Categorized Daily Calorie Intake and its Influencing Factors for Rajshahi District of Bangladesh

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Abstract: *The achievement of households food security status are measured following four well established components like food availability, food accessibility, food stability and food utilization for all people at all time have noticed in most of the research works. The continuous supply of the aforesaid components may not imply the attainment of food security. Even if the food security is dependent on a household access to enough food it is measured by actual dietary intake of all household members it may be estimated by examining the daily calorie intake gained from carbohydrate, protein, fat and other sources of ingredients. As such the food secured households are they who get recommended calories from their daily food intake. According to the objectives of this research we were intended to measure the food security status using the aforesaid calorie intake by developing a food security index with the help of established consumption boundary of 2250 kilocalorie per person per day. Subsequent categories of calorie intake namely Less Secured, Secured and More Secured on basis of the cut off values following the developed index have been constructed on nutritional aspects as an alternative of food security of the households. The nutritional level may also depend on income, expenditure, education, age, family member (child, aged, dependent), earning member, family type, credit access and geographical location. An effort was made in this research to identify the influencing factors for above mentioned categories of daily calorie intake. Finally apposite factors have been extracted using factor analysis on basis of 350 authors' surveyed data for Rajshahi district of Bangladesh. It is revealed from the study that there are four factors extracted for Less Secured group, three for Secured group and four for the More Secured groups with the explained total variation about 69.364%, 68.82% and 69.12% accordingly could be considered as a satisfactory level for the selected region of the country. In this light this research could be able to convey the root level messages of the household food security status to the government and concerning authorities on food policy decision.*
Keywords: *Daily Calorie Intake, Food security index, KMO statistics, Bartlett's test of Sphericity and Factor analysis.*
JEL Classification: *C02; C13; C42; C80; C81; C93 ; D12.*

I. Introduction

Food security is major concern for the over populated countries in the world. Bangladesh is predominantly an agricultural country where agriculture sector plays a vital role in accelerating the economic growth. The population density of Bangladesh is about 1104 per square kilometer which is a big challenge to provide secured and quality food for the growing populations of Bangladesh. The food grain production plays an important role in the economy of Bangladesh and in the Asian countries. Food security is the capacity to obtain the required quantum of food, by producing the requirements or accessing them through imports, rather than the ability to produce all the food needed for consumption.

Since the stable supply of rice has great implications for food security, many views food security as synonymous to achieve self-sufficiency in rice production (Hossain *et. al.,* 2005). In fact 75% land of the country is covered with cultivation to feed the huge population of the country and some sort of addition of new population is continuing in every year. The population growth rate of Bangladesh is 2 million per year, supported the forecast that the total population will reach 233.2 million by 2050. About 80,000 hectre of arable land are going out of production every year (Mondal, 2010). As because there may be a tremendous challenge for providing food security to the increasing population of our country and therefore it is important to increase rice production in order to meet the growing demand for food emanating from population growth.

Food is the basic human need and the peoples of Asian country spend the large portion of their income on it. The first and foremost responsibility of democratic and welfare state is to ensure uninterrupted supply of food and make it available to all people all time. According to the Article-15(a) of the Constitution of Bangladesh, 'it shall be a fundamental responsibility of the State to secure its citizens to the provision of basic necessities of food'. Although after the liberation war all government has taken multidimensional steps to ensure food security to all people and at the same time poverty reduction it becomes fruitful from the last decade. Availability of adequate food at nutritional level and access to that adequate food by every individual are the two most vital concepts of the food security (Islam, 2012).

Self-sufficiency in food grain policies may influence the political, social and economical stability (Byerlee *et. al.,* 2005; Deb *et. al.,* 2009) for the Asian countries as well as in Bangladesh. It is sometimes challenging to meet the the extreme shortage of foods for the self-sufficiency in food grain production. Future food grain production will be constrained by reduction of arable land due to acquisition for housing, rapid urbanization and infrastructure development. Therefore, such constraints affect agricultural production (Baffes and Gautam 2001) as well as food security components. The general tone of discourse would suggest that it implies enough food grain is produced domestically to meet the existing demand of foods and no need to import food grains. Production and availability of food grains through proper utilization of the limited land to meet the demand is a great challenge for Bangladesh. Long-term global food availability and food supply both at the household and individual levels, remain a major concern for the government (Koning, *et al.,* 2008). Therefore, it is necessary to enhance food grain production to meet the increasing demand for food. Again, there may be food insecurity with food self sufficiency. This is the principal and pertinent issue in food security in the rice producing country like Bangladesh. The sustained increases in domestic production of food grain have led, more recently, to the claim that Bangladesh has reached self-sufficiency in food grain production.

The calorie intake from daily food consumption can be an alternative measure of food security status (see Chen and Lu (2018), Begum *et al.* (2013)). Who get recommended calories from their daily food intake are considered as the food secured households. The nutritional level of household may depend on daily calorie intake and income (both from occupational and other sources), expenditure, education, age, family member (child, aged, dependent), earning member, family type, credit access and geographical location can be considered as influencing variables to daily calorie intake in the form of carbohydrate, protein and fat intake. As therefore on the above mention ground we are intended to justify the food security status in connection with aforesaid influential parameters and justify the question that *is there any common factors influencing the food security in considering the daily calorie intake or not and how could we disseminate the security.*

Even though the components of food parameters have been supplied continuously among the peoples of the country the food security status may differs due to consumption and nutritional ground. Most of the studies have performed to judge the food security status on the aforesaid parameters very rear study have been found in the literature on nutritional ground of the study area. As therefore, to measure the influencing factors on the food security status using daily calorie intake in terms of stable and adequate supply of balanced nutritions and to identify the determinants on the food security with the help of classified levels following a proposed food security index could be the objectives of the study.

In the next section, description of the data and the variables of interest followed by the methodologies have been discussed. Under the methodologies section the Factor Analysis are briefly described. Finally the results are presented and the paper ends with a conclusion section.

Food Security Aspects and Components

A broad overview of food security related concepts should be discussed in this section. It is imperative to have these issues clarified at the very beginning which would keep us in strong footing for the rest of the analysis in this study. Food security is a flexible concept as reflected in many attempts at definition in research and policy usage. The initial focus, reflecting the global concerns of 1974, was on the volume and stability of food supplies. Food security was defined in the 1974 World Food Summit as: "availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices" (United Nations 1975).

The 1994 UNDP Human Development Report promoted the construct of human security, including a number of component aspects, of which food security was only one (UNDP 1994). This concept is closely related to the human rights perspective on development that has, in turn, influenced discussions about food security. In the World Food Summit 1996, Rome Declaration on World Food Security was adopted by United Nations, Government of Canada, World Health Organization and 183 participating nations. According to the declaration Food security at the individual, household, national, regional and global levels is a state where, "All people at all times have physical and economic access to sufficient, safe and nutritious foods to meet their dietary needs and food preferences for an active and healthy life." (FAO 1996) The five fundamental aspects

like availability, access, stability, nutritional status and preferences of food can be maintained by such definition.

Food is energy for human body without which we can not survive and thus it should be considered as a security good (Fullbrook, 2010). The definition of food security also alludes to safe and nutritious food which is required for healthy and active life. For this the human body has to effectively utilize the available nutrients in the food consumed (Staaz *et. al.,* 2009). Benson *et. al*., (1986) identified food security in national and household level. They defined national food security of a country having adequate assured supplies of food to meet aggregate consumption needs. It involves stability of supplies and secure access to available supplies on the part of those who need them. As such to achieve food security is a complex and challenging phenomenon in everywhere. Most of the countries focus on assuring stability in supply of affordable nutritious food and oversight the fundamental issue of ensuring food security.

Food security is multi-dimensional aspect having interrelationships with indicators; and it cannot be captured by any single or specific indicator. The dimensions of food security are Access to food, Availability of food, and Utilization of food. The food availability is affected by production of agriculture sector and import of food. Access to food is affected by a variety of socio-economic factors ranging from education and per-capita income to fiscal management and land ownership. Food absorption is affected by health status, awareness and health facilities. Availability refers to the availability of sufficient quantities of food of appropriate qualities, supplied through domestic production or imports (including food aid). On the supply side, cereal output is the key indicator, as cereals provide about 60% of dietary energy in developing countries. At micro or household level, availability is taken as the capacity of the households to produce the food they need. Stability is also a very important component among the food security indicators. To be food secure a population, household, or individual must have access to adequate food at all times. The concept of stability can therefore refer to both the availability and access dimensions of food security.

Household Food Security

The concept of household food security can be found in the literature from 1980s equating national food security with food self-sufficiency is a problem that needs to be clearly understood. The macro-level food sufficiency attainment does not ensure the achievement of household level food production and storage. It is necessary but not sufficient to solve household level malnutrition and food insecurity problems (Rukuni, 2002, as quoted in Workicho, 2007). Household food security is mainly conditioned by factors, which are related to the process of "acquisition, household procurement strategies and socio-economic condition of the society" (Debebe (1995), Eneyew and Bekele (2012)) and indicates that Access to different resources and the pattern of social support have greater impact on the procurement strategies of food supplies. The key elements of a household food security are availability and stability in food access. At individual level, the definition is much straightforward. An individual is food secured if his/her food consumption is determined by the claim the individual has on household food source. Above all Maxwell and Smith (1992) strongly argue that household food security is a complex issue that needs to investigate the food security status of different household members, nutritional content of the food consumed, livelihood security and cultural acceptability of the consumed food item.

Food Availability and Consumption Situation in Bangladesh

The food grain requirement in a country depends on the dietary pattern, which also changes over time. Though the share of food grain in the daily diet has decreased in terms of weight and calorie over the years, it is still the principal source of food calorie and protein supply. According to Household Income Expenditure Survey (HIES) the calorie and protein intake from food grain was 78 and 58.5 percent respectively in 1995-1996; it came down to 75.4 and 58.3 percent in 2000. The non-cereals like potato, vegetables, pulses, meat, poultry, dairy, fish edible oil, condiment and spices etc. constituted about 20.5 percent of the total calorie intake in 2000 and 18.5 percent in 1995-96. The remaining calories were derived from fruits, sugar and miscellaneous items. Different consumption surveys in the country have estimated different figures on food intake.

Nutritional Aspects of Food Security

Food security should also be measured by intake of total calorie per day from the amount of taken daily protein, carbohydrate, fat, vitamin and any source of nutrition. Even if such parameter can be ensured by the authority, sometimes it makes some trouble. Such status can be examined by the total calorie intake, daily carbohydrate intake, daily protein intake, daily fat intake of some family member of randomly selected households in Rajshahi district. Therefore an alternative way have considered the daily food calorie intake as an indication of food security parameter. Smith defined two groups of factors that affect food security, i.e., supply factors (weather, production, policy incentives, stocks, and imports) and demand factors (population growth, income growth and distribution, and export revenue). To achieve the food security level of a country first of all

it should make sure the achievement of household food security. Food is a mixture of nutrients that produce energy for the body, stimulate growth, and maintain life. The nutritions can be found from Protein, Carbohydrates, Fats, Vitamins, Minerals, Water etc. In this research we have analyzed data of daily calorie intakes from first three and their conversion units are

1 gram of carbohydrate = 4 calories; 1 gram of protein = 4 calories and 1 gram of fat = 9 calories

Recommended Calorie

The deficit in calories intake, the normal diet of Bangladeshi people is seriously imbalanced with inadequate shares of fat, oil and protein. The 2015 Dietary Guidelines for Americans Estimates Women (DGAEW) need 1,600 to 2,000 calories, while men generally require 2,000 to 3,000 calories each day to maintain a healthy weight. Harvard Medical School suggests adults need 13 to 18 calories per pound of body weight each day to maintain their weight. Therefore, a 125-pound woman needs 1,625 to 2,250 calories each day and a 165-pound man requires 2,145 to 2,970 calories per day, depending on their activity level. Safe and effective weight loss diets for men and women usually contain 1,200 to 1,600 calories per day, according to the U.S. Department of Health and Human Services.

Study Area

The study was carried out in Rajshahi district of Bangladesh which lies between 24°07' and 24°43' north latitudes and in between 88°17' and 88°58' east longitudes. The total area of the district is 2,425.37 sq. km. Administratively the district consists of one City Corporation including 4 Metropoliton Thana and 9 Upazilla. The metropoliton thanas are Boalia, Rajpara, Motihar and Shah Makhdum and the upazillas are Bagha, Bagmara, Charghat, Durgapur, Godagari, Mohanpur, Paba, Puthia and Tanore.

Figure 3.2.1 Map of Rajshahi District

II. Methodologies

In this study, two stage-sampling techniques were employed in collecting data from the selected area. In the first stage, five thanas namely, Bagha, Matihar, Paba, Puthia and Tanore have selected from 13 units and secondly taking 1 village from one thana 5 villages are randomly selected. Thus from selected 5 villages and total 350 households have interviewed under a pre-tested structured questionnaire and the data of assigned variables have collected for the analysis. Thereafter, Factor Analysis have been applied as a data reduction technique.

This section briefly describes Kaiser-Meyer-Olkin (KMO) statistics, and The Bartlett's test of Sphericity used in this present study.

The Kaiser-Meyer-Olkin (KMO) statistics is used to measure the sampling adequacy in the factor analysis. It is a measure for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients. A large value of KMO statistic indicates that the factor analysis of the variables is good and meaningful, since correlations between pairs of variables can be explained by the other variables (Kaiser 1974). Although the food security has been ensured by the food availability, food access and utilization of food for all people of a country or a geographical region in all time have been stated by FAO (1996) we have been intended to measures such food security status of the people of selected region according

to the calorie intake from the daily food. We have developed a Food Security Index (FSI) based on the total calorie intake for the study area with help of the recommended calorie intake is major contribution and innovation of the thesis. The individual households FSI have categorizes into three different groups named as less secured, secured and more secured. Following the classified groups we have been used the data reduction technique namely factor analysis to identify the factor influencing the aforesaid groups. The Bartlett's test of Sphericity and Scree plot also used herewith. We therefore computed the rotated component matrix for extraction of variables in the respective factors.

III. Discussion of the Results

The values of KMO statistics and Bartlett's test of Sphericity for Daily Calorie Intake of the three groups of the respondent in study area parameterized by the food security status are presented in Table 1.

Table 1. KMO and Bartlett's Test of Daily Calorie Intake

	Less Secured Group	Secured Group	More Secured Group
KMO Measure of Sampling Adequacy	0.582	0.745	0.587
Bartlett's Test of Sphericity Approx. Chi-Square(66 df)	627.417	875.531	1058.607
	0.000	0.000	0.000

It is evident from Table 1. that the KMO statistics of sampling adequacy measure for the factor influencing food security by total calorie are 0.582, 0.745 and 0.587. According to Tabachnick and Fidell (1996), if the KMO value is near about 0.60 or above, the KMO statistics of sampling adequacy indicates that the data are adequate for the purposes of exploratory factor analysis. Thus the KMO values obtained in this study is suitable for factor analysis. The Bartlett's test of Sphericity is used to test the hypothesis, H_0: the correlation matrix is an identity matrix. That is all diagonal terms are unity and all off diagonal terms are zero. The Bartlett's tests of Sphericity of factor influencing food security by total calorie are obtained as 627.417, 875.531 and 1058.607. These values are significant at 1% level for all the groups. Thus KMO obtained by this test is characterized by Norussis as "Miserable" and the highly significant level of the test of Sphericity, are both very comfortable indications that the given data sets are adequate for factor analysis separately for the groups. Thus the data are eligible for factor analysis (Norussis, M. J. ,1985). The Scree plot may be used to determine the number of common factors is very important to represent the data. The Scree test advocated by Cattell directs one to examine the graph of Eigenvalues and stop factoring at a point for assigned Eigenvalues. Conventionally the Eigen Value has been set as 1. This method is often superior in locating only the major common factors have been stated by the statistician Kim and Mueller in 1978. The Scree plot for determining the factors influencing food security in considering the total calorie intake for less secured group of the study areas are also given in the following Figure.

Factor wise eigen values, percentages of variance accounted for the factors and cumulative percentages of variance explained by the factors selected for Daily Calorie Intake by Food Consumption for three classified groups are given in Table 2.

Table 2. Factor wise Explained Variation of Daily Calorie Intake by Groups

Food Security Influencing Factors by Daily Calorie Intake	Eigen Value	Percent of Variance Accounted for	Cumulative Percent of Variance
Less Secured Group			
1	3.410	28.414	28.414
2	1.964	16.369	44.784
3	1.742	14.518	59.302
4	1.208	10.063	69.364
Secured Group			
1	5.266	43.880	43.880
2	1.756	14.634	58.514
3	1.237	10.304	68.818
More Secured Group			
1	3.753	31.273	31.273
2	1.967	16.395	47.669
3	1.520	12.665	60.333
4	1.055	8.792	69.125

It is revealed from Table 2. that for the less secured group of daily calorie intake first factor explained about 28.414% of variation, second factor explained 16.369% and together with first factor it explained 44.784% of variation. The third factor explained 14.518% of variation and together with previous two factors it explained 59.302%; fourth factor explained 10.063% and the four factors jointly explained 69.364% of total variation. For secured group, the first factor explained about 43.88% of variation, second factor explained 14.634% and together with 58.51% of variation. The third factor explained 10.30% of variation and Factor 1, Factor 2 and Factor 3 jointly explained about 68.82% of total variation. Lastly for the more secured group, Factor-1 explained about 31.27% of variation, Factor-2 explained 16.39% and the two factors together with explained 47.67%. Factor-3 explained 12.665% and together with previous two factors explained 60.33% of variation. The fourth factor explained 8.79% of variation and finally they explained about 69.12% of total variation. The rotated component matrix also computed and the results are given in table 3-5 as.

Table 3. Rotated Component Matrix of Daily Calorie Intake (Less Secured)

Variables Name	Component			
	1	2	3	4
Age of Respondent	0.400	-0.002	-0.689	0.093
Total Family Member	0.789	0.214	0.504	0.100
Earning Member	0.776	0.059	-0.047	0.181
Dependent Member	0.581	0.216	0.610	0.066
Child Member	0.206	0.056	0.816	-0.075
Aged Member	0.817	-0.051	-0.045	-0.092
Monthly Income	0.087	0.902	-0.070	0.077
Monthly Expenditure	0.216	0.820	0.039	0.336
Additional Income	0.182	0.217	-0.127	0.817
Weekly Food Expenditure	0.035	0.542	0.230	0.076
Agricultural Income	-0.069	0.016	0.014	0.867
Amount of Loan	-0.157	0.516	0.011	-0.344

Table 4. Rotated Component Matrix of Daily Calorie Intake (Secured)

Variables Name	Component		
	1	2	3
Age of Respondent	0.092	0.271	0.649
Total Family Member	0.266	0.781	0.466
Earning Member	0.615	0.294	0.459
Dependent Member	0.075	0.808	0.426
Child Member	0.199	0.793	-0.098
Aged Member	-0.003	-0.069	0.859
Monthly Income	0.788	0.398	-0.092
Monthly Expenditure	0.859	0.346	0.019
Additional Income	0.807	0.004	0.024
Weekly Food Expenditure	0.838	0.289	0.156
Agricultural Income	-0.323	0.250	-0.162
Amount of Loan	0.422	0.664	0.078

Table 5. Rotated Component Matrix of Daily Calorie Intake (More Secured)

Variables Name	Component			
	1	2	3	4
Age of Respondent	0.114	0.004	-0.014	0.829
Total Family Member	0.098	0.784	0.390	0.044
Earning Member	0.184	0.149	0.803	0.277
Dependent Member	0.059	0.936	-0.070	0.012
Child Member	0.057	0.593	0.411	-0.240
Aged Member	-0.082	0.074	0.314	0.763
Monthly Income	0.853	0.093	0.275	0.026
Monthly Expenditure	0.830	0.103	0.395	0.030
Additional Income	0.289	-0.021	0.788	0.052
Weekly Food Expenditure	0.766	0.105	0.300	-0.103
Agricultural Income	-0.054	0.462	-0.179	0.260
Amount of Loan	0.643	-0.119	-0.224	0.097

It is noticed from Table 3 that for less secured group four factors are extracted among them first factor includes the variables such as Total Family Member, Earning Member, Aged Member; the second factor includes the variables Monthly Income, Monthly Expenditure, Weekly Food Expenditure and Amount of Loan; the third factor includes the variables Dependent Member and Child Member and, the last factor identified two variables Additional Income and Agricultural Income.

For secured group, three factors have been extracted and respective variables of the factors are Earning Member, Monthly Income, Monthly Expenditure, Additional Income and Weekly Food Expenditure for Factor 1; Total Family Member, Dependent Member and Child Member for Factor 2; Age of Respondent and Aged Member for Factor 3 are enlisted in Table 4.

For more secured group four factors have been extracted and respective variables of the factors are Monthly Income, Monthly Expenditure, Weekly Food Expenditure and Amount of Loan for Factor 1; Total Family Member, Dependent Member and Child Member for Factor 2; Earning Member, Additional Income for Factor 3 and for last one only two variables are included i.e. Age of Respondent and Aged Member are given in Table 5.
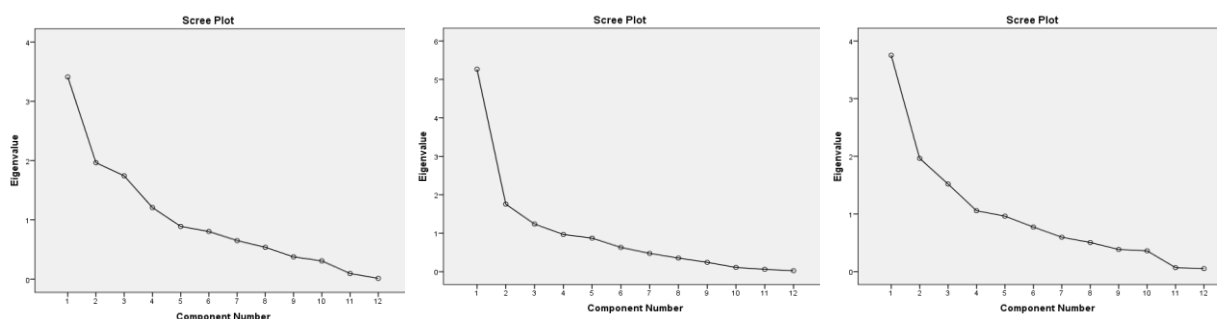
The above Scree Plots is supporting the KMO results of Factor Analysis.

IV. Conclusion

In this research as our objective was to identify responsible variables influencing the food security status of the study region in the aspect of daily calorie intake. Following two stage-sampling techniques 350 households' data have collected for the analysis. As a popular technique of data reduction in multivariate analysis the Factor analysis have been employed. On basis of the authors classified categories less secured, secured and more secured three estimated values of KMO statistics and Bartlett's test of Sphericity for Daily Calorie Intake have been found as (0.582, 627.417); (0.745, 875.531) and (0.587, 1058.607) respectively. The null hypothesis of Bartlett's test of Sphericity is significant at 1% level also indicate that the given data sets are adequate for factor analysis for all three categories.

We have been found that four factors were extracted from the analysis of less secured group and they explained 69.36% of total variation. Three factors were extracted from the analysis of secured group and they explained about 68.18% of total variation. In the case of more secured group, again four factors were extracted for the analysis of daily calorie intake and the four factors together with explained 69.12% of total variation. Among three classified groups we observed that the less secured group is more explained than other.

Finally the variables of extracted factor give the indication that these are important for calorie intake as well as for food security. This is why their contribution has been recorded positively in this research. So this could be a message that if the planners of these areas are very much conscious about these variables, it may have the positive influence for the betterment of the calorie intake level of these research area as well as the country will increase and our vision, our government vision is to touch the developed country should be achieved by nourishing these above factors. So this is very important for the national policy makers of the country.

Reference

[1]. Baffes, J., and M. Gautam (2001).Assessing Sustainability of Rice Production Growth in Bangladesh. Food Policy, Vol. 26, pp. 515-542.
[2]. Begum, M. E. A., M. I. Hossain, and L. D. Haese (2013).Food Security in Bangladesh: Present Status and Trend. Progressive Agriculture, Vol. 24(1 and 2), pp. 263-271.
[3]. Chen Y. and Lu C. (2018). A Comparative Analysis on Food Security in Bangladesh, India and Myanmar. Sustainability 2018, 10, 405. pp. 2-13
[4]. Deb U.K., Hossain M. and Jones S. (2009). Rethinking Food Security Strategy:Self-sufficiency or Self-reliance.
[5]. Debebe Habtewold. 1995. Food security: A Brief Review of Concepts and Indicators. In: Multa. D., Wolday. A., Simeon. E. and Tesfaye. Z. (cds.), Food security. Nutrition and Poverty Alleviation in Ethiopia Problems and Prospects (pp. 1-18), Addis Ababa: Agricultural Economics society of Ethiopia.
[6]. FAO (1983).World Food Security: a Reappraisal of the Concepts and Approaches. Director General's Report, Rome.
[7]. Eneyew A. and Bekele . (2012). Causes of household food insecurity in Wolayta: Southern Ethiopia. Journal of Stored Products and Postharvest Research Vol. 3(3), 35 – 48.
[8]. Fullbrook, D. (2010) Food as Security. Food Security, (2010) 2:5–20
[9]. HIES (2010). Preliminary Report on Household Income and Expenditure Survey, Bureau of Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.
[10]. Hossain, M., F. Naher and Q. Shahabuddin (2005). Food security and nutrition in Bangladesh: Progress and determinants. Electronic journal of Agricultural and Development Economics, Vol. 2(2), pp.103-132.

[11]. Islam, M. M. (2012). The Politics of Food Security in Bangladesh.School of Social Sciences, University of New South Wales.J. Sci. Foundation, 9(1&2): 41-50, June-December 2011 ISSN 1728-7855.
[12]. Kaiser, H. 1974. An index of factor simplicity. Psychometrika 39: 31–36.
[13]. Kim J. O. and Mueller C.W. (1978). Introduction to Factor Analysis: What It is and How to Do It. Sage Publication, Beverly Hills, CA.
[14]. Koning, N. B. J, M. K. Van Ittersum, G. A. Becx, M. A. J. S. Van Boekel, W. A. Brandenburg, J. A. Van Den Broek, J. Goudriaan, G. Van Hofwegen, R. A. Jongeneell, J. B. Schiere and M. Smies (2008). Long-term Global Availability of Food: Continued Abundance or New Scarcity. NJAS Wageningen Journal of Life Science, Vol. 55(3), pp. 229-292.
[15]. Maxwell, S. and M. Smith (1992). Household Food Security: A Conceptual Review, IDS, 1992.
[16]. Mondal M. H. (2010). Crop Agriculture of Bangladesh: Challenges and Opportunities. Bangladesh Journal of Agricultural Research,Vol 35 (2), pp. 235-245.
[17]. Staatz J. M., Boughton D. H. and Donovan C. (2009). Food Security in Developing countries. Critical Food Issues: Problems and Statte-of-the-Art Solutions Worldwide.
[18]. Tabachnick, B. G., & Fidell, L. S. (1996). Using Multivariate Statistics (3rd ed.). New York: Harper Collins.
[19]. UNDP (1994). Human Development Report 1994. Oxford and New York: Oxford University Press.
[20]. Workicho Jatano. 2007. Contribution of small -scale irrigation to households food security and income: the case of Koro Irrigation scheme, Arsi, zone. Unpublished M.A Thesis presented at school of graduate of Haramaya University.