredit and receiving food support is negative. However, sometimes the relationship can become positive too, as in rural areas, some households who received microcredit have not been successful to increase their income level due to improper use of the credit and lack of training. For these households, to fulfill their daily calorie intake it is necessary to receive food support.

In the second stage, this research employed the PSM (propensity score matching) technique to identify the casual effects of receiving food support on the household's daily calorie intake as well as the food security index (i.e., the outcome variables). Predictors (i.e. the independent variables) in the logit model in equation (1), may influence the daily calorie intake and food security index even if the household did not receive any food support. Matching between the nearest neighbors of the treatment and control groups by using the PSM technique can reduce the apparent association between the study variables, where no real association exists between them (Alauddin, Tisdell, Sarker and Islam, 2020; Becker and Ichino, 2002). To find out the potential match between the control group and the treated group, balancing the variables (observed

characteristics) is needed. Equation 3 describes the estimated propensity score for food support receivers or the conditional probability of receiving food support.

$$P_r(X) = P_r\,(FS = 1X) = F\,(\beta X) \qquad (3)$$

This is a logit model and the propensity scores were obtained after estimating the model as the difference between means of covariates of the two groups. The study assumes that the selection effect is possibly zero, since age, education, monthly income, food expenditure, microcredit etc. are independent of the government food support. Here, like in the covariates matching method, a Kernel matching is conducted based on the propensity scores assuming conditional independence. Kernel matching reduces the selection bias since the outcome variables play no part in selecting the groups to be compared (Handouyahia, Haddad and Eaton, 2013).

This research involved 160 sample households from the rural area of the Rajshahi district, and identified the respondents with similar characteristics who received food support. Therefore, the sample remains homogeneous in covariates as the study area is situated in a similar belt, so that most of their characteristics are identical and the impact of food support from the government is assumed to be the same for all of the sample households. Furthermore, from the descriptive statistics, it is evident that the means of observed socio-demographic characteristics and institutional accessibility do not differ substantially.

Now, in the final analysis, if the means of covariates are not statistically significant, that means that the matching pairs will create unbiased estimates of the average treatment effect (ATE); this is the average effect of receiving food support in this study. But as the means of covariates is positive, that means receiving food support has a positive impact on the rural households, so it is

necessary to improve the condition of government food support in the study area. To observe the good effect of receiving food support, this research also calculates the ATET i.e the average treatment effect on the treated.

Following Angrist, Jorn-Steffen and Pischke (2008), Wadud, (2013) and Alauddin, Tisdell, Sarker and Islam (2020) in a matched sample, we obtain the following ATE (average treatment effect) estimate to observe the effects on outcome variable, Yi as specified in Equation (4).

$$\delta_{ATE} = E[E\{Y_{1i}X_i, FS_i = 1\} - E\{Y_{0i}X_i,\ FS_i = 0\}] = E(Y_{1i} - Y_{0i}) \quad (4)$$

We can obtain the ATET to show the effect of receiving food support on rural households from the equation (5).

$$\delta_{ATET} = E(Y_{1i} - Y_{0i}X_i,, FS_i = 1) \quad (5)$$

where,

Y_{1i} is the outcome of interest of food support receivers and Y_{0i} is the outcome of interest of food support non receivers. The casual effect of the treatment variable (i.e. food support) is shown by the difference of the means of the outcome variables for the treatment as well as for the control groups (Huber, Lechner and Wunsch, 2013).

However, there is still the possibility of confounding the variables being left out of this analysis, since conditional independence is merely an assumption. For instance, microcredit, food expenditure and food support could influence calorie intake and have impacts on the outcomes of interest. Often, high dimensionality complicates the matching procedure (Heckman, Ichimura

and Todd, 1998). Since the government food support is not widely diffused in the study areas, sufficient data may not be available to account for these confounding variables. Therefore, this is beyond the scope of this study and warrants further research.

Stage 3 employed a multiple regression model for calorie availability given that the PSM method does not specify the functional form between the effect of selected covariates including the treatment variable and outcome variables. At this stage of the analysis, a double robustness check on the PSM procedure was performed using a weighting method. Following Li and Greene (2013), a regression-based impact analysis, after matching, produces a consistent and balanced estimator of the causal effect of the food support program on food support receivers. The coefficient of the treatment variable defines the ATET, similar to the PSM estimate.

4.5 Ethical considerations

After completing the write up of the final research proposal and the questionnaire, the researcher submitted them to the Research Ethics Board at Grenfell Campus for ethical clearance. Before submitting the research proposal to the Ethics Board, an Informed Consent form has been prepared for obtaining the consent of the participants. Also an interview recruitment letter has been prepared for each interviewee and the supervisor's signature has been collected from the academic supervisor. The Informed Consent form gives assurance to the participant that there are no obvious risks associated with participation in this research. The answers have been codified and aggregated to make it impossible to connect any information participants provide with his/her individual identity. There is also assurance that the data will be stored in a password-protected database (MUN, Grenfell Campus Server). Finally, before submitting the ethical

application, the researcher has completed the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans Course on Research Ethics (TCPS 2: Core Certification).

4.6 Dissemination Plan

The researcher's duty is to submit the final research report at Memorial University of Newfoundland, then the researcher will communicate with a publisher for publication of this research as a chapter of any book or a full book, or one or two peer reviewed articles. In addition, the researcher will try her best to present the final results of the research at different national and international conferences and publish essential parts of the research in relevant peer reviewed journals.

4.7 Conclusion

This chapter described the procedure of the study area selection, the data collection procedure as well as the data analysis techniques, and discussed the methodology of achieving the overall objectives of the study. It was found that a logistic regression model and the propensity score matching method were appropriate to investigate the impact of the existing food policy on rural households' food security. The estimation process and other econometric issues related to the estimation and relevant data have been described in this chapter.

Chapter Five

Socio-Economic Features of the Sample Household

5.1 Introduction

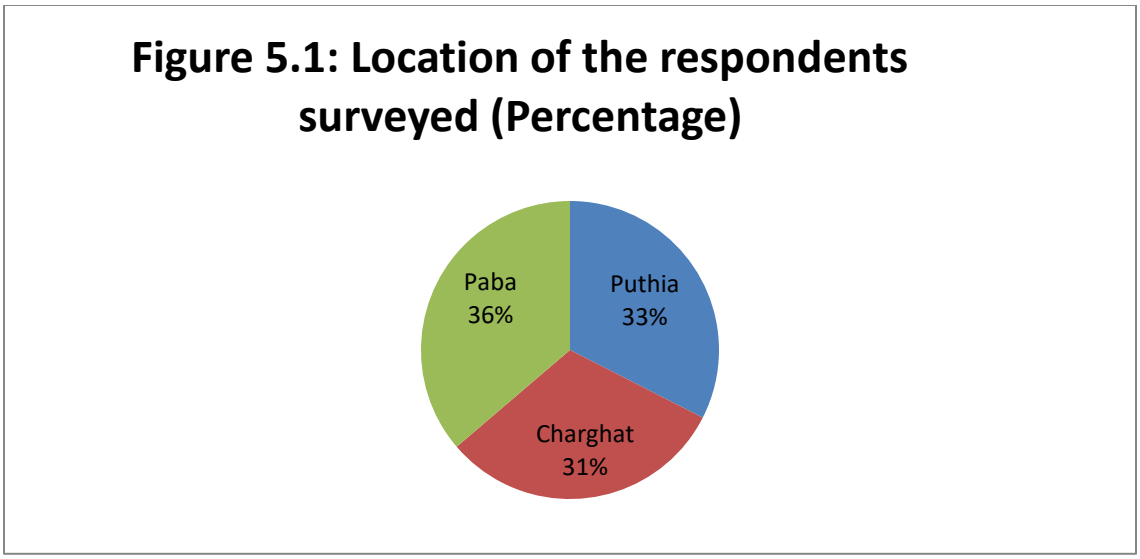
This chapter focuses on identifying and monitoring some socio-economic and demographic features of the rural households in the Rajshah District, Bangladesh, such as the household size, farm size, age distribution, occupational distribution, education level of the household head etc. This chapter aims to explain the social as well as the economic position of the rural households and their living standard in the study area.

The chapter is organized into twenty nine sections. Section 5.1 starts with an introduction and the first three sections 5.2, 5.3 and 5.4 discuss the location, age and the distribution of household size, respectively. Household heads' level of education and the highest level of education of the family are shown in section 5.5 and 5.6, respectively. The occupational distribution as well as the frequency of total income earning members of the household is presented in sections 5.7 and 5.8, respectively. Section 5.9 shows the households' monthly income data while section 5.10 identifies the households' food expenditure. In addition, the average monthly income and expenditure on food of the respondents is shown in section 5.11. Section 5.12 identifies the months in which the respondents have faced food shortage problems in the last year, and the reasons behind this food shortage are identified in section 5.13. The percentage of households who have received microcredit and the Sub-district wise microcredit receivers' distribution, as well as the source of the microcredit received are shown in sections 5.14, 5.15 and 5.16, respectively. Sections 5.17 and 5.18 discuss the purpose of using microcredit, and in section 5.19 it is analyzed whether the microcredit programs helped to increase the respondents' family

income. The reasons for not increasing the family income after taking microcredit are discussed in section 5.20. Sections 5.21, 5.22 and 5.23 include an analysis of whether the microcredit helped to increase the food security of the households, of the reasons behind not increasing the food security identified by the respondents and of the problems faced by the microcredit receiver's respectively. The percentage distribution of food support receivers under the government food policy programs appears in sections 5.24 and 5.25. The effects of the food policy to increase the food supply as well as the reasons for not increasing the food security level of the respondents are shown in sections 5.26 and 5.27, respectively. In section 5.28 some policy suggestions forwarded by the respondents to increase food security household level are discussed, and finally section 5.29 includes some concluding remarks.

5.2 Area-wise Frequency Distribution of the Respondents

According to the report of the Bangladesh Population Census (2011), the Rajshahi district has nine sub-districts named Godagari, Charghat, Tanore, Durgapur, Paba, Puthia, Bagmara, Bagha and Mohonpur. Following a simple random sampling technique, this study collected data from the respondents of three sub-districts namely Puthia (Situated East from the city of Rajshahi), Paba (Situated Northeast part from the city of Rajshahi) and Charghat (Situated Southeast part from the city of Rajshahi). The study found that 36 percent of the respondents were from Paba, 33 percent were from Puthia and 31 percent were form Charghat (Figure 5.1).



Source: Survey, 2020

5.3 Age Distribution of the Respondents

Table 5.1 has shown that 30.0 percent of the respondents' age is less than 30 years and 31.3 percent of the respondents are under 40 years old. This means that about 60 percent of the respondents lie in the median (middile) age group. The percentage of respondents' age between 61 to 70 years and 71 to 80 years are 5 percent and 4.4 percent, respectively, which covers a small portion of the sample respondents. This indicates that a few percentage of respondents are going to retire very soon, but still most of the respondents are involved in money earning incomes.

Table 5.1: Age Distribution of the Respondents

Range of Age	Number of Respondents	Percentage (%)
21-30	48	30.0
31-40	50	31.3
41-50	22	13.8
51-60	25	15.6
61-70	8	5.0
71-80	7	4.4
Total	**160**	**100.0**

Source: Survey, 2020

The percentage of respondents whose age is between 41 to 50 years is very small that is 13.8 percent, whereas 15.6 percent of the respondents' age is between 51-60 years. From Table 5.1 it is clear that a large number of respondents are middle and young age, which is a good indication that they can earn more money and can ensure food security at household level. Better training, education and technical support can increase the productivity of the respondents, as well as the condition of food consumption.

5.4 Distribution of Family Members According to Age Group

Table 5.2 depicts the descriptive statistics of the household size and the distribution of family members according to age group. The data show that the average household size is 4.18, ranging from 2 to 10 members in a family, with a standard deviation of 1.302. According to the Census Report of the GoB (2011), at national level, the household size is 4.35 in Bangladesh, and the data in Table 5.2 indicates that the household size in the study area is smaller than at the national level.

Table 5.2 Distribution of Family Members According to Age Group

	N	Minimum	Maximum	Mean (Average)	Std. Deviation
Total family members	160	2	10	4.18	1.302
Family members 1-15 years	160	0	4	.94	.874
Family members 16-60 years	160	2	7	3.03	.961
Family members 60 years or more	160	0	2	.18	.461
Total respondents	160				

Source: Survey, 2020

On average, every household has 0.94 children with ages between 1 to 15 years, with the range of 0 to 4 children per family, and a standard deviation of 0.874. The average of households with members between 16 to 60 years is 3.03, with a minimum of 2 and a maximum of 7 members, and a standard deviation of 0.961. The average number of people that are 60 years or more is 0.18 with a minimum of 0 and a maximum of 2, with a standard deviation of 0.461, which is very small.

5.5 Level of Education of the Household Head as Answered by the Respondents

The level of education is an important factor and has a positive impact on human development as well as on the household's income (Hassan, 1991). In this study, the education level of the household is classified into 8 categories, namely illiterate, class 1-5, class 6-9, Secondary school certificate (SSC), Higher secondary certificate (HSC), undergraduate, Masters and others (include religious education, vocational or institutional training etc.). The findings show that among the total respondents, 45.60 percent have completed primary education (class 1 to 5), whereas only 3.10 percent have completed Master's degree (graduate studies). Among the total respondents, 21.90 percent completed classes 6 to 9 (under Secondary School Certificate), followed by 8.10 and 7.50 percent, respectively, are having SSC and HSC degrees.

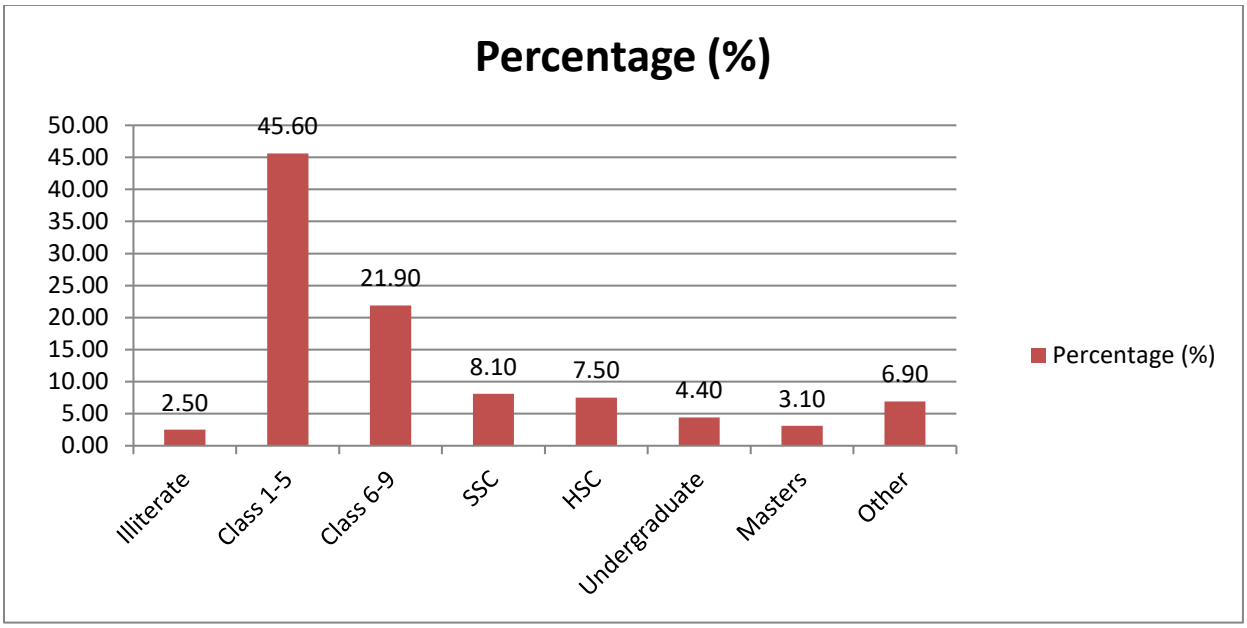


Figure 5.2 Level of education of the household head

Source: Survey, 2020

Figure 5.2 shows that 2.50 percent of the total respondents are illiterate and 3.10 percent have completed graduate level education. Very recently, others forms of education, such as religious education, vocational training etc., are getting popularity in the study area, as this kind of training is helpful to increase the income level; among the sample, 6.90 percent have completed other forms of education.

5.6 Highest Level of Education of the Family Members of the Respondents

The highest level of education of the household members indicates the overall education status of the households, as well as access to job opportunities or income generating activities (Chaudhary, 2009). Table 5.3 presents the highest level of education of the household members, with 35.6 percent of the household members having completed classes 1 to 10 education (under SSC). The frequency of completing SSC, HSC and undergraduate level education among the family members is almost the same percentage, i.e. 16.9, 16.3 and 16.9, respectively. The rest of

the respondents, i.e. 14.4 percent among the total respondents family members have completed a Master's level education.

Table 5.3: Highest Level of Education of the Members of Households

Level of education	Number of respondents	Percentage
Under SSC	57	35.6
SSC	27	16.9
HSC	26	16.3
Undergraduate	27	16.9
Masters	23	14.4
Total	160	100.0

Source: Survey, 2020

5.7 Main and Subsidiary Occupation of the Respondents

The respondents in the study area are involved with a variety of activities for earning their livelihood. In terms of occupation, the respondents are involved in farming, small business, service, auto driving, day laborer, rickshaw or van driver etc. The study found that most of the households have their own arable land but this is not sufficient to supply the food for household members' needs. Due to this reason, the household heads along with their main occupation have some other occupation to supplement their income. Table 5.4 reveals that 65 percent of the respondents have no subsidiary occupation, whereas the remaining 35 percent of the respondents have a main job as well as supplementary jobs. That means more than half of the respondents do not have a second job and they are depending only sources of income due to unavailability of jobs or lack of efficiency. Among different occupations, a large number of respondents, i.e. 46.3 percent are involved with farming as their main occupation, and 10.6 percent are involved with farming as their subsidiary occupation. Day laborer and business are another important sources of occupation in the study area, i.e. 12.5 and 11.9 percent of the respondents are involved with these occupations, respectively; and 6.3 and 8.8 percent, respectively, are adopting day laborer and business as their subsidiary occupation.

Table 5.4 Main and Subsidiary Occupation of the Respondents

Type of occupation	Main occupation		Subsidiary Occupation	
	Number of respondents	Percentage (%)	Number of respondents	Percentage (%)
Farming	74	46.3	17	10.6
Business	19	11.9	14	8.8
Services	4	2.5	-	-
Auto driver	9	5.6	1	0.6
Day laborer	20	12.5	10	6.3
Rickshaw/Van driver	9	5.6	7	4.4
Other	25	15.6	7	4.4
No subsidiary occupation	-	-	104	65.0
Total	160	100.0	160	100.0

Source: Survey, 2020

In the study area, only a small percentage, i.e. 2.5 percent of the respondents are engaged in services as their main occupation, and no one takes this as their subsidiary occupation. The services sector is not wide in the Rajshahi district, and the people who are involved with farming have no or little chance to get a job in the services sector. Followed by this, 5.6 percent of the respondents are involved with auto driving and the same percentage is for rickshaw/van driving as their main occupation, while 0.6 and 4.4 percent of the respondents adopted auto driving and rickshaw or van driving as their subsidiary occupation. The rest of the respondents, 15.6 percent, are involved with other occupations and 4.4 percent adopted other kinds of occupations as their subsidiary occupation.

5.8 Number of Income Earning Members of the Households

Table 5.5 shows that most of the households, that is 72.5 percent, have only 1 income earning member, and this indicates that most of the households have a low level of income. The highest number of income earning members is 4 and a small percentage, i.e., 0.6 percent, lies in this

group. The rest of the households (24.4%) have 2 income earning members, and 2.5 percent of the respondents have 3 income earning members in their family.

Table 5.5: Number of Income Earning Members of the Households

Income earning members of the household	Number of respondents	Percentage (%)
1	116	72.5
2	39	24.4
3	4	2.5
4	1	.6
Total	160	100.0

Source: Survey, 2020

5.9 Monthly Income of the Household

This section shows the monthly income of the rural households converted in Canadian dollars (CAD$). During the interviews, the data related to income were taken in Bangladeshi Taka (BDT) and then converted into CAD$. The respondents are divided into three income groups, such as the low income group ranges from 0 to CAD$200, the middle income group ranges from CAD$201 to CAD$400 and the high income group ranges from CAD$401 to CAD$601 or more. The data in Table 5.6 reveals that a large number of the respondents (63.7 percent) lies in the low income group, whereas 10.6 percent lies in the very low income range, between CAD$0 to CAD$100), and 53.1 percent lies between the income range of CAD$101 to CAD$200. By adding these two groups we get the low income group of respondents that is 63.7 percent as a whole. On the other hand, very few respondents fall into the high income group that is only 4.6 percent.

Table 5.6 Monthly Income Data of the Respondents in CAD$

Range of income (CAD$)	Income group	Number of respondents	Percentage (%)
0-100	Low Income	17	10.6
101-200		85	53.1
201-300	Middle Income	33	20.6
301-400		18	11.3
401-500	High Income	3	1.9
501-600		3	1.9
601 or more		1	.6
Total	**-**	**160**	**100.0**

Source: Survey, 2020

Only 1.9 percent of the respondents' income lies between CAD$401 to CAD$500 and the same percentage is for the income group of CAD$501 to CAD$600, while only 0.6 percent of the respondents' income ranges between CAD$601 or more. It is found from the survey that 31.9 percent of the respondents fall in the middle income group, where 20.6 percent earn monthly earnings of CAD$201 to CAD$300, and 11.3 percent of the respondents earn CAD$301 to CAD$400.

5.10 Monthly Food Expenditure of the Households

The data in Table 5.9 show the monthly food expenditure of the respondents in the study area. The range of food expenditure per month for each household is divided into four categories, namely CAD$1 to CAD$100, CAD$101 to CAD$200, CAD$201 to CAD$300 and CAD$301 or more. A large portion of the respondents, that is 63.1 percent, expends CAD$1 to CAD$100 per month for food consumption, while a very small number, that is 0.6 percent, expends CAD$301 or more. In addition, Table 5.9 shows that 35.0 percent of the respondents' household level

spending on food consumption lies between the range of CAD$101 to CAD$200, and the rest, that is 1.3 percent, expend CAD$201 to CAD$300 for monthly food consumption.

Table 5.7: Monthly Food Expenditure of The Households in CAD$

Range of food expenditure (CAD$)	Number of respondents	Percentage (%)
1-100	101	63.1
101-200	56	35.0
201-300	2	1.3
301 or more	1	.6
Total	160	100.0

Source: Survey, 2020

5.11 Average Monthly Income and Food Expenditure of the Respondents

Table 5.8 presents the descriptive statistics of the respondents' average monthly incomes and expenditures converted in Canadian dollars. It is seen from the table that the average monthly income of the respondents is CAD$199.04, with a minimum of CAD$31.39 and a maximum of CAD$627.84. The value of the standard deviation is 103.01 which indicates that there is a huge income inequality among the respondents; that means the income level of rich people is very high compared to the poor people. The monthly average food expenditure of the respondents is CAD$94.62, with a maximum of CAD$382.99 and a minimum of CAD$25.11, and a standard deviation of 46.11.

Table 5.8: Average Monthly Income and Food Expenditure of the Households in CAD$

Monthly income and expenditure of the household	N	Minimum	Maximum	Mean	Std. Deviation
Monthly income of the household (CAD$)	160	31.39	627.84	199.04	103.01
Monthly food expenditure of the household (CAD $)	160	25.11	382.99	94.62	46.11
Percentage of income expended on food consumption (%)	160	13.33	93.33	50.21	14.78
Total respondents	160				

Source: Survey, 2020

Followed by this, the mean percentage of income spent on food consumption per month is 50.11percent, with a minimum of 13.33 percent and a maximum of 93.33 percent. The maximum percentage shows that some households spend almost all income for food purposes. The standard deviation is 14.78 which means that there is a huge difference between income expended on food consumption data.

5.12 Name of the Month in Which the Respondents Faced Food Shortage in the Last Year (2019)

The bar diagram in Figure 5.3 shows the corresponding months and the percentage of respondents who faced food shortages in the last year (2019). According to the bar diagram, 25.6 percent of the respondents did not face a food shortage problem in the last year. In figure 5.3 the term did not response means that these households did not face any kind of food shortage problem. The study also found that a large portion of the respondents, that is about 74.4 percent, faced food shortage problems in the last year. Among them, 23.8 percent of the respondents faced food shortage problems in the month of July, 18.8 percent faced food problems in June, while 12.5 percent face a food problem in August. From these findings it can be concluded that it was from June to August of 2019 when most of the respondents faced food shortage problems, as this is the rainy season in Bangladesh. Due to continuous rain and severe floods, people cannot go outside for daily work and many people have no work especially the rickshaw drivers and the day laborers. In addition, fresh floods can wash away lots of crops, while people's shelters and crop fields go under water for three to four months. These scenarios occur every year at the same time, almost every year, in Bangladesh.

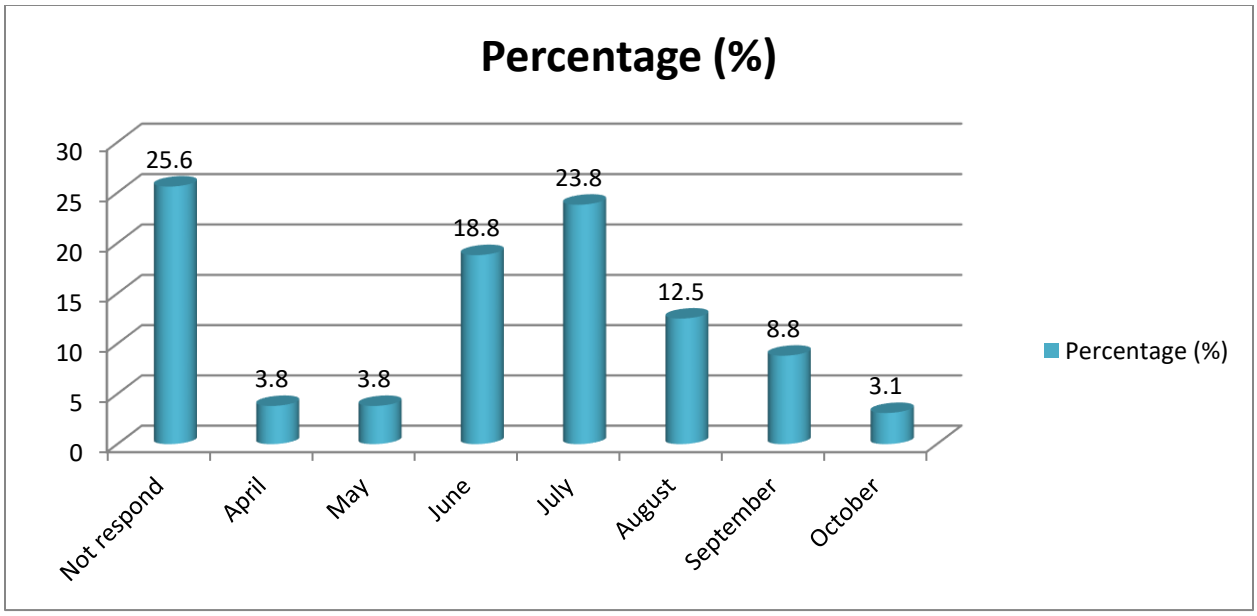


Figure 5.3: Name of month when respondents faced food shortages in year 2019
Source: Survey, 2020

The after effects of the 2019 floods continued to September and October, and for this reason it is seen from the diagram that 8.8 percent of the respondents answered that they faced food shortage in the month of September, and 3.1 percent faced the same problem in October. Besides, some respondents also faced food shortage problems in April and May due to drought and because these two months are also pre harvesting periods for *Boro*, the most produced rice in Bangladesh. In these two months, the hot summer season is running over Bangladesh and due to lack of rainfall and irrigation facilities the agricultural production can be damaged.

5.13 Reasons of Food Shortage of the Households, as Identified by the Respondents

The reasons behind the food shortages from April to October, 2019 are divided into eight main categories, such as the high food price, lack of work or job, low income, shortage of money, bad harvest due to flood and heavy rain, not sufficient food supply, government food policy and others. Some respondents identified these categories as the first reason of their food shortages,

and some identified them as the second reason of food shortages. Table 5.9 postulates that the main reason of food shortages in the last year was the high price of food, i.e. 21.3 percent of the respondents identified this reason as the first one, while 3.1 percent identified this as the second reason of the food shortages. Considering all the respondents, 25.9 percent of the respondents did not answer this question, whereas 56.9 percent of the respondents identified only one reason behind the food shortage. Lack of work or job was another important reason behind food shortages and it was identified by 20 percent of the respondents, while 8.8 percent identified this as a second reason. As Table 5.9 shows, 12.5 percent of the respondents identified low income as a first reason for food shortages, while 9.4 percent identified this as the second reason. Due to floods and other natural calamities, the opportunities for work and agricultural production become very low and the price of food becomes very higher on one hand, and on the other hand the incomes of the people become very low.

Table 5.9: Reasons of Food Shortages of the Households, as Identified by Respondents

Reasons of food shortage identified	1st reasons percentage	2nd reasons percentage
High food price	21.3	3.1
Lack of work or job	20.0	8.8
Low income	12.5	9.4
Shortage of money	7.5	3.8
Bad harvest due to flood and heavy rain	6.9	10.6
Not sufficient food supply	5.6	0
Government food policy	0	4.4
Other	0.6	3.1
No response	25.6	56.9
Total	100	100

Source: Survey, 2020

Money shortage and bad harvest due to flood and excessive rain were also the important reasons for food shortages identified by 7.5 percent and 6.9 percent of the respondents as the first reason of food shortages, while 3.8 and 10. 6 percent identified these as the second reason, respectively. A very small number of respondents (5.6 percent) agreed that lack of sufficient food was the first reason behind food shortages and no respondents identified this as a second reason of food shortages. Government food policy was not identified by any respondent as the first reason of the food shortage, but 4.4 percent of the respondents identified this as the second reason. The rest of the respondents (0.6 percent) mentioned other reasons, such as not being able to work like before, having no land of their own as the first cause of the food shortage and 3.1 percent of the respondents identified this as the second reason.

5.14 Percentage of Respondents Who Received Microcredit

From the above discussion, it is clear that food prices, uncertainty of food production, low incomes, and unemployment were some of the basic reasons of food shortages in the study area. To overcome the food shortages, and get involved in income generating activities and improving their family's socio-economic condition, most of the respondents in the study area received microcredit. As Figure 5.4 shows, 71.2 percent of the respondents received microcredit, and the remaining 28.8 percent did not receive any microcredit. By accessing microcredit, the rural households can employ themselves, as well as diversify their income sources and remove their unemployment status which ultimately can improve their food security condition.

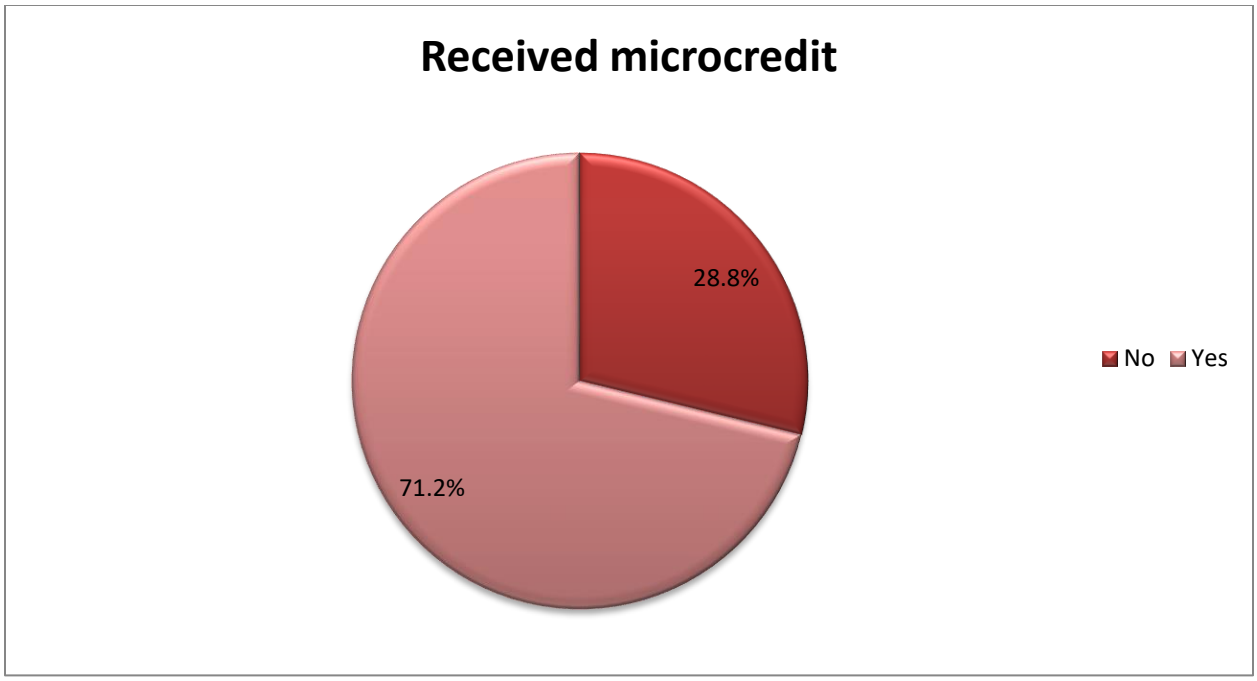


Figure 5.4: Percentage of microcredit receivers
Source: Survey, 2020

5.15 Sub-district Wise Microcredit Received by the Respondents

Table 5.10 shows the distribution of sub-division-wise microcredit receivers. As Table 5.10 shows, the percentage of microcredit receivers is high in Paba compared to Puthia and Charghat. The study has found that 87.9 percent of the respondents in Paba sub-district are microcredit receivers and 12.1 percent of the respondents are microcredit non-receivers. Charghat sub-district holds the second position, where 74.0 percent of the respondents received microcredit and the remaining 26.0 percent of the respondents are not microcredit receivers. The percentage of microcredit receivers is fifty-fifty in Puthia sub-district as 50 percent are microcredit receivers and the rest 50 percent are microcredit non receivers.

Table 5.10 Sub-district Wise Microcredit Received by Respondents

Microcredit received from any source		Name of sub-district			Total
		Puthia	Paba	Charghat	
No	Count	26	7	13	46
	%	50.0%	12.1%	26.0%	28.8%
Yes	Count	26	51	37	114
	%	50.0%	87.9%	74.0%	71.3%
Total	Count	52	58	50	160
	%	100.0%	100.0%	100.0%	100.0%

Source: Survey, 2020

5.16 Sources of Microcredit Received by the Respondents

The field survey found that the respondents generally have taken microcredit from banks and non-bank financial institutions, such as the Grameen Bank, BRAC Bank, NGOs, government banks, private banks, etc. Table 5.11 shows that a large number of respondents (38.8 percent) received loans from different NGOs, such as Association for Social Advancement (ASA), Thengamara (a place name in Bangladesh) Mohila (Female) Sabaj (Green) Sangha (Community) (TMSS), Buro Bangladesh, Sotoful etc. The percentage of respondents who have taken loans from the government and private banks is very low, only 0.6 percent of each. The reasons for not receiving microcredit from banking sources are: the hard financial conditions, such as high interest rates, need for collateral etc. Grameen Bank is one of the remarkable sources providing microcredit to the rural households (14.4 percent).

Table 5.11: Sources of Microcredit Received by the Respondents

Source of microcredit	Number of respondents	Percentage (%)
Not respond (Did not receive any food support)	46	28.8
Grameen Bank	23	14.4
BRAC Bank	14	8.8
NGOs	62	38.8
Government Bank	1	0.6
Private Bank	1	0.6
Friends or Relatives	5	3.1
Other Sources	8	5.0
Total	160	100.0

Source: Survey, 2020

Some respondents, i.e. 8.8 percent, and 5.0 percent of the respondents, have received loans from the BRAC Bank and other sources, respectively. The Table 5.11 also indicates that 28.8 percent did not reply to this question; it can be assumed that they did not receive microcredit.

5.17 Purpose of Using Microcredit, as Answered by the Respondents

The rural households use the microcredit for different purposes ranging from small businesses to building a house or even marriage purposes. The Table 5.12 indicates the main/first purposes of using microcredit, as identified by the respondents. The main purposes of using microcredit as identified by the respondent are: small business (16.3 percent), buying livestock (15.0 percent), rent agricultural land (13.8 percent) and build a house (10.0 percent). It is found that around 28.8 percent of the respondents did not answer about the purpose of using microcredit and it may assumes that they did not able to use the microcredit for any productive purpose.

Table 5.12 First Purpose of Using Microcredit, as Answered by Respondents

Purpose of using microcredit	Number of respondents	Percentage (%)
Not respond	46	28.8
Small business	26	16.3
Buy rickshaw/van	6	3.8
Buy auto rickshaw	9	5.6
Buy livestock	24	15.0
Rent agricultural land	22	13.8
Education of children	7	4.4
Build a house	16	10.0
Other	4	2.5
Total	160	100.0

Source: Survey, 2020

The other purposes, such as buy rickshaw or van, auto rickshaw, education of children and other purposes were identified by 3.8 percent, 5.6 percent, 4.4 percent and 2.5 percent of the respondents, respectively.

5.18 Second Purpose of Using Microcredit, as Answered by Respondents

In this section, the second main purpose of using microcredit, as answered by the respondents are identified. As Table 5.13 shows, 85 percent of the respondents did not respond to this question, that may mean that most of the respondents are using microcredit for only one purpose. A small percentage of the respondents were using the microcredit for different purposes along with a main purpose. Building a house is one of the most important second purpose of taking microcredit, as 8.8 percent of the respondents have used microcredit for this purpose. For small businesses, 1.9 percent of the respondents were using microcredit as their second purpose, whereas 1.3 percent were using microcredit for buying a rickshaw/van and using it for other purposes.

Table 5.13 Second Purpose of Using Microcredit, as Answered by Respondents

Purpose of using microcredit	Number of respondents	Percentage (%)
Not respond	136	85.0
Small business	3	1.9
Buy rickshaw/van	2	1.3
Buy livestock	1	.6
Rent agricultural land	1	.6
Education of children	1	.6
Build a house	14	8.8
Other	2	1.3
Total	160	100.0

Source: Survey, 2020

Buying livestock (0.6 percent), renting agricultural land (0.6 percent), and education of children (0.6 percent) were also identified as second purposes for using microcredit.

5.19 Does Microcredit Help to Increase Family Income of the Respondents?

The pie diagram in Figure 5.5 shows the percentage of the respondents who agreed that microcredit facilities helped to increase their family's income. Among the total respondents, 28.80 percent of the households did not receive any credit facilities. As Figure 5.5 shows, a large percentage of respondents (52.50 percent) answered that microcredit facilities helped to improve their family's income condition, while the rest of the respondents (18.80 percent) replied that this microcredit system could not be able to improve their family's income condition.

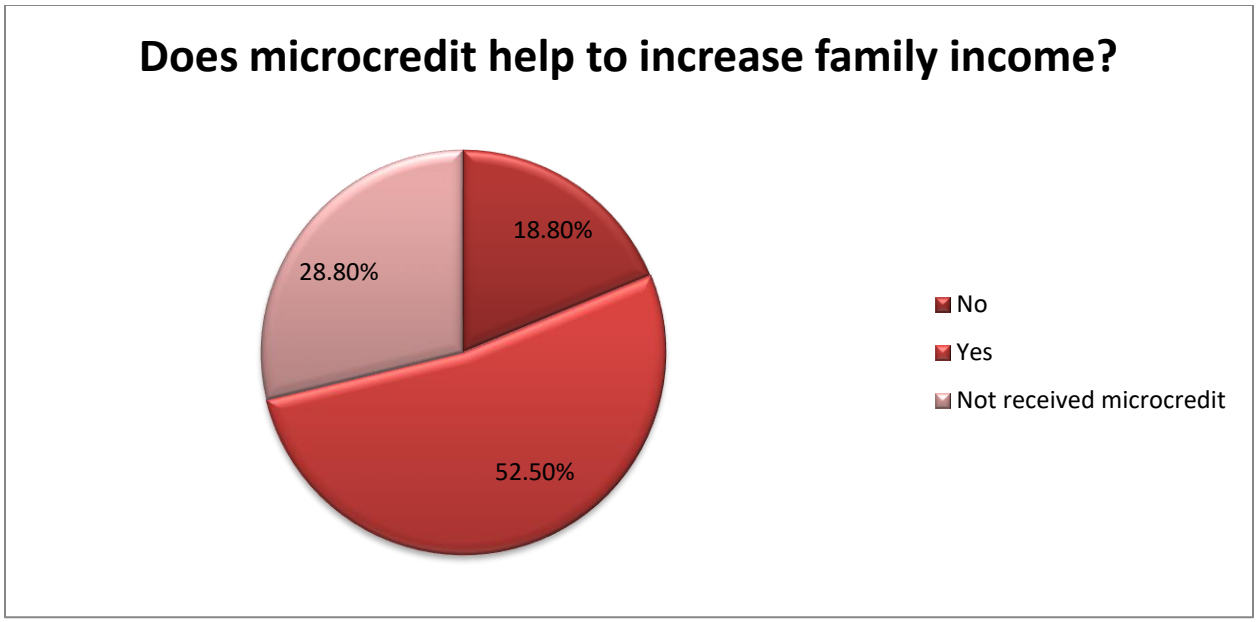


Figure 5.5 Does microcredit help to increase family income?
Source: Survey, 2020

5.20 Reasons for Not Increasing the Family Income after Taking Microcredit

In this case, it was found that 81.3 percent of the respondents neither received microcredit nor answered the question that microcredit increased family income. The rest of the respondents mentioned the reasons for microcredit not helping to increase family's income and food security. As Table 5.14 shows, the reasons identified are the high interest rate, the low profit from business, not sufficient credit amount, and some other reasons. 6.9 percent of the respondents agreed that because of the high interest rate, the program was not helpful at all to increase family's income. After receiving microcredit, most of the people started their own businesses and due to low profit margins from the business, 4.4 percent of the respondents said that microcredit was not helpful to increase the family income.

Table 5.14 Reasons for Not Increasing Family Income after Receiving Microcredit

Reasons for not increasing family income	Number of respondents	Percentage (%)
Neither received microcredit nor answered this question	130	81.3
High interest rate	11	6.9
Low profit from business	7	4.4
Microcredit amount was not sufficient	7	4.4
Other	5	3.1
Total	160	100.0

Source: Survey, 2020

The other reasons included: the amount of microcredit was not sufficient, and 4.4 percent of the respondents agreed with this, while 3.1 percent identified some other reasons for not increasing the family income.

5.21 Does Microcredit Help to Increase Food Security of the Households?

Figure 5.6 shows the percentage of respondents who agreed or disagreed that microcredit helped to increase the food security of the households. The study found that 52.50 percent of the respondents agreed that microcredit helped to increase the food security condition at the household level, as it was found that the same percentage indicated that this microcredit facility helped to increase income. With the help of microcredit, rural people were able to start small businesses or get involved in income generating activities which helped them increase family income, as well as increase food consumption and nutrition level. A small percentage (18.8 percent) of the respondents replied that microcredit did not help to change household income, as they mentioned that it was difficult to increase income due to the small amount of the loan received with high interest. The remaining 28.8 percent of the respondents did not benefit from the facilities of microcredit.

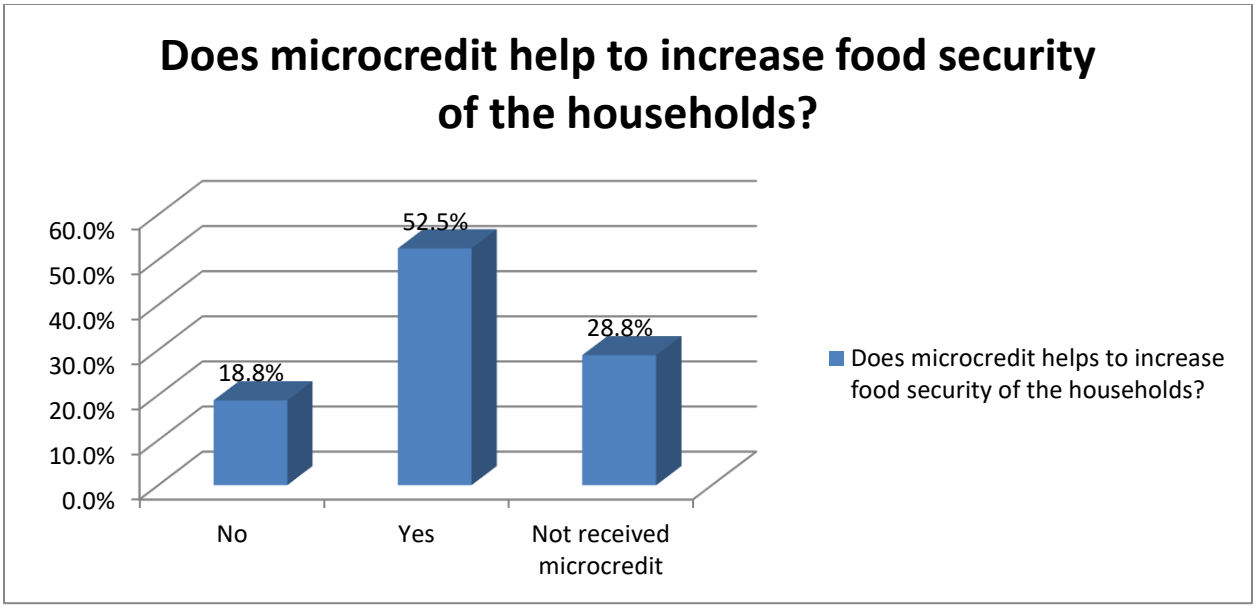


Figure 5.6 Percentage of respondents who agreed/disagreed that microcredit helped to increase food security of the households

Source: Survey, 2020

5.22 Reasons for not Increasing Households' Food Security, as Identified by the Respondents

The respondents identified some reasons for not increasing the households' food security status after receiving microcredit, such as low return from investment, high interest on credit, large size of the family, high amount of weekly installment, loan amount was not sufficient, and others. As Table 5.15 shows, 52.5 percent of the respondents agreed that microcredit increased their food security, whereas 28.8 percent of the respondents did not receive any credit facilities. A very small percentage (14.4 %) of the respondents replied that due to the low return from their investment they were not able to improve their food security condition. The study reveals that 0.6 percent of the respondents replied that the high interest rate on credit and the large amount of weekly installment were the vital reasons behind not improving the family's food security condition. In addition, 1.3 percent of the respondents identified the large number of family

members as the reason behind not increasing the food security condition at the household level since the loan amount was very small compared to the need.

Table 5.15 Reasons for Not Increasing the Food Security of the Households

Reasons for not increasing the food security of the households	Number of respondents	Percentage (%)
Agreed that microcredit increased food security	84	52.5
Low return from investment	23	14.4
High interest rate	1	.6
Large number of family members	2	1.3
High amount of weekly installment	1	0.6
Other	3	1.9
Not received microcredit	46	28.8
Total	160	100.0

Source: Survey, 2020

5.23 Problems Faced by the Respondents after Receiving Microcredit

Table 5.16 shows that 49.4 percent of the respondents agreed that they needed to work more hours to repay the loans, while 21.9 percent replied that they did not need to work more hours and the rest of the respondents, i.e., 28.8 percent, did not receive the microcredit facilities. The table below also shows that 24.4 percent of the respondents replied that they needed to engage their family members in income generating activities in order to repay the loan, but 46.9 percent, representing a large number of respondents, did not agreed with this. Most of the respondents, i.e. 58.8 percent, replied that they did not face any problems at the time of receiving the loan, while only 12.5 percent of the respondents faced some problems, such as needing to submit land documents or give bribes to sanction the loan.

Table 5.16 Problems Faced by the Respondents after Receiving Microcredit

	Yes (%)	No (%)	Not received microcredit (%)
Did you need to work more hours than before to repay your loan?	49.4	21.9	28.8
Did your family members need to work to repay the loan?	24.4	46.9	28.8
Did you face any problems at the time of taking the loan?	12.5	58.8	28.8
Did you face any problems after taking the loan?	25.0	46.3	28.8
Do you believe that microcredit programs help to improve your socio-economic condition?	81.3	3.8	15.0 (NR*)
Has your household's food security status changed after the food policy was introduced in 2006?	58.1	36.3	5.6 (NR*)

***NR: No response** **Source: Survey, 2020**

Almost all the respondents that is 81. 3 percent, believed that microcredit programs help to improve their socio-economic condition, while only a small percentage (3.8 percent) of the respondents did not agree with this. The 2006 food policy was a good initiative to increase the food security conditions of the rural households and 58.1 percent of the respondents supported this statement; however, 36.3 percent of the respondents did not agree with this statement.

5.24 Percentage Distribution of Food Support Receivers Under the Government Food Policy or Food Security Programs

This section provides the distribution of respondents who received food support under different government food policies including the food policy introduced in 2006, such as "100 days' work, food for work" (*kajer binimoye khaddo kormosuchi*), "vulnerable group feeding", "open market sale", "old age allowance" (*boyoshko vata*) etc. Figure 5.9 shows that 41.9 percent of the respondents answered that they received food support under the above mentioned government

food support programs, while more than 50 percent of the respondents, i.e. 58.1 percent, did not receive any support under these programs.

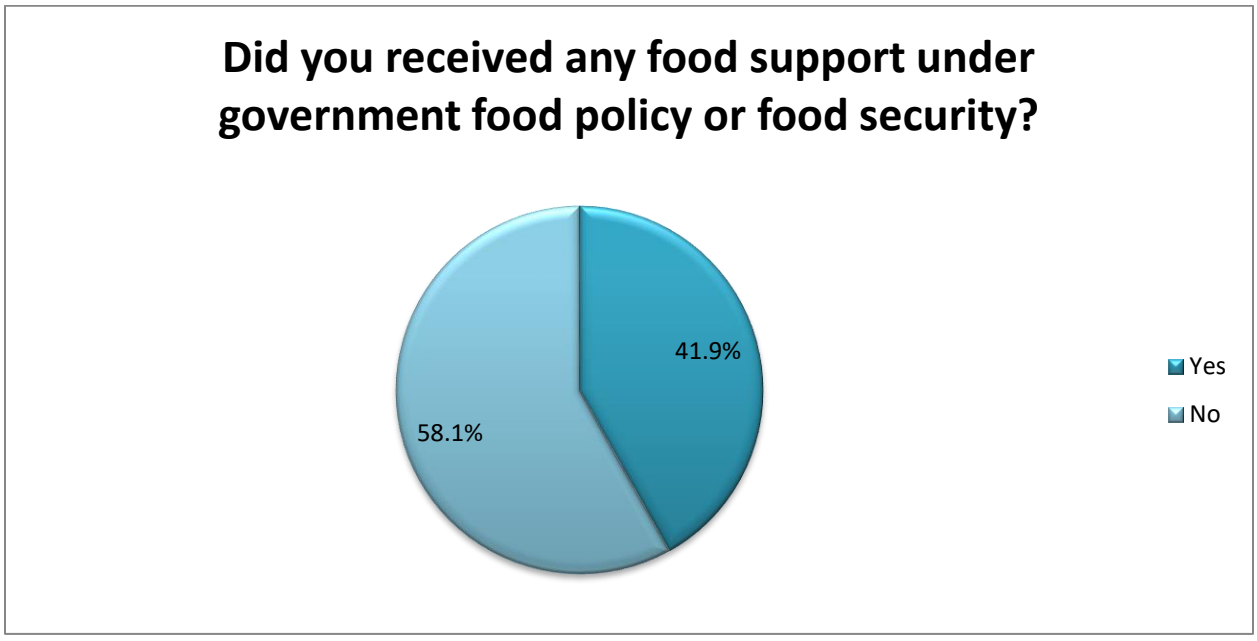


Figure 5.7: Did you receive any food support under government food policy or food security programs?
Source: Survey, 2020

5.25 Distribution of Respondents Who Received at Least One Food Support Program

Table 5.17 describes that most of the respondents did not receive food support from government sources, namely 58.8 percent. “Open market sale” is an important program to increase the food security among the poorer households in the study area as most of them are poor. Under the program, government sells some food items at subsidized prices, as due to the high price of the food most of the people in the study area cannot afford to buy nutritious food regularly. Table 5.17 shows that 11.3 percent of the respondents received food support under the “open market sale” program.

Table 5.17 Distribution of Respondents Who Received at Least One Food Support Program

Name of programs	Number of respondents	Percentage (%)
Not receiving any kind of food support	94	58.8
Vulnerable group feeding	13	8.1
100days work	11	6.9
Food for work	4	2.5
Open market sale	18	11.3
Other	20	12.5
Total	160	100.0

Source: Survey, 2020

"Vulnerable group feeding" and "100 days' work" are also two important programs offered by the Bangladesh government to increase the level of food security, and 8.1 percent and 6.9 percent, respectively, of the respondents received food support under these two programs. A very small portion of the respondents, i.e. 2.5 percent, received food support under the government's food security program named "Food for work". The rest of the respondents (58.8 percent) did not receive any support offered by the Bangladesh government.

5.26 The Effects of Government Food Policy to Increase Food Supply At the Household Level

It was found from the field survey that most of the respondents (70.6 percent) agreed that the 2006 government food policy was helpful to increase the food supply at the household level (Figure 5.8). The remaining respondents (29.4 percent) replied that the present government food policy failed to increase food supply at the household level due to different shortcomings/deficiencies of the policy. The percentage of respondents in this category was only 29.4%.

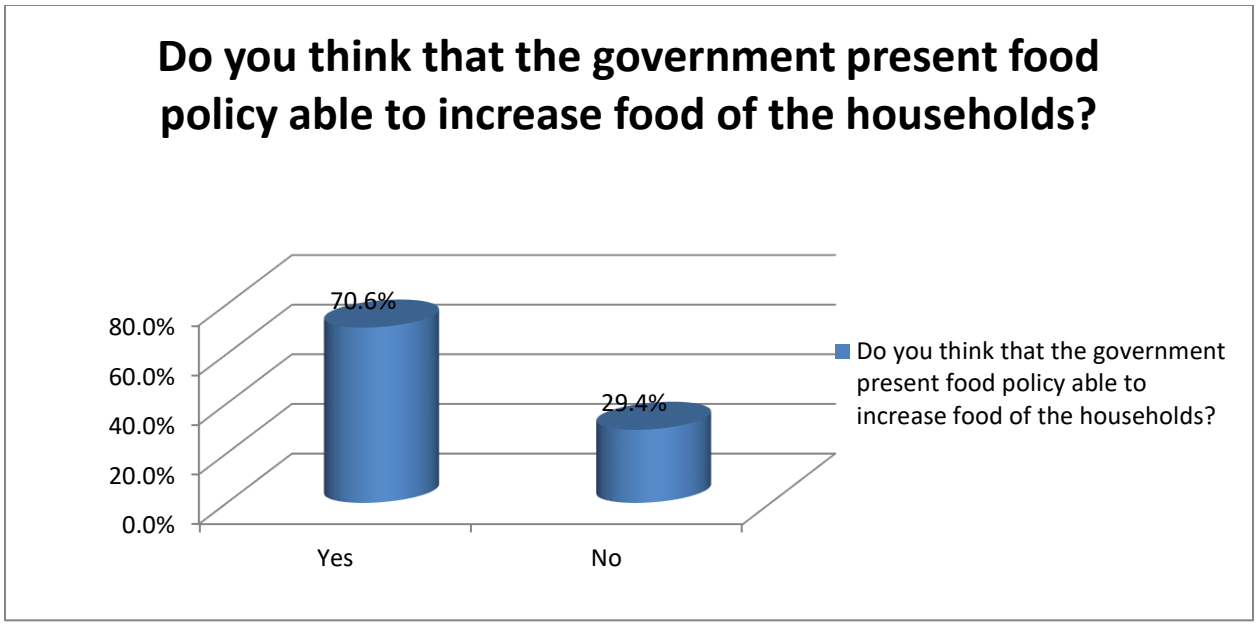


Figure 5.8 Do you think that the government's current food policy is able to increase food security at the household level?
Source: Survey, 2020

5.27 Reasons Identified by the Respondents for the Households' Food Security Not Being Increased under the Government's Current Food Policy

During the survey period, the researcher identified some reasons for not increasing the food security at the household level, depending on the response of the rural households. The reasons include: the food support was not sufficient, a very small portion of poor people get the benefit of food support and the food distribution system was not proper at all. As Table 5.18 shows, most of the respondents (70.6 percent) did not respond to this question, as they agreed that the food policy increased food supply and food security at the household level. Among the rest of the respondents, 16.3 percent identified that the improper food distribution system was an important reason for not increasing the food security status at the household level. The food support was not sufficient in the study area compared to the necessity, and 8.1 percent of the respondents agreed on this point, while the rest of the responders, i.e. 5.0 percent, replied that a

small portion of the poor people get the government support under the present food policy, and this was also considered the reason behind the fact that the food security condition of the rural households was not improving/increasing.

Table 5.18 Reasons for the food security of the households not improving under the government's current food policy

	Number of respondents	**Percentage (%)**
Agreed that government food policy increased food security	113	70.6
Food support not sufficient	13	8.1
Small portion of poor people get food support	8	5.0
Improper food distribution system	26	16.3
Total	160	100.0

Source: Survey, 2020

5.28 Suggestions Offered by Respondents to Increase Food Security at the Household Level

In this section, some policy suggestions are presented in Table 5.19 that were identified by the respondents during the time of the field interviews. The suggestions are categorized as the first important and the second important suggestions and include suggestions such as: eat more vegetables and fish instead of meat, produce healthy food by own farm, improvement of agricultural research and agricultural development etc. As Table 5.19 shows, 26.9 percent of the respondents suggested that it was necessary to eat more vegetables and fish instead of meat and this was the first major suggestion provided by respondents, while 1.3 percent of the respondents identified this as a second important suggestion to increase the level of food security. A large number of respondents, i.e., 41.3 percent, identified the self-production of healthy food as the first major suggestion, while 11.9 percent replied that this was the second major suggestion for increasing the food security condition.

Table 5.19 Suggestions Made by Respondents to Increase Food Security at the Household Level

Suggestions identified by the respondents	First major suggestion made by respondents (%)	Second important suggestion made by respondents (%)
Eat more vegetables and fish instead of meat	26.9	1.3
Produce healthy food on own farm	41.3	11.9
Improvement of agricultural research and agricultural development	1.9	11.9
Increase the number of family members supplying food	10.6	9.4
Improve the present/current food policy	15.0	6.9
No response	4.4	58.8

Source: Survey, 2020

Improvement of the present food policy and bringing more poor people under food support programs were identified as the first policy suggestions to increase households' food security by 15.0 percent and 10.6 percent of the respondents, respectively. These two policies were also identified as the second suggestion by 6.9 percent and 9.4 percent of the respondents, respectively. The rest of the respondents, i.e. 1.9 percent, identified the improvement of agricultural research and the development of agriculture sector as the first policy suggestion for increasing the food security at household level, while 11.9 percent of the respondents identified this as a second suggestion.

5.29 Conclusion

Food security is currently an international phenomenon and ensuring a healthy diet for all at households' level is important. Bangladesh has made substantial progress in enhancing food security of the rural households and the government food policy has had an essential impact behind this improvement. From the above discussion, it is clear that food support plays an

important role in reducing the food insecurity problem at the household level. In addition, it is also true that the amount of food support is not sufficient to fulfill the demand of all households. Therefore, it is necessary to improve the existing government food policy, as well as to develop a new food policy specifically addressing the food security condition of the rural households.

Chapter 06

Food Policy and Its Impact on Households Food Security

6.1 Introduction

This chapter discusses the results of empirical estimations of the impact of the government food support program on rural household level food security in the Rajshahi district, Bangladesh. It also discusses the calculated Food Security Index (FSI) and the empirical relationship between food policy and food security and its impact on rural household level food security. A logistic regression model is used to measure the probability of receiving government food support based on selected predictors. The Propensity Score Matching (PSM) technique is employed to observe the casual effects of government food support program on outcome variables (calorie intake and food security).

This chapter is presented in fourteen main sections. In section 6.2, the status of food security at household level in the Rajshahi district has been discussed. Access to Microcredit and the condition of food security, food support and food security, as well as the food security level by income have been presented in sections 6.3, 6.4 and 6.5, respectively. In sections 6.6 and 6.7, the area-wise overall food security level of the respondents and the calorie intake, as well as the food security status of the respondents are shown. The daily mean calorie intake of the food secure

and food insecure households, the head count ratio and the shortfall or surplus index of food security are presented in sections 6.8, 6.9 and 6.10, respectively. In section 6.11, the result of the Logistic Regression Model is discussed, and the PSM (propensity score matching) result is explained in section 6.12. The results of multiple regression model is presented in section 6.13. Finally, section 6.14 presents some concluding remarks.

6.2 The Status of Food Security at Household Level in the Rajshahi District

According to the FAO report (2005), the household whose members' daily per capita calorie intake is 2,280 kcal or above is a food secure household, while the household whose members' calorie intake lies below 2,280 kcal per day is referred to as a food insecure household (FAO, 2005; Dev, 2014). In Table 6.1, depending on household's basic needs, this study identified some necessary food items, i.e. rice, wheat, potatoes, lentils, fish, meat, eggs, oil, milk/milk products, sugar, vegetables, fruits, spices and others. As it is seen from the table, that rice is the main food item the households consumed two-three times daily in the study area. The survey revealed that the average per capita rice intake is 549.03 g per day, where 554.48 is consumed by those households who are food secure, while the households who are food insecure consumed only 263.8 g (half amount of the secure households) of rice per day. From the Table 6.1, it is seen that the amount of rice consumption is higher in the food secure households compared to the food insecure households. Vegetables are the second important food item observed in the study area, and the consumption amount is on average around 228.48 g per day per capita. The result shows that 230.07 g of vegetables is consumed by food secure households and 145.49 g of vegetables is consumed by food insecure households. The next important food items in the table are: wheat, followed by potatoes, eggs, fish, fruits, meat, oil, lentils, milk/milk products, sugar and spices. From Table 6.2, it is clear that in total 1,621.34 g of food has been consumed by each household member per day, and among them, food secure households consumed 1,636.96 g per

capita per day, while only 804. 24 g of food (almost half of the food intake compared to the food secure household) has been consumed by the food insecure households.

Table 6.1: Per Capita Food Intake Per Day in the Study Area (G)

Food Items	All Households	Food Secure Households	Food Insecure Households
Rice	549.03	554.48	263.58
Wheat	131.02	132.20	69.41
Potatoes	143.83	144.75	95.94
Lentils	49.51	49.91	28.42
Fish	96.83	97.59	57.58
Meat	59.94	60.36	38.05
Eggs	129.97	131.50	49.85
Oil	58.60	59.04	35.43
Milk/Milk products	47.43	48.33	.00
Sugar	41.80	42.37	12.17
Vegetables	228.48	230.07	145.49
Fruits	62.40	63.60	.00
Spices	22.43	22.71	8.26
Total	1,621.34	1,636.96	804.24

Source: Author's own calculation, 2020

6.3 Microcredit Access and the Condition of Food Security

Access to microcredit is indirectly related with food security at rural household level in the Rajshahi district, Bangladesh. From Table 6.2, it is seen that among the 160 respondents, 114 households received microcredit while the rest of the households (46) were microcredit non-receivers. A household who receives microcredit may consume more food than a household who does not receive microcredit. Among the 114 households who received microcredit, 112 are food secure and only 2 households are food insecure; on the contrary, among the 46 microcredit non-receivers only 1 household is food insecure, while the remaining 45 households are food secure. Generally, it is expected that the households who receive microcredit will consume more calories, but the survey results show that microcredit receivers consume less calories (3,869.33 kcal) compared to non-receivers of credit (3,905.75). Table 6.2 also reveals that the value of the

Food Security Index is lower for a household who received microcredit (1.69), compared to the households who did not receive any credit facilities. Thus, it is clear that the microcredit receiving households consume less food than the microcredit non-receiving households. According to the responses of households heads, when they receive microcredit they have to pay loan installments on a weekly basis. Therefore, during the loan period, the household's heads are under pressure to repay the loan and due to this reason they reduce the household's food expenditure. Sometimes, the households who are not able to pay the loan installments on due day, are taking loans from other sources to repay the previous loan, which makes their life more complicated. It is clear from the above discussion is that, the microcredit facilities is not enough as well as sometimes negatively impacted on the rural households food security status.

Table 6.2: Food Security Condition of Households by Status of Receiving Micro Credit or Not

Microcredit Status	All Households	Food Secure Households	Food Insecure Households	Daily Calorie Intake	Food Security Index
Received microcredit	114	112	2	3,869.33	1.69
Did not receive microcredit	46	45	1	3,905.75	1.71

Source: Author's own calculation, 2020

6.4 Food Support and the Households' situation of Food Security

Food support is another important policy aiming to increase the food security condition of the rural households. Table 6.3 shows that, among the total households, 67 households received food support and 93 households did not receive any food support. Among the 67 food support

receivers, only 1 household is food insecure, while among the food support non-receivers only 2 households are food insecure. But the daily calorie intake of food support receiving households is less, i.e. 3,847.66 kcal, than the daily calorie intake of the food support receivers, which is 3,902.96 kcal. Table 6.3 also reveals that the FSI (food security index) is lower for the food support receiving households, i.e. 1.68, whereas the value of the FSI (food security index) is higher for the food support non-receiving households, i.e. 1.71.

Table 6.3: Food Security Condition of the Household by Status of Receiving Food Support

Food Support	All Households	Food Secure Households	Food Insecure Households	Daily Calorie Intake	FSI (Food Security Index)
Received food support	67	66	1	3847.66	1.68
Did not receive food support	93	91	2	3902.96	1.71

Source: Author's own calculation, 2020

6.5 Food Security Condition of Households by Income

Another important determinant of the food security is the income of the households. In Table 6.4, the income of the sample households is shown in Canadian dollars (CAD$). In this research, it is assumed that a household with a high level of income consumes more food compared to the household with low income. Table 6.4 indicates the conditions of food security of the sample households in terms of household's income. In this study, income is categorized into seven levels, namely the first range of income is CAD$ 1 to 100, then CAD$101 to 200, CAD$201 to 300, CAD$301 to 400, CAD$401 to 500, CAD$501 to 600, and the final range of income is $601 or more. The results show that among the total households, 17 households fall in the first income category, 85 households fall in the second income range, that is CAD$101 to 200. The remaining 33 and 18 households fall in the CAD$301 to 400 and the CAD$401 to 500 category,

respectively. From Table 6.4, it is also observed that most of the food secure households lie in the income range of CAD$101 to 200, in the study area. The total number of households in this income range is 85, and among them, 83 households are food secure while only 2 households are food insecure. Though 2 households are identified as food insecure, however, the daily average calories intake for these households is above 2,280 kcal (the suggested kcal amount for food security) namely 3,934.18 kcal. The FSI (food security index) of these households is 1.72, which is lower than for those households who lie in the higher income ranges of CAD$301 to 400 (1.85) and CAD$401 to 500 CAD$ (1.87). The value of the FSI (food security index) is even higher for households who earn CAD$601 or more per month. An interesting finding is that some households who earn CAD$201 to 300 as well as CAD$501 to 600 per month have lower calorie intakes per day and their FSI (food security index) is also very low, i.e. 1.58 and 1.59, respectively. This finding indicates that a household with a higher income may have a higher level of food consumption, but their daily calorie intake will vary in some cases. For instance, the low income households who take loans from a bank or any other financial institution have to spend a large portion of their income to repay the loan and, due to this reason, their level of food consumption is very low which will negatively impact their daily calorie intake.

6.4 Food Security Conditions of the Households by Income (in CAD $)

Income Range (Per month)	Total Households	Food Secure Households	Food Insecure Households	Daily mean Calorie Intake	Food Security Index
1-100	17	17	0	3637.82	1.59
101-200	85	83	2	3934.18	1.72
201-300	33	32	1	3617.54	1.58
301-400	18	18	0	4222.54	1.85
401-500	3	3	0	4275.65	1.87
501-600	3	3	0	3632.66	1.59
601 or more	1	1	0	5404.00	2.37

Source: Author's own calculation, 2020

6.6 Area-wise Overall Food Security Level of the Respondents

In this section, area-wise overall food security level of the respondents is discussed. From Table 6.5, it is found that all the households (52) in the Puthia are food secure, no food insecure households are found among the respondent households. In the Charghat 98 percent, i.e. 49 households among 50, are food secure and only 2 percent, i.e. only 1 household, is food insecure. Finally, in the Paba 97 percent, i.e. 56 households are food secure among 58, while the rest, i.e. 3 percent (2 households) are food insecure.

Table 6.5 Food Security Index: Total Food Secure and Insecure Households in the Study Area

Study Area	Food Secure Households	Food Insecure Households
Puthia Upazila	52 (0.100)	0 (0.00)
Charghat Upazila	49 (0.98)	1 (0.02)
Paba Upazila	56 (0.97)	2 (0.034)
Total Study Area	157 (0.981)	3 (0.019)

Source: Author's own calculation, 2020

6.7 Area-wise Calorie Intake and Food Security Status of the Sample Households

Table 6.6 shows the calories intake and food security status of the respondents in the study area, according to sub-districts. The study identifies that in Puthia, the mean calorie intake is the highest, as well as the value of the food security index (FSI). The average mean calorie intake of the respondents in Puthia is 4,456.07 kcal and the value of the food security index is 1.95. Among the three sub-districts (Puthia, Paba and Charghat), the mean calorie intake of the respondents of Charghat is low, i.e. 3,495.87 kcal, but this value is higher than the FAO recommended calorie intake of 2,250 kcal. The value of the FSI (food security index) is also low for the respondents of Charghat (1.53). The respondents of Paba are in a better condition than the respondents of Charghat, but in a worse condition compared to respondents of Puthia. In Paba,

the average calorie intake is 3,879.80 kcal and their FSI (food security index) value is 1.62. From this result, we can conclude that among these three study areas the level of food security in Puthia is far better compared to Charghat and Paba. This can be explained by the fact that the Puthia is free from floods and the communication system with other sub-districts is better. Therefore, the Puthia rural households can grow three to four crops in a year on the same land and they also have diversified income sources. The quality of the agricultural land in the Paba is relatively lower compared to Puthia and Charghat and the rural households can grow one to two crops in a year on the same land. On the other hand, Charghat is situated close to the river Padma and every year numerous households have lost their lands and houses in the flooded river. Due to these reasons, the food security condition of households in these two sub-districts is very low compared to households in the Puthia.

Table 6.6 Food Security Status of the Respondents in the Study Area by Sub-districts (kcal)

Study Area	Mean Calorie Intake	FSI
Puthia	4.456.07	1.95
Charghat	3,495.87	1.53
Paba	3,694.13	1.62
Total	3,879.80	1.70

Source: Author's own calculation, 2020

6.8 Daily Mean Calorie Intake of Food for Food Secure and Insecure Households

In this section, the total respondents are divided into two groups, the food secure households and the food insecure households and, after that, the mean calories intake, as well as the food security index (FSI) of these two groups are examined. From the Table 6.8, it is found that the daily mean calories intake of the rural households of the three subdistricts (upazilas) is above the FAO recommended calories intake level for food security. In contrast, the food insecure households received a calories intake per day below the recommended minimum level of calories (2,280

kcal); however, the figure is above the minimum calories requirement to overcome the hardcore poverty line, i.e. 1,805 kcal (reference). Considering all sample respondents, the daily mean calorie intake for food insecure households is 1,973.57 kcal and the food security index (FSI) value is 0.87. The overall per capita calories intake of food secure households is 3,916.23 kcal per day and the FSI (food security index) is 1.71; thus the values of both indicators are double compared to food insecure households.

Table 6.7 Sub-district Wise Daily Mean Calories Intake of Food Secure and Insecure Households

Study Area	Food Secure Households		Food Insecure Households	
	Mean calories intake	FSI	Mean calories intake	FSI
Puthia Upazila	4,456.07	1.95	-	-
Charghat Upazila	3,523.02	1.54	2,165.64	0.95
Paba Upazila	3,759.01	1.64	1,877.53	0.82
Total Area	3,916.23	1.71	1,973.57	0.87

Source: Author's own calculation, 2020

6.9 The Head Count Ratio of Food Secure and Insecure Households

The calculated head count ratio (H) for food insecure households is 0.01875, indicating that only 1.87% of the households in the study area are food insecure. For food secure households, the head count ratio is 0.98125, showing that 98.13% of the households in the study area are food secure. From the findings on Table 6.8, it is clear that in the study area the percentage of food secure households is greater compared to the food insecure households.

Table 6.8 The Head Count Ratio of Food Secure and Insecure Households

Households' Characteristics	Head Count Ratio	Percentage of Head Count Ratio
Food insecure households	0.01875	1.87 %
Food secure households	0.98125	98.13%

Source: Author's own calculation, 2020

6.10 Shortfall or Surplus Index: Severity of the Food Insecurity/Security in the Study Area

The Shortfall and the Surplus indices measure the extent of households' food insecurity, as well as food security level. The Shortfall index measures the total food insecurity gap and the Surplus index measures the extent to which households are above the food security line.

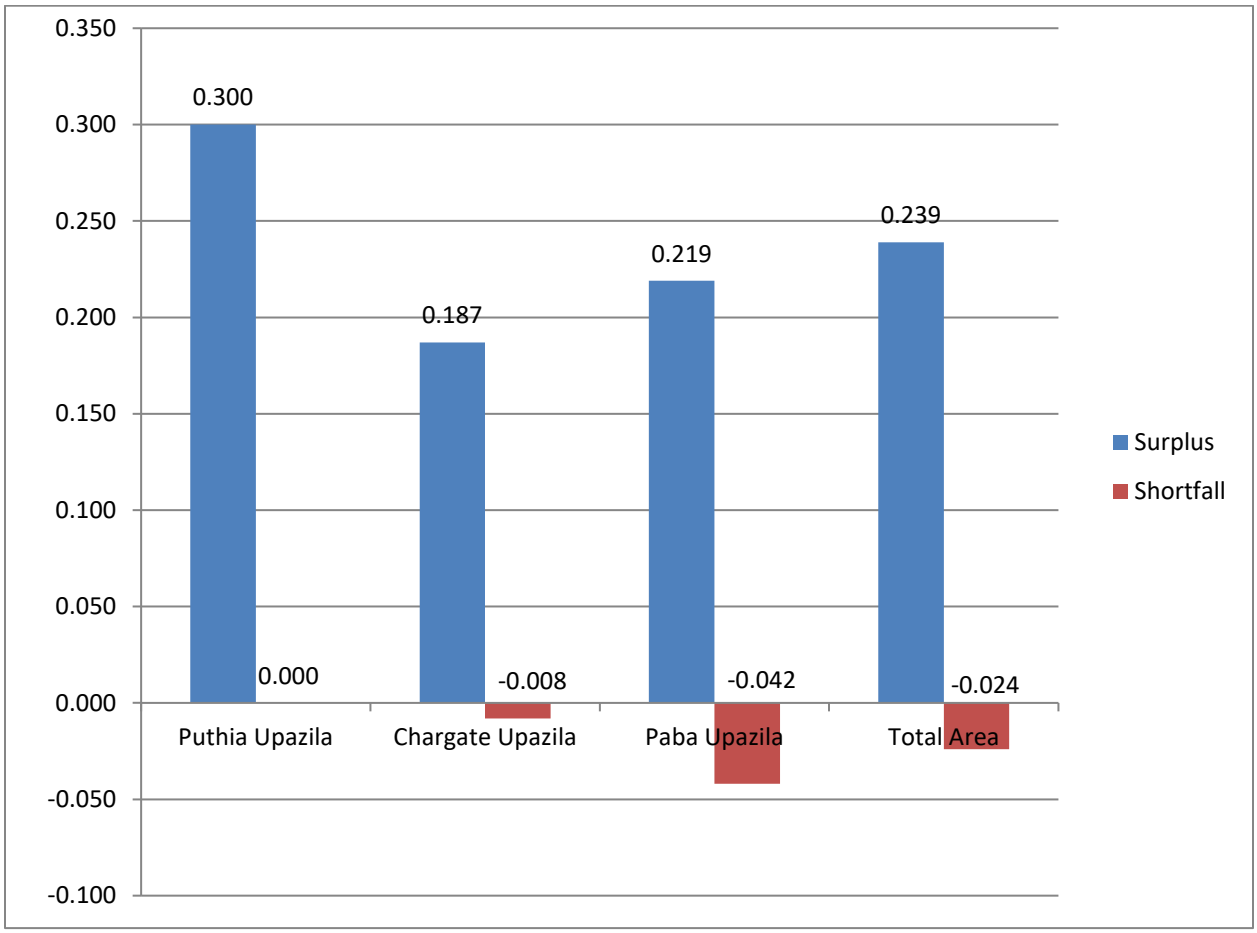


Figure 6.1 Surplus and Shortfall Indices in the Study Area (The terms Upazila means Sub-district)

Source: Author's own calculation, 2020

The Shortfall and the Surplus indices of the food secure and insecure households of the study area are represented in Figure 6.1. The Shortfall and the Surplus indices of the total study area are 0.024 and 0.239, respectively, which indicate that the food insecure household's fall below the food security line by about 2.4% and the food secure households lie above the food security line by 23.9%. In the case of the Puthia, the calculated Shortfall index is 0 and the Surplus index

is 0.30 indicating that there are no food insecure households in Puthia, and the food secure households exceed the food security line by 30%. This percentage of food security in Puthia is higher than the food security for the other two sub-districts. Figure 6.1 also indicates that, in the Charghat the food insecure households fall below the food security line by 0.8%, whereas food secure households are above the food security line by 18.7%. In the Paba the food insecure households fall below the food security line by about 4.2%, while the food secure households exceed the food security line by 21.9%; this indicates that in the Paba the food insecurity percentage is higher compared to the other two sub-districts.

6.11 Description of the Logistic Regression Model Results

Step 1: The step one is the presentation of the estimated result of the logistic regression model while step two will assess the model's fitness and finally in step 3 the result of multiple regression model is described to check the robustness of the model. The estimated result of the logistic regression model is presented in Table 6.9. From these results, it is seen that out of the nine explanatory variables, three variables are statistically significant at different levels, namely household size, monthly income and arable land. The other variables, namely age and education of the household head, earning member, ownership of cattle, food expenditure and received microcredit, are not statistically significant. Pseudo R^2 is a measure of how well variables of the model explain the phenomenon and Table 6.9 has also shown that the value of Pseudo R^2 is 0.0926, which means that only 9.26% of the variation of the effects of food support programs is explained by the considered explanatory variables. The obtained log likelihood ratio is -98.705516 and the LR Chi-square statistic for the goodness of fit of the model is 20.15. This result suggests that, 20.15 percent of the observed frequencies for the categorical variable match with the expected frequencies for the categorical variable.

Table 6.9 Results of the Logistic Regression Model Analysis of Households Receiving Food Support

Variable (Received_Food_Support)	Co-efficient	Std. Err	z-statistic	Prob.
Age	.0225609	.140722	0.16	0.873
HH_Education	-.08423206	.0959138	-0.88	0.380
Household_Size	.3341542*	.1909361	1.75	0.080
Earning_Member	.0760797	.2480191	0.31	0.759
Monthly_Income	-.0082702**	.00327	-2.53	0.011
Arable_Land	-.0204764**	.0084193	-2.43	0.015
Ownership_Cattle	.0482626	.3772397	0.13	0.898
Food_Expenditure	.0050933	.0067067	0.76	0.448
Received_Microcredit	-.1704677	.3948519	-0.43	0.666
Cons	-.0367556	.969412	-0.04	0.970
Number of obs. = 160, Log likelihood = -98.705516, LR Chi-square(9) =20.15, and Probability Chi-square =0.0170, Pseudo R^2= 0.0926				
Source: Author's own calculation, 2020				
Note: ** Significant at 5% level; * Significant at 10% level				

Source: Author's own calculation, 2020

Household Size

The household size is positively and significantly related with receiving food support and the value of the regression co-efficient is 0.3341542*. This value is significant at 10 percent level of significance. The big family size increases the probability (by 33.41%) of receiving government food support, as it is difficult for the household heads to manage sufficient food for all the household members. This result is matched with the findings of Islam, Pakrashi, Maitra and Smyth (2016).

Monthly Income

Monthly income is negatively and significantly related with receiving food support. The value of the regression co-efficient is -.0082702, and it is clear that the value of the co-efficient is significant with 5 percent level of significance. The results of the regression model also indicate that the more the people in a household earn in a month, the less is the probability to receive food

support; and if the monthly income is low, this low income will push the households to apply for and receive more food support.

Arable Land

The finding in Table 6.9 shows that the value of the coefficient is -.0204764 which indicates that there exists a negative relationship between the household's ownership of arable land and it receiving food support. In addition, this value is significant at 5 percent level of significance. The negative relationship implies that if the area of arable land owned is large, then the amount of food support received becomes lower, and on the other hand if the area of arable land is low, then the amount of food support received will be higher.

Summary of the above findings

Table 6.9 provides the results of the logistic regression model predicting the variables which influence the food support received by those of the 160 households which received food support. The results show that among the nine variables, five coefficients are negative and four are positive, but the assumption was that six variables have a negative relationship and three variables have a positive relationship with the dependent variable receiving food support. The variable household ownership of cattle gives a different result in this study, as it was assumed that there is a negative relationship between cattle ownership and receiving food support, but the calculated value shows a positive probability.

As this is a nonlinear model, this study has also estimated the marginal effect from the logit regression model to interpret which and how the selected household characteristics influenced to receiving of food support by the households. The value of the coefficients of the household characteristics has changed in the estimated marginal effect, but the significant level and the p value did not change. The results are shown in the Appendix A1.

6.12 Propensity Score Matching (PSM) Results

Step 2: Table 6.10 shows the results of the significant difference in the observed characteristics of food support receivers and non-receivers. After estimating the Propensity Score from the logit model, the groups of food support receivers and non-receivers were matched. Kernel matching was conducted (See Appendix A2) with a band-width of 0.10 to find out the appropriate non-receivers group. Statistical tests suggested similarities in observed characteristics between food support receivers and non-receivers in the kernel matched sample. This study conducted an analysis of the impact of food support after pooling a group of 67 food support receivers and a group of 93 food support non-receivers.

However, it is reasonable to assume that dissimilarities existed in unobserved characteristics between the groups of food support receivers and non-receivers. For example, food price and agricultural production may influence the households' receiving government food support. This can influence both the calories intake and the food security index (FSI) of the sample respondents. From a comparison of the means of the matched sample, the two groups did not differ in food expenditure. Therefore, the impact of government food support on the calories intake or the food security index in the present study may not be underestimated, due to the likely heterogeneity in agricultural production. Moreover, natural disasters like floods and improper distribution of food, which are unobserved characteristics for the sample, may influence food support received. Descriptive statistics suggested that the age of the household head and the number of income earning family members did not differ in the matched sample. Therefore, the monthly income did not likely differ between the two groups. During the survey, it was found that there is no proper distribution of food supplied by the government among the

rural households or insufficient food support compared to the necessity and, thus, the food support receivers and the non-receivers were unlikely to differ in this regard.

Table 6.10 Mean Observed Characteristics in Unmatched and Matched Sample

Variables	Mean of Unmatched Sample			Mean of Matched Sample		
	Food support receivers	Non-receivers	P-value difference	Food support receivers	Non-receivers	P-value difference
Age	2.50	2.34	0.43`	2.50	2.61	0.62
Household head education	2.16	2.44	0.35	2.16	2.12	0.90
Household size	4.11	3.98	0.40	4.11	4.17	0.73
Earning Member	1.49	1.51	0.84	1.49	1.55	0.60
Monthly income	167.32	199.35	0.003***	167.32	169.59	0.84
Arable land	21.40	33.55	0.002***	21.40	21.68	0.94
Ownership of cattle	0.58	0.65	0.34	.58	.57	0.94
Food expenditure	102.75	107.107	0.39	102.75	101.48	0.82
Received microcredit	0.70	0.72	0.80	.70	.74	0.57
Source: Author's own calculation, 2020; *** means significant at 1% level.						

Source: Author's own calculation, 2020

In the PSM procedure, the mean differences of the outcome variable, namely the per capita calories intake per day is observed in Table 6.11. Results in the unmatched and matched samples indicated that per capita calories intake differed insignificantly between food support receivers and non-receivers. Food support receivers consume less calories compared to food support non-receivers. Therefore, it can be said that the food support program has an important impact on the per capita calories intake, as food support receivers consume sufficient calories, an amount which is far higher than the threshold. These two groups had similarities in calories intake after matching but differed before matching.

Table 6.11 Mean Difference in Calories Intake, Per Day Per Households Calorie Consumption

Outcome Variables	Unmatched Sample (Mean)			Matched Sample (Mean)		
	Food support receivers	Non receivers	P-value	Food support receivers	Non-receivers	P-value
Per day per household calories intake	3384.98	3419.09	0.72	3385	3407.2	0.84
Food Security Index (FSI)	1.6876	1.7118	0.74	1.6876	1.6057	0.31

Source: Author's own calculation, 2020

In order to measure the impact of the government food support on the two outcome variables, the average treatment effect (ATE) and the average treatment effect on the treated (ATET) were estimated. Here, the average treatment effect (ATE) computes the difference in the means of the outcome variables impacted by the government food support program in the matched sample and the average treatment effect on the treated (ATET) indicates the impact of the government food support program for the government food support receivers.

Table 6.12 Estimates of the Effects of Receiving Food Support on the Per Capita Calorie Consumption Per Day

Government food support effect	Per Capita calories intake per day		Food Security Index (FDI)	
	Coefficient	p-value	Coefficient	p-value
Average government food support effect on (ATE)	45.67	0.67	0.1188	0.18
Average government food support effect on food support receivers (ATET)	66.81	0.72	0.0819	0.40

Source: Author's own calculation, 2020

It is evident from the results shown in Table 6.12 that the government food support increases both the per capita calories intake per day, as well as the food security index (FSI), but the results are not statistically significant. In the case of the per capita calories intake, the average effect of the government food support on food support receivers is higher than for food support non-receivers. On the other hand, the average government food support effect on the food support receivers in the case of the food security index is lower than for the food support non-receivers, as the average calories intake on the food support receivers (3,847.66 kcal) is lower than for non-receivers (3,902.96 kcal).

6.13 Multiple Regression Model Results

Step 3: The result of multiple regression model in table 6.13 shows that, the per day calorie intake is negatively and insignificantly related with receiving food support. The reason behind this is that, in the study area, the amount of government food support is very limited and this is not enough to impact significantly on the daily calorie intake of the respondents. The respondents who received food support intake less calorie compare the food support non-receivers. The respondents have sufficient income to fulfill the required calorie for food security and the food support they received from government negligible. However, the impact of food support on household food security index is positively related with receiving food support. Though the coefficient is insignificant but the result suggested that the households who receives food support can able to increase their food security level in compare to those households who did not receive any food support. The average value of food security index of food support receivers is higher than one and number of food insecure household is lower and food support non-receivers. Age of the respondent, household head education level, monthly income, ownership of cattle, food expenditure and receiving microcredit have also a positive but

insignificant impact on daily calorie intake as well as households food security index. The other variable such as household size negatively but significantly affects the daily calorie intake but negatively and insignificantly affects the food security index. Earning member and arable land negatively affects households daily calorie intake but had positive impacts on food security index. It is also seen from the table 6.13 is that ownership of cattle has positive and significant impacts on households daily calorie intake as well as food security index.

Table 6.13 Determinants of Daily Calorie Intake (per day Calorie Consumption) and Food Security Index

Independent Variable	**Dependent Variable**					
	PD_PH_Calorie_Intake			**Food Security Index**		
	Coefficient	**Std. error**	**P-value**	**Coefficient**	**Std. error**	**P-value**
Received Food Support	-34.49724	99.49645	0.729	.0273514	.0753139	0.717
Age	55.72181	38.41447	0.149	.0104767	.0290779	0.719
HH_Education	1.974446	25.28969	0.938	.0043588	.019143	0.820
Household_Size	-81.97713*	50.39937	0.106	-.0517928	.0381498	0.177
Earning_Member	-91.38991	67.11794	0.175	.0452632	.050805	0.374
Monthly_Income	.1509195	0.8729334	0.863	-.0000405	.0006608	0.951
Arable_Land	-2.542778	2.097629	0.227	.0020944	.0015878	0.189
Ownership_Cattle	228.1528**	102.487	0.028	.2334163**	.0775776	0.003
Food_Expenditure	1.722778	1.815196	0.344	.0004398	.001374	0.749
Received Microcredit	71.5379	106.9661	0.505	.0514384	.080968	0.526
Constant	3418.748***	266.5243	0.000	1.515156***	.2017457	0.000
R^2	0.09	-	-	0.11	-	-
Note: *** Significant at 1 % level; ** Significant at 5% level and * Significant at 10% level						

Source: Authors own calculation, 2020

6.14 Conclusion

In this chapter, the results of the logistic regression model and the propensity score matching (PSM) method have been discussed, as well as the extent of the households' food security has also been identified. The logistic regression model result shows that although the value is insignificant, the food support policy positively affects the household's food security level. To investigate the impact of the food support on households' food security, the PSM method has been applied, and the impact is positive. Statistical tests suggested similarities in the observed characteristics between food support receiving households and food support non-receiving households in the study area. It is reasonable to assume that dissimilarities existed in unobserved characteristics between the two groups of food support receivers and non-receivers.

Chapter Seven

Major Findings and Policy Recommendations

7.1 Introduction

Major finding of this research are summarized in this chapter based on the research objectives set in this research aiming to investigate the impact of the government food support program on food security at the level of rural households. The food security condition is analyzed on the basis of different socio-economic factors. Finally, some policy recommendations are presented on the basis of the major findings in this chapter.

This chapter covers a summary and the major findings of this study in section 7.2. Section 7.3 provides some policy recommendations and a conclusion. The limitation of this study and suggestions for further research are presented in the last section (7.4) of this chapter.

7.2 Major Findings

Bangladesh is a small country with a large population where the area of agricultural land is decreasing due to the need to satisfy the increasing demand of housing, industries and infrastructure for a growing population. Though food production is increasing because the country's agriculture is using chemical fertilizers and scientific innovation, however the food security condition is unsatisfactory due to factors such as a low per capita income, high food prices and insufficient government food support for groups of vulnerable people. To increase the food security level, by supplying adequate safe and nutritious food and by securing access to food for everyone, the Bangladesh government has developed a national food policy in 2006. Food consumption and food security are directly related to the households income, food availability, food prices and government food policy.

This study has investigated the impact of the government food support program on household level food security by conducting phone surveys with 160 respondents/households from three sub-districts located in the Northern part of Bangladesh. The major findings of this study are that 46.3 percent and 12.5 percent of the respondents are involved in farming and day labor, respectively, in the study area. It has also found that 72.5 percent of the households have only one income earning member, and for around 63.7 percent of the households the monthly income is less than CAD$200. Among the total respondents, 63.1 percent of the households spend CAD$1-100 and 35.0 percent of the respondents spend CAD$101-200 for monthly food

consumption. On average, the sample respondents spend 50.21 percent of their income on food consumption, and this percentage has reached up to 93.33 percent for low income households. In the study area, most of the respondents (74.4 percent) face food shortages in the months of July and August due to protracted floods, lack of work, high food prices and low crop production. Microcredit access/availability is related with income generating activities and income is related with enhanced food security. Therefore, 71.2 percent of the respondents received microcredit for different purposes like doing business, rent agricultural land, or buy auto rickshaw or livestock. This study has also found that 52.50 percent of the microcredit receivers considered that the microcredit loans help to improve households' income and food consumption conditions. In the case of government food support, 58.8 percent of the respondents did not receive government food support, whereas 41.2 percent of the respondents received government food support in different ways such as purchasing foods at low (subsidized) prices, or receiving free rice/wheat and food for work etc. The results indicate that 70.6 percent of the respondents believed that the government food policy/food support programs can help to increase the households' food security level, and the remaining answered that the present food support program is not helpful to increase the food security level due to insufficient food support, improper food distribution and the small percentage of beneficiaries under food support.

The respondents in the study area consume on average 1,621.34 g of food per day, whereas food secure households consume almost a double amount compared to food insecure households. Among different food items, rice, wheat, potatoes and vegetables are the most consumed food items. This study has calculated a food security index (FSI) from different angles, such as when households received microcredit (Microcredit is define in terms of receivers and non-receivers) or food support, and on the basis of their income. Among the 114 microcredit receivers out of

160 respondents, 112 microcredit receivers are food secure and 2 receivers are not food secure. The microcredit receivers consume less calories per capita per day compared to non-receivers of microcredit, as the households who receive microcredit are generally poor or belong in a low income group and it is hard for them to repay the loan. It has been found that 67 respondents (out of 160) received food support from the government under different forms and, among them, 66 respondents are food secure and one respondent is food insecure. The food security index as well as the daily per capita calories intake of food support receivers are also low compared to non-receivers of food support. The rural households who received food support are generally poor and belong to low income groups of people. Moreover, due to lack of education especially lack of higher education, absence of land ownership and lack of employment opportunities, the monthly income of the food support receivers is very low. This study has found no positive relation between the households monthly income and their calories intake and their food security index. The respondents who fall in a higher income group also consume a low amount of calories and their food security index is also low. Area-wise, the analyses show that the respondents in the Puthia sub-district are more food secure than in the other two analyzed sub-districts, namely Charghat and Paba. The headcount ratio has shown that 1.87 percent of the households are food insecure and 98.13 percent of the households are food secure, with the food insecure households falling below the food security line by 2.4 percent, and the food secure households lying above the food security line by 23.9 percent.

The logistic regression model's results show that the household size is significantly and positively related with receiving food support, thus indicating that the larger the family size, the more food support they needed. The big family size increases the probability (33.41%) of applying and receiving government food support, as it is difficult for the household heads to

secure sufficient food for all the household members. The results have also shown that the household's monthly income and arable land ownership are significantly but negatively related with food support for the household. The higher household income decreases the probability (by 0.82%) of receiving food support and the higher amount of arable land decreases the probability (by 2.4%) of receiving food support, and both these results are significant at the 5% level. Household head's level of education (HH_Education) and household's participation in microcredit programs/loans are negatively related with receiving food support and also both have an insignificant effect on it. After estimating the propensity score from the logit model, the groups of food support receivers and non-receivers were matched. Statistical tests suggested similarities in observed characteristics between the food support receivers and non-receivers in the kernel matched sample. It is reasonable that dissimilarities existed in unobserved characteristics between the groups of food support receivers and non-receivers. For example, food prices and agricultural production may influence the households' decision to receive government food support, and receiving food support influences both the calories intake and the FSI (food security index) of the sample respondents. Moreover, natural disasters such as floods, and improper distribution of food by the Government which are unobserved characteristics for the sample may influence the food support they receive. Descriptive statistics suggested that the age of the household head and the number of income earning family members did not differ in the matched sample. Therefore, the monthly income did not likely differ between the two groups. During the survey, it was found that there is no proper distribution of the food supplied by the government among the rural households, nor sufficient food support compared to households' needs, and thus, food support receivers and non-receivers were unlikely to differ in this regard.

Results in the unmatched and matched samples indicated that the per capita calories intake differed insignificantly between the food support receivers and non-receivers. Even if food support receivers consume less calories compared to food support non-receivers, it can be said that the food support program has an important impact on the per capita calories intake, as food support receivers consume a sufficient amount of calories which is far higher than the FAO threshold level (2,280 kcal). These two groups had similarities in calories intake after matching but they differed before matching.

The estimated results of the average treatment effect (ATE) and the average treatment effect on the treated (ATET) have shown that the government food support programs have increased both the per capita calories intake per day, as well as the food security index, but the results are not statistically significant. In the case of the per capita calories intake, the average effect of the government food support on food support receivers is higher than for non-receivers. On the other hand, the average government food support effect on food support receivers in the case of the food security index is lower than for non-receivers, as the average calories intake of food support receivers (3,847.66 kcal) is lower than for non-receivers (3,902.96 kcal).

7.3 Policy Recommendations and Conclusion

The Bangladesh government is making efforts to reduce poverty as well as to increase the food security at the rural households level in order to achieve the sustainable development goals set by the United Nations (UN) in 2015. In the meantime, Bangladesh has achieved self-sufficiency in food grain production but still there are problems in the food distribution system, as well as in the government food policy. The poverty level in Bangladesh was gradually decreasing in the last decade, but due to the Covid-19 pandemic, the poverty level is increasing again, and some new people have entered below the poverty line. To fulfill the third objective of this study, the

researcher has asked the survey respondents some questions about possible ways to improve the food security condition at the household level.

Based on the findings of the study the researcher generated some policy suggestions which might be useful to policy makers as well as to other decision-makers of the relevant authorities. These policy recommendations are:

1) Food security is related to the household's income and the study has found that the income is very low at the household level in the study area. Therefore, creating employment opportunities is necessary to increase the income level of the households. Sometimes, the government can offer 100 days of work or food for work under a food policy program. However, these government programs are not sufficient to ensure food security. It is important that formal jobs be created for the rural households.
2) Generally, it is said that microcredit loans contribute to income generation and the generated income would help with poverty reduction and ensure food security of rural households (Wadus, 2013). Studies show that, in the short run, participation in microcredit programs has had no significant effect on food security, measured in terms of calories consumption or food poverty reduction, but participation in long-term microcredit programs is found to benefit households significantly (Islam et al. 2016). The duration of microcredit loans is one year and the interest rate is very high, which is not effective to increase income and food security. Therefore, increasing the duration of loan repayment and reducing the interest rate will help to improve both income and consumption level.
3) The agriculture sector plays an important role in supplying food items domestically as well as in enhancing the food security level. Though the food prices are high in

Bangladesh, the farmers receive low prices compared to the production cost. Therefore, government should provide cash subsidies as well as input support to the farmers for increasing their agricultural production.

4) This study has found that the food security condition of the rural households is quite good but they do not consume a balanced diet either due to lack of knowledge about nutritious food or to money shortage. Day by day, the price of meat, fish, milk and fruits goes beyond the purchasing capability of the rural households. The households who eat too much rice, potatoes and wheat may fulfill the required calories intake, but this is not a balanced diet. To address this problem, the government should increase awareness among rural households about nutritious foods though community-based health and nutrition education and by transferring knowledge about a balanced diet and its usefulness to the households, especially to the mothers. Creating income generating activities, reducing the price of meat, fish, fruits and milk through deliberate increases of the food supply locally and encouraging people to farm fish and raise livestock at home, are other ways of securing a balanced diet for rural households..
5) The existing food policies are old and not sufficient to solve the present food security problem. The existing food policy legislation, food regulations and other food related acts and programs should be updated based on scientific and technical advances.
6) Targeted safety net programmes for the poor and ultra-poor should be extended so that more poor people will come under the food support program. The government can set up a network of ‘Food Banks’ to provide emergency food support to the poor or vulnerable people.

Policies Suggested by the Respondents

During periods of collecting data the respondents were asked to identify some policy which may be helpful to increase their food security level. The following policy suggestions were found from the respondents:

1. To increase the food security level of the rural households, self-production is necessary for consumption. To increase self-production, households can use fallow land as well as unused land surrounding the house. In this case, female members of households and children can be involve in this work.
2. Proper distribution of the food and of the food support is a part of the food policy, but there are serious deficiencies in identification of the households who need food support, as well as in the food distribution process. During the Covid-19 pandemic, it has been found that the government has no database of the poor or marginal people who need food or financial support. The government should develop a database with contact address and numbers to provide food or financial support directly to the rural households.
3. Volatile food prices may affect the food security condition of the poor households, as high food prices reduce the purchasing power of the consumers. To stabilize food prices, the government should estimate the exact amount of demand and supply of food items. Every year, the price of some food items goes very high due to shortage of supply or the syndicate of the businessmen who store food items illegally in order to hike prices artificially. Therefore, to break the impact of the syndicate of the businessmen and keep the food supply stable, The government should enforce the law more strictly, should import food items within a short period, and should strengthen policies on grain reserves. The government should increase open market sale programs aiming to increase the food security level, as well as to stabilize the food prices.

In conclusion, this study has investigated the impact of government food support on food security level of rural households through analyzing the existing food policy and several dimensions of the food security assessment. A Food Security Index was calculated and the technique of probability score matching was used to assess the impact of the government food support program on the food security level of rural households. The average value of the FSI (food security index) is more than one, which indicates that the sample respondents' per capita calories intake per day is more than the FAO threshold level. The food security condition of the respondents who receive government food support is good, but they identified several limitations of the existing food policy. Insufficient food support, improper distribution of food, absence of an exact database with names of people who really need food support, and the very small number of poor people under food support coverage were identified as the major problems of the present food policy. Therefore, the government should build an updated database including the necessary information about the poor and marginalized people, should make efforts to reduce corruption in the food distribution system, and extend the food support coverage among the poor people, to implement the food support program effectively. In addition, employment generation for rural households, controls for food prices, producing more food locally and providing subsidies to the agricultural sector and local markets will be helpful to increase the food security level of the rural households.

7.4 Limitations of the research

There are some limitations of this research, such as: Firstly, due to the recent COVID 19 pandemic, the researcher has had to change the technique of data collection from face-to-face interviews to telephone interviews. If the data were collected through face-to-face interviews, more reliable and clear answers to the questions could have been found. Additionally, this

research only covered three sub-districts and 160 respondents from the Rajshahi district; if the study area, as well as the sample size were larger, then more relevant information would have been available to analyze the impact of the food policy on households' food security. Secondly, during the periods of data collection some of the respondents answered the questions from their memories, so there exists the possibility of errors in the data. Besides these, due to network problems and other technical issues, the data collection was hampered greatly. Thirdly, for simplification, the researcher has only chosen two outcome variables, i.e. the daily mean calories intake and the food security index, to examine the impact of the food policy. Other relevant indicators of food security, such as the nutritional status, the body mass index, the food variety score and the households' dietary diversity score, could be calculated to examine the impact. Finally, budget constraints was another limitation of this research; if the researcher could use funding opportunities for collecting data, then more data could have been collected, which would have been more relevant to identify the impact of the food policy on households' food security. In spite of all these limitations, this study has taken the initiative to reveal the impact of the food policy on households' food security, as well as to provide some policy recommendations for developing a more adequate food policy, for adopting more appropriate policies and programs and for taking the necessary steps to improve the condition of food security of rural people in the Rajshahi district.

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Appendix

Appendix A

Appendix A1: Marginal Effect table of Logistic Regression Model

Marginal effects after logit
y = Pr(Received_Food_Support) (predict)
= .40419206

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
Age	.0054331	.03389	0.16	0.873	-.06099	.071857	2.4125
HH_EDU~n	-.020285	.02308	-0.88	0.380	-.065527	.024957	2.325
Househ~e	.0804713	.04586	1.75	0.079	-.009422	.170365	4.04375
Earnin~r	.0183216	.05971	0.31	0.759	-.098717	.135361	1.50625
Monthl~e	-.0019916	.00079	-2.53	0.011	-.003532	-.000451	185.948
Arable~d	-.0049311	.00201	-2.45	0.014	-.008875	-.000988	28.4625
Owners~e*	.0116086	.09061	0.13	0.898	-.165992	.189209	.625
Food_E~e	.0012266	.00162	0.76	0.448	-.001941	.004394	105.283
Recei~it*	-.0413023	.09613	-0.43	0.667	-.229709	.147104	.7125

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Appendix A2: The Result of Logistic Regression Model and Kernel Logit

```
. psmatch2 Received_Food_Support Age HH_EDUCAtion Household_Size Earning_Member Monthly_
> Income Arable_Land Ownership_Cattle Food_Expenditure Received_Microcredit, logit

Logistic regression                             Number of obs     =        160
                                                LR chi2(9)        =      20.15
                                                Prob > chi2       =     0.0170
Log likelihood = -98.705516                     Pseudo R2         =     0.0926

------------------------------------------------------------------------------
Received_Food_Support |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
----------------------+-------------------------------------------------------
                  Age |   .0225609    .140722     0.16   0.873    -.2532491    .2983709
         HH_EDUCAtion |  -.0842326   .0959138    -0.88   0.380    -.2722202     .103755
       Household_Size |   .3341542   .1909361     1.75   0.080    -.0400736    .7083821
       Earning_Member |   .0760797   .2480191     0.31   0.759    -.4100288    .5621883
       Monthly_Income |  -.0082702     .00327    -2.53   0.011    -.0146792   -.0018611
          Arable_Land |  -.0204764   .0084193    -2.43   0.015    -.0369779    -.003975
     Ownership_Cattle |   .0482626   .3772397     0.13   0.898    -.6911137    .7876389
     Food_Expenditure |   .0050933   .0067067     0.76   0.448    -.0080516    .0182382
 Received_Microcredit |  -.1704677   .3948519    -0.43   0.666    -.9443632    .6034279
                _cons |  -.0367556    .969412    -0.04   0.970    -1.936768    1.863257
------------------------------------------------------------------------------

. psmatch2 Received_Food_Support Age HH_EDUCAtion Household_Size Earning_Member Monthly_
> Income Arable_Land Ownership_Cattle Food_Expenditure Received_Microcredit, kernel logi
> t

Logistic regression                             Number of obs     =        160
                                                LR chi2(9)        =      20.15
                                                Prob > chi2       =     0.0170
Log likelihood = -98.705516                     Pseudo R2         =     0.0926

------------------------------------------------------------------------------
Received_Food_Support |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
----------------------+-------------------------------------------------------
                  Age |   .0225609    .140722     0.16   0.873    -.2532491    .2983709
         HH_EDUCAtion |  -.0842326   .0959138    -0.88   0.380    -.2722202     .103755
       Household_Size |   .3341542   .1909361     1.75   0.080    -.0400736    .7083821
       Earning_Member |   .0760797   .2480191     0.31   0.759    -.4100288    .5621883
       Monthly_Income |  -.0082702     .00327    -2.53   0.011    -.0146792   -.0018611
          Arable_Land |  -.0204764   .0084193    -2.43   0.015    -.0369779    -.003975
     Ownership_Cattle |   .0482626   .3772397     0.13   0.898    -.6911137    .7876389
     Food_Expenditure |   .0050933   .0067067     0.76   0.448    -.0080516    .0182382
 Received_Microcredit |  -.1704677   .3948519    -0.43   0.666    -.9443632    .6034279
                _cons |  -.0367556    .969412    -0.04   0.970    -1.936768    1.863257
------------------------------------------------------------------------------
```

Appendix B

Thesis Impact Statement (COVID 19)

The COVID-19 pandemic has had a significant impact on my thesis, as it has forced me to change the overall methodology of my thesis, especially the data collection techniques, the sample area and sample sizes of the present research which were changed due to the pandemic.

Thesis methodology PRIOR to the pandemic

This research proposed to use quantitative as well as qualitative techniques. The goal of this study was to compare the condition of household food security before and after implementing the 2006 National Food Policy in Bangladesh (National Food Policy, 2006), by using both a literature review and a face-to-face primary data collection and analysis. The literature review section will include literature on the concept of food security, will describe the condition of food insecurity in Bangladesh and identify the causes of the lack of households' food security in Bangladesh. Additionally, will present secondary data on the national food policy and existing analyses of its impact on the food security in Bangladesh.

This research basically depends on primary as well as secondary data. Primary data will be collected through a well-structured and pre-tested questionnaire by using the face-to-face interview method. The respondents will be selected randomly from four villages located in the Northern part of Bangladesh. The reason behind choosing these villages is that most of the people of those villages are farmers. This opens up an opportunity to differentiate the condition of food security for farmers before and after the policy of reducing food insecurity was implemented. For conducting the study, the Rajshahi district has been selected from the Northern part of Bangladesh, as most of the people of this district depend on agriculture activities and food

production for their livelihood. Four sub-districts of the Rajshahi district (Puthia, Paba, Mohanpur and Tanore) have been randomly selected for collecting primary data from the rural households.

According to the report of the 2011 Bangladesh census, Puthia had a population of 207,490, Paba had a population of 314,196, Mohanpur had 43,984 households and Tanore had a population of 19,130 people. The total number of households from all four sub-districts is approximately 584,800 people. The respondents of this study are the rural households and they are selected by using the technique of random sampling. Using the random sampling technique, 80 households will be selected from each of the two large sub-districts (Puthia and Paba) and from Mohanpur and Tanore 30 households will be selected from each of these sub-districts, for a total number of the sample 220 among the total households. The author will collect data using the face-to-face interview method to conduct the survey. The questionnaire for interview has been prepared based on the review of literature and the research objectives. The researcher will seek ethical clearance for the research tools (survey), according to the MUN ethical research requirements.

Impact of COVID-19

Due to the recent COVID 19 pandemic, I was compelled to change the methodology of my thesis, especially the data collection procedure. Actually, I came to Bangladesh for collecting data for my thesis but due to the recent pandemic the Memorial University (MUN) Research Ethics Board (REB) did not permit me to collect face-to-face data. In addition, it will take more time to give me the final research ethics approval. After considering the overall situation, the MUN REB suggested that I consider changing the interview method of my thesis. After that, I have changed my data collection procedure from face-to-face interviews to telephone interviews as I had to maintain the social distance while collecting data for my thesis. Additionally, I

changed the research area and sample size. For telephone interviews it was very difficult in Bangladesh to collect data over the phone, as most of the rural people are not fully educated, and managing/finding the contact numbers of all farmers was difficult too. To collect the data, the researcher will contact every sub-district (Upazilla) office for collecting the phone numbers of the rural households and will conduct interviews by phone calls with household's heads from different sub-districts (Upazillas). Due to the pandemic, the research area was changed also, and Puthia, Paba and Charghat were selected as a research area and the sample size was reduced to 162 instead of 220 samples. The surveys (converted to Bengali version), the informed consent forms, the letter of invitation and a return envelope will be sent to the particular households before the phone calls, by the Bangladesh postal service. The respondents will be invited to participate in the interview through a cover letter and will be asked to sign the informed consent when the researcher contacts with them for the interview. While starting the phone interview process, a short briefing about the research will be provided to the particular respondents. The permission of the respondents would be sought to record the interviews and if they do not agree to the recording, then the important points of the responses will be noted down.

The whole procedure takes more time and I had to spend a lot of time for collection of data over the telephone, as some respondents could not understand my questions easily. Some respondents did not answer the phone call and for this reason I had to reduce my sample size, also my study area was changed due to lack of contact phone numbers of the respondents.

I had a plan to complete my thesis by July 30, 2020, but due to these changes in my methodology section I was forced to extend my semester into another one.

Appendix C

Survey Question

1. Are you the household head? i) Yes ii) No
2. Address: i) Village: _____ ii) Upazilla (sub-district)_____
3. Gender: i) Male ii)Female iii) Other
4. Age: _____
5. Marital status: i) Married ii) Unmarried iii) Divorced iv) Widow
6. Your level of education:

   i) Class 1-5 ii) Class 6-9 iii) SSC (Secondary School Certificate)

   v) HSC (Higher Secondary School Certificate) v) Undergraduate

   vi) Master vii) Other, please specify_____
7. Highest level of education in the household:

   i) Under SSC ii) SSC iii) HSC

   iv) Undergraduate v) Master vi) PhD
8. Number of people in the household: Total_____

   i) Between 1 to 15years: _____ ii) Between 15 to 60 years _____

   iii) More than 60 years_____
9. Total land (in decimal)_____
10. Arable Land (in decimal)_____

11. Do you have any cattle (like cow, buffalo, goat, hen, duck etc.)? i) Yes ii) No

12. What is your employment/occupation?: i) Main_____ ii) Subsidiary_____

(1= farming, 2 = businessman/shopkeeper, 3 = service holder, 4 = auto driver, 5 = Day labor, 6 = smith/potter/weaver, 6 = rickshaw-puller/van puller, 7 = other (please specify).

13. Number of income earning members in the household, including children: _____

14. Monthly average income of the household, including children: _____

15. How much do you spend for food buying in the household in a typical week? Tk._____

16. Food consumed in your household last week:

Items of the goods	Quantity (unit)	Price (taka)	% of own production	Items of the goods	Quantity (unit)	Price (taka)	% of own production
Rice				Oil/ghee			
Flour				Milk			
Potatoes				Sugar/Gur			
Lentil				Vegetables			
Fish				Fruits			
Meat				Spices			
Eggs				Other			

17. What was the percentage of the household's income spent on food last week?_____

18. Could any member of the household not afford at least one meal/day in the last 12 months? i) Yes ii) No

19. If the answer is yes, then how many members of the household could not afford at least one meal/day in the last 12 months? _____

20. If the answer is yes to question 18, then how many days in a year, the household member did not afford at least one meal/day? _____

21. In which month, you have faced serious food deficit in the previous year (2019)? _____

22. What are the causes of food deficit in your household (if any) this month?

i) Food was not available to buy ii) Higher price of food

iii) Bad harvest due to drought/flood/cyclone iv) Lack of money

v) No work vi) Government food policy vii) Low income

viii) Other (specify) _____

23. Do you receive micro credit from any source? i) Yes ii) No

24. If yes, then what is the source: i) Grameen Bank ii) BRAC Bank iii) NGOs

iv) Government Bank v) Private Bank vi) Mahajan (local lender) vii) Relatives

25. If you answered Yes to question 30, for what purpose did you spend your micro credit:

i) Small business ii) Bought rickshaw iii) Bought auto rickshaw

iv) Bought cattle v) Rent land for farming vi) Spent for children's education

vii) Build house viii) Other (specify):_____

26. Did this credit help to increase the household income? i) Yes ii) No

27. If no, what are the reasons?

i) Interest on loan is too high ii) Low return from business/Investment

iii) Credit amount is not sufficient iv) Repayment period is too short

28. Did this credit help to increase your food security? i) Yes ii) No

29. If no, what are the reasons?

i) Income did not increase ii) Food price is too high

iii) Large number of family members iv) Weekly loan repayment installment is too high

v) Loan repayment period is too short

30. Did you need to work more hours than before to repay your loan? i) Yes ii) No

31. Did your family memberneed to work to repay the loan? i) Yes ii) No

32. Did you face any problems at the time of taking the loan? i) Yes ii) No

33. If yes, mention:

i) Need to mortgage land ii) Give bribe iii) Took long time to sanction loan

34. Did you face any problems after taking theloan? i) Yes ii) No

35. Do you believe that microcredit programs help to improve your socio-economic condition? i) Yes ii) No

42. Has your household's food security status changed after the food security policy was introduced in 2006? i) Yes ii) No

43. If yes, was there a reduction in your household' s food security? (%):_____

44. If yes, was there an improvement in your household's food security? (%):_____

45. There was no visible change in the household's food security: _____

46. Did you receive any food support from the government under the government's food security or food policy program? i) Yes ii) No

47. If yes, then from which program/programs did you receive support?

i) Vulnerable group feeding ii) 100 Days work iii) Food for work

iv) Open market sale

48. Do you believe that the government's current food policy program can increase your household's food security situation? i) Yes ii) No

49. If no, what are the reasons?

i) Food support is not enough ii) Food distribution process is not proper

iii) The quality of food is not good iv) Small portion of poor people receive food support

50. Please provide below your suggestions to improve your household food security:

a) Changing the food pattern such as eating more vegetables rather than meat or eating healthier food from own production

b) Expand agriculture research and development

c) Increasing food providers in the household level

d) Improved recent food policy programs by updating the policy depending on the present situation of food security

e) Other (in your words, what do you consider the most important action i) which you can take to solve the problem of your household's food security; ii) which the government can take to solve the problem of your household's food security)

i)_____

___

_____

___

ii)_____

___

_____

___

Thank you for your participation!

Appendix D

Appendix D1: Informed Consent Form

Title: Food Policy and Food Security: A Potential Impact of Food Policy on Household Food Security in Rural Bangladesh

Researcher Naznin Sultana, Graduate Student, Master of Art in Environmental Policy; nsultana@grenfell.mun.ca; Dr. Gabriela Sabau, Academic Supervisor, gsabau@grenfell.mun.ca, Memorial University of Newfoundland, Grenfell Campus, Newfoundland and Labrador, Canada.

This is an informed consent form. To understand the information, please read carefully the whole form. If you need any additional information or if you have any queries related to this, please feel free to contact the researcher. After reading this, if you are not willing to take part in this research there will be no consequences for you, at present or in the future.

I am inviting you to participate in this study as you are a resident of the rural area of Rajshahi district, Bangladesh. This study covers the rural households in Rajshahi district, Bangladesh. The purpose of this research is to investigate the consequences of the food policy on household's food security in Rajshahi district, Bangladesh. It also aims to examine the food security issue, its causes in Bangladesh and to make some policy suggestions for further development of the existing food policies.

You are selected as a respondent by using a random sampling technique. Your participation involves answering 50 questions about yourself and the food consumption patterns of your family. It will take around 20 to 30 minutes to answer these questions. The questions you will be

answering are related to your family's food consumption pattern and to the income of your family. Some questions are related to your family's assets, like possession of land and other assets. I assure you that this data is used only for academic purposes. The findings of this study will be helpful to provide some suggestions for the regional Government of Rajshahi, and the policy makers, other researchers, research institutions and the general public for implementing new food-related policies. I will also share my results with the Food and Agricultural Organization (FAO), Bangladesh, as I think it will be helpful for them to implement a new food policy for the rural people. My research paper will be stored in the MUN library, where future students will have an opportunity to review the results.

All answers to this survey will be codified and aggregated to make it impossible to connect any information you provide with your individual identity. By aggregating the data, both your privacy and confidentially will be maintained. The completed surveys will be stored in a locked filling cabinet and any information coded electrically will be stored in a password-protected computer. The data will be kept for a minimum five years, as required by Memorial University's Policy on Integrity in Scholarly Research. There are no obvious risks associated with your participation in this research. Moreover, you can choose not to answer any questions which you consider that they may potentially harm your personal life.

The proposal for this research has been reviewed by Grenfell Campus Research Ethics Board (GCREB) and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the GCREB by email: gcethics@grenfell.mun.ca or by telephone at (709) 639-2736.

Please sign to indicate your understanding and receipt of this form.

Do you accept that your answers be recorded: ☐ Yes ☐ No

_____

Signature of Participant

_____

Signature of Principal Investigator

Date: _____

APPENDIX D2: RECRUITMENT LETTER TO INTERVIEWEES

Subject: Food Policy and Food Security: A Potential Impact of Food Policy on Household Food Security in Rural Bangladesh.

Dear Sir/Madam,

My name is Naznin Sultana; I am a graduate student at the Grenfell Campus of Memorial University of Newfoundland, Canada. As part of my Master thesis, I am doing a research titled "Food Policy and Food Security: A Potential Impact of Food Policy on Household Food Security in Rural Bangladesh". This research investigates the consequences of food policy on households' food security in Rajshahi district, Bangladesh. It also aims to examine the food security issue and its causes in Bangladesh, and to make some policy suggestions for further development of the existing food policies. This research is being supervised by Dr. Gabriela Sabau, Professor, School of Science and the Environment, Grenfell Campus, Memorial University of Newfoundland, Canada.

I would like to invite you to participate in a survey and share with the researcher information related to the Government's food policy. Your answers could help improve the food security condition of your family in a sustainable way.

Your participation and responses will help provide data to enrich the research results. I want to assure you that the information or data given will not be attributed to you personally anywhere in the research and I will make every effort to ensure that you remain anonymous in the whole span of the research, except if you decide otherwise (please see the informed consent form). Please let me know if you have any questions or need any information related to this survey via email (nsultana@grenfell.mun.ca). Please try to respond within 10 days after receiving this letter.

I greatly appreciate your time and input to this research.

Thank you.

Naznin Sultana

Graduate Research Assistant

Candidate of MA in Environmental Policy

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