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Measurement of Food Insecurity and Poverty by Different Methods - Does the Method Matter?

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Abstract

A variety of methods was found to use to measure the level of food insecurity and poverty. Among them, coping strategy index (CSI) score, perception analysis, food consumption score (FCS), cost of basic needs (CBN), direct calorie intake (DCI), and food energy intake (FEI) were widely used. This study aims to explore whether method selection does matter in evaluating the level of food insecurity and poverty. The data for this study has been collected from 600 households covering 30 rural clusters (primary sampling units of Bangladesh Bureau of Statistics) of Bangladesh. The CSI score method reveals that 21.2% of the surveyed households are found to suffer from normal food insecurity, 4.5% from moderate food insecurity and 5.4% from severe food insecurity. The perception analysis explores that about 18% of the households appeared to have normal food insecurity, 9.7% moderate food insecurity, and 3.5% severe food insecurity. The Food Consumption Score (FCS) method finds out that 5.6% of the surveyed households suffered from severe food insecurity, about 8% from moderate food insecurity, and 16.2% from normal food insecurity. The findings indicates significant variation among the estimates of food insecurity by different methods. Based on CBN method, it is found that 12.3% households lie below the lower poverty line and about 22.1% below the upper poverty line. Based on the food intake data collected through measurement, it is found that 15.24% households lie below hardcore poverty and 31.78% households lie below absolute poverty. The modified approach (households took less amount of food than required considering age and sex of the members) of DCI method provides that 25.7% households lie in poverty. The incidence of poverty was found to very in-between 13% and 18% by FEI method considering average, weighted average and weighted regression model. The incidence of poverty is found lower when weighted regression model has been applied. Since this study explores significant variations among the estimates by different methods, method selection does matter in estimating the incidence of poverty and the level of food insecurity.

Keywords: Food Insecurity, Poverty, Coping Strategy Index score, Perception Analysis of Food Security, Food Consumption Score Method, Cost of Basic Needs Method, Direct Calorie Intake Method, and Food Energy Intake Method.

AMS Classification: 91B82.

1. Introduction

Food security has been a major concern for human beings since the dawn of mankind, particularly civilization. On the contrary, the concept of measuring food security has emerged much later with the advent and development of science and technology. Intuitively, both food insecurity and poverty appear synonymous to mass people; though interlinked, but differ from each other. A number of studies have been conducted on different dimensions of food security that identified lack of economic and social access to food items to meet daily dietary need as the major reason for food insecurity (Dash, 2005; GOB-WFP, 2005; Hossain, 1989; Kazalet al., 2010; 2017; Kundu, 2004; WFP-IFPRI-BBS, 2007). Different measurement techniques were found to use by several studies at home and abroad (Bickel et al., 2000; Fengyinget al., 2011; Hossain et al., 2014; Maxwell and Caldwell, 2008; Nguyen and Winters, 2011). In a UN manual, Maxwell and Caldwell (2008) illustrate the Coping Strategy Index score method to evaluate the level of household food insecurity. The Food Expenditure method was used by Nguyen and Winters (2011) for Viet Nam data and Karambaet al. (2011) for Ghana data to measure food security at household level. Since 2003, WFP conducted Comprehensive Food Security Vulnerability Analysis (CFSVA) in a number of countries to understand the in-depth picture of the food security situation and the vulnerability in a given community. An analysis of food security and vulnerability in six counties of rural China was conducted in 2011 through collection of data using Food Consumption Score (FCS) method (Fengyinget al., 2011). In a study, Kazalet al., (2010) have estimated the level of food security of haor people of Bangladesh by using Direct Calorie Intake (DCI) method, Cost of basic needs (CBN) and Perception Analysis. In a recently conducted study, Hossainet al.(2014) used four techniques, viz., Perception Analysis, DCI, Food Expenditure and CSI score for measuring food security to investigate the implications of rural-urban migration on food security in Bangladesh with a view to sharpening policy-makers' understanding in order to strengthen food security for the individuals/households involved in this process. The ADB study documented that the Asian countries used different methods to estimate the poverty line (Kakwani, 2003). After evaluation of poverty lines estimation of several Asian countries including India, Pakistan, Bangladesh, Nepal, and

Hossain: Measurement of Food Insecurity and Poverty ...

Thailand, Kakwani (2003) has concluded that most countries do not have consistent poverty lines, which might provide biased estimates of the incidence of poverty.

In the context of measuring poverty, Bangladesh Bureau of Statistics has used all commonly known methodologies for poverty measurement since 1973-74 through several rounds of Household Income and Expenditure Surveys (Ahmed, 2004). In early years, BBS used mainly the Direct Calorie Intake (DCI) method of poverty line estimation, and a little later the Food Energy Intake (FEI) method. Since the mid-1990s it has switched to the Cost of Basic Needs (CBN) method. The BBS has used both DCI and CBN methods for estimating poverty level in Household Income and Expenditure Survey 2000 (BBS, 2001). In HIES-2010 and HIES-2016, the BBS has collected information on food consumption of the households for 14 days by paying 7 visits, that is, information and data on food consumption of previous two days were collected during each visit (BBS, 2017).

The researchers and practitioners are found to adopt easy access methods in measuring food insecurity and poverty without much more thinking about choice of methods. However, the estimates may differ due to the methodological differences of data collection by different methods of measuring food insecurity and poverty. Therefore, it is essential to verify whether the level of poverty and food insecurity vary due to selection of measurement methods. The aim of this study is to explore the status and intensity of food insecurity and/or poverty of the surveyed households in order to identify whether the status of food insecurity and poverty differs due to measurement methods. This study considers (i) coping strategy index (CSI) score, (ii) perception analysis, and (iii) food consumption score (FCS) methods to measure the level of food insecurity; while (i) cost of basic needs (CBN), (ii) direct calorie intake (DCI), and (iii) food energy intake (FEI) methods have been used to measure the extent of poverty.

2. Materials and Methodology

Literature suggests that the status of food security can be measured through perception-based information. However, numerically measured data is essential to measure the level of poverty. As the study require to gather primary cross-section data from a representative number of households for estimating the level of food insecurity and poverty, a household-level survey was conducted. In addition, participatory rural appraisals have been conducted to collect the community-based data to measure the food security through CSI and FCS method. The household survey is designed in such a way that it has covered all the information to measure food insecurity and poverty through CSI, Perception, FCS, CBN and DCI methods. Special emphasis has been given on 3-days' food intake data, which is collected through both perception and weight scale.

The data for this study has been collected through a research project "Reducing the Errors in the Measurement of Food Security in Bangladesh through Development and Implementation of an Innovative Method", sponsored by the Ministry of Education, Government of Bangladesh under the canopy of *Grants for Advanced Research in Education* (GARE) (Hossain and Ahmed, 2019). The study has adopted cluster-sampling method in which the *primary sampling units* of Bangladesh Bureau of Statistics (BBS) have been considered as clusters. Following formula has been used to determine the sample size for household-level survey:

 $n = \frac{p(1-p)Z^2}{(0.18p)^2} \times Deff$

where p is the indicator percentage, Z is the value of normal variate with 95% confidence interval, $0.18 \times p$ is the relative error margin and *Deff* is the design effect. Following the above formula with 24% indicator percentage (proportion of households lie below the poverty line), 95% confidence interval and assumed design effect 1.5, the study planned to collect data from 600 households covering 30 rural clusters of Sylhet division of Bangladesh. The analysis has been performed based on the data of 538 households, because the complete data, particularly 3-days food intake, were not available for the rest of the households.

In addition to the household-level data, some information was required to collect from community level through Participatory Rural Appraisal (PRA) for measuring food security by coping strategy index score and food consumption score method. Hence, the study collected necessary data and information from both households and related communities for measuring food security by all the conventional techniques as well as direct calorie intake method through innovative approach. The measurement methods of food security (coping strategy index score, perception analysis, and food consumption score) and poverty (cost of basic needs, direct calorie intake, food energy intake) are briefly described in ANNEX-1.

3. Result and Discussions

The study estimates the level of food insecurity and poverty by different methods using an empirical primary dataset covering both perception-based and

numerically measured information. Following sections have categorically describe the findings of selected six methods of measuring the level of food insecurity and poverty.

3.1 Coping Strategy Index (CSI) Score Method

The value of CSI score is generally used to assess the relative position of food insecurity among/between different households instead of assessing the absolute position. However, the relative position of food insecurity can be considered based on inter-household comparison at the same point of time and based on intra-household at the different points of time or over time. A low CSI score indicates less food insecure (i.e. more food secure) than that of high score. The coping strategies index data are more powerful if they are analyzed and interpreted over multiple time periods, among multiple locations, and/or across specific groups (sub-populations) including the evaluation of an intervention program.

The coping strategies index (CSI) score has been computed for the households who had reported to suffer any form of food insecurity, mainly had been anxious about sufficient food during the three months prior to the survey. The CSI method has the advantage that it provides the degree of food insecurity rather than status of food insecurity. In a study, Kyaw (2009) categorized the households into four groups based on the coping strategies index (CSI) score: No (Score=0), Low (score 1-19), Medium (score 20-30) and High (score 31 & above). In the similar fashion, the study households have been categorized based on the CSI score and Table 1 shows the results.

It is found that 21.2% households have low CSI score, indicating that they were less food insecure, and hence can be treated as suffering from normal food insecurity. The findings indicate that 4.5% households had medium CSI score and these households can be treated as moderately food insecure. It is found that 5.4% households had high CSI score, indicating that they are suffering from severely food insecure. The rest of the households (69%) had zero CSI score, since they were not anxious about food deficit in their households, and consequently these households were not asked about the coping strategies. The proportion of households suffering from different levels of food insecurity is somewhat consistent with the perception-based food insecurity levels.

CSI Score	% of	Remarks on the status of food	
	Households	insecurity	
No CSI Score (0)	69.00	No food insecurity	
Low CSI Score (1-19)	21.20	Normal food insecurity	
Medium CSI Score (20-30)	4.50	Moderate food insecurity	
High CSI Score (above 30)	5.40	Severe food insecurity	
Mean CSI Score± SD	5.59 ± 12.11		
Total (n)	538		

Table 1: Coping Strategies Index (CSI) Score of the Sampled Households

3.2 Perception Method

Three questions were asked to the respondents (preferably household heads) to understand the level of food insecurity of the surveyed households. This was scaled as normal (had been anxious about sufficient food), moderate (took less than 3 meals a day) and severe (slept with hunger) according to the responses. Table 2 shows the percentage of households suffering from different levels of food insecurity. It is to be noted that the results portrayed in the Table specify that the households who suffered from severe food insecurity, also suffered from moderate and normal food insecurity; similarly, those who suffered from moderate food insecurity, also suffered from normal food insecurity. It is also mentionable that in calculating the incidence of food insecurity in different scales, the denominator indicates the total number of cases for pertaining group of households.

At first, the respondents were asked whether they had been anxious about sufficient food during the three months prior to the survey. About 18% of the respondents of were anxious about food deficit in their households. Among them, over three-fifths claimed that they faced the problems for sometimes and near one-quarter faced the same problem for most of the times.

The households who were anxious about sufficient food, i. e. suffering from normal food insecurity, were further asked whether they had to take less than three meals in a day. About 10% respondents agreed that kind of food insecurity. According to them, the moderate food insecurity situation happened most frequently for about 14% cases, sometimes for about 71% cases and suddenly for about 15% cases (Table 2). While these respondents were questioned whether they had been bound to sleep with hunger during last three months prior to the survey, only about 4% respondents agreed to have experienced the same situation.

	Status of foo	us of food insecurity		Frequency of insecurity	
Status of Food Insecurity	No. of	% of	Very	Sometimes	Sudden
	Households	Households	often		
Had been anxious about					
sufficient food	96	17.80	24.0	61.5	14.6
(normal food insecurity)					
Had been bound to take					
less than three meals in a					
day	52	9.70	13.5	71.2	15.4
(moderate food					
insecurity)					
Had been bound to sleep in					
hunger	19	3.50	15.8	42.1	42.1
(severe food insecurity)					
Not anxious about	442	82.20	_	_	-
sufficient food					
Total = 538					

Table 2: Food Security Status with Its Degree by Perception Method

3.3 Food Consumption Score (FCS)

The food consumption score (FCS) has been constructed following several steps as stated below:

- a) A seven day recall of the frequency of consumption of major food groups (cereals, pulses, vegetables, fruits, meat and fish, milk, sugar, oil) are collected for each of the surveyed households,
- b)Each food groups is assigned a weight based on relative nutritional value following WFP standard,
- c) The weight is multiplied by the frequency of consumption and summed to generate FCS. It is to be mentioned that the frequency has been converted to 7 if it becomes more due to inclusion of multiple food items into one food group.

The FCS scores have been categorized considering the suggested category for Bangladesh in the Technical Guideline for constructing Food Consumption Score (IFPRI, 2009) and Table 3 shows the results. It is found that 5.6% of the surveyed households have poor food consumption score (28 or less), may be treated that these households are suffered from severe food insecurity. About 8% households have borderline food consumption score, indicating that these households are moderately food insecure. It is found that 16.2% households have low food consumption score, demonstrating that these households are suffered from normal

food insecurity. The rest of the households (70.4%) can be treated as food secured households.

Food Consumption Score (CSI)	Status of food insecurity (% of HHs)		
Poor consumption (score: ≤ 28)	5.60		
Borderline consumption (score: 29 to \leq 42)	7.80		
Acceptable low consumption (score: 43 to \leq 52)	16.20		
Acceptable high consumption (score: 53+)	70.40		
Mean CSI Score ± SD	62.94 ± 21.20		
Total (n)	538		

Table 3: Food Consumption Score (FCS) of the Sampled Households

3.4 Cost of Basic Needs (CBN) Method

In Bangladesh, poverty is quantified based on a per capita minimum diet of 2122 calories, termed as "absolute poor". "Hard-core poor" describes one who does not have a sufficient income to meet even an energy intake of 1,805 calories (WFP, 1997). The terms "ultra poor" and "hungry poor" are used to identify the poorest of the poor. According to WFP, they are those poor in Bangladesh who live below the poverty line of 1600 calories food intake. It is documented that an adult person in Bangladesh requires an average minimum amount of 832 gm of food a day, which is converted to 2122 k.cal energy (BIDS, 1997). The suggested food combination was 397gm of rice, 40gm of wheat, 40 gm of pulse, 58gm of milk, 20gm of oil, 12 gm of meat, 48gm of fish, 27gm potato, 150gm of vegetables, 20gm of sugar, and another 20gm of fruits. In practice, the rural people are dependent more on rice than on other items. In a study, the BBS has used a larger combination of food and per capita per day intake of rice was suggested as 455.01gm (BBS, 2001). The per capita per day food combination for this study has been prepared by considering the food combination suggested by BBS (2000) and BIDS (1997).

In order to meet 2122 k.cal per capita per day energy requirements, the study considered the food combination as 448gm of rice, 36.6gm of wheat, 9.5gm of pulse, 29.6gm of milk, 8.6gm of oil, 9.6gm of meat, 29.1gm of fish, 61.1gm potato, 129.8gm of vegetables, 33.9gm spices, 7gm of sugar, and another 20gm of fruits. The costs of the selected 832gm of food stands Tk. 41.84 at the survey point. Table 4 shows the estimate of the poverty lines and the incidence of poverty

Hossain: Measurement of Food Insecurity and Poverty ...

by head count ratio. Using the selected food combination and price, the food poverty line had been estimated as Tk.15271.60 per capita per year. The per capita per year "lower" and "upper" allowances had been estimated as Tk. 2315.43 and Tk. 6850.85 respectively, which were 15.16% and 44.86% of the food poverty line expenditure. The corresponding per capita per year "lower" and "upper" poverty lines had been estimated as Tk. 1449.92 and Tk. 1818.39 respectively. The non-food expenditure was found consistent with other studies of Bangladesh. By converting the per capita poverty lines into household level, the "lower" and "upper" poverty lines for the study population had been estimated as Tk. 92859.52 and Tk. 116806.54 respectively (Table 4). The result suggests that 12.3% households lie below the lower poverty line and about 22.1% below the upper poverty line. The incidence of poverty estimated by CBN method for the study population was found consistent with the national figures (12.9% by lower poverty line and 24.3% by upper poverty line for rural Bangladesh) reported by BBS through HIES-2016 (BBS, 2017).

Per capita Food Poverty Line (Z_f)		15271.6		
Per capita lower allowance	2315.4	Per capita lower poverty line	17587.03	
$(ZL_n)^{**}$	3	$(ZL = Z_f + ZL_n)$		
Per capita upper allowance	6850.8	Per capita upper poverty line	22122.45	
$(ZL_n)^{**}$	5	$(ZU = Z_f + ZU_n)$		
Per household lower poverty line	92859.	% HH below the lower poverty	12.3	
expenditure	52	line expenditure		
Per household upper poverty line	116806	% HH below the upper poverty	22.1	
expenditure	.54	line expenditure		

Table 4: Incidence of Poverty at Household Level by CBN Method

** $ZL_n = E[y_i - x_i | y_i = Z_f]$ and $ZU_n = E[y_i - x_i | x_i = Z_f]$, where y denotes the total per capita consumption; x denotes the food per capita consumption and Z_f denotes the food poverty line.

3.5 Direct Calorie Intake (DCI)

For estimating the incidence of poverty by the direct calorie intake method, the food consumption data collected through measurement (innovative approach) is used (Hossain and Ahmed, 2019). The incidence of poverty by direct calorie intake method is shown in Table 5. It is found that 15.24% households lie below hardcore poverty and 31.78% households lie below absolute poverty. The innovative approach (households took less amount of food than required considering age and sex of the members) of DCI method provides that 25.7% households lie in poverty.

Households lie below hardcore poverty (<1805 K.Cal)	15.24
Households lie below absolute poverty (<2122 K.Cal)	31.78
Households took less amount of food than required considering age and sex of the members	25.7

Table 5: Incidence of poverty by Direct Calorie Intake Method

3.6 Food Energy Intake (FEI)

The CBN approach needs information on the prices of the goods that the household required to meet their energy requirements. When price data are not available, the *food energy intake method* were used by a number of researchers. The goal is to find the level of consumption expenditure (or income) that allows the household to obtain enough food to meet its energy requirements. Actually, the food-energy-intake (FEI) method is an alternative of CBN method. This method developed a poverty line expenditure/income in which an individual's food energy intake is sufficient to satisfy per day energy requirement. In the context of Bangladesh, BBS suggested that on average 2122 k.calenergy is sufficient for an individual.

The data of per capita total monthly expenditure (food and non-food) (or per capita total monthly income) and per capita calorie intake is needed to calculate the poverty line. A simple way of the estimation of poverty line includes the computation of average expenditure (or income) of a subsample of households, whose estimated calorie intakes are approximately 10% deviation (the range of 10% plus & minus) of minimum required calorie (2122 k.cal). The average expenditure (or income) of households are finally used as a cut-off point of poverty line.

Another method of calculating poverty line includes an algebraic form of exp ($\hat{a} + \hat{b} \times 2122$), where \hat{a} and \hat{b} are the estimates of the cost-of-calorie model which are obtained by weighted regression method (Greer and Thorbecke, 1986). The functional form of the cost-of-calorie model is: Ln(E) = $a + b \times C + u$; where E is the per capita total monthly expenditure (or income) and C is the per capita amount of calories obtained from the food basket.

For the estimation of poverty line, unweighted average, weighted average and weighted regression model have been applied. A household is then declared to lie in poverty if per capita monthly total expenditure (or income) is less than poverty line. Table 6 shows the incidence of poverty for simple average, weighted average and weighted regression model, where weight has been given by population

density of the region and asset scores of the households. The incidence of poverty is estimated at 16.4% for simple average method using the cut-off point of per capita monthly expenditure. However, it is found 15.1% and 18.0% for weighted average methods where weight has been assigned by population density and asset score respectively. The incidence of poverty is found lower when weighted regression model has been applied. The overall findings indicate that the incidence of poverty varied in-between 13% and 18% by FEI method with different models and approaches.

Required Calorie	2122 kcal			
Unweighted average method				
Average expenditure within 10% variation of required calorie	3270.67			
Average income within 10% variation of required calorie	3973.09			
% of households lie below the average expenditure of required calorie	16.4			
% of households lie below the average income of required calorie	16.7			
Weighted average method: Weight by population density				
Weighted average expenditure within 10% variation of required calorie	3185.94			
Weighted average income within 10% variation of required calorie	3827.99			
% of households lie below the weighted average expenditure of required	15.1			
calorie				
% of households lie below the weighted average income of required	16.0			
calorie				
Weighted average method: Weight by asset score of the household				
Weighted average expenditure within 10% variation of required calorie	3676.58			
Weighted average income within 10% variation of required calorie	4777.88			
% of households lie below the weighted average expenditure of required	18.0			
calorie				
% of households lie below the weighted average income of required	18.4			
calorie				
Weighted Regression method: Weight by population density				
Poverty Line: Exp (7.68+0.000142×2122) based on the regression model:	2925.80			
$Ln(Expenditure) = 7.68+0.000142 \times Calorie$				
Poverty Line: Exp (7.54+0.000201×2122) based on the regression model:	2882.81			
$Ln (Income) = 7.68 + 0.000201 \times Calorie).$				
% of households lie below the poverty line based on expenditure	13.4			
% of households lie below the poverty line based on income	12.6			
Weighted Regression method: Weight by asset score of the household				

Table 6: Incidence of poverty by Food Energy Intake method

Poverty Line: Exp (12.06+0.000059×2122) based on the regression	3158.74
model: Ln(Expenditure) = 12.06+0.000059×Calorie	
Poverty Line: Exp (11.85+0.000129×2122) based on the regression	2983.09
model: $Ln(Income) = 11.85 + 0.000129 \times Calorie.$	
% of households lie below the poverty line based on expenditure	14.9
% of households lie below the poverty line based on income	12.8

4. Conclusion

This study estimated the level of food security using three methods viz, coping strategy index score, perception analysis, and food consumption score. On the other hand, the level of poverty has been evaluated by three methods, viz., cost of basic needs, direct calorie intake, and food energy intake. The level of food insecurity has been estimated 21.2% by coping strategy index score, 18% by perception analysis, and 16.2% by food consumption score method. The incidence of absolute poverty was found 22.1% by cost of basic needs method, 31.78% by direct calorie intake method, and 13-18% by food-energy intake method with different approaches. The incidence of absolute poverty has been estimated at 25.7% by modified approach of direct calorie intake method (households took less amount of food than required considering age and sex of the members). The findings indicate that the level of food insecurity and poverty varied according to the methodological variation, i.e. all the methods did not provide uniform result. Among the measurement methods used in this study, direct calorie intake method provided highest level of poverty. The high incidence of poverty through direct calorie intake method has been observed by several studies (Hossain et al., 2014; Kazal et al., 2010; 2017). The findings clearly revealed that the conventional methods of measuring poverty underestimated the level of poverty and food insecurity. The study recommends for re-thinking about choice of methods to estimate the level of food security and poverty since the estimates varied due to the methodological differences of data collection by different methods.

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Annex-I: Measurement Methods of Food Security and Poverty

(i) Coping strategy index (CSI) Score

The CSI score will be constructed by using the food insecurity coping strategies adopted by the respective households. This method estimates the level of household's food insecurity using a set of questions related to the adopted coping strategies by the household during crisis period. A series of questions about how household manage to cope with a shortfall in food for consumption results in a sample numeric score. The CSI score is constructed in four steps. In the first step, the locally adoptable coping strategies are listed a priori and finalized after a thorough investigation. In the second step, the adopted coping strategies by the food in-secure households are documented along with their respective frequencies. In the third step, the severity weight of the coping strategies is determined through conducting interviews at community level; and finally in the fourth step, the scores obtained by multiplying the frequencies with respective weights are summed up to have the CSI score. The following questions and weights have been assigned for implementation of the method.

Did you (Read coping strategy)during the last fortnight?		Yes=1, No=2	If yes, how frequently? (Code)
a.	Rely on less preferred and less expensive foods		
b.	Undertaking more jobs and/or/working longer hours		
C.	Borrow food or rely on help from a friend or relative		
d.	Purchase food on credit		
e.	Gather wild food, hunt or harvest immature crops		
f.	Consume seed stock held for next season		
g.	Send household members to eat elsewhere		
h.	Sending children for working		
i.	Send household members to beg		
j.	Limit portion size at mealtimes		
k.	Restrict consumption by adults in order for small children to eat		
1.	Feed working members at the expense of non-working members		
m.	Reduce number of meals eaten in a day		
n.	Skip entire days without eating		

Every day (All 15 days)=1;.Most days (10-14 days)=2; Half the time (6-9 days)=3;.Some days (1-5 days)=4;.Never (No day)=5.

(ii) <u>Perception Method</u>

Three questions are asked to the respondents to understand the level of food insecurity of their households. These are - whether the households had been anxious about sufficient food; whether the household members took less than 3 meals a day; whether the household members slept with hunger during the last 3 months; and the corresponding level of food insecurity is scaled as normal, moderate and severe respectively.

(iii) Food Consumption Score (FCS) Method

Since 2003, WFP conducted comprehensive food security vulnerability analysis (CFSVA) in a number of countries to understand the in-depth picture of the food security situation and the vulnerability in a given community. An analysis of food security and vulnerability in six counties of rural China was conducted in May 2011 through collection of primary data and the information from secondary sources (Fengying *et al.*, 2011). The study used food consumption score (FCS) to measure the food security situation. In this method, a seven day recall of the frequency of consumption of major food groups (cereals, pulses, vegetables, fruits, meat and fish, milk, sugar, oil) are collected and then each food groups is assigned a weight based on WFP standard which reflect the relative nutritional value of each group. Finally, the weight is multiplied by the frequency of consumption and summed to generate FCS.

(iv) DCI Method

The earliest official poverty estimates in Bangladesh were made through the usage of the DCI method. Using this method, poor households were defined as those with per capita energy intake less than the standard per capita requirement of energy. Reviews made of the DCI method conclude that it results in a consistent poverty line in terms of reflecting the same nutrient intake. The number and percentage of poor are easy to understand because of the simplicity and transparency of the standard used. Under the DCI method, data collected from the households on food consumption (quantities) are converted to calorie by multiplying each food item consumed by that household by its corresponding calorie content. The conversion factor derived by the Institute of Nutrition and Food Science, Dhaka University, is used. The population/households consuming less than 2122 kilocalories (kcal) are defined as poor.

(v) FEI Method

It is said that the DCI measures "undernourishment" and not poverty. Therefore, the food energy intake (FEI) method has been used officially along with the DCI method. The FEI method sets the poverty line as the income or consumption level at which "basic needs" are met. It estimates the poverty line based on the empirical relationship between food energy intakes and consumption expenditure. This method, like the DCI method, is consistent in terms of calorie intake, since individuals at the poverty line, on average, have the same food energy intake. But this poverty line, when converted into expenditure levels, has a consistency problem. Instead of representing, a consistent cut-off that should differ only with the cost of a fixed basic needs bundle, the expenditure level is in fact a revealed preference based on different market conditions where individuals operate.

Under the FEI method, a poverty line expenditure is determined based on the threshold calorie intake of 2122 k.cal from the food and non-food expenditure using the semi-log model:

 $ln(E) = a + b \times C$, where E is the per capita expenditure per month (food + non-food) and C is the per capita calorie intake per day.

(vi) CBN Method

The Bangladesh Bureau of Statistics uses the CBN method for analyzing the data of Household Expenditure Survey (HES) 1995-96 in order to estimate poverty line (BBS, 2001). This method sets the poverty line by computing the cost of a food basket that enables a household to meet predetermined nutritional requirements, and adds to this an allowance for basic non-food consumption. The CBN method yields a poverty line that provides for non-food needs and is consistent in terms of the assumed living standard. The CBN method estimates the poverty level in a year in three steps.

First, the cost of a bundle of fixed food items is estimated. The food items are rice, wheat, pulses, milk, oil, meat, fish, potato, vegetables, sugar and fruits, which provide minimal nutritional requirements corresponding to 2,122 K.cal per day per person. The required quantities in the food bundle is denoted by $(F_1, F_2,...,F_N)$ to meet the calorie requirement; that is, F_j is the required per capita quantity of the food item j. The food poverty line is computed as $Z_f=\Sigma P_jF_j$, where P_j is the unit price of j-th food item.

International Journal of Statistical Sciences, Vol. 20(1), 2020

In the second step, two non-food allowances for non-food consumption are computed. First one was obtained by taking the amount spent on non-food items by those households whose total consumption is equal to their food poverty line Z_f . These households spend less amount on food than the food poverty line and spend only on the essential items in non-food consumption. Algebraically, if the total per capita consumption is denoted by y and food per capita consumption by x, the "lower" allowances for non-food consumption were estimated as $ZL_n=E[y_i-x_i|y_i=Z_f]$, where E denotes the mathematical expectation. The second one, "upper" allowances, was obtained by taking the amount spent on non-food items by those households whose food expenditure was equal to the food poverty line. These households do meet their food requirement comfortably. Mathematically, the "upper" allowances for non-food items can be expressed as $ZU_n=E[y_i-x_i|x_i=Z_f]$. Obviously, ZU_n is larger than ZL_n , because the share of food expenditure in total consumption decreases as consumption increases.

In the third step, estimation of the poverty lines consisted simply of adding to the food poverty line with the "lower" and "upper" non-food allowances to yield the total lower and upper poverty lines.

Lower poverty line: $Z_L=Z_f+ZL_n$ where $ZL_n=E[y_i-x_i|y_i=Z_f]$ Upper poverty line: $Z_U=Z_f+ZU_n$ where $ZU_n=E[y_i-x_i|x_i=Z_f]$

The difference between the two lines is due to the difference in estimation of the allowances for non-food consumption. The lower poverty line incorporates a minimal allowance for non-food goods, while the upper poverty line includes more allowance.