FARMERS' FOOD SECURITY STATUS IN BANGLADESH

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SHER-E-BANGLA NAGAR, DHAKA-1207

JUNE, 2016

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REGISTRATION NO.: 10-03892

A Thesis

Submitted to the Faculty of Agriculture,
Sher-e-Bangla Agricultural University, Dhaka,
in Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE (MS)

IN

AGRICULTURAL EXTENSION

SEMESTER: JANUARY - JUNE, 2016

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CERTIFICATE

This is to certify that the thesis entitled, **"FARMERS' FOOD SECURITY STATUS IN BANGLADESH"** submitted to the faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **Master of Science (MS) in Agricultural Extension,** embodies the result of a piece of bona fide research work carried out by **Md. Abdullah Al Noman**, Registration No. 10-03892, under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.

I further certify that any help or sources of information, as has been availed of during the course of investigation have been duly acknowledged.

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DEDICATION

DEDICATED TO

THIS THESIS IS LOVINGLY DEDICATED TO MY PARENTS AND RESPECTED TEACHERS FOR THEIR ENDLESS SUPPORTS, ENCOURAGEMENT THROUGHOUT MY LIFE.

ACKNOWLEDGEMENTS

All praises, thanks and gratitude are due to the Supreme Ruler of the Universe, the Almighty Allah for his grace bestowed upon the author for accomplishing this research study. With boundless love and appreciation, the researcher would like to extend his heartfelt gratitude and appreciation to all who helped him bring this study into reality.

In particular, the researcher takes the opportunity to express thanks to his respectable supervisor **Professor Dr. Md. Rafiquel Islam**, Department of Agricultural Extension & Information System, Sher-e-Bangla Agricultural University, for his noble guidance, constructive criticism, constant stimulation and encouragement thorough supervision during the course of preparation of this thesis, without which this work would not have been possible. For his unwavering support, I am truly grateful.

The researcher also wishes to express sincere appreciation and heartfelt gratitude to his co-supervisor **Dr. Mohummed Shofi Ullah Mazumder,** Associate Professor, Department of Agricultural Extension & Information System, Sher-e-Bangla Agricultural University, for his valuable suggestions, constant cooperation, inspirations and sincere advice to improve the quality of the thesis throughout the period of this research program.

The researcher also wishes to express heartfelt gratitude to **Md. Mahbubul Alam, PhD,** Associate Prof. & Chairman, Department of Agricultural Extension & Information System, Sher-e-Bangla Agricultural University, for his valuable suggestions, constant cooperation, inspirations and sincere advice to improve the quality of the thesis throughout the period of this research program.

Heartfelt thanks and appreciations are also expressed to the Upazila Agriculture Officer and SAAO of Gangni upazila of Meherpur district in the study area for their benevolent help and cooperation in data collection period. The researcher is especially grateful to all the respondents in the study area for their cooperation and help in accomplishing the objectives of this research work.

The researcher expresses heartfelt thanks and sincere appreciations to all other departmental and out of departmental teachers of Sher-e-Bangla Agricultural University for their help and encouragement. Last but not the least, the author expresses his immense indebtedness, deepest senses of gratitude to his beloved parents, brother and sisters who sacrificed all their happiness during the whole study period especially during his MS study.

Finally, the wishes, heartfelt thanks and gratitude to extend to all his relatives, well-wishers especially friends for their inspiration, blessing, cooperation and encouragement in all phases of this academic pursuit from the very beginning to the end.

June, 2016 **The Researcher**

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX

LIST OF ABBREVIATIONS AND GLOSSARY

Abbreviation	Full word
Ag. Ext. Ed.	Agricultural Extension Education
Ag. Ext. and Info. Sys.	Agricultural Extension and Information System
B	Multiple regression
BBS	Bangladesh Bureau of Statistics
BER	Bangladesh Economic Review
DAE	Department of Agricultural Extension
et al.	All Others
FANTA	Food and Nutrition Technical Assistance
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Statistics
GOB	Government of Bangladesh
MOA	Ministry of Agriculture
MoF	Ministry of Food
MoYS	Ministry of Youth and Sports

FARMERS' FOOD SECURITY STATUS IN BANGLADESH

ABSTRACT

Food security is a condition related to the supply of food, and individuals' access to it. The research was designed to investigate the farmers' food security status. The methodology of this study is an integration of quantitative and qualitative methods based on data collection in Betbaria, Vobanipur and Naodapara villages of Kazipur union Gangni upazila of Meherpur district. Data were collected from 121 farmers from February 05 to March 06, 2017. Descriptive statistics, Multiple regression (B), Problem Facing Index (PFI) were used for analysis. Majority of the farmers had medium category of food security. Findings reveal that the farmers level of education, family size, effective farm size, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security had significant contribution to change in food security including the dimensions of the food security policy. Majority (53.7%) of the farmers faced medium level problems in achieving household food security. Based on the findings, it is recommended that respective authorities should implement and popularize farmers based projects on a massive scale for achieving household food security status of the farmers.

CHAPTER I

INTRODUCTION

1.1 General Background

In Bangladesh, the agricultural sector is one of the main contributors to the national GDP. An amount of 15.95 %(including fisheries) of the total GDP in the fiscal year 2014-2015 of our country has come from the agricultural sector (BER, 2015). Agricultural development provides food security status of the people of a nation. One of the fundamental rights of the citizens stipulated in the Bangladesh Constitution is food security for all. Food security exists when all people, at all times, have access to sufficient, safe and nutritious food to maintain healthy and productive lives. The key elements of food security are: a) availability of enough food from domestic production and/or imports to meet the demand, b) access of the food to all people at all times through enough incomes and affordable prices, c) proper hygiene and sanitary practices and safe water for utilization of food to have optimum impact on health and nutrition, and d) a regulatory framework in place and its proper implementation for controlling contamination to ensure food safety.

Food security is a condition related to the supply of food, and individuals' access to it. Concerns over food security have existed throughout history. There is evidence of granaries being in use over 10,000 years ago, with central authorities in civilizations including ancient China and ancient Egypt being known to release food from storage in times of famine. At the 1974 World Food Conference the term "food security" was defined with an emphasis on supply. Food security, they said, is the "availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices" (FAO, 2003). Later definitions added demand and access issues to the definition. The final report of the 1996 World Food Summit states that food security "exists when all people, at all times, have physical and economic access to sufficient,

safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (Patel, 2016).

Household food security exists when all members, at all times, have access to enough food for an active, healthy life (USDA, 2016). Individuals who are food secure do not live in hunger or fear of starvation (FAO, 2013). Food insecurity, on the other hand, is a situation of "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways", according to the United States Department of Agriculture (USDA, 2016). Food security incorporates a measure of resilience to future disruption or unavailability of critical food supply due to various risk factors including droughts, shipping disruptions, fuel shortages, economic instability, and wars (Boeing, 2016). In the years 2011-2013, an estimated 842 million people were suffering from chronic hunger. The Food and Agriculture Organization of the United Nations, or FAO, identified the four pillars of food security as availability, access, utilization, and stability. The United Nations (UN) recognized the Right to Food in the Declaration of Human Rights in 1948, and has since noted that it is vital for the enjoyment of all other rights (UNCESCR, 2016).

In view of repeated experience of severe hunger and famine, food security in Bangladesh has long been synonymous with achieving self-sufficiency in rice, the dominant staple food. The Bangladesh economy has made respectable progress in rice, tripping production from 11 million tons in 1971 to 33 million in 2012 (BBS, 2014). The per capita rice production has increased substantially over the level at independence. The growth of production was achieved by fast adoption by farmers of higher yielding crop varieties developed by scientists, supported by rapid expansion of irrigation infrastructure through private investment in tube wells. Bangladesh used to receive substantial amount of wheat, the secondary staple food, as food aid from developed countries. Commercial import of wheat has however increased despite growth in domestic production till the 1990s, mainly due to the discontinuation of food aid and

stagnation of domestic production after a rapid growth in the 1980s. The import has recently exceeded three million tons. It appears that even if Bangladesh achieves self-sufficiency in rice production the import of wheat will continue (Nath, 2015).

Bangladesh remains highly food insecure in spite of important economic progress. Bangladesh is ranked 129thout of 169 countries in the 2010 Human Development Index (HDI) (UNDP, 2010). About 60 million people consume less than the minimum daily recommended amount of food (HIES, 2010). According to IFPRI's 2009 Global Hunger Index-which is a combined measure of the proportion of undernourishment, child malnutrition and child mortality-food security has improved in Bangladesh since 1990, with country moving from an "extremely alarming" to an "alarming" level of hunger. The proportion of undernourished has fallen from 36 per cent of the population to 26 per cent in2006. Despite this progress, Bangladesh's food security is still fragile and major challenges remain as well. The farmers of Bangladesh mainly depend on agriculture and agriculture related activities. Opportunities for off-farm activities are marginal. As a result of river erosion, cultivable land, crops and homestead are often damaged or devoured by rivers regularly. The level of awareness with respect to health, water and sanitation, environment, rights and gender is at a minimum. The life of char people in Bangladesh is very much uncertain and vulnerable to so many shocks of the environmental factors. But the need to secure food is a certain matter to continue their lives. Special emphasis also is to be placed on the landless people of char areas as they do not have their own land to produce enough food to meet household food demand. Development of farmers' livelihood, knowing of position of food security of farmers is essential where a major portion is secured by a landless people. If their state of food insecurity is revealed, careful and need-based interventions may possibly be taken properly to mitigate the crises. For this reason, it was deemed necessary to undertake this study.

The researcher intended to take an attempt to understand the status of farmers' food security in Bangladesh. Appreciating and analyzing the aforesaid conditions the researcher has become interested in undertaking a research entitled, "**Farmers' Food Security Status in Bangladesh**".

1.2 Statement of the Problem

Food, in the hierarchy of needs, is the most basic need for sustenance of life and is the perennial problem issue for healthy and active life of mankind. Food security is not just an economic problem but also a social and political issue in as much as food insecurity is a factor to create social and political instability in the country. Food security is a basic factor for development of human capital and starter for overall development of the society. Right to adequate and stable supply of safe food is a constitutional right of the people in Bangladesh. The Government of Bangladesh is firmly committed to the progressive realization of the right to food, as enshrined in the constitution. Food security, as put by FAO, involves four dimensions: availability, accessibility, food utilization and stability of components of food security. Nutrition, food safety and quality have attained considerable importance recently in Bangladesh. Ensuring food security for all is one of the major challenges that Bangladesh faces today. Despite significant achievements in food grain production and food availability, food security at national, household and individual levels remains a matter of major concern for the country and its Government.

Since independence, Bangladesh has made significant progress in increasing domestic production of food grains. This, to a large extent, helped in overcoming the constraints of insufficient national food availability. Adequate food availability however was not a sufficient condition for ensuring national food security. Ensuring food security for all reportedly require a major effort at enhancing access to food and subsequent utilization of food by the poor and distressed households. Though hunger is the number one issue, malnutrition has become emerging problem for treatment. Along with underweight, overweight including obesity has become another problem of health related to

food intake. In this situation, providing adequate, stable, safe and nutritious balanced food to all becomes a challenging task in the way of development ahead, and there is a serious need to develop a road map to achieve this visionary goal for a healthy society. The present research is designed to make an empirical analysis on components of food security status of farmers.

1.3 Specific objectives of the Study

The focal point of the research work was to explore the farmers' food security status. This is why the following objectives were framed out in order to provide an appropriate track to the research work:

i) To assess the extent of the existing food security status of the farmers;

ii) To describe following influencing characteristics of the farmers:

- Age
- Level of Education
- Family size
- Effective Farm size
- Number of Earning Members
- Farmer`s Daily Wage value
- Economic Status
- Body Mass Index (BMI)
- Agricultural Extension Media Contact
- Knowledge on Food Security

iii) To estimate the contribution of selected characteristics of the farmers on food security;

iv) To identify the problem associated with achieving food security;

1.4 Scope of the Study

i) The present study was designed to have an understanding of food security status of farmers and to estimate its contribution with their selected characteristics.

ii) The findings of the study will be applicable to the study area at Kazipur union under Gangni upazila of Meherpur district. The findings may also be applicable to other areas of Bangladesh where socio-cultural, psychological and economic status do not differ much than those of the study areas.

iii) The findings of the study may also be helpful to the field worker of extension service to improve their action strategies for food security.

v) The findings of the study will be helpful to accelerate the development in agriculture, farmers' logistic supports, information needs and the way of dissemination especially tuned to key role players in the society as well as ensuring food security of the farmers. The findings might also be helpful to the planners and policy makers, extension workers etc.

vi) To the academicians, it may help in the further conceptualization of the systems model for analyzing the food security status of farmers. In addition, the findings of this study may have other empirical evidence to all aspects of food security of farmers which may be used to build theory of food security.

1.5 Justification of the Study

Bangladesh has made substantial progress in enhancing food security by increasing production of food grains, particularly rice. Rice has contributed most to self-sufficiency in food grain. Rice production gains have been mainly driven by an increased use of irrigation water, expanded use of other agricultural inputs along with an increased coverage of high-yielding and modern rice varieties. However, the sustainability of domestic food grain production remains an issue. Rice cannot be expected to experience the growth rate of the past without net technological breakthrough. Furthermore, demographic pressures and increased urbanization have caused cultivated area to decline at a rate of 1 percent per year, whilst cropping intensity has virtually reached its limit. Small and marginal farmers represent more than 80% of all farmers. Only a limited percentage of crops circulate through commercial channels. This also results in a situation where, despite efforts, food grain

procurement remains limited and size able food grain imports are needed for public distribution. In the last five years, total annual imports of food grains have ranged between 2 to 3 million tons. Imports consist mainly of wheat, whose production has been continuously reducing over the past years, with rice accounting for about half million tons per year.

It is notable that the emphasis placed on rice production has resulted in an increased dependency on imports for non-food grain commodities, such as pulses, oil seeds and fruits which remain unaffordable to many consumers, especially poor consumers. For instance, 70% of the pulses and 66% of the edible oil (MoF, 2016) requirements are currently imported traditionally, the two most important non-cereal foods for the poor were fish and pulses. Due to crop substitution, the national supply of pulses decreased substantially, and the poor substituted cereals for pulses with negative nutritional implications especially for children, pregnant and lactating women.

Only a few researches have so far been conducted in Bangladesh on farmers' food security status. From the extension and overall national development point of view, a research study on farmers' food security status is important to understand and to get schematic knowledge about farmers' position in this society. The researcher intended to make an attempt to realize how the farmers' socio-economic condition could uplift their food security status. The researcher also aimed to know present condition of food security of the farmers. Therefore, the study "Farmers' Food Security Status in Bangladesh" has been undertaken.

1.6 Assumptions of the Study

An assumption is the supposition that an apparent fact or principle is true in the light of available evidence (Goode and Hatt, 1952). The researcher had considered the following assumptions while undertaking the study:

i) The respondents were capable of furnishing proper responses to the questions contained in the interview schedule.

ii) The data collected by the researcher were free from bias and they were normally distributed.

iii) The responses provided by the respondents were valid and reliable.

iv) Information sought by the researcher revealed the real situation and was the representative of the whole population of the study area to satisfy the objectives of the study.

v) The researcher was well adjusted to himself with the social environment of the study area. Hence, the collected data from the respondents were free from interviewer's bias.

vi) The selected characteristics and the food security of the farmers of the study were normally and independently distributed with respective means and standard deviation.

1.7. Limitations of the Study

Considering the time, respondents, communication facilities and other necessary resources available to the researcher and to make the study manageable and meaningful, it became necessary to impose certain limitations as mentioned bellow-

i) The study was confined to three villages of Kazipur union under Gangni upazila of Meherpur district.

ii) It is difficult to get accurate information regarding food security status of the farmers indicator from the respondents as many of them are illiterate.

iii) Characteristics of the farmers were many and varied, but only ten characteristics were selected for the research work.

iv) The researcher was a male person and the respondents were both males and females. The researcher had to establish proper rapport with the respondents to collect accurate information.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this chapter is to review the past studies and opinions of experts and social scientists having relevance to this investigation based on the major objectives of the study. Attempts have been made in this chapter to review that finding of past researches having relevance to the present study. But unfortunately, very few studies have been obtained which were directly related with farmers' food security status in general or which explain the factors that influence the farmers' food security status. The researcher, therefore, made exhaustive effort to review the previous research works directly or indirectly related to the present study by different researcher in home and abroad. However, many studies could be found on food security problem confrontation, the result of which were indirectly related to the present study, and also which focuses general behavior pattern of the farmers and their overall survive strategies.

This chapter comprises with several sections. The concepts of food security have been presented in the first section. As certain fundamental, general observations on food security status or its related issues also have been presented subsequently. At last conceptual model of the study is presented in the last sections of the study.

2.1 Food Security

Food security encompasses three elements: availability, accessibility and utilization (USAID, 1996). Food availability refers to the physical presence of food at various levels from household to national level, be that from own production or through markets. Food access refers to the ability to obtain an appropriate and nutritious diet and is in particular linked to resources at the household level. Food utilization refers to the proper use of food, which includes the existence of proper food processing and storage practices,

adequate knowledge and application of nutrition and child care, and adequate health and sanitation services (FANTA, 2006).

The past half-century has seen marked growth in food production, allowing for a dramatic decrease in the proportion of the world's people that are hungry, despite a doubling of the total population (Figure 2.1) (FAOSTAT, 2009 and World Bank, 2008). Nevertheless, more than one in seven people today still do not have access to sufficient protein and energy from their diet, and even more suffer from some form of micronutrient malnourishment (FAO, 2009). The world is now facing a new set of intersecting challenges (Evans, 2009). The global population will continue to grow, yet it is likely to plateau at some 9 billion people by roughly the middle of this century. A major correlate of this deceleration in population growth is increased wealth, and with higher purchasing power comes higher consumption and a greater demand for processed food, meat, dairy, and fish, all of which add pressure to the food supply system. At the same time, food producers are experiencing greater competition for land, water, and energy, and the need to curb the many negative effects of food production on the environment is becoming increasingly clear (Tilmanet *et al.*, 2001 and MEA, 2005). Overarching all of these issues is the threat of the effects of substantial climate change and concerns about how mitigation and adaptation measures may affect the food system (Parry *et al., 2007*).

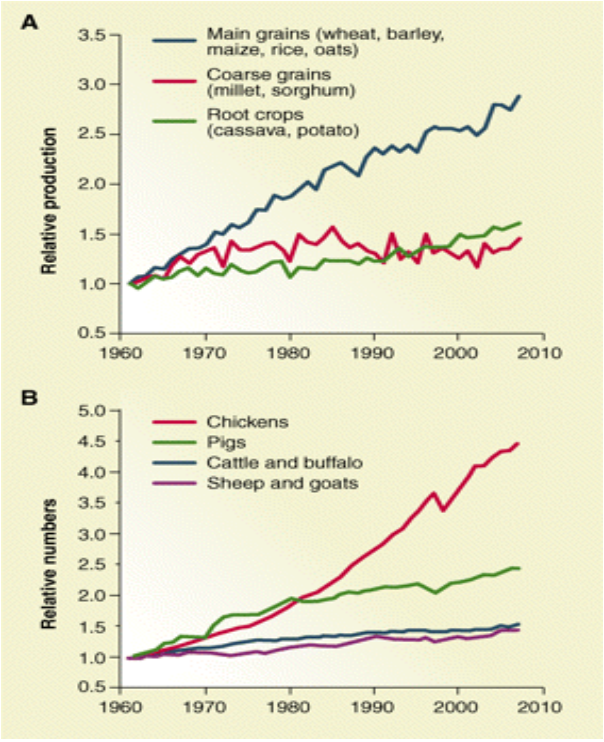

Figure 2.1 Changes in the relative global production of crops and animals since 1961 (scaled to 1 in 1961). (**A**) Major crop plants and (**B**) major types of livestock. (FAOSTAT, 2009)

Patterns in global food prices are indicators of trends in the availability of food, at least for those who can afford it and have access to world markets. Over the past century, gross food prices have generally fallen, leveling off in the past three decades but punctuated by price spikes such as that caused by the 1970s-oil crisis. In mid-2008, there was an unexpected rapid rise in food prices, the cause of which is still being debated, that subsided when the world economy went into recession (Piesse and Thirtle, 2009). However, many (but not all) commentators have predicted that this spike heralds a period of rising and more volatile food prices driven primarily by increased demand from rapidly developing countries, as well as by competition for resources from first-generation bio fuels production (Royal Society, 2008). Increased food prices will stimulate greater investment in food production, but the critical importance of food to human well-being and also to social and political stability makes it likely that governments and other organizations will want to encourage food production beyond that driven by simple market mechanisms (Skidelsky, 2009). The long-term nature of returns on investment for many aspects of food production and the importance of policies that promote sustainability and equity also argue against purely relying on market solutions. Recent studies suggest that the world will need 70 to 100% more food by 2050 ((Royal Society, 2009 and World Bank, 2008).

2.2 Closing the Yield Gap

The farmers of Bangladesh are the front-line actor to produce food. There is wide geographic variation in crop and livestock productivity, even across regions that experience similar climates. The difference between realized productivity and the best that can be achieved using current genetic material and available technologies and management is termed the “yield gap.” The best yields that can be obtained locally depend on the capacity of farmers to access and use, among other things, seeds, water, nutrients, pest management, soils, biodiversity, and knowledge. It has been estimated that in those parts of Southeast Asia where irrigation is available, average maximum climate-

adjusted rice yields are 8.5 metric tons per hectare, yet the average actually achieved yields are 60% of this figure (Cassman, 1999). Similar yield gaps are found in rain-fed wheat in central Asia and rain-fed cereals in Argentina and Brazil. Another way to illustrate the yield gap is to compare changes in per capita food production over the past 50 years. In Asia, this amount has increased approximately twofold (in China, by a factor of nearly 3.5), and in Latin America, it has increased 1.6-fold; in Africa, per capita production fell back from the mid-1970s and has only just reached the same level as in 1961 (Evenson and Gollin, 2003). Substantially more food, as well as the income to purchase food, could be produced with current crops and livestock if methods were found to close the yield gaps.

Low yields occur because of technical constraints that prevent local food producers from increasing productivity or for economic reasons arising from market conditions. After harvest or slaughter, they may not be able to store the produce or have access to the infrastructure to transport the produce to consumer markets. Exactly how best to facilitate increased food production is highly site-specific. In some situations, such as low-income food-importing countries, investing purely in generating widespread income growth to allow food purchases from regions and countries with better production capabilities may be the best choice. When investment is targeted at food production, a further issue is the balance between putting resources into regional and national infrastructure, such as roads and ports, and investing in local social and economic capital (Hazell and Haddad, 2001).

There is also a role for large-scale farming operations in poor-country agriculture, though the value and contexts in which this is feasible are much debated (Collier, 2008). This debate has been fanned by a substantial increase in the number of sovereign wealth funds, companies, and individuals leasing, purchasing, or attempting to purchase large tracts of agricultural land in developing countries. This external investment in developing-country agriculture may bring major benefits, especially where investors bring

considerable improvements to crop production and processing, but only if the rights and welfare of the tenants and existing resource users are properly addressed (Cotula, 2009). The yield gap would have emphasized on farmers' food security status in Bangladesh.

2.3 Increasing Production Limits

The most productive crops, such as sugar cane, growing in optimum conditions, can convert solar energy into biomass with an efficiency of ~2%, resulting in high yields of biomass (up to 150 metric tons per hectare) (Gilbert *et al,* 2006). There is much debate over exactly what the theoretical limits are for the major crops under different conditions, and similarly, for the maximum yield that can be obtained for livestock rearing (Royal Society, 2009). However, there is clearly considerable scope for increasing production limits.

The Green Revolution succeeded by using conventional breeding to develop F_1 hybrid varieties of maize and semi-dwarf, disease-resistant varieties of wheat and rice. These varieties could be provided with more irrigation and fertilizer (Evenson and Gollin, 2003) without the risk of major crop losses due to lodging (falling over) or severe rust epidemics. Increased yield is still a major goal, but the importance of greater water- and nutrient-use efficiency, as well as tolerance of a biotic stress, is also likely to increase. Modern genetic techniques and a better understanding of crop physiology allow for a more directed approach to selection across multiple traits. The speed and costs at which genomes today can be sequenced now means that these techniques can be more easily applied to develop varieties of crop species that will yield well in challenging environments. These include crops such as sorghum, millet, cassava, and banana, species that are staple foods for many of the world's poorest communities (IAASTD, 2008). The production increasing limits would have emphasized on farmers' food security status in Bangladesh.

2.4 Reducing Waste

Roughly 30 to 40% of food in both the developed and developing worlds is lost to waste, though the causes behind this are very different (Figure 2.2) (Nellemannet *et al.*, 2009). In the developing world, losses are mainly attributable to the absence of food-chain infrastructure and the lack of knowledge or investment in storage technologies on the farm, although data are scarce. For example, in India, it is estimated that 35 to 40% of fresh produce is lost because neither wholesale nor retail outlets have cold storage (Nellemannet *et al.*, 2009). Even with rice grain, which can be stored more readily, as much as one-third of the harvest in Southeast Asia can be lost after harvest to pests and spoilage (FAO, 2009). But the picture is more complex than a simple lack of storage facilities: Although storage after harvest when there is a glut of food would seem to make economic sense, the farmer often has to sell immediately to raise cash.

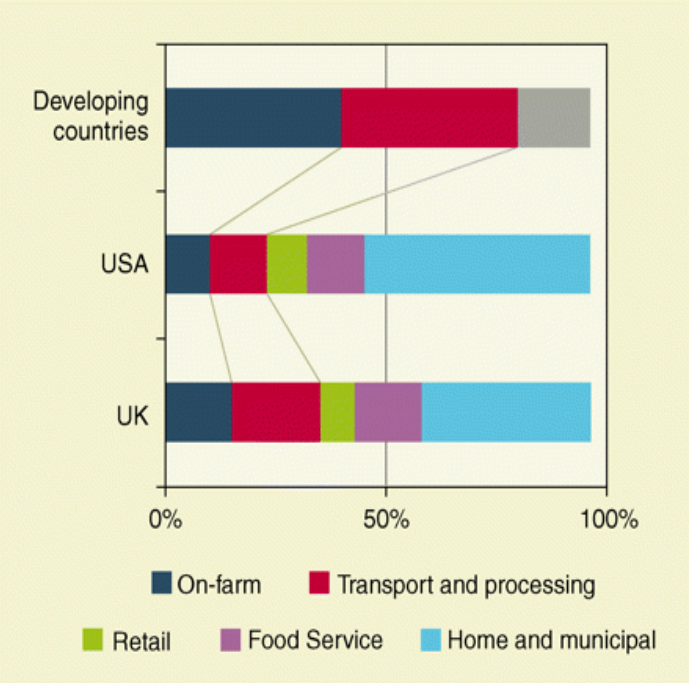

Figure 2.2 Makeup of total food waste in developed and developing countries. Retail, food service, and home and municipal categories are lumped together for developing countries. (Nellemannet *et al.*, 2009)

If food prices were to rise again, it is likely that there would be a decrease in the volume of waste produced by consumers in developed countries. Waste may also be reduced by alerting consumers to the scale of the issue, as well as to domestic strategies for reducing food loss. Advocacy, education, and possibly legislation may also reduce waste in the food service and retail sectors. Legislation such as that on sell-by dates and swill that has

inadvertently increased food waste should be reexamined within a more inclusive competing-risks framework. Reducing developed-country food waste is particularly challenging, as it is so closely linked to individual behavior and cultural attitudes toward food. The reducing waste would have emphasized on farmers' food security status in Bangladesh.

2.5 Changing diets

The conversion efficiency of plant into animal matter is ~10%; thus, there is a prima facie case that more people could be supported from the same amount of land if they were vegetarians. About one-third of global cereal production is fed to animals (*FAO,* 2014). But currently, one of the major challenges to the food system is the rapidly increasing demand for meat and dairy products that has led, over the past 50 years, to a ~1.5-fold increase in the global numbers of cattle, sheep, and goats, with equivalent increases of ~2.5- and ~4.5-fold for pigs and chickens, respectively (FAOSTAT, 2009) (Figure 2.1). This is largely attributable to the increased wealth of consumers everywhere and most recently in countries such as China and India.

Well-balanced diets rich in grains and other vegetable products are considered to be more healthful than those containing a high proportion of meat (especially red meat) and dairy products. As developing countries consume more meat in combination with high-sugar and -fat foods, they may find themselves having to deal with obesity before they have overcome under nutrition, leading to an increase in spending on health that could otherwise be used to alleviate poverty. Livestock production is also a major source of methane, a very powerful greenhouse gas, though this can be partially offset by the use of animal manure to replace synthetic nitrogen fertilizer. Of the five strategies, we discuss here, assessing the value of decreasing the fraction of meat in our diets is the most difficult and needs to be better understood. The changing diet patterns would have emphasized on farmers' food security status in Bangladesh.

2.6 Expanding Aquaculture

Aquatic products (mainly fish, aquatic molluscs, and crustaceans) have a critical role in the food system, providing nearly 3 billion people with at least 15% of their animal protein intake (Mithet *et. al.*, 2010). In many regions, aquaculture has been sufficiently profitable to permit strong growth; replicating this growth in areas such as Africa where it has not occurred could bring major benefits. Technical advances in hatchery systems, feeds and feed-delivery systems, and disease management could all increase output. Future gains may also come from better stock selection, larger-scale production technologies, aquaculture in open seas and larger inland water bodies, and the culture of a wider range of species. The long production cycle of many species (typically 6 to 24 months) requires a financing system that is capable of providing working capital as well as offsetting risk. Wider production options (such as temperature and salinity tolerance and disease resistance) and cheaper feed substrates (for instance, plant material with enhanced nutritional features) might also be accessed with the use of GM technologies. The expanding aquaculture would have emphasized on farmers' food security status in Bangladesh.

2.7 Food Security Status in Bangladesh

Food security is multi-dimensional having interrelationships among availability, accessibility and utilization elements. There is a fourth exogenous dimension that has significant interface with food security, i.e. the nature. The natural disasters affect all the three dimensions of food security. Food availability by itself does not ensure adequate access to food, although it is a necessary precondition for access to food. If people have access to livelihood, they would have access to food and nutrition. Poor physical access to food leads to poor consumption and poor nutrition. The levels of food consumption depend mainly upon food availability and food access. Food production is linked to livelihood access and food consumption. Livelihood access in turn influences the demand for food and better prices and production thereof. Better

livelihood access also leads to improved living standard, better education, better knowledge on health etc. The interrelationships among food availability, access, utilization and nature are shown in the Figure 2.3.

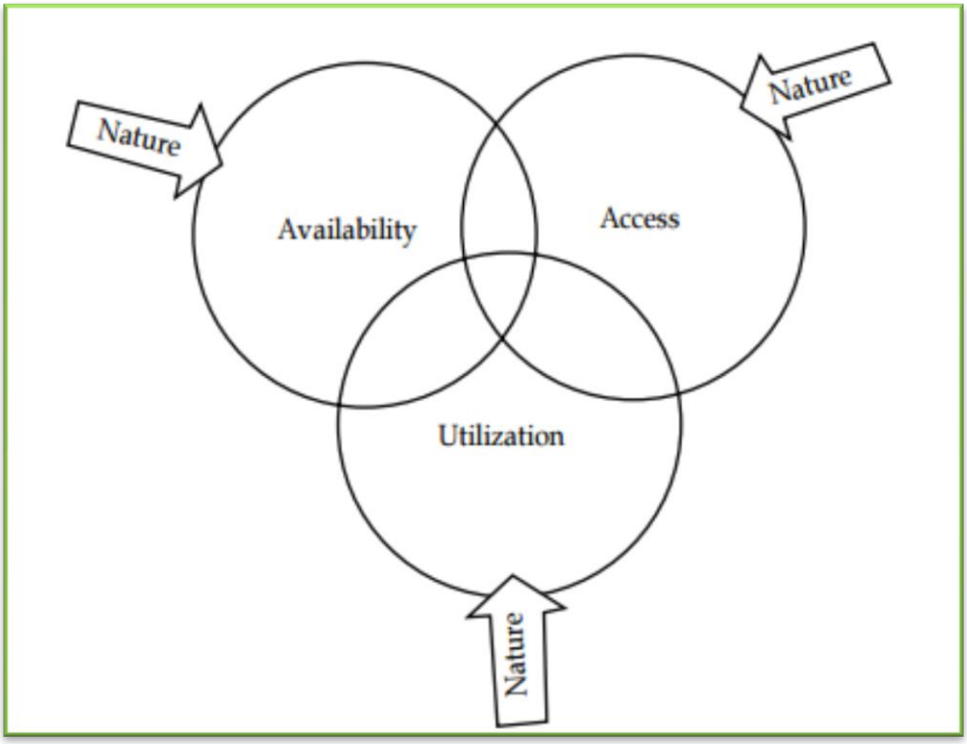

Figure 2.3: The interrelationship among major components of food security (Partially adopted from Dash, 2005)

Although food grain production has more than doubled since independence in 1971, food insecurity both in national and household level remains a matter of concern for the government. About half of the population cannot reach the minimum dietary energy requirement (2122 kcal/capita/day) and one quarter of them subsist in extreme shortage of energy consuming less than 1800 kcal/capita/day (GOB, 2000). Apart from the prevailing deficit in total calorie intake, the normal diet of Bangladeshi people is seriously imbalanced, with inadequate shares of fat, oil and protein (GOB, 2000). Women and children are especially vulnerable due to their limited access to food. This dietary imbalance reflects insufficient domestic production of non-cereal foods (pulses, oilseeds, fruits, meat, milk and eggs), low incomes, food preferences and lack of nutrition knowledge.

Past studies suggest that consumed cereal diets meet nutritional demand in terms of energy needs as well as protein requirements (Sukhatme, 1978 and Gopalan, 1968). Indeed, many vitamins and mineral deficiencies would also be reduced if sufficient calories were consumed (Greer and Thorbecke, 1986). The cereals, particularly rice (currently over 470 g/person/day) in the diet is so high that their contribution to total dietary energy nears about 75-80% in Bangladesh (Yusuf, 1997). And over the period, the supply of cereals (mainly rice) increased (despite consumption of cereals even in excess of the set amount of 454 gm/person/day (Hossain *et al.,* 2005), but the country suffers sufficient consumption of balanced food which indicates the inadequateness of diet from nutritional point of view. Also, due to the low yield of production and lack of access to food turn the country to the problem of balanced diet alone with sufficient amount of calorie intake from cereals and non-cereals. Therefore, insufficient calories, energy and protein intake which can be supplemented by cereals and non-cereals intake are also a problem in Bangladesh.

2.8 Relationship between Influencing Characteristics of the Farmers and Food Security Related Items

Bhuiyan (2002) in his study found a positive and significant relationship between age of the farmers and their constraint in banana cultivation. Similar finding was obtained by Haque (1995) and Rahman (1996) in their respective study. Hossain (1985) in a study on landless laborers in Bhabakhali union of Mymensingh district found that there was no relationship between age of the landless laborers and their problem confrontation. Similar findings were obtained by Rahman (1995), Ali (1999), Rashid (1999), Pramanik (2001), Salam (2003) and Halim (2003) in their respective studies. Hossain (1990) found that age did not show and significant relationship with production of crop. Mansur (1989) found that age of the farmers had no significant relationship with the feeds and feeding problem confrontation. Rashid (2003) found that age of the rural youth had significant negative relationship with problem confrontation in selected agricultural production activities. Sarkar

(1996) observed that there was no significant relationship between age and adoption of improved potato cultivation practices. Karim and Mahboob (1986), Singh (1990) and many others observed similar findings.

Alam (1997) observed that the level of education of the farmer had a positive and significant relationship with the use of improved farm practices. ESCAP (1997) stated that small farmers deal with agricultural production and natural resources management with poor or no education, within a global context that is marked by changing techniques and technologies including those relevant to sustainable agriculture and information. Haque (1995) in his study on problem confrontation by farmers of Mohila Bittaheen Samabaya Samittee working under the Bangladesh Rural Development Board found a significant negative relationship between education of members and their problem confrontation. Similar finding were obtained by Mansur (1989), Rahman (1995), Rahman (1996), Faroque (1997), Ahmed (2002), Hossain (2002), Bhuiyan (2002) and Salam (2003) in their respective studies. Hasan (2005) found that there was no relationship between education of the farmers and their problem confrontation in crop production activities.

Alam (2007) in his study entitled "Impact of Food Security Project on Crop Production" showed that the family size of the rural people had no significant relationship with their crop production after involvement with food security project. Begum (1998) found that family size had no significant relationship with their poverty alleviation owing to involvement in ASA activities. Kobir (2007) in his study entitled "Contribution of farming enterprises of the small farmers towards household food security" showed that the family size of the small farmers had strong negatively significant relationship with their farming enterprises towards the household food security. Rahman (2007) showed that the family size of the rural farmers had no significant relationship with their average per day per family vegetable consumption. Saha (2001) found that family size had no significant relationship with their Knowledge of pineapple cultivation.

Alam (1997) studied the use of improved farm practices in rice cultivation by the farmers. The findings of the study showed that the farm size had a significant relationship with their use of improved farm practices in rice cultivation. Hasan (2005) in his study found that there was no relationship between farm size of the farmers and their problem confrontation in crop production activities. Mannan and Miah (2007) showed that the land size has negative trend of relationship with their problem confrontation. Muttalab (1995) observed that farm size of the farmers had a positive relationship with the adoption of improved potato farmers and showed positive and significant effect. Rahman (1995) found that farm size of the farmers had a significant negative relationship with their problem confrontation in cotton cultivation. Similar finding were obtained by Islam (1987), Mansur (1989), Rahman (1996), Faroque (1997) and Halim (2003) in their respective studies. Rahman (1995) found that farm size of the farmers was negatively related with their constraints.

Braun (1995) highlighted the fact that cash crops contribute only a portion of household food security and household income. He also stated that diversification of farming enterprises reduces risk and maximize food security and household income. FAO (1995) reported that the lack of adequate incomes and purchasing power of large parts of the population is expected to slow down world agricultural growth. Hirschman (1958) found that changes in a small holder output mixes typically affect the overall level of rural employment and which ultimately affects the household food security. Hossain (1999) found a positive significant relationship between family income and effectiveness of agricultural activities. Hussen (2001) found that the annual income had positive significant relationship with their adoption of modern sugarcane cultivation practices. Karim (1996) found in his study that annual family income of the farmers had a negative significant relationship on their problem confrontation in Kakrol cultivation. Kobir (2007) in his study entitled “Contribution of farming enterprises of the small farmers towards household food security” showed that the family annual income of the small farmers had negatively

significant relationship with their farming enterprises towards the household food security. Mansur (1989) in his found that the relationship between income of the farmers and their problem confrontation in feeds and feeding cattle was significant but show a negative trend. Quisumbing *et al.* (1995) cited that household food security depends on both the level of household income and who earns it. Rahman (1995) found in his study that annual family income of the farmers had a significant negative effect on their problem confrontation in pineapple cultivation. Rahman (2007) showed that the family annual income of the rural farmers had strongly positive significant relationship with their average per day per family vegetable consumption.

Alam (2007) in his study entitled "Impact of Food Security Project on Crop Production" showed that the extension contact of the rural people had strongly positive significant relationship with their crop production after involvement with food security project. Ali (1978) found that contact and non-contact farmers differed significantly in respect of their extension contact. He observed that extension contact of the contact and non-contact farmers had significant contribution towards their agricultural knowledge.

Anon (1994) presented an evaluation study of investment in pond development for pisciculture under two island fisheries scheme supported by the Indian's National Bank for rural development. The study revealed that extension services were significantly related to encourage to adoption of a complete package of practices for fish culture. Aurangozeb (2002) observed that there was significant relationship between contact with extension media and adoption of integrated homestead farming technologies. Biswas (2003) reported that extension contact of the rural women had positive and significant relationship with their accessibility of family decision making. Hasan (2005) in his study found that there was no relationship between extension contact of the farmers and their problem confrontation in crop production activities. Kobir (2007) showed that the exposure of farming information of the family members had insignificant relationship with their farming enterprises towards the

household food security. Rahman (1995) in his study conducted that extension contact of the farmer had significant negative relationship with their problem confrontation. Similar findings were obtained by Rahman (1996), Faroque (1997), Pramanik (2001), Hossain (2002), Bhuiyan (2002), Ahmed (2002), Salam (2003) and Halim (2003) their respective studies. Rahman (1995) studied farmers' knowledge on improved practices on potato cultivation by the farmers of Kajipurthana of Sirajgong district. The study indicated a significant relationship between extension contact and knowledge of improved practices on potato cultivation. Rahman (2007) showed that the extension contact of the rural farmers had insignificant relationship with their average per day per family vegetable consumption.

Little or no research have been found regarding the influencing characteristics of the farmers on their food security status namely number of earning members, farmer`s daily wage value, Body Mass Index (BMI), knowledge on food security

2.9 Research Gap of the Study

Previous research has, for the most part, agreed about the relevance of food production, reducing the waste, and promotes the idea to change diets which direct towards food safety as well as food security. But very few researches had been done to assess the food security status of the farmers in Bangladesh. This was one of the research gaps of the study. Hence, the researcher conducted the present study to assess the food security status of the farmers of Gangni upazila under Meherpur district.

Therefore, no research was undertaken previously following the regression analysis. This was also a significant research gap of the study. The method of the present work was very unique in this regard.

Additionally, taking the variables of food security into consideration was also unique. This was another research gap of the present work. Hence, the researcher followed current study using those indicators to assess food security.

2.10 Conceptual Framework of the Study

It is evident from the past studies that every occurrence or phenomenon is the outcome of a number of variables, which may or may not be interdependent or interrelated with each other. Variables together are the cause effect and thus, there is cause-effect relationship everywhere in the universe.

The conceptual framework of Rosenberg and Hovland (1960) was kept in mind while framing the structural arrangement for the dependent and independent variables of the study. The hypothesis of a research while constructed properly contains at least two important elements i.e. a dependent variable and independent variables. A dependent variable is that factor which appears, disappears or varies as the research introduces, removes or varies the independent variables (Townsend, 1953). Here, food security status of farmers has been selected as dependent variable and the characteristics of the farmers were considered as the independent variables. It is not possible to deal with all characteristics in a single study.

It was therefore, necessary to limit the characteristics, which include age, level of education, family size, effective farm size, number of earning members, farmer`s daily wage value, economic status, Body Mass Index (BMI), agricultural extension media contact and knowledge on food security are independent variables.

In order to have a clear understanding of the farmers' food security status, the dependent variables were considered from the view of dissemination of food security. These were food availability, food stock ability and nutritional security.

In view about discussion and prime findings of review of literature, the researcher constructed a conceptual framework of the study which is self-explanatory and is presented in figure 2.4.

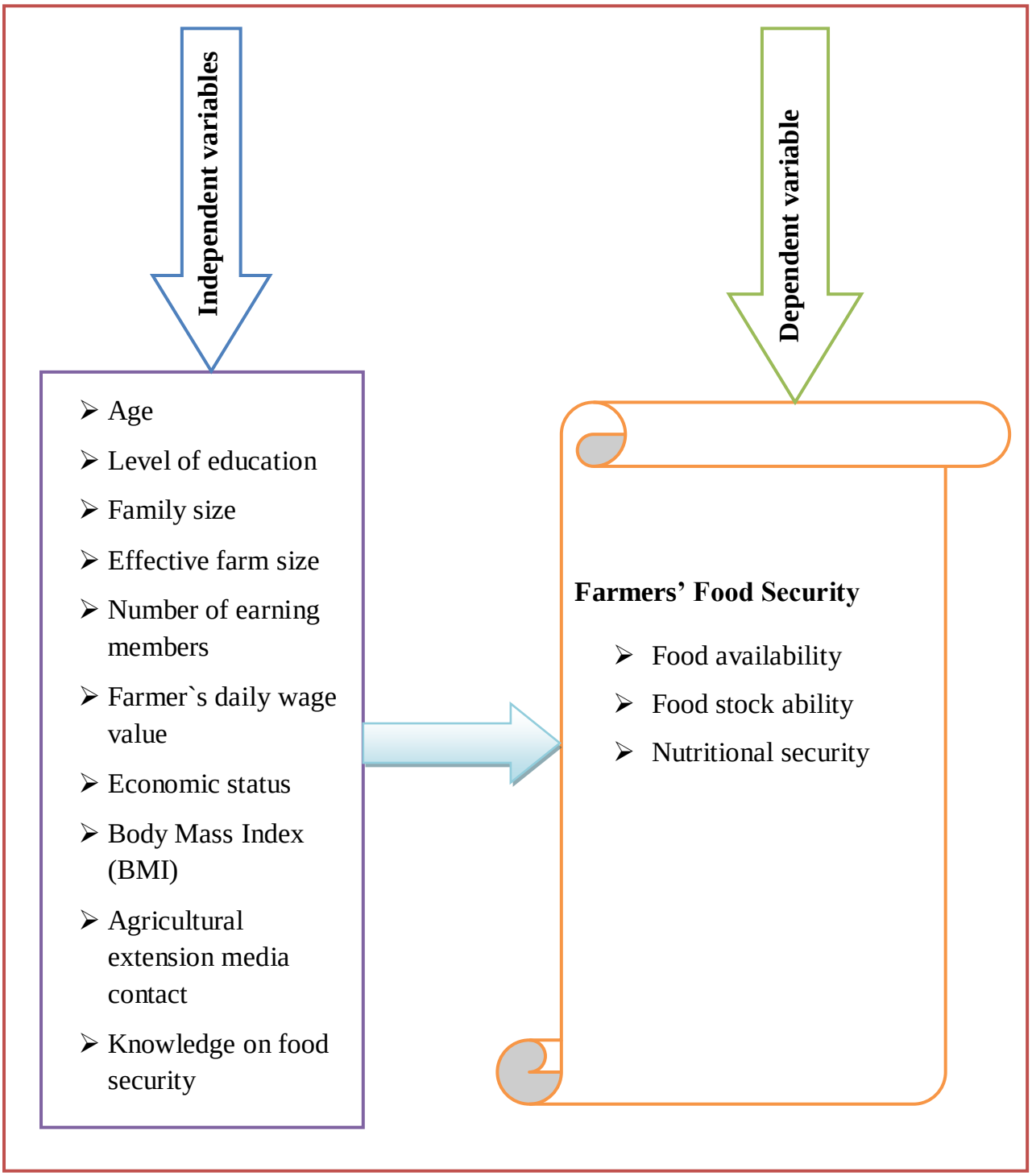

Figure 2.4 The conceptual framework of the study

CHAPTER III

MATERIALS AND METHODS

The materials and methods used in conducting any research play a critically important role and deserve careful consideration by the researcher. The researcher was very much careful for using proper methods in all aspects of the investigation. Methods and procedures followed in conducting the study have been discussed in this chapter. Further, the chapter includes the operational format and comparative reflection of some variables used in the study. Also statistical methods and their use have been mention in this chapter.

3.1 Locale of the Study

The study was taken at Gangni upazila (Meherpur district) where the most of the people are engaged in farming activities as well as farmers. There are nine unions at Gangni upazila and the present study was conducted three villages of Kazipur union namely Betbaria, Vobanipur and Naodapara based on the population size in the selected area. The population of the study area had almost eagerness to farming activities. The union of the study area is bounded by the Garpara union on the north, Ghior upazila on the south, Jaigir and Meherpur Pourosova on the east, Ghior upazila on the west.

The map of the Meherpur district has been presented in Figure 3.1. and the specific study locations of Kazipur union under Gangni upazila of Meherpur district have also been shown in Figure 3.2.

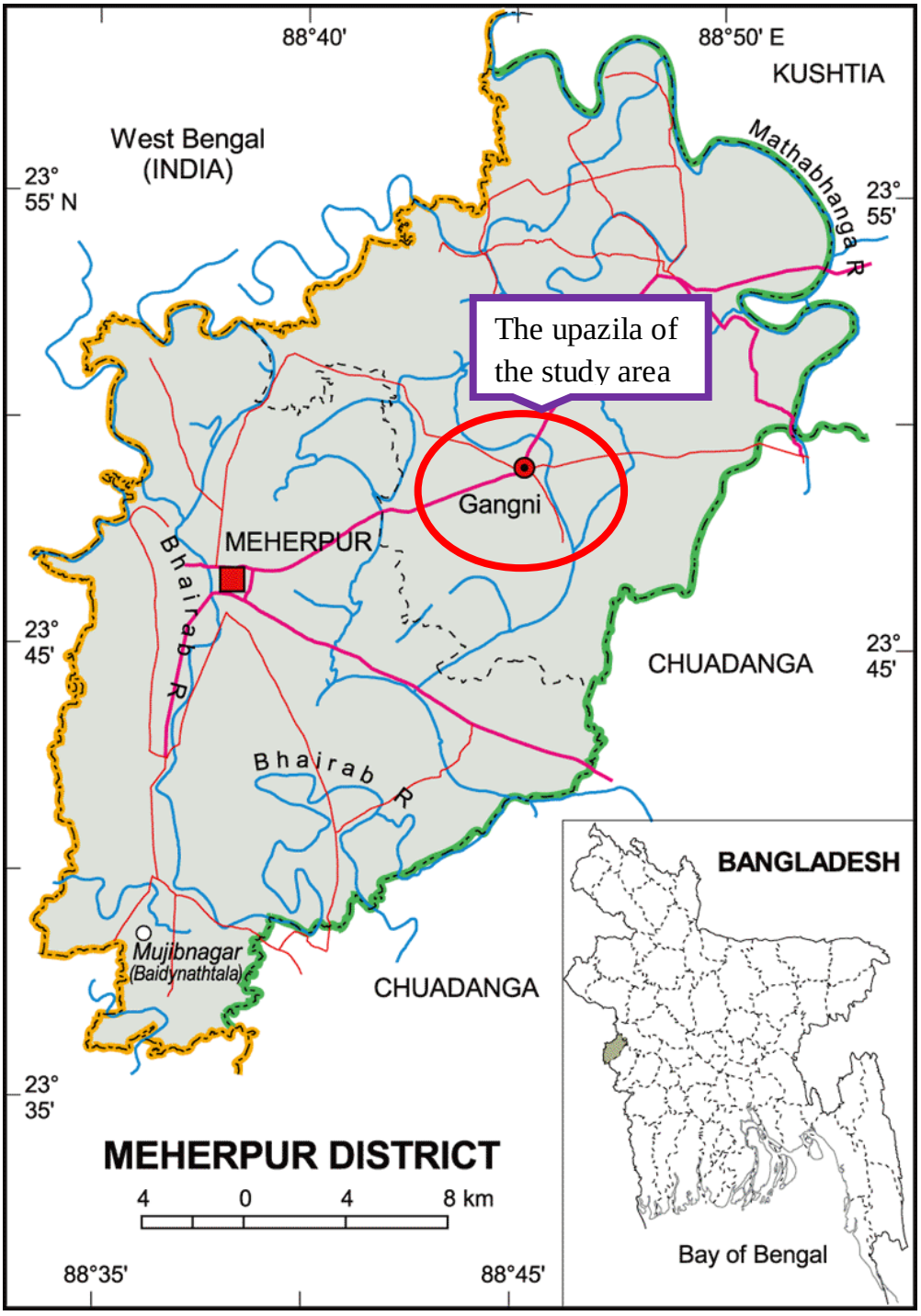

Figure 3.1 Map of Meherpur District showing the study area- Gangni upazila

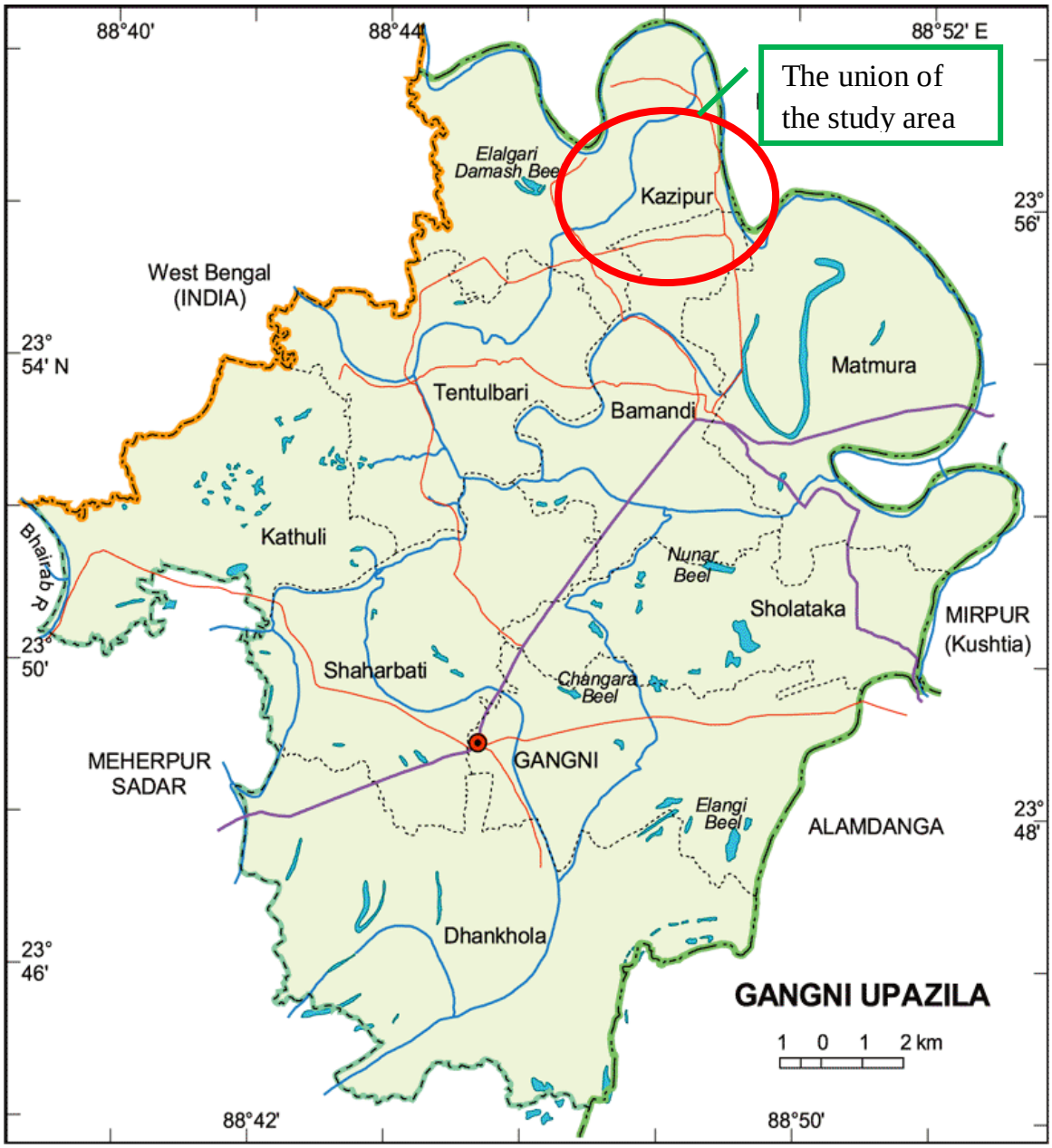

Figure 3.2 Map of Kazipur union of Gangni upazila showing the study area

3.2 Population and Sampling

People who engaged faring activities and permanently reside in the selected villages constituted the active population of this study. As all population of the study area could not possible to measure, head of the farm families of Betbaria, Vobanipur and Naodapara villages of Kazipur union of Gangni upazila under Meherpur district were the population of the study. However, representative of the population were taken for collection of data following randomly sampling technique. One farmer (who mainly operated the farming activities of the family) from each of the farm families was considered as the farmers. Updated lists of all farm families of the selected villages were prepared with the help of SAAO and local leader (Matobbor). Farm families of the villages of Kazipur union were considered as the study group. A random sampling procedure was followed to select one district from the whole of Bangladesh, and same method was used to select the upazila. This, random sampling was also used to select the Betbaria, Vobanipur and Naodapara villages of Kazipur union as the study group. The total number of individuals under study was estimated 632 in the study area which is showing in the following table 3.1.

Table 3.1 Population of the study area

Name of the selected upazila	**Name of the selected union**	**Name of the selected villages**	**Number of the farmers**
Gangni	Kazipur	Betbaria	190
		Vobanipur	227
		Naodapara	215
Total			632

3.2.1 Determination of sample size

There are several methods for determining the sample size; here, the researcher used Yamane's (1967) formula for study group:

$$n = \frac{z^2 P\ (1-P) N}{z^2 P\ (1-P) + N\ (e)^2}$$

Where,

n = Sample size;

N, Population size = 632;

e, The level of precision = 8%;

z = the value of the standard normal variable given the chosen confidence level (e.g., z = 1.96 with a confidence level of 95 %) and

P, The proportion or degree of variability = 50%;

The sample size (n) is 121

3.2.2 Distribution of the population of sample size

According to Yamane's formula, the farmers comprising 121 farmers constituted the sample size. A reserve list of ten percent of the study population was also prepared. The reserve lists comprised of 12 farmers. Farmers in the reserve list were used only when a farmer in the original list was not available. The farmers of the Betbaria, Vobanipur and Naodapara villages of Kazipur union were measured according to the proportionate of the total sample size (121) which was calculated using Yamane's (1967) formula. The distribution of the sample farmers and those in the reserved list from the villages is shown in Table 3.2.

Table 3.2 Distribution of the farmers according to population and sample size

Name of villages	Population of farmers	Sample Size	Farmers number in the reserve list
Betbaria	190	37	4
Vobanipur	227	43	4
Naodapara	215	41	4
Total	632	121	12

3.3 Variables and Their Measurement Techniques

In a descriptive social research, selection and measurement of the variable is an important task. A variable is any characteristics which can assume varying or different values are successive individuals' cases (Ezekiel and Fox, 1959). An organized research usually contains at least two identical elements i.e. independent and dependent variable. An independent variable is a factor which is manipulated by the researcher in his attempt to ascertain its relationship to an observed phenomenon. A dependent variable is a factor, which appears, disappears or varies as the experimenter introduces, removes or varies the independent variables (Townsend, 1953). According to the relevance of the research area, the researcher selected 10 characteristics of the farmers as the independent variables (e.g. age, level of education, family size, effective farm size, number of earning members, farmer`s daily wage value, economic status, Body Mass Index (BMI), agricultural extension media contact, knowledge on food security). On the other hand, farmers' food security status was dependent variable consisted of three dimensions i.e. food availability, food stock ability and nutritional security. The following sections contain procedures of measurement of dependent and independent variables of the study.

3.3.1 Measurement of independent variables

The independent variables of the study were age, level of education, family size, effective farm size, number of earning members, farmer`s daily wage value, economic status, Body Mass Index (BMI), agricultural extension media contact and knowledge on food security. The procedure followed in measuring the independent variables have been discussed in the subsequent sections.

3.3.1.1 Age

Age of the farmers was measured in terms of actual years from their birth to the time of the interview, which was found on the basis of the verbal response of the rural people. A score of one (1) was assigned for each year of one's age. This variable appears in item number 1.1 in the interview schedule as presented in Appendix-I. Based on the available information cited by the farmers, they were classified into three categories(MoYS, 2012).

Category	Years
Young age	≤ 35
Middle age	36 to 50
Old age	> 50

3.3.1.2 Level of Education

Education was measured by assigning score against successful years of schooling by a farmer. One score was given for passing each level in an educational institution (Rashid, 2014).

For example, if a farmer passed the final examination of class five or equivalent examination, his/her education score has given five (5). Each farmer of can't read & write has given a score of zero (0). A person not knowing reading or writing but being able to sign only has given a score of 0.5. If a farmer did not go to school but took non-formal education, his educational status was determined as the equivalent to a formal school student. This

variable appears in item number 1.2 in the interview schedule as presented in Appendix-I. Based on the available information cited by the farmers, they were classified into five categories.

Category	Education (year of schooling)
Can't read & write	0
Can sign only	0.5
Primary education	1 to 5
Secondary education	6 to 10
Above secondary	> 10

3.3.1.3 Family size

Family size of a farmer was determined by the total number of members in his/her family including him/her, children and other dependents. The scoring was made by the actual number of family members expressed by the farmers. For example, if a farmer had five members in his/her family, his/her score was given as 5. This variable appears in item number 1.3 in the interview schedule as presented in Appendix-I. Based on the available information cited by the farmers, they were classified into three categories (Mean ± Standard Deviation) namely 'small', 'medium' and 'large' family.

3.3.1.4 Effective farm size

Effective farm size of a farmer referred to the total area of land on which his/her family carried out the farming operation, the area being in terms of full benefit to the family. The term refers to the cultivated area either owned by the farmer or cultivated on sharecropping, lease or taking from other including homestead area and measured using the following formula (Rashid, 2014):

$$EFS = A + B + \frac{1}{2}(C + D) + E$$

Where,

EFS = Effective Farm size

A = Homestead area including garden and pond

B = Own land under own cultivation

C = Land taken from others as borga

D = Land given to other as borga

E = Land taken from others on lease

The data was first recorded in terms of local measurement unit i.e. kani or decimal and then converted into hectare. The total area, thus, obtained is considered as his farm size score (assigning a score of one for each hectare of land). This variable appears in item number three (4) in the interview schedule as presented in Appendix-I. Based on their total farm size, the farmers were classified into five categories according to Department of Agricultural Extension (DAE, 1999).

Category	**Area (hectare)**
Landless	≤ 0.020
Marginal farmer	0.021 to 0.20
Small farmer	0.21 to 1.00
Medium farmer	1.01 to 3
Large farmer	>3

3.3.1.5 Number of earning members

Number of earning members a farmer's family was determined by the total number of members in his/her family including him/her, children and other dependents who engaged in income generating activities. The scoring was made by the actual number of earning family members expressed by the farmers. For example, if a farmer had five members in his/her family and two members are engaged in income generating activities, his/her score was given

as two (2). This variable appears in item number 1.5 in the interview schedule as presented in Appendix-I. Based on the available information cited by the farmers, they were classified into three categories (Mean ± Standard Deviation) namely 'small', 'medium' and 'large' number of earning members at family.

3.3.1.6 Farmer`s daily wage value

The term farmer`s daily wage value refers to the daily income of the farmer and the members of his family from different sources. It was expressed in taka. In measuring this variable, total earning taka of an individual farmer was converted into score. A score of one was given for every one taka. For example, if a farmer earns 250TK. Daily, his/her score was given as 250. This variable appears in item number 1.6 in the interview schedule as presented in Appendix-I. Based on the available information cited by the farmers, they were classified into three categories (Mean ± Standard Deviation) namely 'small', 'medium' and 'large' wage value.

3.3.1.7 Economic status

The term economic status refers to the annual gross income of a farmer and the members of his/her family from different sources. It was expressed in taka. In measuring this variable, total earning taka of an individual farmer was converted into score. A score of one was given for every one thousand taka. The method of ascertaining income involved two phases. Firstly, the income from agricultural sector income like the income from crops, livestock, poultry and fishery in the preceding year was noted and converted into taka. Secondly, non-agricultural sector income included earning form small business, service, other family members' income, day labor, fishing and others if any. For example, if a farmer earns 150,000TK. In a year, his/her score was given as 15. This variable appears in item number 1.7 in the interview schedule as presented in Appendix-I. Based on the available information cited by the farmers, they were classified into three categories (Mean ± Standard Deviation) namely 'small', 'medium' and 'high' economic status.

3.3.1.8 Body Mass Index (BMI)

Body mass index (BMI) is a measure of body fat based on height and weight that applies to adult men and women. The body mass index (BMI) is a statistic developed by Adolphe Quetelet in the 1900's for evaluating body mass (Eknoyan, 2007). It is not related to gender and age. It uses the same formula for men as for women and children.The body mass index is calculated based on the following formula (Bodyweight in kilograms divided by height in meters squared):

BMI = x KG / (y M × y M)

Where:

x=bodyweight in kilogram (KG)

y=height in meter (M)

Example for 175 cm height and 70 kg weight:

BMI = 70 / (1.75 × 1.75) = 22.86. This variable appears in item number 1.8 in the interview schedule as presented in Appendix-I. The WHO regards a BMI of less than 18.5 as underweight and may indicate malnutrition, an eating disorder, or other health problems, while a BMI equal to or greater than 25 is considered overweight and above 30 is considered obese. Based on the available information cited by the farmers, they were classified into four categories according to (WHO, 2006) i.e. Underweight (<18.5), Normal weight (18.5–24.9), Overweight (25–29.9) and Obesity (BMI of 30 or greater).

3.3.1.9 Agricultural extension media contact

It was defined as one's extent of exposure to different communication media related to farming activities. Agricultural extension media contact of a farmer was measured by computing agricultural extension media contact score on the basis of their nature of contact with nine agricultural extension media. Each farmer was asked to indicate his nature of contact with four alternative responses, like frequently, sometimes, rarely and not at all basis to each of the nine media and score of three, two, one and zero were assigned for those

alternative responses, respectively. These four options for each medium were defined specially to each medium considering the situation, rationality and result of pre-test. Logical frequencies were assigned for each of the four-alternative nature of contact. Agricultural extension media contact of the farmers was measured by adding the scores of nine selected source of information. Thus, agricultural extension media contact score of a farmer could range from 0 to 27, where zero indicated no agricultural extension media contact and twenty-seven indicated highest level of agricultural extension media contact. This variable appears in item number 1.9 in the interview schedule as presented in Appendix-I. Based on the available information cited by the farmers, they were classified into three categories (Mean ± Standard Deviation) namely 'small', 'medium' and 'high' agricultural extension media contact.

3.3.1.10 Knowledge on food security

Food security knowledge of a farmers was measured by asking him/her 10 questions related to different components of food security, e.g. relation between education and food security, benefits of achieving food security, role of food security in achieving a developed country, etc. It was measured assigning weightage two (2) for each question. So, the total assigned scores for all the questions became twenty. The score was given according to response at the time of interview. Answering a question correctly an individual could obtain full score while for wrong answer or no answer he obtained zero (0) score. Partial score was assigned for partially correct answer. Thus, the food security knowledge score of a farmer could range from zero (0) to twenty (20), where zero indicates no knowledge and twenty indicates highest knowledge. This variable appears in item number 1.10 in the interview schedule as presented in Appendix-I. Based on the available information cited by the farmers, they were classified into three categories (Mean ± Standard Deviation) namely 'small', 'medium' and 'high' knowledge on food security.

3.3.2 Measurement of dependent variable

As stated earlier, the dependent variable of this study was 'farmers' food security status'. Three dimensions namely food availability, food stock ability and nutritional security were used to determine food security status of farmers. The dimensions were also sub-categorized as low, medium, high and given score 1, 2, 3 respectively. Then the scores were added to calculate the food security status (unit free). All the major components were measured with the help of identified subcomponents. Each subcomponent was measured against the identified items, collected through the process of review of relevant literature, focused discussion with the officials, experts, experienced farmers.

3.3.2.1 Food availability

It was defined as one's available source of food. Food availability of a farmer was measured by computing score on the basis of available source of cereal, vegetables, meat, fish and fruits. Each farmer was asked to indicate available food source with five alternative responses, like more available, sufficient, less than sufficient, less available and always with shortage basis to each of the five food types and score of five, four, three, two, and one were assigned for those alternative responses, respectively. These five options for each medium were defined specially to each medium considering the situation, rationality and result of pre-test. Food availability of the farmers was measured by adding the scores of five selected source of food.

Thus, food availability score of a farmer could range from 5 to 25, where five indicated always with shortage food availability and twenty-five indicated more available of food. This variable appears in item number 2.1 in the interview schedule as presented in Appendix-I. Based on the information cited by the farmers, they were classified into three categories (Mean ± Standard Deviation) namely 'low', 'medium' and 'high' food availability.

3.3.2.2 Food stock ability

Food stock ability of a farmer's family was determined by the total number of meal stocked at his/her family. The measurement of food stock ability was followed by up to one day (up to 3 meals), up to one week (4 to 21 meals), up to one month (22 to 90 meals) and more than one month (>90 meals). The scoring was made by the 1 for each meal stock ability.

For example, if a farmer had one month food stock ability, his/her score was given as two (90). This variable appears in item number 2.2 in the interview schedule as presented in Appendix-I. Based on the information cited by the farmers, they were classified into three categories (Mean ± Standard Deviation) namely 'low', 'medium' and 'high' food stock ability of the farmers' family.

3.3.2.3 Nutritional security

Nutrition security of the respondents was measured in score on the basis of his daily consumption of food. One hundred cal. nutrition consumption value was assigned for score 1. According to daily nutrition consumption, the nutrition security of the respondents was classified into three categories (Mean ± Standard Deviation) namely 'low', 'medium' and 'high' nutrition security.

3.4 Measurement of Problem Faced by Farmers

Problems faced by the rural people in achieving food security were measured by asking their opinion on 12 selected problems. A five-point rating scale was used for computing the problem score of the farmers. Problem confrontation faced by the rural people in achieving food security was measured by asking their opinion on twelve selected problems. For each problem score of four (4), three (3), two (2), one (1) and zero (0) was assigned to indicate extent of problem as 'high', 'medium', 'low', 'very low' and 'not at all', respectively. For each of the problem confrontation in achieving food security was determined by summing-up scores obtained by farmers for the twelve (12) concerned problems, while the overall problem confrontation of a farmer was computed by adding together the score. The possible range of food security

problem score could be zero (0) to forty-eight (48), a total score of zero (0) indicated no problems while a score of forty-eight (48) indicated highest difficulties with achieving food security.

To ascertain the comparison among the problems of farmers, index for each item along with rank order Problem Facing Index (PFI) was computed (Afique, 2006) using the following formula:

$$PFI = (P_h \times 3) + (P_m \times 2) + (P_l \times 1) + (P_n \times 0)$$

Where, PFI = Problem Facing Index;

P_h = Number of farmers having high problem;

P_m = Number of farmers having medium problem;

P_l = Number of farmers having low problem;

P_n= Number of farmers having no problem at all;

Problem Facing Index (PFI) related to difficulties with achieving household food security could range from 0 to 484, 0 indicating no problem and 484 indicating very high problem with the particular problem. However, attempts were also made to seek out the suggestions from the farmers to overcome the problem identified. This variable appears in item number three (3) in the interview schedule as presented in Appendix-I. The rank order on the basis of problem confrontation in achieving food security was formed according to score cited by the farmers.

3.5 Hypothesis of the Study

According to Kerlinger (1973) a hypothesis is a conjectural statement of the relation between two or more variables. Hypothesis are always in declarative sentence form and they are related, either generally or specifically from variables to variables. In broad sense hypotheses are divided into two categories: (a) Research hypothesis and (b) Null hypothesis.

3.5.1 Research hypothesis

Based on review of literature and development of conceptual framework, the following research hypothesis was formulated:

"Each of the 10 selected characteristics (age, level of education, family size, effective farm size, number of earning members, farmer`s daily wage value, economic status, Body Mass Index (BMI), agricultural extension media contact, knowledge on food security)of the farmers has significant contribution on their food security"

However, when a researcher tries to perform statistical tests, then it becomes necessary to formulate null hypothesis.

3.5.2 Null hypothesis

A null hypothesis states that there is no contribution between the concerned variables. The following null hypothesis was formulated to explore the contribution of the selected characteristics on food security. In order to conduct tests, the earlier research hypothesis was converted into null form as follows:

"There is no contribution of the selected characteristics (age, level of education, family size, effective farm size, number of earning members, farmer`s daily wage value, economic status, Body Mass Index (BMI), agricultural extension media contact, knowledge on food security) of farmers on their food security."

3.6 Instrument for Collection of Data

In order to collect reliable and valid information from the farmers, an interview schedule was prepared for collection of data from farmers keeping the objectives of the study in mind. The schedule was prepared in Bangla for a clear understanding to the farmers. The Bengali version of interview schedule was used to collect data. The question and statements contained in the schedule were simple, direct and easily understandable by the farmers. Simple and direct question, different scales, closed and open form statements and questions were included in the interview schedule to obtain necessary information. The draft

interview schedule was prepared in accordance with the objective of the study. The interview schedule was pre-tested with 15 farmers of the farmers in the study area during 01 to 03 February, 2017.

The draft interview schedule was pretested in actual field situation before finalizing it for collection of data. The pre-test was helpful to identify inappropriate questions and statements in the draft schedule. Necessary addition, alternation and adjustments were made on the basis of the experience of the pretest. The interview schedule was then cyclostyled in its final form for the collection of data. The interview schedule was then printed in its final form. An English version of the interview schedule has been shown in Appendix-I.

3.7 Data Collection

Data were collected personally by the researcher himself through personal interview schedule from the sampled farm families of the selected villages. Before starting the collection of data; the researcher met the respective Upazila Agriculture Officer (UAO), Agriculture Extension Officer (AEO), Upazila Food Program Officer (UFPO), Assistant Health Inspector (AHI) and the concerned SAAOs. The researcher also discussed the objectives of the present study with the farmers and above mentioned officers and requested them to provide actual information. A rapport was established with the rural people so that they feel easy to answer the questions. The researcher took all possible care to establish rapport with the farmers so that they would not feel any indecision while starting the interview. Very good cooperation was obtained from the field extension workers and the local leaders. No serious difficulty was faced by the researcher during the collection of data. The interviews were made individually in the houses of farmers. Questions were asked in different ways so that the farmers could easily understand the questions. Whenever a farmer faced difficulty in understanding any questions, care was taken to explain the same clearly with a view to enabling him to answer it properly.

Before going to the farmers' home for interviewing they were informed verbally to ensure their availability at home as per schedule date and time. In the case of failure to collect information from the farmers due to their other business, a revisit was made with prior appointment. If any farmers failed to understand, the researcher took great care to explain the issue. If the farmers could not clear about what was wanted to know then supplementary questions were asked for further clarification. The researcher received full cooperation from the farmers during the time of interview. Data were collected during 05 February, 2017 to 06 March, 2017.

3.8 Compilation of Data

After completion of field survey, data recorded in the interview schedules were coded, compiled, tabulated and analyzed in accordance with the objectives of the study. In this process, all the responses in the interview schedule were given numerically coded values. Local units were converted into standard units and qualitative data were converted into quantitative ones by means of suitable scoring whenever necessary. All the collected data were checked and cross-checked before transplanting to the master sheets. To facilitate tabulation, the collected data were properly coded and transferred from interview schedule to a master sheet. Tabulation and cross tabulation was done on the basis of categorization developed by the researcher.

3.9 Categorization of the Farmers

It was necessary to develop suitable categories to determine the food security status of farmers in selected aspects. For the purpose, the farmers were classified into categories on the basis of obtained score of food security status by them. Categories were also developed for describing each of the selected characteristics of the rural people. Nature of the data and mode of the categorization prevailing on the social system guided the researcher in developing categories in respect of selected characteristics.

3.10 Statistical Analysis

Regression analysis was used to identify the linear combination between independent variables used collectively to predict the dependent variables (Miles and Shevlin, 2001). Regression analysis helps us understand how the typical value of the dependent variable changes when any one of the independent variables is varied, while the other independent variables are held fixed. Ordinary Least Squares (OLS) is used most extensively for estimation of regression functions. In short, the method chooses a regression where the sum of residuals, ΣUi is as small as possible (Gujarati, 1995). The factors that contribute to the food security status of the farmers are analyzed using a regression model. The overall quality of fit of the model has been tested by ANOVA specifically F and R^2 test.

The data were analyzed in accordance with the objectives of the proposed research work. The factors that contribute to the attitude of rural women towards livestock rearing are analyzed using a regression model, multiple regression analysis (B) was used. Throughout the study, five (0.05) percent and one (0.01) percent level of significance were used as the basis for rejecting any null hypothesis. If the computed value of (B) was equal to or greater than the designated level of significance (*p*), the null hypothesis was rejected and it was concluded that there was a significant contribution between the concerned variable. Whenever the computed value of (B) was found to be smaller at the designated level of significance (*p*), the null hypothesis could not be rejected. It was concluded that there was no contribution of the concerned variables.

The model used for this analysis can be explained as follows:

$$Y_i = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10} + e; \quad (i=1,2,3)$$

Where, $Y_{i=1}$ is the food availability

$Y_{i=2}$ is the food stock ability

$Y_{i=3}$ is the nutritional security

Of the independent variables, x_1 is the farmer's age, x_2 is level of education, x_3 is family size, x_4 is effective farm size, x_5 is number of earning members, x_6 is farmer`s daily wage value, x_7 is economic status, x_8 is Body Mass Index (BMI), x_9 is agricultural extension media contact and x_{10} is knowledge on food security. b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8, b_9 and b_{10} are regression coefficients of the corresponding independent variables, and e is random error, which is normally and independently distributed with zero mean and constant variance.

CHAPTER IV

RESULTS AND DISCUSSION

The recorded observations in accordance with the objective of the study were presented and probable discussion was made of the findings with probable justifiable and relevant interpretation under this chapter. The findings of the study and their interpretation have been presented in this chapter. These are presented in four sections according to the objective of the study. The first section deals with the selected characteristics of the farmers, while the second section deals with the food security status of the farmers. The third section deals with contribution of the farmers' selected characteristics on their food security status, while the fourth section deals with the problem faced associated with achieving food security.

4.1 Characteristics of the Farmers

Behavior of an individual is determined to a large extent by one's personal characteristics. There were various characteristics of the farmers that might have consequence to food security. But in this study, ten characteristics of them were selected as independent variables, which included their age, level of education, family size, effective farm size, number of earning members, farmer`s daily wage value, economic status, Body Mass Index (BMI), agricultural extension media contact, knowledge on food security that might be greatly influenced the food security status of farmers are presented below-

4.1.1 Age

The age of the farmers has been varied from 30 to 52 years with a mean and standard deviation of 42.19and 5.35, respectively. Considering the recorded age farmers were classified into three categories namely 'young', 'middle' and 'old' aged following MoYS (2014). The distribution of the farmers in accordance of their age is presented in Table 4.1.

Table 4.1 Distribution of the farmers according to their age

Category	Range (Years)		Farmers		Mean	SD
	Score	Observed	Number	Percent		
Young aged	Up to 35	30-52	9	7.4	42.19	5.35
Middle aged	36-50		106	87.6		
Old aged	Above 50		6	5.0		
Total			121	100.0		

From Table 4.1 reveals that the middle-aged farmers comprised the highest proportion (87.6percent) followed by young aged category (7.4percent) and the lowest proportion were made by the old aged category (5.0percent). Data also indicates that the middle and young aged category constitute almost 95 percent of total farmers. Young and middle aged farmers were generally more involved in farming than the older due to their energetic, enthusiastic nature.

4.1.2 Level of education

The level of educational scores of the farmers ranged from 0 to 10 with a mean and standard deviation of 5.84and 2.87, respectively. Based on the educational scores, the farmers were classified into five categories. The distributions of farmers according to their level of education are presented in Table 4.2.

Table 4.2 Distribution of the farmers according to their level of education

Category	Range (years)		Farmers		Mean	SD
	Score	Observed	Number	Percent		
Can't read and sign	0	0-10	8	6.6	5.84	2.87
Can sign only	0.5		9	7.4		
Primary education	1-5		26	21.5		
Secondary education	6-10		78	64.5		
Above secondary	>10		0	0		
Total			121	100.0		

Table 4.2 shows that farmers under secondary education category constitute the highest proportion (64.5 percent) followed by primary education (21.5percent). On the other hand, the lowest 6.6 percent in can't read and sign category followed by can sign only category (7.4 percent) and no respondents were above secondary category. Education broadens the horizon of outlook of farmers and expands their capability to analyze situation related to food security. To adjust with same, they would be progressive minded to secure their food and involve with modern cultural, processing and marketing facilities of farm products.

4.1.3 Family size

Family size of the farmers ranged from 3 to 9 with the mean and standard deviation of 5.93and 1.27, respectively. According to family size the farmers were classified into three categories (Mean ± Standard Deviation) viz. 'small', 'medium' and 'large' family. The distribution of the cultivators according to their family size is presented in Table 4.3.

Table 4.3 Distribution of the farmers according to their family size

Category	Range (Number)		Farmers		Mean	SD
	Score	Observed	Number	Percent		
Small family	≤ 4	3-9	16	13.2	5.93	1.27
Medium family	5-7		91	75.2		
Large family	> 7		14	11.6		
Total			121	100.0		

Data in Table 4.3 indicates that the medium size family constitute the highest proportion (75.2 percent) followed by the small size family (13.2 percent). Only 11.6 percent farmers had large family size. Such finding is quite normal as per the situation of Bangladesh. The findings from Table 4.3 indicated that average family size of the study area was smaller than the national average which is 4.85 (BBS, 2014). The trend of nuclear family has been rising in the study area and subsequently the family member becoming smaller than the extended family.

4.1.4 Effective farm size

The effective farm size of the farmers ranged from 0.02ha to 2.50ha with a mean and standard deviation of 0.78 and 0.58, respectively. Based on their farm size, the farmers were classified into five categories following the categorization according to DAE. The distribution of the farmers according to their farm size is presented in Table 4.4.

Table 4.4 Distribution of the farmers according to their farm size

Category	Range (ha)		Farmers		Mean	SD
	Score (ha)	Observed	Number	Percent		
Landless	≤0.02	0.02-2.5	3	2.5	0.78	0.58
Marginal	0.021-0.20		3	2.5		
Small	0.21-1.00		89	73.6		
Medium	1.01-3.0		26	21.5		
Large	>3		0	0		
Total			121	100.0		

Table 4.4 indicates that the small farm holder constituted the highest proportion (73.6 percent) followed by medium farm holder (21.5 percent). The findings of the study reveal that majority of the farmers were small to medium sized farm holder. The average farm size of the farmers of the study area (0.78ha) was higher than that of national average (0.60 ha) of Bangladesh (BBS, 2014). Due to the enhancing the economic status of the farmers, the farmers are likely to motivate to buy the land.

4.1.5 Number of earning members

Score number of earning members of farmers could range from 1 to 5 with mean and standard deviation of 2.32 and .91, respectively. On the basis of number of earning members scores of the farmers, the farmers were classified into three categories (Mean ± Standard Deviation) namely ‘small’, ‘medium’ and ‘high’ number of earning members at family. The distribution of the farmers according to the number of earning members of their family is given in Table 4.5.

Table 4.5 Distribution of the farmers according to the number of earning members of their family

Category	Range (Number)		Farmers		Mean	SD
	Score	Observed	Number	Percent		
Low earning members	≤ 2	1-5	74	61.2	2.32	.91
Medium earning members	3-4		44	36.4		
High earning members	> 4		3	2.5		
Total			121	100.0		

Data in Table 4.5 indicates that the low category of earning member family constitute the highest proportion (61.2 percent) followed by the medium category of earning member family (36.4 percent). Only 2.5 percent farmers were high category of earning member family. The findings of the present study reveal that around 97 percent of the farmers in the study area were low to medium category of earning member family. The trend of nuclear family has been rising in the study area and subsequently the earning member of the family becoming smaller.

4.1.6 Farmer`s daily wage value

Daily wage value of the farmers ranged from 220 to 430 taka with a mean and standard deviation of 327.35 and 54.71, respectively. On the basis of daily wage value, the farmers were classified into three categories (Mean ± Standard Deviation) viz. ‘small’, ‘medium’ and ‘large’ wage value. The distribution of the farmers according to their daily wage value is presented in Table 4.6.

Table 4.6 Distribution of the farmers according to their daily wage value

Category	Range (Taka)		Farmers		Mean	SD
	Score	Observed	Number	Percent		
Low wage	Up to 271	220-430	13	10.7	327.35	54.71
Medium wage	272-382		93	76.9		
High wage	> 382		15	12.4		
Total			121	100.0		

Data reveals that the farmers having medium daily wage constituted the highest proportion (76.9 percent), while the lowest proportion in low income (10.7 percent) followed by high income (12.4 percent). Overwhelming majority (87.6 percent) farmers have low to medium level daily wage value. The farmers cannot consider the working value when they work in their field. Besides availability of labor force reduces the daily wage value in the study area.

4.1.7 Economic status

Economic status of the farmers ranged from -6 to 56.43 thousand taka with a mean and standard deviation of 20.06and 11.73, respectively. On the basis of economic status, the farmers were classified into three categories(Mean ± Standard Deviation) viz. 'small', 'medium' and 'high' economic status. The distribution of the farmers according to their economic status is presented in Table 4.7.

Table 4.7 Distribution of the farmers according to their economic status

Category	Range ('000 Tk.)		Farmers		Mean	SD
	Score	Observed	Number	Percent		
Low economic status	≤ 8.3	-6 to 56.43	16	13.2	20.06	11.73
Medium economic status	8.4-31.8		86	71.1		
High economic status	> 31.8		19	15.7		
Total			121	100.0		

Data reveals that the farmers having medium economic status constituted the highest proportion (71.1 percent), while the lowest proportion in low economic status (13.2 percent) followed by economic status (15.7 percent). Overwhelming majority (84.3 percent) farmers have low to medium level economic status. The high living cost reduces the economic status of the farmers in the study area.

4.1.8 Body Mass Index (BMI)

Body Mass Index (BMI) score of the farmers ranged from 16 to 26.72 with a mean and standard deviation of 20.81 and 2.66, respectively. Based on the Body Mass Index (BMI) score, the farmers were classified into four categories according to (WHO, 2006) i.e. underweight (<18.5), normal weight (18.5–24.9), overweight (25–29.9) and obesity (BMI of 30 or greater). The distribution of the farmers according to their Body Mass Index (BMI)is presented in Table 4.8.

Table 4.8 Distribution of the farmers according to their Body Mass Index

Category	Range (BMI)		Farmers		Mean	SD
	Score	Observed	Number	Percent		
Underweight	≤18.5	16 - 26.72	22	18.2	20.81	2.66
Normal weight	18.5–24.9		77	63.6		
Overweight	25–29.9		22	18.2		
Obesity	≥30		0	0		
Total			121	100.0		

Table 4.8 indicates that the highest proportion (63.6 percent) of the farmers had normal weight compared to 18.2 percent in underweight and overweight. No farmers were found in obesity category. The supply of daily food in the farmers' family and their daily works keep them normal weight most of the farmers in the study area.

4.1.9 Agricultural extension media contact

The observed score of agricultural extension contact of the farmers ranged from 8 to 25 against a possible range of 0 to 27. The average score of the farmers was 14.23 with a standard deviation 4.18 (Table 4.9). The farmers were classified into three categories on the basis of their exposure to farming information through communication exposure scores and distribution of the three categories (Mean ± Standard Deviation) namely 'less', 'medium' and 'high' agricultural extension media contact of the farmers. Data showed that the highest proportion (52.9 %) of the farmers had medium agricultural

extension contact as compared to 28.9 percent of them having less agricultural extension contact and 18.2 percent fell in high extension contact (Table 4.9).

Table 4.9 Distribution of the farmers according to their agricultural extension contact

Category	Range		Farmers		Mean	SD
	Score	Observed	Number	Percent		
Less contact	≤10	8-25	35	28.9	14.23	4.18
Medium contact	11-18		64	52.9		
High contact	>18		22	18.2		
Total			121	100.0		

From this table, it might be concluded that majority of the farmers had medium extension contact. It could be concluded that extension agent or media of the study area were available to the farmers. The finding was interesting but logical because in general the farmers in the rural areas of Bangladesh are less cosmopolite in nature and less exposed to different information sources. Finding revealed that 28.9 percent of the farmers had low agricultural extension media contact which demands for strengthening and improving the communication strategy. Low agricultural extension media contact might be the reason that some respondent may think that they have enough knowledge about farming activities. Agriculturalextension media contact pertains to ones contact with multifarious sources of farming knowledge and information. The farmers of the study area receive information from their neighbors, relatives and workmates etc. which reflects in the study result.

4.1.10 Knowledge on food security

Food security knowledge scores of the farmers ranged from 5 to 15 against possible score of 0 to 30. The average score and standard deviation were 8.09and 2.41, respectively. Based on the food security knowledge scores, the farmers were classified into three categories (Mean ± Standard Deviation) namely low, medium and high knowledge on food security (Table 4.10).

Table 4.10 Distribution of the farmers according to their knowledge on food security

Category	Range		Farmers		Mean	SD
	Score	Observed	Number	Percent		
Low knowledge	≤ 6	5-15	15	12.4	8.09	2.41
Medium knowledge	7-11		80	66.1		
High knowledge	≥ 12		26	21.5		
Total			121	100.0		

Data presented in the Table 4.10 revealed that 66.1 percent of the farmers had medium food security knowledge, 12.4 percent had low knowledge and 21.5 percent had high knowledge on food security. Thus, an overwhelming majority (66.1%) of the farmers had medium knowledge. This lead to understanding that household food security would reflected more by the medium knowledge on agriculture group in the present study. Knowledge on food security of the farmers is definitely affected by the education of the farmers because education helps to enhance the eagerness to be acquainted with new variety or technology. In addition, the farmers' education in the study area reflects this food security knowledge result due to having the formal and non-formal educational capacity.

4.2 Food security status of the farmers

As stated earlier, the dependent variable of this study was 'farmers' food security status'. Farmers' food security status had three selected dimensions namely a) food availability, b) food stock ability and c) nutritional security. Direct survey measures level of food security through a series of questions designed to identify food availability, food stock ability and nutritional security. The results of different dimensions are presented in bellow:

4.2.1 Food availability

Food availability scores of the farmers ranged from 6 to 20 against possible score of 0 to 25. The average score and standard deviation were 12.0 and 2.87,

respectively. Based on the scores, the farmers were classified into three categories namely low, medium and high food availability (Table 4.11).

Table 4.11 Distribution of the farmers according to their food availability

Category	Range		Farmers		Mean	SD
	Score	Observed	Number	Percent		
Low food availability	≤11	6-20	26	21.5	16.95	4.39
Medium food availability	10-14		81	66.9		
High food availability	≥ 15		14	11.6		
Total			121	100.0		

Results presented in the Table4.11 reveals that the food availability of the farmers were highest in medium level, it was 66.9 percent and medium food availability was closer to the low food availability as 21.5 percent. The high food availability category constituted by 11.6 percent farmers. The economic status and good agricultural production by the farmers help to get this result where most of the farmers in medium food availability category.

4.2.2 Food stock ability

Food stock ability scores of the farmers ranged from 21 to 150 and the average score and standard deviation were 70.77 and 35.16, respectively. Based on the scores, the farmers were classified into three categories (Mean ± Standard Deviation) namely low, medium and high food stock ability (Table 4.12).

Table 4.12 Distribution of the farmers according to their food stock ability

Category	Range		Farmers		Mean	SD
	Score	Observed	Number	Percent		
Low ability	≤35	21 -150	28	23.1	70.77	35.16
Medium ability	36-106		67	55.4		
High ability	≥ 107		26	21.5		
Total			121	100.0		

Results presented in the Table4.12 reveals that the food stock ability of the farmers were highest in medium level, it was 55.4 percent and medium food

stock ability was closer to the low food stock ability as 23.1 percent. The high food stock ability category constituted by 21.5 percent farmers. The knowledge on food security and economic status of the farmers help to get this result where most of the farmers in medium food stock ability category.

4.2.3 Nutritional security

Food stock ability scores of the farmers ranged from 14 to 25.56 and the average score and standard deviation were 19.83 and 3.03, respectively. Based on the nutritional security scores, the farmers were classified into three categories (Mean ± Standard Deviation) namely low, medium and high nutritional security (Table 4.13).

Table 4.13 Distribution of the farmers according to their nutritional security

Category	Range		Farmers		Mean	SD
	Score	Observed	Number	Percent		
Low nutritional security	≤16	14 - 25.56	18	14.9	16.95	4.39
Medium nutritional security	17-22		71	58.7		
High nutritional security	≥ 23		32	26.4		
Total			121	100.0		

Results presented in the Table 4.13 reveals that the nutritional security of the farmers were highest in medium level, it was 58.7 percent and medium nutritional security was closer to the high nutritional security as 26.4 percent. The low nutritional security ability category constituted by 14.9 percent farmers. The economic status and knowledge on food security of the farmers help to get this result where most of the farmers in medium nutritional security category.

4.3 Factors related to the Food Security Status of the Farmers

In order to estimate the farmers' food security status through three selected dimensions namely a) food availability, b) food stock ability and c) nutritional security, multiple regression analysis was used which is shown in Table 4.14.

Table 4.14 Multiple regression coefficients of contributing factors related to the farmers' food availability

Dimension	Independent variables	B	*p*	R^2	Adj. R^2	F	*p*
Farmers' food availability	Age	0.008	0.852	0.538	0.518	25.61	0.000**
	Level of education	0.039	0.049*				
	Family size	-0.078	0.004**				
	Effective farm size	0.764	0.034**				
	Number of earning members	0.826	0.059				
	Farmer`s daily wage value	0.017	0.021*				
	Economic status	0.013	0.039*				
	Body Mass Index (BMI)	0.409	0.000**				
	Agricultural extension media contact	0.051	0.676				
	knowledge on food security	0.178	0.002**				

** Significant at $p < 0.01$;

* Significant at $p < 0.05$

Table 4.14 shows that there is a significant contribution of respondents' level of education, family size, effective farm size, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security to change their food availability status. Of these, family size, effective farm size, Body Mass Index (BMI) and knowledge on food security were the most important contributing factors (significant at the 1% level of significance). Level of education, farmer`s daily wage value and economic status were also the important contributing factors (significant at the 5% level of significance

while coefficients of other selected variables don't have any contribution on food availability.

53.8% (R^2 = 0.538) of the variation in the respondents changed food availability can be attributed to their level of education, family size, effective farm size, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security, making this an excellent model (see Table 4.14). The F value indicates that the model is significant ($p<0.000$).

However, each predictor may explain some of the variance in respondents' food availability conditions simply by chance. The adjusted R-square value penalizes the addition of extraneous predictors in the model, but values of 0.518 still show that the variance in respondents' food availability can be attributed to the predictor variables rather than by chance, and that both are suitable models (Table 4.14). In summary, the models suggest that the respective authority should consider their recipients' level of education, family size, effective farm size, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security**.**

Table 4.15 Multiple regression coefficients of contributing factors related to the farmers' food stock ability

Dimension	Independent variables	B	*p*	R^2	Adj. R^2	F	*p*
Farmers' food stock ability	Age	0.454	0.472	0.368	0.325	17.362	0.016*
	Level of education	0.606	0.041*				
	Family size	-2.010	0.653				
	Effective farm size	1.356	0.065				
	Number of earning members	1.694	0.007**				
	Farmer`s daily wage value	0.027	0.012*				
	Economic status	0.089	0.028*				
	Body Mass Index (BMI)	0.888	0.000**				
	Agricultural extension media contact	0.947	0.587				
	knowledge on food security	0.337	0.009**				

** Significant at $p < 0.01$;

* Significant at $p < 0.05$

Table 4.15 shows that there is a significant contribution of respondents' level of education, number of earning members, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security to change their food stock ability status. Of these, number of earning members, Body Mass Index (BMI) and knowledge on food security were the most important contributing factors (significant at the 1% level of significance). Level of education, farmer`s daily wage value and economic status were also

the important contributing factors (significant at 5% while coefficients of other selected variables don't have any contribution on food stock ability.

36.8% (R^2 = 0.368) of the variation in the respondents changed food stock ability can be attributed to their level of education, number of earning members, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security, making this an excellent model (see Table 4.15). The F value indicates that the model is significant ($p<0.016$).

However, each predictor may explain some of the variance in respondents' food stock ability conditions simply by chance. The adjusted R-square value penalizes the addition of extraneous predictors in the model, but values of 0.325 still show that the variance in respondents' food stock ability can be attributed to the predictor variables rather than by chance, and that both are suitable models (Table 4.15). In summary, the models suggest that the respective authority should consider their recipients' level of education, number of earning members, farmer`s daily wage value, economic status, Body Mass Index (BMI), knowledge on food security.

Table 4.16 Multiple regression coefficients of contributing factors related to the farmers' nutritional security status

Dimension	Independent variables	B	*p*	R^2	Adj. R^2	F	*p*
Farmers' nutritional security status	Age	0.071	0.194	0.466	0.431	21.450	0.000**
	Level of education	0.036	0.012*				
	Family size	-0.286	0.457				
	Effective farm size	0.583	0.225				
	Number of earning members	0.411	0.437				
	Farmer`s daily wage value	0.001	0.045*				
	Economic status	0.068	0.009**				
	Body Mass Index (BMI)	0.009	0.037*				
	Agricultural extension media contact	0.030	0.843				
	knowledge on food security	0.096	0.005**				

** Significant at $p < 0.01$;

* Significant at $p < 0.05$

Table 4.16 shows that there is a significant contribution of respondents' level of education, farmer`s daily wage value, economic status, Body Mass Index (BMI), knowledge on food security to change their nutritional security status. Of these, economic status and knowledge on food security were the most important contributing factors (significant at the 1% level of significance). Level of education, farmer`s daily wage value and Body Mass Index (BMI) were also the important contributing factors (significant at the 5% while

coefficients of other selected variables don't have any contribution on nutritional security.

46.6% (R^2 = 0.466) of the variation in the respondents changed nutritional security can be attributed to their level of education, farmer`s daily wage value, economic status, Body Mass Index (BMI), knowledge on food security, making this an excellent model (see Table 4.16). The F value indicates that the model is significant ($p<0.016$).

However, each predictor may explain some of the variance in respondents' nutritional security conditions simply by chance. The adjusted R-square value penalizes the addition of extraneous predictors in the model, but values of 0.431 still show that the variance in respondents' nutritional security can be attributed to the predictor variables rather than by chance, and that both are suitable models (Table 4.16). In summary, the models suggest that the respective authority should consider their recipients' level of education, farmer`s daily wage value, economic status, Body Mass Index (BMI), knowledge on food security.

Table 4.17 Multiple regression coefficients of contributing factors related to the farmers' food security status

Dependent variable	Independent variables	B	*p*	R^2	Adj. R^2	F	*p*
Farmers' food security status	Age	0.419	0.398	0.497	0.471	31.587	0.003**
	Level of education	1.425	0.039*				
	Family size	-1.176	0.536				
	Effective farm size	2.891	0.047*				
	Number of earning members	3.362	0.631				
	Farmer`s daily wage value	0.137	0.006**				
	Economic status	0.125	0.001**				
	Body Mass Index (BMI)	1.273	0.003**				
	Agricultural extension media contact	0.856	0.439				
	knowledge on food security	0.536	0.027*				

** Significant at $p < 0.01$;

* Significant at $p < 0.05$

Table 4.17 shows that there is a significant contribution of respondents' level of education, effective farm size, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security to change their food security status. Of these, farmer`s daily wage value, economic status and Body Mass Index (BMI) were the most important contributing factors (significant at the 1% level of significance). Level of education, level of education, effective farm size and knowledge on food security were also the important contributing

factors (significant at the 5% level of significance while coefficients of other selected variables don't have any contribution on food security.

49.7% (R^2 = 0.497) of the variation in the respondents changed food security can be attributed to their education, effective farm size, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security, making this an excellent model (see Table 4.17). The F value indicates that the model is significant ($p<0.008$).

However, each predictor may explain some of the variance in respondents' food security conditions simply by chance. The adjusted R-square value penalizes the addition of extraneous predictors in the model, but values of 0.471 still show that the variance in respondents' food security can be attributed to the predictor variables rather than by chance, and that both are suitable models (Table 4.17). In summary, the models suggest that the respective authority should consider their recipients' education, effective farm size, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security**.**

4.4 Problem Faced in Achieving Food Security

4.4.1 Problem faced by farmers

The purpose of this section was to find out the problem faced by the farmers in achieving food security. Respondent were asked to mention the problems they faced. Problem faced by the farmers in achieving food security were identified and also determine its extent as severe, medium, low, very low and not at all. The observed score of the problems faced by the farmers in achieving household food security ranged from 21 to 38 against a possible of 0 to 48. Data presented in table 4.18 show that mean and standard deviation of this score was 29.56 and 4.38, respectively. Among the farmers, majority (53.7%) of them faced medium level, 22.3 percent of them faced low level and 24.0 percent faced severe level of problems in achieving household food security.

Table 4.18 Problem faced by farmers in achieving food security

Category	Range		Farmers		Mean	SD
	Score	Observed	Number	Percent		
Low problem	≤25	21-38	27	22.3	29.56	4.38
Medium problem	26-33		65	53.7		
High problem	≥34		29	24.0		
Total			121	100		

The range and standard deviation of the scores were small. This means that almost all of the farmers faced similar problems to similar extent. This was might be due to the similar socio-economic background of the farmers.

4.4.2 Problem Facing Index (PFI) along with rank order

The extent of problems faced by the farmers in achieving household food security in terms of Problem Facing Index (PFI) along with their rank order based on the PFI values have been presented in table 4.19. Data furnished in the table indicate that the problem which ranked first was ‘less market value of produced crops’ followed by second ranked ‘high price of food items’ and third ranked ‘lack of good quality seed’. ‘Flood’ was the least important problem among those faced by the farmers in achieving household food security.

The problems faced by farmers in achieving food security according to descending order through the analysis of the received data from farmers are less market value of produced crops, high price of food items, lack of good quality seed, lack of improved breed of cattle and poultry, high cost of production, natural calamities, insufficient credit support, lack of income generating activities, declining soil fertility, weak marketing facilities, poor storage facilities, flood respectively.

Table 4.19 Ranking of problems according to descending order

Sl. No.	Problems	PFI	Rank Order
1	Less market value of produced crops	386	1st
2	High price of food items	367	2nd
3	Lack of good quality seed	355	3rd
4	Lack of improved breed of cattle and poultry	315	4th
5	High cost of production	309	5th
6	Natural calamities	301	6th
7	Insufficient credit support	298	7th
8	Lack of income generating activities	282	8th
9	Declining soil fertility	268	9th
10	Weak marketing facilities	256	10th
11	Poor storage facilities	246	11th
12	Flood	194	12th

The result shows that the highest problem faced by farmers in achieving food security is less market value of produced crops. This is caused due to weakness of the supply chain found in the study area. The lowest cause in achieving food security at the study area is flood. This happens because the flood had not flourished for the last several years in the study area.

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents summary of major findings, conclusions and recommendations of the study.

5.1 Summary of Findings

5.1.1 Selected characteristics of the farmers

Findings in respect of the 10 selected characteristics of the farmers are summarized below:

- **Age**

The researcher found that 7.4 percent of the respondents were young, 87.6 percent were middle aged and the rest 5.0 percent were old.

- **Education**

The highest proportions (64.5 percent) of the farmers were found to be under secondary education category and 6.6 percent of the farmers can't read & write. On the other hand, only 21.5 percent of farmers had primary and no farmers were higher secondary level of education respectively. Only 7.4 percent farmers found who can sign only.

- **Family size**

The medium size family constituted the highest proportion (75.2 percent) followed by the small size family (13.2 percent). Only 11.6 percent farmers had large family size.

- **Farm size**

The researcher found that 73.6percent of the farmers had small farm size while 21.5 percent of the farmers were the medium farm and landless, marginal farm size category constituted by 2.5 percent farmers.

- **Number of earning members**

The low category of earning member family constituted the highest proportion (61.2 percent) followed by the medium category of earning member family (36.4 percent). Only 2.5 percent farmers were high category of earning member family.

- **Farmer`s daily wage value**

The farmers having medium daily wage constituted the highest proportion (76.9 percent), while the lowest proportion in low income (10.7 percent) followed by high income (12.4 percent).

- **Economic status**

The farmers having medium economic status constituted the highest proportion (71.1 percent), while the lowest proportion in low economic status (13.2 percent) followed by economic status (15.7 percent).

- **Body Mass Index (BMI)**

The highest proportion (63.6 percent) of the farmers had normal weight compared to 18.2 percent in underweight and overweight. No farmers were found in obesity category.

- **Agricultural extension media contact**

The highest proportion (52.9 %) of the farmers had medium agricultural extension contact as compared to 28.9 percent of them having less agricultural extension contact and 18.2 percent fell in high extension contact.

- **Knowledge on food security**

Food security knowledge scores of the farmers ranged from 5 to 15 where the average score and standard deviation were 8.09 and 2.41, respectively. 66.1 percent of the farmers had medium food security knowledge, 12.4 percent had low knowledge and 21.5 percent had high knowledge on food security.

5.1.2 Food security status of the farmers

- **Food availability**

The respondents having medium food availability (66.9 %) was higher than low food availability (21.5 %) and high food availability (11.6%).

- **Food stock ability**

The respondents having medium food stock ability (55.4%) was higher than low food stock ability (23.1%) and high food stock ability (21.5%).

- **Nutritional security**

The respondents having medium nutritional security (55.4%) was higher than high nutritional security (23.1%) and low nutritional security (21.5%).

5.1.3 Contribution of the selected characteristics of the respondents

- There was a significant contribution of the farmer level of education, family size, effective farm size, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security to change in food availability status through which 53.8% (R^2 = 0.538) of the variation attributed.

- There was a significant contribution of the farmer level of education, number of earning members, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security to change in food stock ability status through which 36.8% (R^2 = 0.368) of the variation attributed.

- There was a significant contribution of the farmer level of education, farmer`s daily wage value, economic status, Body Mass Index (BMI), knowledge on food security to change in nutritional security status through which 46.6% (R^2 = 0.466) of the variation attributed.

- There was a significant contribution of the farmer level of education, effective farm size, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security to change in food security status through which 49.7% (R^2 = 0.497) of the variation attributed.

5.1.4 Problem faced in achieving food security

- **Problem faced**

Among the farmers, majority (53.7%) of them faced medium level, 22.3 percent of them faced low level and 24.0 percent faced severe level of problems in achieving household food security.

- **Problem Facing Index (PFI)**

The problem which ranked first was ‘less market value of produced crops’ and ‘Flood’ was the least important problem among those faced by the farmers in achieving household food security.

5.2 Conclusions

Findings of the study enabled the researcher to formulate the following:

- Findings reveal that respondents having medium food availability (66.9 %) was higher and high food availability (11.6%) category constituted the by lower number of farmers.

- Findings reveal that the respondents having medium food stock ability (55.4%) was higher and 21.5% (lower) farmers were high food stock ability.

- Findings reveal that he respondents having medium nutritional security (55.4 %) was higher and low nutritional security was constituted by 21.5% (lower) farmers.
- Findings reveal that the farmers level of education, family size, effective farm size, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security to change in food availability of the farmers. It may be concluded that the food availability is likely to be influenced by the farmers` level of education, family size, effective farm size, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security to achieve food security.
- Findings indicate that the farmers level of education, number of earning members, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security to change in food stock ability of the farmers. It may be concluded that the food stock ability is likely to be influenced by the farmers` level of education, number of earning members, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security to achieve food security.
- Findings show that the farmers level of education, farmer`s daily wage value, economic status, Body Mass Index (BMI), knowledge on food security to change in nutritional security of the farmers. It may be concluded that the nutritional security is likely to be influenced by the farmers` level of education, farmer`s daily wage value, economic status, Body Mass Index (BMI), knowledge on food security.
- Findings reveal that the farmers level of education, effective farm size, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security to change in food security status of the farmers. It may be concluded that the food security is likely to be influenced by the farmers` level of education, effective farm size, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security.

5.3 Recommendations

5.3.1 Recommendations for policy implications

On the basis of the findings and conclusion of the research some recommendations have been formulated. These are following-

- The study indicated that most of the farmers enabled them to their food security as medium category in aspect food security dimension. To uplift their food security condition, the government should take more initiatives through increasing awareness of the farmers about convenience of the food security so that they can lead their life safely from adverse future effect.
- The findings of the research indicate that the different indicators of food security including the dimensions of the food security were attributed to the farmers` level of education, family size, effective farm size, farmer`s daily wage value, economic status, Body Mass Index (BMI) and knowledge on food security. It may be recommended that the government should consider the farmers` mentioned characteristics during providing any program or training for the farmers.
- The research findings indicate that the level of education, knowledge on food security had significant contribution to the food security status of the farmers. It may be recommended that the government along with NGOs should provide educational facilities to the farmers of villages so that they can get more knowledge on food security to uplift their food security status.
- The research findings indicate that farmers` family size, effective farm size had significant contribution to the food security status of the farmers. It may be recommended that the government should considered these characteristics during providing any program so that they can get the opportunities to promote their food security status.
- The research findings indicate that farmer`s daily wage value, Body Mass Index (BMI), economic status of the farmers had significant contribution of the farmers. So, it may be recommended that the government should

arrange more training through different GO & NGO organization such as Department of Agricultural Extension (DAE) on improving the income generating activities, so that all farmers can get the facilities to apply their knowledge to increase their income generating activities with a view to achieving improved food security status.

5.3.2 Recommendations for further study

- The present research was undertaken in the Kazipur union of Gangni upazila of Meherpur district. The findings of the study are needed to be tested in the other areas of the country
- The present research was undertaken to measure the food security status of the farmers. Further research should be conducted to assess the effect of food security on livelihood.
- Contribution of only ten selected characteristics of the respondents to the food security status was examined. It may be recommended for further research to examine the contribution of other socio-economic characteristics of the farmers to the food security status.
- This study was conducted at 8% precision level of the population. It would be conducted at 5% precision level of the population for the better output.
- The present study was included three dimensions of food security. There is also various another dimension by food security can measure. Further research may be conducted by considering another dimension of food security.
- The present study was included three dimensions of food security. There are various another dimension by food security can measure. Further research may be conducted by considering another dimension of food security.

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Appendix-I

ENGLISH VERSION OF THE INTERVIEW SCHEDULE

Department of Agricultural Extension and Information System

Sher-e-Bangla Agricultural University
Dhaka-1207

An Interview Schedule for the Study Entitled

FARMERS' FOOD SECURITY STATUS IN BANGLADESH

Name of the respondent: …… Serial No: ……

Village: ……...

Union: ……..……..

(Please provide following information. Your information will be kept confidential and will be used for research purpose only)

1.

1. 1 Age: How old are you? _____years.

1.2 Level of Education: Please mention your level of education.

a) I can't read and write ☐

b) I can sign only ☐

c) I have passed…….class.

d) I took _____ years non-formal education.

1.3 Family Size

How many members are there in your household including you? .....

1**.4 Effective Farm Size**

What is your total farm size according to use?

Sl. No.	Use of land	Land possession	
		Local unit	Hectare
1.	Homestead area (A_1)		
2.	Own land own cultivation (A_2)		
3.	Land takenfrom others on borga system(A_3)		
4.	Land given to others on borga system (A_4)		
5.	Land taken from others on lease (A_5)		
Total			

Total farm size = $A_1 + A_2 + 1/2 (A_3 + A_4) + A_5$

1.5 Number of Earning Members:

How many earning members do you have?.....

1.6 Farmer`s Daily Wage Value:

Usually how much do you earn daily?.....Tk

1.7 Economic Status

a) Annual family income

Mention your annual family income from the following sources

Income sources			Income in '000' Tk.
A.	Agricultural sources		
1)	Crop		
2)	Livestock		
3)	Poultry		
4)	Fisheries		
B.	Non-Agricultural sources		
i)	Business		
ii)	Job		
iii)	Laborer		
iv)	Others		
Total Income:			

b) Annual Household Expenditure:

Please mention your annual family expenditure.

Items	Expenditure in `000` Tk
Food	
Clothing	
Housing	
Education	
Health	
Transport	
Religious functions	
Crop production	
Poultry and livestock rearing	
Taxes	
Others, if any	
Total Expenditure	

1.8 Body Mass Index (BMI)

Sl. No	Person`s weight (kg)	Person`s Height (m)	BMI= Person`s Weight (kg)/ Person`s Height (m^2)
1.			

1.9 Agricultural Extension Media Contact

Please state the extent of your contact with the following ones

Sl. No.	Name of Information Sources	Extent of contact			
		Frequently (3)	Sometimes (2)	Rarely (1)	Not at all (0)
1.	Ideal farmer	6 or more times/3months	4-5 times/3 months	1-3 times/3 months	
2.	Fertilizer dealer	8 or more times/3 months	4-7 times/3 months	1-3 times/3 months	
3.	Insecticide dealer	8 or more times/3 months	4-7 times/3 months	1-3 times/3 months	
4.	Seed dealer	8 or more times/3 months	4-7 times/3 months	1-3 times/3 months	
5.	Poultry feed dealer	8 or more times/3 months	4-7 times/3 months	1-3 times/3 months	
6.	Fish feed dealer	8 or more times/3 months	4-7 times/3 months	1-3 times/3 months	
7.	Watching Agricultural Programs through TV channel	8 or more times/3 months	4-7 times/3 months	1-3 times/3 months	
8.	Agricultural magazine, poster, leaflet etc.	8 or more times/3 months	4-7 times/3months	1-3 times/3 months	
9.	Sub Assistant Agricultural Officer	8 or more times/3 months	4-7 times/3 months	1-3 times/3 months	
Total					

1.10 Knowledge on Food Security

Sl. No.	Questions	Assigned Mark	Obtain Mark
1	What is food security?	2	
2.	What is the relation between education and food security?	2	
3.	How can we achieve food security?	2	
4.	What are the benefits of achieving food security?	2	
5.	How can food security fulfill your nutritional status?	2	
6.	How does food security develop your family status?	2	
7.	What is the role of food security in achieving a developed country?	2	
8.	What is your present condition of food security?	2	
9.	What are the major constraints of achieving food security?	2	
10.	What are the solutions of food security problem?	2	

2. Food Security Status

2.1 Food availability

Sl. No.	Type of food	Availability of Food				
		More Available (5)	Sufficient (4)	Less than Sufficient (3)	Less Available (2)	Always with Shortage (1)
1.	Cereal					
2.	Vegetables					
3.	Meat					
4.	Fish					
5.	Fruits					

2.2 Food stock ability

How many meals do you have in your stock?

Sl. No.	Time period	No. of Meals
1.	Up to one day (up to 3 meals)	
2.	Up to one week (4 to 21 meals)	
3.	Up to one month (22 to 90 meals)	
4.	More than one month (>90 meals)	

Score 1 of each meal stock ability

2.3Nutritional security

Sl. No.	Name of Meal	Nutrition Value (Cal/K.Cal)
1.	Breakfast	
2.	Lunch	
3.	Supper/dinner	
4.	Others (if any)	

Score 1 for each 100 Cal nutrition consumption ability per head per day

3. Problems Faced by the Farmers in Achieving Food Security

Please mention the extent of problems you face in achieving food security.

Sl. No.	Constraints	Extent of constraints				
		Severe (4)	Medium (3)	Low (2)	Very Low (1)	Not at all (0)
1.	High price of food items					
2.	Lack of income generating activities					
3.	Flood					
4.	Insufficient credit support					
5.	High cost of production					
6.	Less market value of produced crops					
7.	Lack of improved breed of cattle and poultry					
8.	Declining soil fertility					
9.	Poor storage facilities					
10.	Weak marketing facilities					
11.	Lack of good quality seed					
12.	Natural calamities					

Thank you for your kind co-operation.

Date: ……

(Signature of the interviewer)