

# Food Security in Rural Bangladesh: Examining the Role of Women's Earnings and Food Budget Control

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**Abstract** Household food security is vital to measure of a country's advancement and well-being. Three mostly usage determinants to measure household food security are per capita daily calorie availability, dietary diversity, and individuals body mass index (BMI) scores. Food security condition in rural Bangladesh is vulnerable due to poverty, unavailability and high prices of food. Almost every year food price is increasing in Bangladesh due to the low level of production, improper market management and fraud business syndicate from some top traders. In Bangladesh, food production is affected by natural calamities such as the flood in monsoon period. Rice is considering as the leading food and dominating 70% of total calorie intake in rural Bangladesh. Rural inhabitants are consuming protein and micronutrient-rich food very infrequent. The main barriers to decrease the malnutrition rate are a lack of access to protein and micronutrient rich foods and inappropriate health services. Women and children are the primary targets of ensuring nutrition security in developing worlds. However, in rural Bangladesh, in practice, both women and children are getting fewer privileges regarding food consumption and health facilitates. The main objective of this paper is to examine the role of women's earnings and food budget control. Very authentic, recognized and useful datasets are needed to get the precise insights and information about food security condition and the role of women in food security in the rural Bangladesh. Bangladesh Integrated Household Survey 2011-12 datasets are used for this study. Regression method is used to analyze the research objectives. This paper found that women control over food budget has positive roles to ensure food availability in the house and more dietary diversity. However, the BMI scores indicate that rural people are heavily under-weight and under-nutrition.

**Keywords:** *food security, women earnings, food budget, food availability, dietary diversity, food utilization*

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## 1. Introduction

### 1.1. Background

Bangladesh is one of the low-middle income and populated countries in the world. According to the report of World Bank in 2015 the per capita, Gross Domestic Production (GDP) was 12,11\$ in Bangladesh. The majority number of population is living in rural areas where less income, food deficit, and malnutrition are common problems. In 2015, Food and Agriculture Organization (FAO) reported over 159 million inhabitants in Bangladesh, where 67.5% populations are living in rural areas. In rural Bangladesh, female have low socioeconomic status, and a male child is treated as an economic asset [1]. The large number of population means the large number of households. In 2011 there was 32,067,700 Number of families in Bangladesh, and the number of average persons per household was 4.4. Rural women traditionally play the central role to manage households beyond agriculture and non-agriculture activities. They prepare and process all types of food for the family, and take care household members particularly

children and elders. The participation of women in mainstream economics activities is increasing significantly. A project was launched in 1993 under the name of "NGO Gardening and Nutrition Education Surveillance Project" which called NGNESP aimed at encouraging poor citizens to start homestead gardening through which they are producing vegetables in each season of the year. Poor women are the central target in this program. This program covered more than 860,000 households in Bangladesh by February 2000 [2].

FAO reported that 80% energy consumption derives from cereals, roots, and tubers. Interestingly, only 10 gm./capita/day average supply of protein derived from animal origin. In 2011 the average quantity of protein was 55 gm./capita/day, and in 2013 the average dietary energy supply was 2450 kcal/capita/day. The consumption deficit of micronutrient-rich foods has the large effect on nutritional status in Bangladesh. FAO statistical report also shows that in Bangladesh in 2015, the depth of food deficit was 116 kcal/capita/day and 26.3 million peoples were undernourished, which was 16.4% of total population. In 2007, children under five years of age 43.2% stunted, 17.5% affected by wasting and, 41.3% were underweight [3].

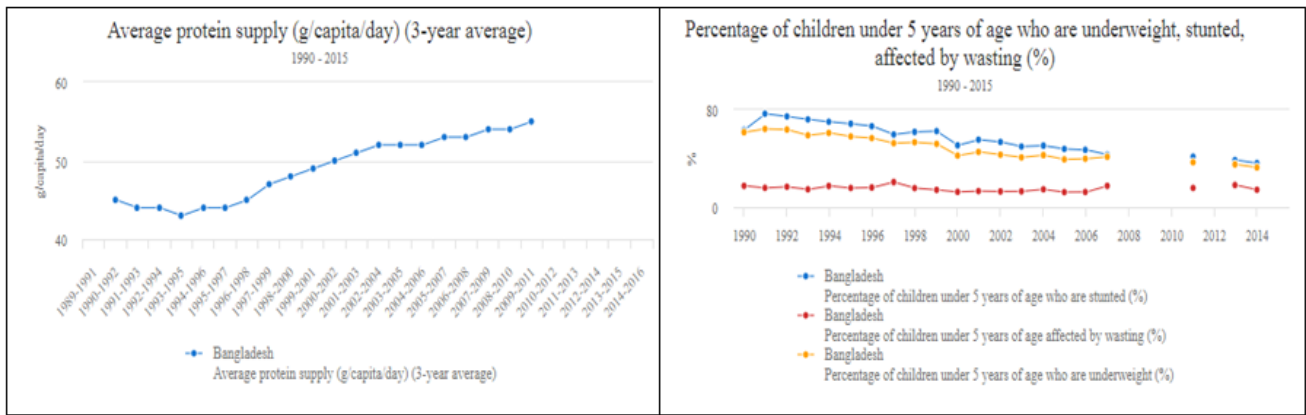


Figure 1. Average protein supply & the percentage of underweight, stunted and wasted children (Source: FAOSTAT, 2017)

## 1.2. Research Problem

Poverty and food insecurity issues are united with each other. As mentioned in the previous section, in the rural Bangladesh food deficit in daily consumption and undernourishment are common problems, around 160 million people can't afford required diet due to poverty. Bangladesh holds the third largest poor population after China and India, the number of hungry people is over 60 million and half of the children in Bangladesh are underweight [4]. Despite limitations women in the rural Bangladesh are playing a magic role to improve food security condition through participation in economic activities [5]. The number of current studies focused on women's empowerment, and women's employment in various sectors and found that household food security condition increases with increase of women's empowerment scores [1]. However, there is no study in rural Bangladesh to test the induction of women's earnings, and their controlling over food budget. Regarding the food security in rural Bangladesh, the primary objective of this study is to examine the role of women's earnings and control over food budget.

## 1.3. Research Objectives

Household food security consists mainly three components: food availability, food accessibility, and utilization of food. Food availability means interruption free supplies of food and food accessibility implies to both ways of physical and economic access to food. The utilization of food relates to the betterment of food allow for individual health conditions including nutrients absorption [6,7,8,9]. The primary objective of this study is to examine the role of women's earnings and food budget control regarding food security in rural Bangladesh. In brief women's food budget control means women's handling, deciding and, maintaining in the household food budget. Some sub-research objectives identified to attain this goal.

- To discuss the food security scenario in rural Bangladesh.
- To identify the role of wage earners women and their control over food budget on food security in rural Bangladesh.
- To examine the three principal instruments of food security: subjective ratings of food availability, per capita food frequency and body mass index (BMI)

regarding women's earnings and control over food budget.

## 2. Food Security Concept and Practices in Rural Bangladesh

Food security means "access by all people at all times to enough food needed for an active and healthy life" [10]. The "food security" concept has evolved since 1974 in the World Food Conference. Since this conference, this concept has developed, spread out and diversified [8]. "World Food Summit, 1996: Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life". World Food Summit in 1996 has triggered developing countries to deliver efforts to strengthen food security through proper measurement of periodic food production, consumption and nutritional status [7].

Researchers argue that food security has different meanings between national and individual level. At the individual level, food security means that individual has access to the food what he/she needs from anywhere. At the national level, it means the sufficient stocks of food in the country to fulfill domestic demand. In Bangladesh, the meaning of food security treated as a synonymous with sufficient rice production and stabilization of rice prices. Since past few decades, Bangladesh has achieved remarkable progress to increase rice production through research and technological development. However, other food production still not increase in the same number as rice. That's why nutritional intake has remained quiet [11].

According to the report of Ministry of Food and Disaster Management and World Food Programme in Bangladesh, overall food security situation in Bangladesh is improving in large-scale in food availability section, but other means of food security such as food accessibility and food utilization are growing in small-scale. The government, donor countries, civil society and local media are trying to renew their policies and efforts to make this improvement more sustainable [4]. Since the last decade, Bangladesh is observed slow improvement in food utilization and some socioeconomic areas such as lower level of infant mortality, higher child immunization rates, life expectancy ratio, access to pure drinking water and agricultural land use [11].

Mainly cereals production is the leading agriculture production in Bangladesh. For the first time in 1990s, Bangladesh had gained adequate food production when food grain production exceeded its target and it was 454 gm./person/day. In cereal production, Bangladesh has observed a silent revolution due to the seasonal composition of production, particularly in rice production [11]. FAO's statistical report has described that in 2014 main agricultural production kinds of cereal were harvested in 12,073,173 hectare areas. The total yield of cereals was 46,184 hg./hectare and the total production of cereals was 55,758,786 tonnes. In 2013 the value of total agriculture production was 17343.5\$ million within this the value of cereals production was 10993.5\$ million [3].

In rural Bangladesh, rice is the primary source to reduce hunger and counting as the regular item of the diet. Rural peoples used to eat boiled rice three times in a day and urban areas at least twice daily. Household expenditure survey 2000, found that poor rural people are spent almost 70% of their income on food and 35% spending of food only is used to buy rice. In spite of this favorable rice production, Bangladesh still needs to import rice to cope up with unexpected deficit situation due to frequent floods and droughts. As a resource-scarce country it's difficult to make viable of her progress in food grain production due to growing pressure on population and natural disasters [11].

The issue of improving food security condition is the primary concern of the Government of Bangladesh. The government gives priority to increasing agricultural production besides nutritional security. Since the past several decades, Bangladesh has experienced advances in food security. However, the country faces some stiff challenges in food security due to population growth, decreasing soil fertility, downing the water level, decreasing the agricultural land, increasing the frequency of natural calamity and so on. It has predicted that the population of Bangladesh to be 198 million in the year of 2050 and demand for food grains will be increased more than 50% in amount. Severally, cultivable land and coastal areas crop production may affect for sea level rising [12].

### 3: Materials and Methods

#### 3.1. Theoretical Framework

To investigate the household food security the demographic and economic characteristics should be considered. Food budget mainly depends on household size and composition. People who have congruent, reliable access to sufficient foods for a productive and healthy living treated as food secure. Low-income families apply a variety of coping strategies to meet their daily food needs [13]. Researchers were used the food security indicators called "the per capita calorie availability," "dietary diversity," "body mass index (BMI)," "household size," "household wealth," "educational level" and, "occupation category" to examine the food security condition in rural Bangladesh. The per capita calorie availability and dietary diversity are linked with each other. The more dietary diversity increases the per capita calorie availability. The large household size can enjoy the diet diversity because of more household members have more choices which forces to consume

foods variety. The BMI scores of individuals is a useful and standard measurement tool to measure the food utilization. Educational level and occupation categories are also significant determinants to measure the nutritional status. Higher educational attainment and higher pay scale profession of the household head increases the food security status of whole families [1].

"The certainty of the food supply" is one of the potential food security determinants, which is often ignored to examine food security status in developing countries [9]. The food security indicator "the sustainability of food production and consumption" is linked with "the certainty of food supply" and these ideas came from the notion of risks and vulnerability due to natural calamities and sudden crop failure [8]. Researchers have found that "the income level of the household" and "the purchasing power" means the ability of individuals to buy particular products and services are the most influential factors to ensure the accessibility to sufficient foods [13]. The strongest food security indicator is "the agriculture production" of a country, which is the largest source of food, nutrition and income. Country's agriculture production has direct influences on food prices and food availability [14]. Bangladesh is one of the top agriculture based countries in South Asia. The seasonal enough production of food also has an impact on food security and nutritional intake of individuals [15].

"The global warming effect" is a new determinant of household food security in Bangladesh because of low lying land [12]. Due to climate change, the frequency of cyclone and natural disasters are increasing in Bangladesh. The government of Bangladesh and some international organizations are used to provide incentives in disaster affected areas as a one of coping strategy during calamity period [16]. Researchers were found the diet and nutrition intervention programs in developing countries increase household food security [13]. Another essential food security indicator in the third world countries is "the women empowerment scores". Women work earnings and control over assets have the positive association with the household food security. Researchers found that higher women empowerment scores have an active relationship with the household food security [1]. Women work earning also provide access to credit, education, agricultural production and ultimately raises the household income level, which is necessary to ensure sufficient level of foods consumption [17]. A recent study in India had reported that educated women who have control over food budget have fewer chances to get food insecure than females who also have control over food budget but not educated [18].

These all determinants may not give an actual measurement of household food insecurity in developing countries. The concept of food security differs between developed countries and developing countries regarding perceptions, feelings, coping strategies and intra-household decision makings [9]. Mainly, two international institutions "International Food Policy Research Institute (IFPRI)" and "Food and Agriculture Organization (FAO)" are doing surveys and measuring household food insecurity in developing worlds to find out a sustainable solution to end hunger and malnutrition and to reduce poverty [3,19]. IFPRI's conceptual framework of food security considered

three primary determinants, food availability, food accessibility and food utilization (Akhter U. Ahmed et. al., 2013). FAO's food security policy considered one more determinant which named food stability [3].

### 3.1.1. Food Availability

Food production is an important factor to make food available in the house. On the early stage, the Bangladeshi policy makers have considered "food security" as "food self-sufficiency." The government had taken initiatives to increase food grains production; they subsidized on agriculture production to produce high-yielding crops such as rice and wheat through providing high standard seeds and fertilizers and extending the irrigation land. Rice is the primary food in Bangladesh, and it is yielding in everywhere almost 90% of total food grain production is rice. There is seasonal variation in rice production in Bangladesh. Three mostly consuming types of rice called *aus*, *aman* and *boro* are producing in different regions with seasonal variation. The second major cereal is wheat. But the production of wheat is less risky than rice because wheat is temperature-sensitive crop and production is flexible with climatic variability [12]. Nowadays, the potato is considering as a major crop in Bangladesh. Within South Asian countries, Bangladesh producing the maximum amount of potato and the average production cost is lower than rice. Potato contains the huge amount of vitamin C, essential minerals and well-known source of protein. High productivity crops like potato could be one option to increase agricultural production to face the feeding challenge which emerges from higher population growth [20].

Bangladesh has gained self-sufficiency in rice production, and the production is exceeded country's requirement, but the success in rice production is not sustainable due to increasing frequency of disasters such as flood, cyclone, sidr (a type of strong cyclone), etc. The strong cyclones and floods damaged crops almost every year [21]. Due to climate change effect to gain the national target regarding food security might become tougher [12] and due to this effect, Bangladesh loses 1% of agricultural land annually [4]. Food availability at the country level not only depends on the domestic production but also depends on the imports and the exports. Bangladesh only export shrimp within a lot of food items and the country mainly relies on imports of various kind of food items to meet the domestic demand. Now the volume of imports is very high for following food items: fruits, milk, oils, pulses, and sugar [11].

### 3.1.2. Food Accessibility

Amartya Sen explained that to define the food security the first important issue is the food accessibility rather than the food availability [22]. Food accessibility which means the country has enough both production and supply of farm and non-farm food and peoples have the income to consume both farm and non-farm food [6]. Individual per capita income may change individual per capita food grain consumption [12]. Individual demand also effect on food consumption frequency and dietary diversity. The dietary diversity needs for ensuring protein and, micronutrient-rich foods intake of household members through having a sufficient and diverse supply of nutritious foods throughout the year [23]. The dietary diversity of

households is going high when they are producing more food crops [1]. Two things are considered as driving forces of household food demand, one is the level of income, and the other one is the purchasing power which means the individual ability to buy certain products and services [24].

Rice, the first highest share of calories is consuming in the maximum amount by all income groups. Potatoes and vegetables, the second highest percentage of calories also consumed in large amount. The food items such as beef, chicken and various kinds of fruits are infrequently consumed and in the small amount. Cereals such as barley, maize, millet are rarely consumed across all income groups. Micronutrient and vitamin-rich foods such as fruits and protein-rich foods such as meat, poultry, dairy, eggs, lentils, beans are rarely consumed in poor rural households [6]. The high price of food in Bangladesh is considered as crisis situations of food stock and interpreted as a government failure regarding food security [11]. Also, food prices in rural areas have significant variances due to seasonal supply, production variation of food and, inadequate transportation system. Rice price doesn't influence the food energy availability, but it effects on the household dietary diversity [1]. The global price hike of rice has the damaging effect on Bangladesh's food security condition. The price of rice started to rise significantly since the year of 2004. During the price hiking period in 2008, poor rural people of Bangladesh especially slum dwellers were extensively affected. To buy rice poor people relied upon the 'open market sale' shops from government and other licensed subsidized rice sellers in local areas but those 'public food distribution schemes' weren't sufficient for all of them [25].

The natural disaster has the large effect on food consumption frequency and dietary diversity in Bangladesh. Researchers have found the shortfall of rice, vegetables, and many other foods after 1998 floods in Bangladesh. The study also reported that in November 1998 after seductive floods, there was 227 calories/person/day [26]. Though government provides incentives and sanctions subsidies on some selected food items such as rice, wheat flour, lentils and oil in flood and disaster affected areas but in a small amount. Poor households borrow rice from neighbors', work more than their ability to earn more, buy less and more cheaper food as a coping strategy during the food crisis session [25].

### 3.1.3. Food Utilization

In developing worlds, it's tough to understand the specific determinants that influence on nutritional intake and household food security. During the monsoon period due to less work, and less cultivation the household remains more food insecure than dry season. Researchers also found huge seasonal fluctuation in body measurement tools WHZ (weight for height z-score) [15]. In rural areas, the consumption of micronutrient foods such as meat and eggs are below than the desired level. The national level of the average calorie intake has improved impressively; however, the nutritional intake hasn't improved as much as it is expected. The majority rural inhabitants have micronutrient deficiencies [4]. Rural households mainly get 80% of calories from cereals. There is greater dietary imbalance existing in Bangladesh because of inadequate

domestic production of micronutrient-rich foods, for example, meat, milk, eggs, fruits, pulses and oil seeds [11].

The “Hellen Keller International,” an international non-government organization has been taking an initiative to increase and to ensure micronutrient-rich foods intake in poor rural households, especially among female members and children through homestead food production (HFP) programs. Micronutrient deficiencies are higher in these countries due to cereal-based diet regulation in daily routine, lack of the dietary diversity and, inadequate consumption of nutritious foods. As a strategy to get more micronutrient intake in daily feeding habit, homestead food production has positive effects in developing countries to increase household income and micronutrient-rich food consumption. The Hellen Keller International’s Homestead Food Production (HFP) programs in Asia has improved household food security through increasing year-round production of the number of varieties of micronutrient-rich foods. Researchers have found that homestead food production ensures higher diversity of consumption among family members. Household members can consume yellow fruits, green leafy vegetables, eggs, poultry meat, and beef from animal husbandry which contains sufficient amount of vitamin A and protein. After meeting the micronutrient requirements of family members, the rest of homestead production can be sold out in the market to increase household income and to buy additional food items. The 70% of households in rural Bangladesh have used income from homestead food production to buy more foods [23].

Malnutrition in Bangladesh is still common public health challenge. The low-income household gives more concentration on meeting core and nutritional needs from foods rather than taste from foods and chooses inexpensive sources of nutrients for example vegetables. A study based on slum dwellers in the capital city Dhaka reported that the poor households spend 127% of their income on food. The study also reported that 50% of respondents whose primary sources of earning are working as servants, security guards, and street vendors have below 18.5 body mass indexes (BMI) scores. This score is a clear indication of malnutrition and low level of food security status. In contrast, households, whose main income sources rely on agriculture and farming are less food insecure [25].

Food availability in rural households regarding calories doesn’t provide the guarantee of food security; to get the nutritional security families need to consider the quality of food [7]. Ordinary methods to introduce micronutrient malnutrition towards rural populations are dietary diversity strategies, nutrition education, food fortification, and supplementation. From those approaches, dietary diversity strategies are considered more viable because of its economic feasibility [27]. An important initiative has taken by the USAID including the government under the Feed the Future (FTF) program to deliver efforts and to give nutrition education towards rural inhabitants. This program has extra focus on women and children to ensure that women and next generation farmers have better agricultural information and nutrition education [6].

#### 3.1.4. Food Security Intervention

Bangladesh situated in a vulnerable geographical location. Natural disaster such as floods and cyclones are

widespread issues in Bangladesh. Frequent soil erosion also common in riverine Bangladesh. Bangladesh had launched two large food intervention programs to provide food security to the poor rural people one is Rural Rationing (RR) program, and another is Vulnerable Group Development (VGD) program. Later, in May 1992 RR program was abolished due to its poor performance. The VGD program performances are satisfactory, and the study found that individual beneficiaries get 19.4% additional income from this program [16]. The government always is feeding disaster affected people through VGD (vulnerable group development), VGF (Vulnerable group feeding), RMP (Rural Maintenance Program) and, other types of relief programs [11].

The Food for Education (FFE), the first ever innovative program in the world had launched by the Government of Bangladesh (GoB) in 1993 for considering the poor and undernourished condition of rural Bangladesh where half of the country’s people cannot afford the adequate diet. The main goal of FFE program is to deliver food resources such as rice or wheat through monthly rationing to rural low-income families in against of primary school enrollment of their children. Before FFE program, the GoB has conducted another program called *Palli* (village) rationing program, under that program, GoB distributed subsidized food towards 6.1 million rural households. Since its beginning, the FFE program has funded by the GoB, and this program is considered as one of the largest food distribution channels under country’s Public Food Distribution System (PFDS). Later 44% food aid for PFDS came from donor countries. The poor selected rural households were received 16 kilograms of rice or 20 kilograms of wheat per month as free ration under FFE program. Researchers have found the positive result from FFE program. The student enrollment ratio in FFE primary schools increased by 35%. And the beneficiaries of this program are consumed 10% extra calories than non-beneficiaries and, also the average nutritional intake was more than the nonbeneficiaries [28].

The government of Bangladesh has started implementing “Global Agriculture and Food Security Program” a \$52 million project to increase agricultural productivity through proper water management and new technology adoption. USAID is one the best partner of the government of Bangladesh to formulate policy, to take the initiative and to donate to the different food security development project. USAID-led worldwide initiative for food security called Feed the Future (FTF). This program aims to help children, vulnerable women, and rural farmers through disseminating nutrition information and reducing poverty and undernutrition and to strengthen the private sector, civil society, research institutions and multilateral agencies to intensify rice and micronutrient-rich foods production [6]. USAID uses the new technology and innovation to influence agricultural production. They dispatch the technical know-how to farmers and support researchers to develop different types of rice to maximize production. They also support farmers to increase incomes through connecting small firms to large and regional markets and encourage general peoples to consume nutritious food. In 2015, the USAID has helped 2.1 million Bangladeshi rural farmers to boost their production by adopting improved agricultural technologies and conducted

more than 12,600 demonstrations on high-yielding and flood-tolerant rice varieties and introducing new varieties of wheat and maize. Also, the USAID has provided training and promoted the use of high-quality fish and shrimp varieties and fingerlings, resulting in \$127 million in incremental sales of fish and shrimp [29].

### 3.1.5. Income Effect

The income effect means that the change in individual's purchasing power influence to change in individual's total quantities of consumption. The increase in purchasing power allows people to enjoy a higher level of utility than individuals consumed before. The income effect also changes the individual choices by individuals shift in purchasing power [30]. The personal level of income and food security and nutritional intake are vividly connected. Households, who have less money for per member to buy necessary amount of food are food insecure and poor people spend more on food sometimes more than their income [25].

In rural Bangladesh, where to earn money isn't easy for household head due to lack of credit, lack of education, lack of access to cultivable land and lower level of infrastructure. It's a significant opportunity to save money when female members or housemakers engage in financial activities to earn money. The average number of members in rural households is 4.4. Household heads need to deliver more effort to gain more money to feed these 4-5 family members. However, in the limited resource condition to dedicate effort from one isn't enough. Female work earnings help to improve the total household earnings and gain more and various kind of foods. According to the report from FAOSTAT in rural Bangladesh, 29.5% female-headed family living in absolute poverty line where it is 44% for male-headed family [3].

### 3.1.6. Women's Relative Economic Power

"Women's relative economic power is conceptualized regarding degrees of control of critical financial resources: income, property, and other means of production." When women's have the greater relative economic power, then they have the largest control over their own lives. Men considered as the primary earners and main food providers but "maternal altruism" ideology says that capable women also devote their income to feed their child and family. Another study in Bangladesh reported that women retain less for their expenses, but they like to control resources and income to take care of the children nutritional intake and to support the family in future [31].

Women ownership of assets and control over using of those assets have a positive effect on household food security. The IFPRI Researchers, Esha Sraboni et al. have used to WEAI method to diagnose the women empowerment gaps in five domains such as production, resources, income, leadership and, time. The study found that household food security could be improved, and economic advancement could become faster in rural Bangladesh through women empowerment [1]. The government of Bangladesh recalculated the rights and benefits of women and reformulated the Bangladesh Labor Act 2006. This law gives legal protection to vulnerable women regarding women rights and benefits in government and non-government working sectors [32].

Since the last decade the women participation in the agricultural sector is increasing. One study over poor landless farm laborers in India reported that female earnings are vital for family survival. Women lost control over income affects family well-being. Researchers collected data from three villages of South India and measured that women were contributed 92% of their income for household survival while men contributed 76% of their income [31].

## 3.2. Empirical Analysis

### 3.2.1. Sources of Data

In developing countries, national dietary surveys data are very scarce and results from published reports are not easy to access [33]. Domestic and International organization are collecting data to measure and analyze the socioeconomic condition. The IFPRI is one recognized and renowned institution, whose vision is to make the world free of hunger and zero level of malnutrition and mission is to provide research oriented policy solutions in developing countries to reduce poverty, hunger and, malnutrition in a sustainable way. The Bangladesh Integrated Household Survey called "BIHS" conducted by IFPRI researchers is the most comprehensive, efficient and, first nationally representative survey ever carried out in Bangladesh. In the year 2011-12, the first round of the BIHS survey took place [19], and these datasets are used for this study. This comprehensive and nationally representative survey was designed, supervised, and administered by the IFPRI. And this survey has collected data based on four major food insecurity related phenomena (1) agricultural production and practices of each household, (2) dietary consumption of each household members, (3) anthropometric (height and weight) measurements of each household members and, (4) women's empowerment data.

To determine the sample size of 6,503 in 325 primary sampling units (PSUs), the BIHS is used stratified sampling method, the total sample of 325 PSUs allocated among the eight previously defined strata including seven divisions of Bangladesh and one FTF zone. During the sampling process, IFPRI listed all 325 villages from eight strata (seven divisions and one FTF zone) and conducted the total census of 325 villages and then from each villages IFPRI randomly selected 20 households for the survey [6]. The scientific literature sources are used to develop research objectives and to derive more data. Furthermore, data from the Food and Agriculture Organization (FAO), United States Agency for International Development (USAID), Bangladesh Bureau of Statistics (BBS), Ministry of Food and Disaster Management of Bangladesh also used for this study.

### 3.2.2. Data Collection

A Bangladeshi research-based organization called the Data Analysis and Technical Assistance Limited (DATA) together with IFPRI conducting the survey named BIHS in both rounds. The IFPRI prepared questionnaires for respondents which divided into 27 modules with category based sub-modules. These inquiries reflect a complete and integrated data platform to analyze and to get the answer to various research questions regarding food insecurity in rural Bangladesh. Also, some new modules and

questionnaires are added in the second round of survey such as respondent's age at marriage. The first set of the database is used for this study [19].

All countries are using structured questionnaire via interviews to collect food security data, [7,23]. DATA enumerators have collected data by using IFPRI pre-defined and pre-selected questionnaire. The IFPRI has used four types of measurement scales: nominal, ordinal, interval and ratio scales to gather data. The structured interview was conducted with selected questionnaire which started in October 2011. The following required BIHS data: sample household and identification of male and female data, household composition data, employment data, food consumption data, anthropometry data, household food security data and women work earnings and expenses data collected from the *Harvard Dataverse* website.

Relevant and current scientific literature, discussion papers and, books are studied to derive theoretical and empirical basis regarding food security, the role of female earnings and the female control over food budget. *Google Scholar* is used as a platform to search relevant scientific literature.

### 3.2.3. Data Analyzing

Data analysis is performed in STATA. Multiple regression analysis used for this study to examine the role of women work earnings and control over food budget regarding food security in Bangladesh. Before doing multiple regression analysis, descriptive statistics of the subjective ratings of food unavailability data, the fourteen selected categories of food consumption frequencies data and, anthropometric data are measured to know the present food security scenario in rural Bangladesh. These help to form the basis of quantitative analysis of collected data. All these data haven't the equivalent number of observations. Household composition, employment and anthropometric data including all household members. The subjective ratings of food unavailability and the fourteen selected categories of food frequencies data including household numbers. Three dummy variables (women work earnings, women control over food budget, simultaneously women work earnings and control over food budget) are created from the data of women work earnings and expenses to perform regression. The last seven days household food consumption data used to get the consumption frequencies of the number of fourteen selected categories of food. These foods consumption frequencies data are used to conduct multiple linear regression to examine the role of women earnings and their control over food budget.

Multiple regression is performed to examine the role of three independent variables: women earnings, women control over food budget, and simultaneously women earnings & control over food budget which are classified separately into three alternative models. The multiple regression models expressed as:

The multiple regression equations are:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki} + U_i$$

Where  $Y$  is the dependent variables (the fourteen categories of foods consumption frequencies in the last seven days),  $\beta$  is a parameter,  $X$  represents the independent variables

(women earnings and control over food budget) and,  $u$  represents the net effect of unobservable factors. Forty-two times multiple regression are performed for fourteen categories of food consumption frequencies in the last seven days for three different models.

Multiple regression equations for this study looks like:

Model 1:

$$\begin{aligned} &\text{Food consumption frequency} \\ &= \beta_0 + \beta_1 \text{Women workearnings}_i + \beta_2 \text{Householdsize}_i \\ &+ \beta_3 \text{Per capita householdincome}_i \\ &+ \beta_4 \text{Educationallevel}_i + \beta_5 \text{Occupation}_i + \text{Errorterms}_i \end{aligned} \quad (1)$$

Model 2:

$$\begin{aligned} &\text{Food consumption frequency} \\ &= \beta_0 + \beta_1 \text{Women control over foodbudget}_i \\ &+ \beta_2 \text{Householdsize}_i + \beta_3 \text{Per capita householdincome}_i \\ &+ \beta_4 \text{Educationallevel}_i + \beta_5 \text{Occupation}_i + \text{Errorterms}_i \end{aligned} \quad (2)$$

Model 3:

$$\begin{aligned} &\text{Food consumption frequency} \\ &= \beta_0 + \beta_1 \text{Simultaneously women work earnings} \\ &\quad \text{and control over foodbudget}_i \\ &+ \beta_2 \text{Householdsize}_i + \beta_3 \text{Per capita householdincome}_i \\ &+ \beta_4 \text{Educationallevel}_i + \beta_5 \text{Occupation}_i + \text{Errorterms}_i \end{aligned} \quad (3)$$

Probit regression is used to model binary dependent variables: the subjective ratings of food unavailability. The subjective ratings data are collected including the response code *yes* and *no*, 1 for *yes* and 2 for *no*. Three more dummy variables (no food due to lack of resources to get food, go to sleep without food and, passing a day and night without food) are created to fit with probit regression model, where 1 represents *yes* and 0 accounts for *no* response. The probit model comprises that only the values of 0 and 1 can be observed for the outcome variable  $Y$ , there is a dormant continuous variable  $Y^*$  which determines the underlying latent tendency that  $Y=1$ .  $Y^*$  can illustrate as follows:

$$Y^* = \alpha + \beta X + \varepsilon$$

$$Y = \begin{cases} 1 & \text{if } Y^* > 0 \\ 0 & \text{otherwise} \end{cases}$$

Where  $Y$  represents the value of dependent variables (the subjective ratings of food unavailability) in observation,  $\alpha$  used as intercept,  $\beta$  is coefficient,  $x$  is independent variables (women work earnings and control over food budget) and,  $\varepsilon$  denotes error terms here.

The anthropometric measurement index is used to know about the food utilization and nutritional condition. An anthropometric index mainly shows the quantitative change in the human body to measure nutritional well-being. The anthropometric index is considering as a valid and useful method to measure the body mass index (BMI) of the individual level. The BMI scores of all household members are calculated to investigate the nutritional status [1]. The index of weight-for-age and height-for-age is known and widely used approach. One more variable is created by converting height measurement centimeter to

the meter to calculate the BMI. The BMI of male and female and BMI of age group under 18 and over 18 are separately illustrated. Also, adult BMI and child BMI, whose age below than 60 months are independently measured.

### 3.2.3.1. Dependent Variables

#### (a) Subjective ratings of food unavailability

The subjective ratings are used as a source of standardization of objective ratings and utilized for the different psychophysical model [34]. Three basic questionnaires related to food unavailability are asked respondents. And this is particularly necessary for developing countries like Bangladesh where most of the population are living in rural areas with the vulnerable economy and inadequate income.

#### (b) Household food consumption frequency

Food consumption frequencies reveal valuable information related to dietary preferences and quantities of food consumption. In this study, the fourteen categories of food items which are mostly consumed by the people of Bangladesh include rice, wheat flour, potatoes, beans, vegetables, fruits, meat, poultry, dairy, fish and, others considered to get food consumption frequencies. To get the dietary diversity of rural citizens seven days recall data collected of pre-selected food categories. Researchers found that in the lean season the average thirty-three types and maximum fifty-nine types of foods are consuming in Bangladesh [35].

#### (c) Body mass index (BMI)

One important issue regarding food security is to maintain a balance between the supply of food and nutritional quality of food [5]. Nowadays the BMI is a widely used method to know the food utilization of individuals. Protein and micronutrient-rich foods have a profound effect on individuals BMI scores. In Bangladesh, the maximum amount of dietary energy almost 80% derives from cereals [3]. In rural Bangladesh where malnutrition is an everyday affair, individual BMI is the most important food security indicator to measure.

### 3.2.3.2. Control Variables

#### (a) Household size

The family size has influences on household food security and children health care practices in developing countries like Bangladesh. It is assuming that family with large household size are less food secure [36]. There is also in contrast evidence that large household size has the possibility to gain more food secure status in developing countries [35]. In rural Bangladesh, the average household size is 4.6 which considered as medium household size.

#### (b) Per capita household income

The per capita household income has direct effects on food security. This study found that the per capita monthly income in rural Bangladesh is around \$15.30. The total income including women's earnings of each household was divided by the number of household members to calculate the per capita monthly income. But the homestead production which used to feed themselves doesn't included in the per capita income. The income of rural peoples in Bangladesh mostly depends on the farming activities, agricultural production and, small business. The rural populations have very less access to

the high-paying off-firm workings. To build sustainable rural economy off-firm income is essential.

#### (c) Educational level

Demographic characteristics of households have large influences on household food security condition. In rural Bangladesh, male members are more educated than female members and the maximum households are male-headed. This study is considered the educational level of household head. Household members, who have at least a degree certificate such as secondary school certificate, higher secondary school certificate, bachelor certificate, masters certificate or any other equivalent certificates considered as an educated person. Moreover, the education level of the head of household has the positive effect on the household dietary diversity and the calorie availability. Educated people have good chances to get a good job and to get sufficient wages than non-educated individuals. Education helps to close the knowledge gap regarding dietary and nutritional intake among community members [1]. This study considered the educational level of household heads whose have at least one-degree certificates.

#### (d) Occupation:

In rural Bangladesh, most of the inhabitants are working on the farm, and less amount of income generates from the non-farm sources. The main occupation of household heads considered for this study. Researchers have found that household heads are more potential wage earners than other members and male-headed households are comparatively more income than female-headed households [37].

### 3.2.3.3. Key Independent Variables

#### (a) Women earnings

Women work earnings have a large contribution to the family earnings. Decades before rural women's have less access to work beyond house in Bangladesh. Nowadays situations are going to change. In this survey, the rural women asked whether they are doing any business or work that in return brings in cash.

#### (b) Women control over food budget

Generally, in rural Bangladesh women have less mobility in the market, but women play a significant role in the food budget. Even though the mother isn't household head, but the mother is considering as a key person in the family. Especially, the mother is responsible for cooking, caring children and, doing others household works.

#### (c) Simultaneously women earnings and control over food budget

Women's at the same time who have both earnings and control over food budget. This study found that in rural Bangladesh, all wage earner's women haven't control over food budget. It is assuming that women who have both work earnings and control over food budget are more food secure.

## 3.3. Analyzing Model

Three different models are developed to measure the household food security in rural Bangladesh. Two separate regression analysis called *multiple linear regression* and, *probit regression* analysis performed for measuring these three different models. The four above mentioned control



variables are considered in the analysis of these three alternative models.

Model 1: Examining the role of women earnings in the household food security in the rural Bangladesh.

Model 2: Examining the role of women control over food budget in the household food security in the rural Bangladesh.

Model 3: Examining the role of simultaneously women earnings and control over food budget in the household food security in the rural Bangladesh.

## 4. Results

### 4.1. Descriptive Statistics

#### 4.1.1. Household Composition

Table 1 presents the summary statistics of household composition, including the observations, mean, and standard deviation, of respondent gender group, age,

education, and occupation. The summary statistics show that 6,503 households consist 27,285 members and the average household size is 4.6 close to the national counting. This study is found the largest household size is 16. The mean value of male members and female members are 0.48 and 0.52 respectively, and this ratio of male and female numbers is also close to the national ratio of male and female numbers. Summary statistics found the significant number of young and workable population in rural Bangladesh. The observations follow the minimum age 0 (whose age below complete one year) and maximum age 120 where the mean value for the population age group >18 and, the age group <18 are 0.57 and, 0.41 respectively. The statistics shows that the rural population has poor educational qualification. Almost half (41%) of the rural population are illiterate, 3.42% rural population has completed secondary school, and only 1.75% rural population has a higher secondary degree. The statistics also shows that the female aback than male in all kinds of educational level.

**Table 1. Description of household composition**

Variable Name	Definition	Obs.	Mean	Std. Dev.
Number of Females		27285	0.523	0.499
Household size		6503	4.597	2.083
Age		27285	26.581	19.897
Age group >18	HH members whose age >18	27285	0.572	0.494
Age group <18	HH members whose age <18	27285	0.412	0.492
Education				
No schooling	Members never attended school	27285	0.413	0.492
Degree holder	Household members who have minimum a degree certificate.	27285	0.034	0.182
Degree holder (male)		27285	0.019	0.137
Degree holder (female)		27285	0.015	0.122
Main Occupation				
Wage Labor	Who works as a day laborer	27285	0.04	0.195
Wage Labor (male)	Day laborer/worker (male)	27285	0.037	0.188
Wage Labor (female)	Day laborer/worker (female)	27285	0.003	0.054
Salaried Worker	Who work in Gov./NG service	27285	0.002	0.044
Salaried Worker (male)	Service holder (male)	27285	0.002	0.041
Salaried Worker (female)	Service holder (female)	27285	0.0003	0.017
Self-employment	Who doing small work	27285	0.012	0.108
Self-employment (male)	Small worker (male)	27285	0.012	0.108
Self-employment (female)	Small worker (female)	27285	0.00004	0.006
Trader	Who have business	27285	0.014	0.117
Trader (male)	Business holder (male)	27285	0.013	0.112
Trader (female)	Business holder (female)	27285	0.001	0.036
Production	Who have small industry	27285	0.00011	0.01
Production (male)	Small industry owner (male)	27285	0.00007	0.009
Production (female)	Small industry owner (female)	27285	0.00004	0.006
Farming	Farmer/fisherman/raising poultry, livestock	27285	0.066	0.248
Farming (male)	Farmer (male)	27285	0.064	0.245
Farming (female)	Farmer (female)	27285	0.002	0.044
Non-earning	Student, housewife, retired, child	27285	0.246	0.431
Non -earning (male)		27285	0.121	0.326
Non-earning (female)		27285	0.125	0.331

Statistics present that in rural areas people also are working in diversified sectors, and most of them are working in a firm or as a day laborer. Only a few number of peoples (0.19%) are government and non-government service holder who gets fixed salary after a month. The most number of rural peoples (6.60%) are farmers who are cultivating crops, raising poultry and livestock in the own firm or working in another firm through share cropping contract. The 24.60% of respondents have no earnings which include children, housewife, retired peoples, physically/mentally challenged and jobless. Significantly, women are lag behind in all of the occupation sectors than men.

#### 4.1.2. Subjective Ratings of Food Unavailability

The subjective ratings of food unavailability are useful to measure the performance of food production, work earnings and socioeconomic condition of rural villagers. Three questionnaires are used to measure the food unavailability in households. The first question is “there was no food to eat in the house due to lack of resources to get food”, the second question is “any household members go to sleep hungry because there wasn’t enough food to eat in the house” and, the third question is “any household members passing a whole day and night without eating food because there wasn’t enough food to eat in the house”. These three questions are related to the measurement of the absolute poverty level.

Table 2 presents the subjective ratings of food unavailability and frequency of unavailability of food in the house. Result indicates that to some extent the constant level of poverty still exists in rural Bangladesh. Within 6503 households, 9.72% households are told that in the past four weeks there was ever no any kind of food to eat in the house due to lack of resources to get food which was happened 1-2 times to 4% households, 3-10 times to 4.6% households and >10 times to 1.1% households. The 5.6% households are answered that some household members go to sleep at night hungry because there was not enough food to eat and 2.1% households are replied that some household

members pass a whole day and night without eating any kinds of food at all because there was not enough food.

The subjective ratings of food unavailability result indicate that food isn’t available and accessible for all rural people in Bangladesh. The reasons behind this condition are the large number of landless rural people have limited access to the cultivable land and low wages. Also, limited production, small infrastructure, high production cost, limited control over market management, and natural calamities are responsible for food unavailability in the house. There isn’t notable progress in agriculture production except rice in Bangladesh. Public and private traders import foods, but the market price of imported foods isn’t affordable to rural villagers. The government is gradually withdrawing subsidy, and this also affects the daily life of rural inhabitants in Bangladesh [11,26].

#### 4.1.3. Food Consumption Frequency

Figure 2 represents the fourteen categories of food consumption frequencies of households in the last seven days. Food items consumption such as wheat flour, rice, potato, cassava, roots, tubers, cereals, vegetables, fruits, beans, lentils, peas, eggs, dairy, meat, poultry, fish, oil, fats, nuts, and seeds considered in this study. All other food items except rice have minimum zero and maximum seven food frequencies; only rice has three minimum consumption frequencies. In Bangladesh, rural people are used to eat rice three times in a day, and the result shows that rice has the highest mean value.

Potato, cassava, roots, and tubers are used as co-food of rice in Bangladesh and used to eat with every meal. Oils and fats are used to process food and consume in almost every day. Wheat flour is used to make *ruti* (local bread), bread and noodles also are used as the alternative food of rice but mostly used to eat in urban areas than rural areas. Cereals food items such as maize, sorghum, millet, and barley are necessary food items for children, but these food items are most expensive in Bangladesh.

Table 2. The subjective ratings of food unavailability

Variable	Definition	Obs.	Mean	Std. Dev.
No food due to lack of resources to get food.	In the past four weeks, there was ever no food to eat of any kind in the house because the lack of resources to get food.	6503	0.097	0.296
No food to eat (rare)	This has happened 1-2 times	6503	0.039	0.196
No food to eat (sometimes)	This has happened 3-10 times	6503	0.046	0.209
No food to eat (often)	This has happened >10 times	6503	0.011	0.104
Go to sleep without having food.	In the past four weeks, any household member goes to sleep hungry because there was not enough food to eat.	6503	0.056	0.229
Go to sleep hungry (rare)	This has happened 1-2 times	6503	0.023	0.149
Go to sleep hungry (sometimes)	This has happened 3-10 times	6503	0.027	0.163
Go to sleep hungry (often)	This has happened >10 times	6503	0.006	0.076
Household members passing a day & night without food.	In the past four weeks, any household member goes a whole day night without eating food because there wasn’t enough food.	6503	0.021	0.144
Household members Passing day & night without food (rare)	This has happened 1-2 times	6503	0.01	0.103
Household members passing day & night without food (sometimes)	This has happened 3-10 times	6503	0.008	0.089
Household members passing day & night without food (often)	This has happened >10 times	6503	0.002	0.047

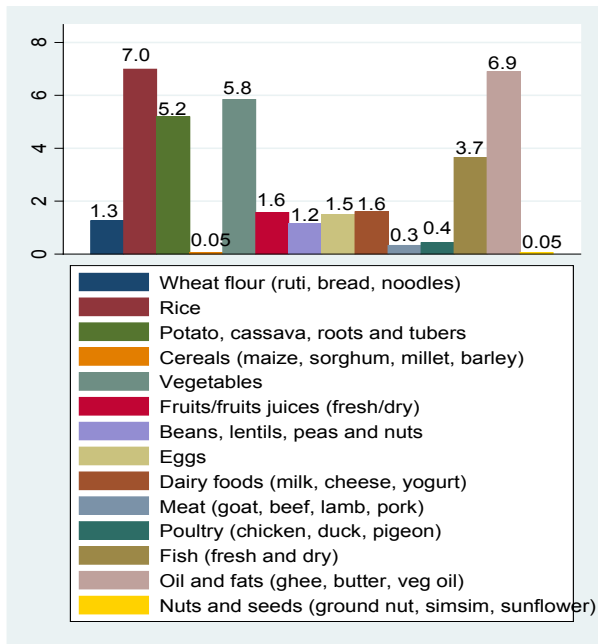


Figure 2. The food consumption frequency in a week

The intake of amino acids and protein-rich foods are very infrequent, but these are the most important for health maintenance. Protein and nutrition rich food items meat and poultry are available in the market, but the price of those food items is not affordable to the rural peoples. The protein-rich food item fish is considering one of the national food items and rural peoples consuming fish mostly than meat and poultry because of comparatively low price and availability. Also, the main occupation of some rural household heads is fishing. The micronutrient-rich food items fruits and fruits juice are very rare food items in daily food consumption of rural peoples and the fruits market in Bangladesh is mostly import dependent and costlier rather than other food items. Another most important protein-rich food items dairy foods such as milk, cheese, yogurt, etc. also not available in daily food consumption routine of the rural inhabitants.

The low production of non-cereal foods, low quality and the high price of foods are considered as the main reasons for the low-level nutritional and dietary intake in rural Bangladesh [32]. This result indicates that in the rural Bangladesh mainly diet constitutes based on rice. In the countryside, rice and vegetables are heavily consumed and fish is considered as the largest sources of protein. This study also supports that the overall energy intakes and

nutrient intakes aren't in satisfactory level except for rice.

#### 4.1.4. Anthropometric Measurement

Table 3 represents the anthropometric measurement of household members. Anthropometric measurement is one of the approaches to measure food security and to get the result of food utilization. The weight and height were measured of 22832 and 22781 household members respectively. Some household members were missing due to absent and sickness. The result shows that the average weight is 42.31 and the average height is 1.47 meter.

Body mass index (BMI), which is a good gauge of body fat and the weight-height relationship of human body and this is a well-established method for diagnosing overweight, underweight and obesity. Many researchers show a connection between individual BMI score and several diseases such high blood pressure, heart disease, female infertility, etc. Here, adult and child BMI are separately calculated of each household members. Also, adult BMI of male and female household members and household members of different age groups are measured separately to get a clear distinction.

The BMI scores from 18.5 kg/m<sup>2</sup> up to 25 kg/m<sup>2</sup> are considered optimal weight, scores lower than 18.5 kg/m<sup>2</sup> considered underweight and scores over 30kg/m<sup>2</sup> considered obese [38]. This study found that the adult BMI scores of male and female are 18.47 kg/m<sup>2</sup> and, 19.98 kg/m<sup>2</sup> respectively. The average adult BMI scores of the female are higher than the average BMI scores of male and over 18.5 kg/m<sup>2</sup>. All adult BMI average scores from different age groups are 18.8 kg/m<sup>2</sup>, which is close to underweight. The mean of child BMI scores is 15.14. The average of weight and height of children below 60 months are 10.25 kg and 0.82 meters respectively, and this is below than standard.

#### 4.1.5. Women Earnings and Expenses

The Table 4 below show the results that within 6,503 households, 58.80% women are working or doing business that brings in cash and allows them to accumulate assets for their household, 45.95% women have control over food budget and 31.49% women have simultaneously work earnings and control over food budget. The descriptive statistics depicts that the majority number of women have earnings than women, who have control over food budget. In rural Bangladesh, most of the women have less mobility in the market for shopping, but most of them manage the food budget.

Table 3. Anthropometric measurement of household members

	Variable	Definition	Obs.	Mean	Std. Dev.	Min	Max
Adult	Weight	Weight in kilogram	22832	42.302	14.183	8.8	98.9
	Height	Height in meter	22781	1.474	0.171	0.64	1.984
	BMI	(Weight/height)/height	22778	18.805	3.817	9.271	37.638
	BMI Male		10612	18.47	3.513	9.425	36.896
	BMI Female		12166	19.976	4.042	9.271	37.638
	BMI <18	Household members age below than 18.	7714	15.61	2.586	9.271	35.622
	BMI >18	Household members age more than 18.	14686	20.465	3.288	9.874	37.638
Child (age <60 months)	Weight	Weight in kilogram	2815	10.226	3.005	1.6	19.6
	Height	Height in meter	2783	0.816	0.135	0.422	1.262
	BMI	(Weight/height/height)	2783	15.136	1.778	8.725	26.402

**Table 4. Women earnings and control over food budget**

Women earnings	Women control over food budget		Total
	Yes	No	
Yes	2,048	1,776	3,824
	<b>31.49</b>	<b>27.31</b>	<b>58.80</b>
No	940	1,739	2,679
	<b>14.46</b>	<b>26.74</b>	<b>41.20</b>
Total	2,988	3,515	6,503
	<b>45.95</b>	<b>54.05</b>	<b>100.00</b>

## 4.2. Multiple Regression Results of Foods Consumption Frequencies

The output regarding fourteen categories of food consumption frequencies indicates that increases in *women earnings* lead to increase in *potato, cassava, roots, tubers, cereals, vegetables, fruits, fruits juices, eggs, and, seeds* consumption frequencies. Increases in *women control over food budget* lead to increase in consumption of *wheat flour, rice, potato, cassava, roots tubers, cereals, vegetables, fruits, fruits juices, dairy foods, poultry, meat, fish nuts, and seeds*. Increases in *simultaneously women earnings and control over food budget* lead to increase in *potato, cassava, roots tubers, cereals, vegetables, fruits, fruits juices, dairy foods, poultry, meat, fish, nuts and, seeds* consumption. The control variables household size, per capita household income educational level and occupation categories; salaried worker and farming have the positive association with almost all kinds of foods consumption frequencies.

The **Table 5 - Table 7** present the result of *model 1-3* of *multiple regression* of fourteen categories of food consumption frequencies which are comprising with food items such as *wheat flour, rice, potato, cassava, roots, tubers, cereals, vegetables, fruits, fruits juices, beans, lentils, peas, dairy foods, meat, poultry, fish, oil, fats, nuts and seeds*. The models included the three independent variables are *women earnings, women control over food budget, and simultaneously women earnings and control over food budget* and the control variables are *household size, per capita household income, education level, and occupation*. The level of significance of coefficients measured into three levels of confidence 99% (\*\*\*, when  $p < 0.01$ ), 95% (\*\*, when  $p < 0.05$ ) and 90% (\*, when  $p < 0.1$ ). The standard errors of coefficients presented in parentheses below the coefficients of each variable.

**Table 5** shows the result of *model 1* of multiple regression of fourteen categories of foods consumption frequencies. The consumption of meat and, wheat flour is predicted to decrease by 0.088 and, 0.251 respectively when the women earnings increase by one. After getting the negative association with these protein-rich foods consumption, this study is analyzed wage earners women economic sources, occupation categories and, the ways of expense earnings money (**Table 09**). And this study found that rural female employees have low paying work, they need to pay the loan to NGO and, deposits money for future living and child care. Perhaps, these have an impact on costlier food expenditures. In contrast, the consumption of fruits and fruits juices are predicted to increase by

0.223, when the women earnings increase by one. The coefficients of the independent variable, *women earnings* are statistically highly significant ( $p < 0.01$ ) in *wheat flour and meat* consumption, but negatively correlated. In the case of *potato, cassava, roots, tubers, vegetables, fruits and fruits juice* consumption frequencies, the coefficients of the independent variable, *women earnings* are highly significant ( $p < 0.01$ ) and positively correlated. And this indicates that any number of increase in *women earnings* direct to increase in *potato, cassava, roots, tubers, vegetables, fruits and fruits juices* consumption. The coefficients of the control variables, *household size and per capita household income* are highly significant and positively associated with *vegetables, fruits, fruits juices, beans, lentils, peas, eggs, dairy foods, poultry, fish. Oil and fats* consumption frequencies. The coefficients of control variables, *per capita household income, education level, salaried worker and farming* are highly significant, and the relationship is positive with protein rich food item *meat*.

**Table 6** shows the result of *model 2* of multiple regression of selected foods consumption frequencies. The consumption of cereals, fruits, dairy foods, meat and, fish predicted to increase by 0.031, 0.389, 0.374, 0.089 and, 0.204 respectively when the women control over food budget increase by one. The coefficients of the independent variable, *women control over food budget* are statistically highly significant ( $p < 0.01$ ) and positively correlated with *wheat flour, potato, cassava, roots, tubers, fruits, fruits juices, eggs, dairy foods, meat and fish* consumption frequencies. The coefficients of the control variable, *household size* are significant and positively associated with all categories of food consumption frequencies except *cereals and meat*. The coefficients of control variables, *per capita household income and education*, are highly significant ( $p < 0.01$ ) and positively related to *fruits, fruits juice, beans, lentils, peas, eggs, poultry, meat and fish* consumption frequencies. The coefficients of control variables, occupation categories such as *wage labor and self-employment* are highly significant ( $p < 0.01$ ), but the association is negative with *fruits, fruits juices, beans, lentils, peas, eggs, dairy foods, poultry and fish* consumption frequencies.

**Table 7** shows the result of *model 3* of multiple regression of selected foods consumption frequencies. The consumption of cereals, fruits, dairy foods, meat and, fish is predicted to increase by 0.029, 0.291, 0.176, 0.001 and, 0.033 respectively, when the contemporary women earnings and control over food budget is increased by one. The coefficients of the independent variable, *simultaneously women earnings and control over food budget* are statistically highly significant ( $p < 0.01$ ), and positively associated with *potato, cassava, roots, tubers, cereals, fruits, fruits juice and dairy foods* consumption frequencies. The coefficients of the control variables, *household size, per capita household income and education level*, are statistically significant, and positively associated with *fruits, fruits juices, beans, lentils, peas, eggs, dairy foods, meat and poultry* foods consumption frequencies. The coefficients of control variables, occupation categories such as *wage labor and self-employment* are significant, but negative correlation with *fruits, fruits juice, beans, lentils, peas, eggs, dairy foods, poultry and fish* consumption frequencies.

Model 1: Women earnings and household food consumption frequencies.

Table 5. Multiple regression result of model 1.

Variable name		Wheat flour	Rice	Potato, cassava, roots. ...	Cereals	Vegetables	Fruits, fruits juice	Beans, lentils, peas. ...
Women earnings		-0.251*** (0.056)	-0.005 (0.005)	0.0362*** (0.049)	0.008 (0.14)	0.206*** (0.044)	0.223*** (0.05)	-0.047 (0.041)
Household Size		0.045*** (0.136)	0.003*** (0.001)	0.1*** (0.011)	-0.002 (0.003)	0.086*** (0.01)	0.078*** (0.012)	0.037*** (0.01)
Per capita Household Income		0.00003* (0.000)	2.5 (1.66)	0.00001 (0.000)	0.00001** (4.96)	0.00005*** (0.000)	0.00008*** (0.000)	0.00006*** (0.000)
Education		0.233* (0.13)	0.001 (0.011)	-0.042 (0.113)	0.04 (0.033)	0.17* (0.101)	0.66*** (0.116)	0.26*** (0.095)
Occupation	Wage Labor	-0.517*** (0.086)	0.011 (0.007)	-0.037 (0.075)	-0.008 (0.022)	-0.103 (0.067)	-0.551*** (0.077)	-0.44*** (0.063)
	Salaried Worker	0.773** (0.375)	0.01 (0.32)	-0.207 (0.327)	0.131 (0.096)	0.271 (0.293)	0.267 (0.334)	0.493* (0.276)
	Self Emp.	-0.377*** (0.136)	-0.004 (0.012)	0.039 (0.119)	-0.001 (0.035)	-0.162 (0.107)	-0.289** (0.121)	-0.555*** (0.01)
	Trader	0.038 (0.137)	0.014 (0.012)	0.068 (0.12)	-0.001 (0.035)	-0.201 (0.107)	-0.005 (0.122)	-0.042 (0.1)
	Farming	-0.364*** (0.07)	0.006 (0.006)	0.011 (0.06)	-0.009 (0.018)	0.008 (0.054)	-0.0004 (0.062)	-0.195*** (0.051)
_cons		1.297*** (0.076)	6.97*** (0.006)	4.479*** (0.066)	-0.045** (0.019)	5.27*** (0.059)	1.029*** (0.067)	1.049*** (0.056)
Number of obs.		6503	6503	6503	6503	6503	6503	6503
F		10.94	1.75	18.49	1.25	15.23	22.75	13.29
Adj. R square		0.014	0.001	0.024	0.000	0.019	0.029	0.017
Root MSE		2.17	0.185	1.894	0.552	1.696	1.933	1.6
Variable name		Eggs	Dairy foods.	Meat	Poultry	Fish	Oil, Fats	Nuts seeds
Women earnings		0.038 (0.049)	-0.053 (0.068)	-0.088*** (0.021)	-0.016 (0.02)	-0.073 (0.051)	0.0003 (0.02)	0.004 (0.01)
Household Size		0.035*** (0.019)	0.133*** (0.016)	0.004 (0.005)	0.02*** (0.005)	0.112*** (0.013)	0.017*** (0.005)	0.006** (0.002)
Per capita Household Income		0.0002*** (0.000)	0.0001*** (0.000)	0.00003*** (7.32)	0.00003*** (7.22)	0.0001*** (0.000)	0.00002** (7.0)	2.26 (3.81)
Education		0.77*** (0.113)	0.802*** (0.157)	0.196*** (0.049)	0.139*** (0.048)	0.423*** (0.12)	-0.025 (0.047)	0.039 (0.025)
Occupation	Wage Labor	-0.599*** (0.075)	-0.859*** (0.104)	-0.188*** (0.032)	-0.183*** (0.031)	-0.829*** (0.079)	0.01 (0.03)	-0.027* (0.017)
	Salaried Worker	0.912*** (0.328)	1.492*** (0.454)	0.184 (0.140)	0.153 (0.139)	0.66* (0.346)	0.091 (0.135)	-0.062 (0.073)
	Self Emp.	-0.326*** (0.119)	-0.832*** (0.165)	-0.06 (0.051)	-0.176*** (0.05)	-0.547*** (0.126)	0.029 (0.049)	0.014 (0.027)
	Trader	-0.051 (0.12)	-0.267* (0.166)	0.047 (0.051)	-0.001 (0.05)	0.045 (0.126)	0.01 (0.049)	0.075*** (0.027)
	Farming	0.175*** (0.06)	0.115 (0.084)	0.7*** (0.026)	-0.039 (0.026)	0.156** (0.064)	0.43* (0.025)	0.02 (0.014)
_cons		1.116*** (0.066)	0.958*** (0.092)	0.313*** (0.028)	0.338*** (0.028)	3.086*** (0.07)	6.78*** (0.027)	0.02 (0.015)
Number of obs.		6503	6503	6503	6503	6503	6503	6503
F		30.19	28.50	13.31	9.90	36.68	2.91	2.91
Adj. R square		0.039	0.037	0.017	0.12	0.047	0.002	0.002
Root MSE		1.9	2.628	0.815	0.804	1.2	0.78	0.425

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1.

Model 2: Women control over food budget and household food consumption frequencies.

Table 6. Multiple regression result of model 2

Variable name		Wheat flour	Rice	Potato, cassava, roots. ...	Cereals	Vegetables	Fruits, fruits juice	Beans, lentils, peas. ...
Women control over food budget		0.154*** (0.055)	0.000 (0.005)	0.236*** (0.048)	0.031* (0.014)	0.022 (0.043)	0.389*** (0.049)	0.096* (0.041)
Household Size		0.035*** (0.013)	0.003*** (0.001)	0.121*** (0.012)	-0.001 (0.003)	0.097*** (0.01)	0.093*** (0.012)	0.036*** (0.01)
Per capita Household Income		0.00005** (0.000)	2.60 (1.67)	0.00002 (0.000)	0.00001*** (4.98)	0.0005*** (0.000)	0.00009*** (0.000)	0.0006*** (0.000)
Education level		0.251* (0.13)	0.002 (0.011)	-0.065 (0.113)	0.04 (0.033)	0.157 (0.101)	0.648*** (0.115)	0.264*** (0.095)
Occupation	Wage Labor	-0.485*** (0.087)	0.011 (0.007)	0.087 (0.076)	-0.001 (0.022)	-0.099 (0.068)	-0.469*** (0.077)	-0.42*** (0.064)
	Salaried Worker	0.79** (0.375)	0.01 (0.032)	-0.232 (0.328)	0.13 (0.095)	0.257 (0.294)	0.25 (0.333)	0.496* (0.275)
	Self Emp.	-0.336** (0.137)	-0.003 (0.012)	0.043 (0.12)	0.002 (0.035)	-0.176* (0.107)	-0.252*** (0.121)	-0.538*** (0.1)
	Trader	0.059 (0.137)	0.014 (0.012)	0.112 (0.12)	0.004 (0.035)	-0.195* (0.107)	0.063 (0.122)	-0.027 (0.1)
	Farming	-0.353*** (0.07)	0.005 (0.006)	0.06 (0.061)	-0.004 (0.018)	0.02 (0.055)	0.064 (0.062)	-0.183*** (0.051)
_cons		1.099*** (0.081)	6.968*** (0.007)	4.467*** (0.071)	0.028 (0.021)	5.337*** (0.063)	0.864*** (0.072)	0.969*** (0.059)
Number of obs.		6503	6503	6503	6503	6503	6503	6503
F		9.56	1.65	15.03	1.76	12.76	27.67	13.78
Adj. R square		0.012	0.001	0.019	0.001	0.16	0.036	0.017
Root MSE		2.171	0.185	1.899	0.552	1.698	1.927	1.594
Variable name		Eggs	Dairy foods.	Meat	Poultry	Fish	Oil, Fats	Nuts seeds
Women control over food budget		0.222*** (0.048)	0.374*** (0.067)	0.089*** (0.021)	0.04* (0.02)	0.204*** (0.051)	-0.012 (0.02)	0.013 (0.011)
Household Size		0.04*** (0.012)	0.136*** (0.016)	0.002 (0.005)	0.02*** (0.005)	0.111*** (0.012)	0.017*** (0.005)	0.006** (0.003)
Per capita Household Income		0.0002*** (0.000)	0.0001*** (0.000)	0.00004*** (7.35)	0.00003*** (7.25)	0.0001*** (0.000)	0.0002* (7.03)	2.70 (3.83)
Education level		0.77*** (0.113)	0.806*** (0.157)	0.203*** (0.049)	0.141*** (0.048)	0.43*** (0.12)	-0.025 (0.047)	0.039 (0.025)
Occupation	Wage Labor	-0.552*** (0.076)	-0.78*** (0.105)	-0.169*** (0.033)	-0.175*** (0.032)	-0.786*** (0.08)	0.008 (0.031)	-0.025 (0.017)
	Salaried Worker	0.908*** (0.328)	1.494*** (0.453)	0.19 (0.141)	0.154 (0.139)	0.664* (0.345)	0.091 (0.135)	-0.062 (0.073)
	Self Emp.	-0.298** (0.119)	-0.776*** (0.165)	0.04 (0.051)	-0.17*** (0.051)	-0.513*** (0.126)	0.028 (0.049)	0.015 (0.027)
	Trader	-0.014 (0.12)	-0.206 (0.166)	0.061 (0.052)	0.005 (0.051)	0.078 (0.126)	0.008 (0.049)	0.077*** (0.027)
	Farming	0.207*** (0.061)	0.165* (0.085)	0.079*** (0.026)	-0.034 (0.026)	0.182*** (0.065)	0.042 (0.025)	0.022 (0.014)
_cons		0.988*** (0.071)	0.696*** (0.098)	0.221*** (0.03)	0.306*** (0.03)	2.926*** (0.074)	6.789*** (0.029)	0.013 (0.016)
Number of obs.		6503	6503	6503	6503	6503	6503	6503
F		32.56	32.06	13.42	10.25	38.33	2.95	3.05
Adj. R square		0.042	0.041	0.017	0.013	0.05	0.003	0.003
Root MSE		1.895	2.621	0.815	0.804	1.997	0.78	0.425

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1.

Model 3: Simultaneous women earnings &amp; control over food budget and household food consumption frequencies.

Table 7. Multiple regression result of model 3

Variable name		Wheat flour	Rice	Potato, cassava, roots. ...	Cereals	Vegetables	Fruits, fruits juice	Beans, lentils, peas. ...
Simultaneously women earnings and control		-0.128*** (0.058)	-0.007 (0.005)	0.277*** (0.051)	0.029* (0.015)	0.085* (0.046)	0.291*** (0.052)	0.006 (0.043)
Household Size		0.034*** (0.013)	0.003*** (0.001)	0.114*** (0.012)	-0.002 (0.003)	0.095*** (0.01)	0.084*** (0.012)	0.034*** (0.01)
Per capita Household Income		0.00004*** (0.000)	2.45 (1.66)	0.00002 (0.000)	0.00001* (4.96)	0.00005*** (0.000)	0.00008*** (0.000)	0.00006*** (0.000)
Education		0.242* (0.13)	0.002 (0.011)	-0.05 (0.113)	0.041 (0.033)	0.161 (0.101)	0.662*** (0.116)	0.264** (0.095)
Occupation	Wage Labor	-0.532*** (0.086)	0.01 (0.007)	0.066 (0.075)	-0.005 (0.022)	-0.093 (0.067)	-0.524*** (0.077)	-0.439*** (0.063)
	Salaried Worker	0.787** (0.375)	0.01 (0.032)	-0.225 (0.328)	0.131 (0.095)	0.259 (0.293)	0.258 (0.334)	0.497* (0.275)
	Self Emp.	-0.374*** (0.136)	-0.004 (0.012)	0.045 (0.119)	0.001 (0.035)	-0.165 (0.107)	-0.258** (0.121)	-0.554*** (0.1)
	Trader	0.024 (0.137)	0.014 (0.012)	0.093 (0.12)	0.001 (0.035)	-0.193* (0.107)	0.018 (0.122)	-0.042 (0.1)
	Farming	-0.384*** (0.07)	0.005 (0.006)	0.045 (0.061)	-0.007 (0.018)	0.023 (0.055)	0.028 (0.062)	-0.196*** (0.051)
_cons		1.241*** (0.075)	6.97*** (0.006)	4.532*** (0.066)	0.039* (0.019)	5.326*** (0.059)	1.026*** (0.067)	1.029*** (0.055)
Number of obs.		6503	6503	6503	6503	6503	6503	6503
F		9.28	1.84	15.61	1.64	13.03	23.91	13.19
Adj. R square		0.011	0.001	0.012	0.001	0.016	0.031	0.017
Root MSE		2.172	0.185	1.898	0.552	1.698	1.933	1.594
Variable name		Eggs	Dairy foods.	Meat	Poultry	Fish	Oil, Fats	Nuts seeds
Simultaneously women earnings and control		0.078 (0.051)	0.176*** (0.071)	0.001 (0.022)	0.008 (0.022)	0.035 (0.054)	-0.03 (0.021)	0.004 (0.011)
Household Size		0.035*** (0.012)	0.128*** (0.016)	0.000 (0.005)	0.019*** (0.005)	0.108*** (0.012)	0.018*** (0.005)	0.006* (0.003)
Per capita Household Income		0.0002*** (0.000)	0.0001*** (0.000)	0.00004*** (7.33)	0.00003*** (7.22)	0.0001*** (0.000)	0.00002* (7.0)	2.28 (3.81)
Education		0.772*** (0.114)	0.816*** (0.157)	0.202*** (0.049)	0.141*** (0.048)	0.431*** (0.119)	-0.027 (0.047)	0.039 (0.025)
Occupation	Wage Labor	-0.585*** (0.075)	-0.842*** (0.104)	-0.188*** (0.032)	-0.183*** (0.032)	-0.824*** (0.079)	0.007 (0.031)	-0.027 (0.017)
	Salaried Worker	0.911*** (0.328)	1.5*** (0.454)	0.19 (0.141)	0.155 (0.139)	0.667* (0.346)	0.09 (0.135)	-0.062 (0.073)
	Self Emp.	-0.3** (0.119)	-0.809*** (0.165)	-0.054 (0.051)	-0.168*** (0.05)	-0.534*** (0.125)	0.027 (0.049)	0.014 (0.027)
	Trader	-0.044 (0.12)	-0.255 (0.166)	0.046 (0.052)	-0.001 (0.051)	0.047 (0.126)	0.008 (0.049)	0.075*** (0.027)
	Farming	0.183*** (0.061)	0.124 (0.084)	0.067** (0.026)	-0.039 (0.026)	0.156* (0.064)	0.041* (0.025)	0.02 (0.014)
_cons		1.108*** (0.066)	0.88*** (0.091)	0.278*** (0.028)	0.33** (0.028)	3.045*** (0.069)	6.791*** (0.027)	0.02 (0.015)
Number of obs.		6503	6503	6503	6503	6503	6503	6503
F		30.18	29.21	11.37	9.78	36.52	3.14	2.92
Adj. R square		0.039	0.038	0.014	0.012	0.047	0.003	0.003
Root MSE		1.9	2.626	0.816	0.804	1.999	0.78	0.425

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1.

### 4.3. Probit Regression Result of Subjective Ratings of Food Unavailability

The tables 8-10 illustrate the result of *model 1-3* of *probit regression* of the three subjective ratings of food unavailability. The results show that the *model 2* which comprising with the independent variable *women control over food budget* negatively associated with food unavailability. The subjective ratings of food unavailability considered three questionnaires to collect past four weeks data about food unavailability. The questions were “there was no food due to lack of resources to get food,” “any household members go to sleep at night because there was not enough food” and “any household members pass a whole day and night without eating anything at all because there was not enough food.” The first column of the following three tables shows the model’s variable name and next three column shows the coefficients of the three subjective measurements of food unavailability. The occupation category *salaried worker* omitted from *probit regression* analysis of the third number of subjective ratings of food unavailability due to “0” predictor values. The level of significance of coefficients measured into three levels of confidence 99% (\*\*\*, when  $p < 0.01$ ), 95% (\*\*, when  $p < 0.05$ ) and 90% (\*, when  $p < 0.1$ ). The standard errors of coefficients presented in parentheses below the coefficients of each variable.

The following *Table 8* shows the result of *probit regression* of *model 1* which includes the independent variable *women earnings* and the four control variables *household size, per capita household income, education level, and occupation*. The parametric estimates of coefficients of the independent variable *women earnings* are highly statistically significant ( $p < 0.01$ ) but positively correlated with all of three subjective ratings of food unavailability. The coefficients of the control variables *household size and per capita household income* are highly significant ( $p < 0.01$ ) and negatively correlated with

food unavailability. The coefficients of the control variable, *education level* is significant in first two measurements and negatively correlated with food unavailability. The coefficients of control variable, occupation category such as *farming* is highly significant ( $p < 0.01$ ) and negatively correlated with food unavailability.

*Table 9* illustrates the result of *probit regression* of *model 2* of three subjective ratings of food unavailability with the independent variable *women control over food budget* and four control variables *household size, per capita household income, education and occupation*. The parametric estimates of coefficients of the independent variable *women control over food budget* is negatively associated with all of the three subjective ratings of food unavailability. The coefficients of control variables *household size, per capita household income* and occupation category such as *farming* are highly significant ( $p < 0.01$ ) and negatively associated which means an increase in *household size, per capita household income and farming* decrease the food unavailability in the house.

*Table 10* illustrates the result of *probit regression* of *model 3* of the three subjective ratings of food unavailability with the independent variable *simultaneously women earnings and control over food budget* and four control variables *household size, per capita household income, education, and occupation*. The parametric estimates of coefficients of the independent variable *simultaneously women earnings and control over food budget* is significant ( $p < 0.05$ ) in the first subjective ratings and negatively correlated with the third number of subjective ratings of food unavailability. The coefficients of control variables *household size, per capita household income, education level* and occupation category such as *farming* are highly significant and negatively correlated which means increases in *household size, per capita household income, education level and farming* decreases the food unavailability.

Model 1: Women earnings and the subjective ratings of food unavailability.

**Table 8. Probit regression result of model 1**

Variable		No food due to lack of resources	Go to sleep without food	Passing day and night without food
Women earnings		0.158*** (0.047)	0.124** (0.055)	0.156** (0.076)
Household size		-0.071*** (0.012)	-0.078*** (0.015)	-0.081*** (0.021)
Per capita household income		-0.0002*** (0.000)	-0.0001*** (0.000)	-0.0001*** (0.000)
Education level		-0.49*** (0.159)	-0.42** (0.19)	-0.287 (0.258)
Occupation	Wage labor	0.519*** (0.594)	0.387*** (0.069)	0.343*** (0.096)
	Salaried worker	0.228 (0.324)	-0.12 (0.473)	–
	Self-employment	0.486*** (0.942)	0.374*** (0.11)	0.587*** (0.132)
	Trader	0.116 (0.109)	0.041 (0.131)	-0.331 (0.264)
	Farming	-0.552*** (0.078)	-0.679*** (0.108)	-0.416*** (0.137)
_cons		-0.925*** (0.064)	-1.161*** (0.075)	-1.645*** (0.105)
Number of observation		6503	6503	6469
Pseudo R2		0.078	0.072	0.067

\*\*\*  $p < 0.01$ . \*\*  $p < 0.05$ , \*  $p < 0.1$



Model 2: Women control over food budget and the subjective ratings of food unavailability.

**Table 9. Probit regression result of model 2**

Variable		No food due to lack of resources	Go to sleep without food	Passing day and night without food
Women control over food budget		-0.0461 (0.465)	-0.003 (0.055)	-0.099 (0.077)
Household size		-0.635*** (0.118)	-0.071*** (0.014)	-0.075*** (0.02)
Per capita household income		-0.0002*** (0.000)	-0.0001*** (0.000)	-0.0002*** (0.000)
Education		-0.513*** (0.159)	-0.443** (0.19)	-0.316 (0.26)
Occupation	Wage labor	0.51*** (0.06)	0.387*** (0.067)	0.321*** (0.097)
	Salaried worker	0.227 (0.323)	-0.119 (0.469)	–
	Self-employment	0.465*** (0.094)	0.362*** (0.11)	0.563*** (0.132)
	Trader	0.107 (0.109)	0.038 (0.131)	-0.355 (0.267)
	Farming	-0.553*** (0.078)	-0.674*** (0.108)	-0.418*** (0.137)
_cons		-0.826*** (0.07)	-1.107*** (0.082)	-1.506*** (0.114)
Number of observation		6503	6503	6469
Pseudo R2		0.076	0.071	0.065

\*\*\* p<0.01. \*\* p<0.05, \* p<0.1.

Model 3: Simultaneously women earnings & control over food budget and the subjective ratings of food unavailability.

**Table 10. Probit regression result of model 3**

Variable		No food due to lack of resources	Go to sleep without food	Passing day and night without food
Simultaneously women earnings and control over food budget		0.953** (0.479)	0.075 (0.057)	-0.007 (0.08)
Household size		-0.063*** (0.012)	-0.072*** (0.014)	-0.072*** (0.02)
Per capita household income		-0.0002*** (0.000)	-0.0001*** (0.000)	-0.0002*** (0.000)
Education		-0.499*** (0.159)	-0.433** (0.19)	-0.318 (0.26)
Occupation	Wage labor	0.528*** (0.06)	0.394*** (0.069)	0.34*** (0.096)
	Salaried worker	0.227 (0.322)	-0.113 (0.467)	–
	Self-employment	0.48*** (0.094)	0.369*** (0.11)	0.573*** (0.132)
	Trader	0.121 (0.109)	0.044 (0.131)	-0.34 (0.267)
	Farming	-0.541*** (0.078)	-0.67*** (0.108)	-0.408*** (0.137)
_cons		-0.896*** (0.064)	-1.14*** (0.075)	-1.577*** (0.103)
Number of observation		6503	6503	6469
Pseudo R2		0.076	0.071	0.064

\*\*\* p<0.01. \*\* p<0.05, \* p<0.1.

## 5. Discussions, Conclusions and Future Research

### 5.1. Discussions

Results of descriptive statistics and regression analysis indicate that low level of food security condition exists in rural Bangladesh. The availability of non-cereal based foods doesn't match with expectation. Rural households haven't enough ability to spend money to fulfill their basic needs. Lack of socioeconomic resources affects dietary and nutritional intake. The main characteristics of household food insecurity such as foods unavailability, unacceptable

food, and a few of control over the food situation, disturbance in food production and supply [39] exist in rural Bangladesh. Food security heavily relies on agricultural production which is the primary source of food and nutrition. The most of rural farmers used to lease land to cultivate crop or using crop sharing policy with the land owner. After deducting all expenses of food production and giving the portion of the land lord, rural farmers and day laborers are getting very less. Poor households and landless farmers easy access to the resources such as bank loan, land, water, and technology can rise socioeconomic condition. The government also should take all fallow arable lands under cultivation.

This study further found that the food accessibility isn't in satisfactory level. The majority number of rural families

have poor monthly income and the per capita income is below the normal. Most of the rural peoples used to buy necessary food such as rice, oil, vegetable, and condiments from the market. In this present price hiking era and with this poor income level it's hard to fulfill the basic needs of poor rural inhabitants in Bangladesh whose main occupation is working on farming, raising poultry and, raising livestock. Whereas cultivable land is limited and most of the arable land owned by the richest persons. The issue of climate change should take under consideration to increase food security condition. Experts are suspecting that the frequency of heavy rainfall can be increased, and the sea level can be risen and inundated vast coastal areas of Bangladesh. This will ultimately affect the agriculture production, live of coastal regions and food security condition of rural Bangladesh. Due to heavy rainfall in monsoon period crops are wasted and overall food security systems are affected.

Bangladesh has achieved noticeable improvements in women empowerment, and it's cleared that women play's vital role in rural areas to keep household's food secure. The number of women of more than 50% households in rural Bangladesh are working or doing business such as homestead farming, raising poultry, raising livestock and doing household works. However, women in rural Bangladesh still in many socioeconomic challenges. This paper also found that those households consume more protein-rich foods when women have control over food budget. Bangladesh also has made noticeable progress to reduce the undernutrition level, maternal mortality ratio, infant mortality rate, and in others health related issues. The incidence of poverty is declining, the income level is increasing, and the purchasing power of rural peoples are slightly increasing. In spite of this, the levels of underweight and stunting are still high, but the trend is downward, and this study is found the average BMI scores of the household members are 18.8kg/m<sup>2</sup>. Mostly, children and mothers are bearing the brunt of malnutrition.

After all, women's role needs to maximize in rural areas not only in agriculture, farming, and food processing sectors but also in education, health, and technology sectors. Rural women's need to be given proper knowledge regarding health, child care, and equal intra-household food distribution. National and international institutions should encourage and provide supports to make homestead gardening and to increase farming in village areas. And also, rural farmers need to be given proper learning regarding the marketing of their agriculture and non-agriculture production.

## 5.2. Conclusions

The staple food, rice production in Bangladesh is sufficient enough even after facing challenges due to climate change, but self-sufficiency still needs to be gained in other food items. The operational capacity of the government in the regards of food planning and monitoring in rural areas should increase. Evidence from Bangladesh and other developing countries show that development in household food security doesn't mean that eradication of nutritional risks in the household. The caring practices among individual members and within household also important to reduce malnutrition. The government should take proper initiative and monitor the

food market to make sure that the rural villagers have enough purchasing power and the dietary diversity are existing in their diet plan. Authorities proper actions can minimize the loss of rural poor wage earners. Without proper monitoring, the initiatives are taken by the government and International institutions will not succeed to minimize these barriers.

## 5.3. Future Research

This study found the positive association between women control over food budget and food security, interestingly the role of women earnings isn't clear. In rural Bangladesh, most of the case women from low-income families have work earnings but not adequate to purchase protein rich foods. Most of the wage earners women have NGO loans, and they need to pay installment in every month which may have the effect on the food budget. This study found women earnings have the negative association with the consumption of some protein-rich and carbohydrate-rich foods such as meat, poultry, fish, beans and lentils and positive association with the consumption of some carbohydrate-rich and protein-rich foods such as cereals, eggs, potato, cassava, roots, tubers, and vegetables. It is expected that women work earnings increase the consumption of protein-rich and nutritious foods. Further research is to be needed to examine the household composition, way of expenses and, role on food consumption of rural wage earners women.

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