Measuring Household Food Security: 
A Dimension Based Approach

Bishweshwar Bhattacharjee

Former Research Scholar, Department of Economics, Assam University, Silchar, Pin: 788011, Assam, India, Mobile: 9859044684, Email: bbishweshwar@yahoo.co.in

Abstract: One’s nutritional status, health, physical and mental faculties depend on the food one eats. Thus, access to good quality food has been man’s main endeavour from the earliest days of human existence. The importance of food for human existence brings the concept of food security into the limelight, which is getting expanded to include four aspects of food availability, food access and food utilization and stability. But to date, no research is undertaken to measure food security considering all dimensions. In this regard, the per capita calorie availability is used to assess the food availability in a household. Food accessibility is judged by the change in economic access to food. The utilization of food at the household level is judged from the processing, preparation and preservation practice of food along with health and drinking water accessibility status. Finally, for capturing the stability aspect the standard of living of the household is evaluated. This information is utilised to gauge household food security status. This sort of analysis would help in accurately classifying households concerning their food security status.

Key Words: Food Security, Availability, Accessibility, Utilisation, Stability, Household
1.0 Introduction

Food security has more than 50 years of history of being accepted internationally in the historic Hot Spring Conference of Food and Agriculture in 1943 (Gross et al., 2000). However, the term got introduced at the World Food Conference in 1974 which later evolved, developed, multiplied and diversified over time (Maxwell, 1996). This leads to the focus shift from global to the household level acknowledging the human right to food. Food security thus exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life (Napoli et al., 2011). Household food security is the application of this concept to the family level, with individuals within households as the focus point. This definition reflects four dimensions as food availability, accessibility, utilisation and stability (Bhattacharjee, 2017). Food availability is a concept that emphasizes the relationship between population and food. This refers to the combination of domestic food production, commercial food imports and exports, food aid and domestic food stocks. Food security is majorly determined by food availability and food trade (Burchi and De Muro 2015). Food accessibility refers to the act of making food available to all at any particular time. For this to be ensured, all individuals within households must have sufficient resources to acquire appropriate foods (through production, purchase or donation) for a nutritious and healthy diet (Mbow et al., 2019). The nutritional impact of food on the consumer, its preparation, and overall state of health is the main priorities of food utilization (Dutta and Saikia 2018; Mbow et al. 2019). Food stability, the fourth dimension of food security, is the ability of people to have continuous access to food (Mbow et al., 2019). More so, there is no clear composite measure that tries to measure food security comprising all of its goals (Altman, 2009). The present study tries to bridge this gap through

1 Household is defined as a group of people living together and eating from the same pot.
building a comprehensive index of food security encompassing all four dimensions of food security. This involves three steps: identification, aggregation and categorization. Identification is related to identifying various indicators, while, aggregation is concerned with deriving food security statistics for the households. Finally, categorization of households is being made across various levels of food security (Bhattacharjee, 2017).

2.0 Approaches in Measuring Household Food Security: A Review

Analysts previously operate on the principle that other needs are usually satisfied when calorie intake is sufficient (Maxwell and Smith, 1992). So, the measurement of food security is undertaken through the use of the Calories Gap Approach by classifying households into two categories: food secure (calories sufficient) and food insecure (calories deficit) (Singh and Datta, 2015). But often there is a double burden of malnutrition – undernutrition accompanied by overnutrition and obesity which raises doubt on the relevance of calories as an indicator of food access. This initiated various researchers to undertake indicators such as quantity measured by the number of meals per day; diversity measured by various food group consumption; access by sources concerning household food; and quality by the changes in the pattern of diet change in adverse situations (Diehl, et al., 2019). As these measures cannot be used to measure the food security in a wholesome manner, so, in the quest for measuring food security, a short-form six-item Household Food Security Scale (HFSS) (Blumberg et al., 1999) was constructed and subsequently revised in a four-items version including adequacy of money in buying the food, affordability of balanced meal representing a measure of dietary quality (Gulliford et al., 2003; Gulliford et al., 2006) occasions of skipping meals, affordability of enough food (Agarwal et al., 2009; Bhattacharjee, 2012). Measuring from the food insecurity side, various indicators have been used. Among these indicators, the promising tool is the household food insecurity access scale (HFIAS). The scale captures the
extent of worry about households not having enough food, meals, preferred food and variety of food (Chatterjee et al., 2012; Chinnakali et al., 2014; Keshari and Shankar, 2016). With these indicators, simple derived measures such as household dietary diversity score, Body mass Index or nutritional status provide additional complementary data of the prevailing situation (Coates et al., 2007; Haddad et al, 1994) Another similar approach is the Food Insecurity Experience Scale. This scale reckons household food- related behaviours associated with difficulty in accessing food due to resource constraints with a set of questions (Srivastava et al., 2014).

Some studies integrated the measurement concepts of food security and food insecurity to compute the Food Security Index. It is calculated with the difference between a minimum of four food security measurements and a maximum of two food insecurity measurements. The four components of food security developed are namely Household Diet Diversity Score, Food Consumption Score, Coping Strategy Index, Self-Assessed Food Security Scale, and two components of household food insecurity namely Household Hunger Scale and Household Food Insecurity and Access Scale.

Following Deaton and Dreze (2009), casting doubt on the validity of the hunger questions, or the relevance of the calorie norms, or even both, researchers tried to follow the conventional components embedded in the definition of food security. Three mainly important components: food quantity available in the household, food quality as captured by diet diversity and stability of adequate food supplies are utilised to construct a composite food security index by incorporating several indicators (Adjimoti and Kwadzo, 2018). However, the literature lacks in capturing all four dimensions while dictating a measure of household food security.

3.0 Household Food Security: Dimension based Approach
Household food security is a complex phenomenon. It is mainly the interaction of four aspects of food availability, food access, food utilization and stability which results in a situation of food security. Food availability, food access and food utilization and stability dimensions are not separate phenomena they overlap. (Chambers, 1989; Foster, 1992; Maxwell, 1995).

3.1 Availability Dimension

For estimating the food availability in a household, the per capita calorie availability of a household is taken as a proxy variable since it acts as a ‘gold standard’ indicator of food security (Burchi and Buro, 2015; Chung et al., 1997; Maxwell et al., 1999; Riely et al., 1995). Firstly, the nutrient content of both produced and purchased food items for various food groups (See Appendix 1.1) is calculated in terms of kcal. We have taken a 7 days recall period (Hossain et al., 2016) (as a short duration recalling of the consumed item becomes easier) of food item in attaining information about the produced and purchased food items of the household. The value of the total calorie available to the household is divided by the adjusted household size (See Appendix 1.2) to arrive at the per capita calorie availability of a household.

\[ PCCA_i = \frac{CA_i}{AHS_i} \ldots(1) \]

Where,

\[ PCCA_i = \text{Per Capita Calorie Availability of the } i^{th} \text{ Household} \]

\[ CA_i = \text{Calorie Availability in the } i^{th} \text{ Household} \]

\[ AHS_i = \text{Adjusted Household Size of the } i^{th} \text{ Household}. \]
These values are normalised following the Max-Min Approach. Under this approach, firstly minimum and maximum values (goalposts) are chosen. Then we use the formula provided in equation (2) to get food availability index for the $i^{th}$ Household.

$$FAVI_i = \frac{(CA_i - \text{Min}(PCCA))}{\text{Max}(PCCA) - \text{Min}(PCCA)} \ldots (2)$$

Where,

$FAVI_i =$ Food Availability Index for the $i^{th}$ Household

$CA_i =$ Calorie Availability in the $i^{th}$ Household

$PCCA =$ Per Capita Calorie Availability.

### 3.2 Accessibility Dimension

But, food availability by itself does not ensure adequate access to food: though adequate food availability is necessary for food access. Food accessibility indicates having physical, economic and social access (Bhattacharjee, 2017). From a household point of view, economic access becomes more vital. Food accessibility issues arise when food is available but people are unable to afford it (OXFAM, 2007). So, for assessing the condition of food access in a household we construct a food accessibility index which assumes values based on a comparison of household-specific food price impact index and income index as detailed in equation (5).

So, a household-specific food price impact index for each household is constructed. For this, a set of standard food baskets is selected comprising various food groups (See Appendix 1.1). The price level of these food items' is to be collected for the five consecutive periods i.e. for the period under consideration and also for the four preceding periods. Then logarithmic transformations of these values are carried on as it evens out fluctuations (Mohanty and Dehury, 2012). A base period average price ($P_0$) of various items is calculated by aggregating these four preceding period price values (Chiripanhra, 2011). The current period price
values would correspond to the current period price \( (P_n) \) for various items. We shall use Fisher’s Ideal Index Number Formula for calculating food price impact index as specified by equation (3).

\[
HFPII_i = \frac{\sqrt{\sum P_nQ_0 \sum P_nQ_n}}{\sum P_0Q_0 \sum P_0Q_n} \times 100 \quad (3)
\]

\( HFPII_i \) = Household Food Price Impact Index of the \( i^{th} \) household.

\( P_0 \) = Price of the \( j^{th} \) food item consumed by the \( i^{th} \) household in the base period.

\( P_n \) = Price of the \( j^{th} \) food item consumed by the \( i^{th} \) household in the current period.

\( Q_0 \) = Quantity of the \( j^{th} \) food item consumed by the \( i^{th} \) household in the base period.

\( Q_n \) = Quantity of the \( j^{th} \) food item consumed by the \( i^{th} \) household in the current period.

Secondly, we construct the household specific income index by capturing household income information accruing from six categories (See Appendix 1.3) of the household for the last five years. Then logarithmic transformations of these values are carried on. Average income of the household (Transformed) for the base period\(^2\) gives rise to the average household income in base period (HIB). Current year aggregate income is calculated from the total incomes generating the broad income earning sources which yields (HIC). The values of HIB and HIC are utilised to get household specific income index as quantified in equation (4).

\[
HII_i = \frac{HIC}{HIB} \times 100 \quad (4)
\]

Where,

\(^2\) Base period values of income corresponds to the average annual values of the variable for four continuous time periods preceding the current period under consideration.
\( HII_i = \) Income Index of the \( i^{th} \) household

\( HIC = \) Aggregate annual income of the household during the survey year

\( HIB = \) Average annual income of the household in the base period.

Based on the values of two indices HFPII and HII, we arrive at the Food Accessibility Index \( (FACI_i) \) for the using the criteria discussed below,

\[
FACI_i = \begin{cases} 
0, & HFPII > HII \\
0.5, & HFPII = HII \\
1, & HFPII < HII 
\end{cases} \quad \text{(5)}
\]

The food accessibility index takes value 1 to indicate the highest degree of accessibility, while it takes the value 0 to point out the lowest degree of accessibility.

### 3.3 Utilisation Dimension

Given a certain basic level of food acquisition, a household's food security level would depend on how well this food was utilized. Food utilisation ensures that an adequate diet coupled with clean water, sanitation and health care brings a state of nutritional well-being where all physiological needs are met (NFHS 2). The utilization of food at the household level is a function of food storage, food preparation, and the food sharing pattern followed in the household. It is also dependent on health status and accessibility status in respect of drinking water facilities. Differences in these respects yield different levels of food security given the same level of acquisition. Thus, for assessing the level of food utilization in a household, we have considered five indicators. These indicators are elaborated below with the respective scoring pattern (Bhattacharjee, 2017) being detailed in Appendix 1.4.

- **Household food storage facilities**: Proper food storage helps to preserve the quality and nutritional value of the foods one purchases, and also helps in preventing spoilage.
Additionally, proper food storage can help prevent foodborne illnesses caused by harmful bacteria. So the facilities that the household has for food storage becomes important for better food utilization.

- **Household Food Preparation Practices**: Food is a prime factor of life so it is very important to prepare and manage food well. Better practices of food preparation lead to an improved level of food utilization.

- **Household Food Sharing Pattern**: Food sharing has been defined as the unresisted transfer of food from one food motivated individual to another. Proper food sharing in the household, a situation when both non-adult and adult members of the household are getting a proportionately equal share of food, leads to higher levels of food utilization.

- **Household Health Status**: Health is a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity. A good health condition of the members of the household will reflect better levels of food utilization in the household.

- **Household Safe Drinking Water Accessibility Status**: Polluted and contaminated water undermines the safety and the nutritional well-being of individuals. Studies have shown that water has a significant contribution to the food utilization level of a household.

The household’s level of attainment in all these regards is captured through some scores assigned for each level of achievement for each sub-indicator and these scores are then added to arrive at a composite score. This composite score is finally standardised (Appendix 1.5) to get the food utilization index ($FUTI_t$).

### 3.4 Stability Dimension
The last dimension addresses the stability of the other three dimensions over time. People cannot be considered food secure until they feel so and they do not feel food secure until there is stability. i.e. to be food secure, a household must have access to adequate food at all times. They should have the capacity to recover against sudden shocks (e.g. an economic or climatic crisis) or cyclical events (Bhattacharjee, 2017). One of the variables that can be used as a proxy variable for capturing the stability dimension of food security is the standard of living of the household as it has an implicit relationship with competitiveness (Okrepilov, 2015; Yakovieva, 2015). Standard of living refers to the material basis of well-being. Metrics to measure living standard are most frequently identified with the valuation of life quality (Kral, 2011). Researchers used both objectively measurable indicators and indicators of perception (Diener, 2003) but social indicators research has succeeded to considerably improve the measurement of people’s quality of life (Noll, 2004).

For measuring the standard of living of the household we have taken attributes like House type, Toilet facility, Source of lighting, Main fuel for cooking, Source of drinking water, Separate room for cooking, Ownership of house, Ownership of agricultural land, Ownership of irrigated land, Ownership of livestock, Ownership of durable goods along with scores (Chatterjee et al., 2012)(See Appendix 1.6). The household’s level of attainment in all these regards is captured through some scores assigned for each level of achievement for each sub-indicator and these scores are then added to arrive at a composite score. This composite score is finally standardised (Appendix 1.5) to get the food stability index \((FST_i)\) for the \(i^{th}\) household. Finally, the simple average of all four values of indices is calculated which gives the household food security index of the \(i^{th}\) household \((HFSI_i)\). Households are then categorised into various level of food security based on a specified criteria (See Appendix 1.7).

\[
HFSI_i = \frac{1}{4}(FAVI_i + FACI_i + FUTI_i + FSTI_i) \quad \text{...(6)}
\]
4.0 Conclusion

Food security is a complex multidimensional phenomenon. The study tried to build a methodology through a set of indicators by capturing dimensional aspects of food availability, accessibility, utilisation and stability so as to assess the household food security status at household level. This framework can be used in analysing various dynamisms related to the concept of household food security which would be beneficial in identifying nutritional issues, providing targeted food relief and also for designing anti-poverty programs in an effective manner.

References


[38] Riley, B., Church, P., Downer, G., Faux, D. and Ulrich, P. (2002). The impact of Title II Food


**Appendix 1.1: Classification of Various Food Groups Consumed by the Household**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Food Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cereals</td>
</tr>
<tr>
<td>2</td>
<td>Root And Tubers</td>
</tr>
<tr>
<td>3</td>
<td>Vegetables</td>
</tr>
<tr>
<td>4</td>
<td>Fruits</td>
</tr>
<tr>
<td>5</td>
<td>Meat And Poultry</td>
</tr>
<tr>
<td>6</td>
<td>Eggs</td>
</tr>
<tr>
<td>7</td>
<td>Fish And Seafood</td>
</tr>
<tr>
<td>8</td>
<td>Pulses/Legumes/Nuts</td>
</tr>
<tr>
<td>9</td>
<td>Milk And Milk Products</td>
</tr>
<tr>
<td>10</td>
<td>Oil/Fats</td>
</tr>
<tr>
<td>11</td>
<td>Sugar/Honey</td>
</tr>
<tr>
<td>12</td>
<td>Miscellaneous Food Items</td>
</tr>
<tr>
<td></td>
<td>Served and Processed Food</td>
</tr>
<tr>
<td></td>
<td>Packaged Processed Food</td>
</tr>
<tr>
<td></td>
<td>Others</td>
</tr>
</tbody>
</table>

Source: Swindale et al. (2006).
Appendix 1.2: OECD-modified equivalence scale for Adjusted Household Size

<table>
<thead>
<tr>
<th>Category</th>
<th>Adjusted Household Size</th>
<th>Under 14 Years</th>
<th>Above 14 Years</th>
<th>Irrespective of Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person living alone</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Couple without children</td>
<td></td>
<td></td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td>Couple with</td>
<td></td>
<td>1.8</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One child</td>
<td>1.8</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two child</td>
<td>2.1</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Three child</td>
<td>2.4</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>Single parent with</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>One child</td>
<td>1.3</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two child</td>
<td>1.6</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Three child</td>
<td>1.9</td>
<td>2.5</td>
<td></td>
</tr>
</tbody>
</table>

Source: Martin (2017)

Appendix 1.3: Classification of Income Earning Sources of the Household

<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Income Earning Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Agriculture</td>
</tr>
<tr>
<td>2</td>
<td>Livestock</td>
</tr>
<tr>
<td>3</td>
<td>Forestry</td>
</tr>
<tr>
<td>4</td>
<td>Non-farm activities</td>
</tr>
<tr>
<td>5</td>
<td>Income from Household Assets</td>
</tr>
<tr>
<td>6</td>
<td>Cash benefit received</td>
</tr>
</tbody>
</table>

Source: Bhattacharjee (2017)
Appendix 1.4: Scoring Pattern of the Food Utilisation Measuring Attributes

<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Food Utilisation Attributes</th>
<th>Scoring Pattern</th>
</tr>
</thead>
</table>
| 1         | Accessibility to Safe Drinking Water | 3-Supply water with boiling or Filtering  
2-Supply water without boiling or Filtering  
1-Water from tube well/Hand pump without boiling or Filtering  
0--Water from any other sources without boiling or Filtering |
| 2         | Facilities for Food Storage          | 3- Store food in Containers designed for freezer storage  
2- Store food in the cool cabinet  
1-Store food in Plastic wrap/ plastic bags  
0-Do not have storage facilities |
| 3         | Food Preparation Pattern             | 3- Prepares food in LPG/BioGas stoves in a separate Kitchen  
2- Prepares food in Kerosine/coal/ charcoal fueled stoves in a separate kitchen  
1-Prepares food in chullahs using wood/ agricultural crop waste/dung cakes/ straw/shrubs/ grass as a fuel in a separate kitchen  
0-Prepares food in Chullahsor open fire with no separate kitchen |
| 4         | Food Sharing Pattern                 | 3-Each member gets adequate food share  
2-Occasional adult share shortages  
1-Occasional children and adult share shortages  
0- Persistent children and adult share shortages |
| 5         | Household Health Status              | 3-No member is affected with any disease  
2- One or more member is infected with diseases caused by Bacteria  
1- One or more member is infected with diseases caused by Virus  
0- One or more member is infected with diseases caused by Parasite |

Source: Bhattacharjee (2017)

Appendix 1.5: Standardisation process of score attained by \( i^{th} \) household for kth dimension of food security

\[
STSC_{ik} = \frac{TSC_{ik}}{Max(SC_k)}
\]

Where \( STSC_{ik} \) = Standardised score of \( i^{th} \) household for kth dimension of food security

\( TSC_{ik} = \text{Total Score Accumulated by the } i^{th} \text{ household for } k^{th} \text{ dimension} \)

\( Max(SC_k) = \text{Maximum Score allocated for } k^{th} \text{ dimension} \)
Appendix 1.6: Scoring Pattern of the Food Stability Measuring Attributes

<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Attributes</th>
<th>Scoring Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>House type</td>
<td>4 for pucca, 2 for semi-pucca, 0 for kachha</td>
</tr>
<tr>
<td>2</td>
<td>Toilet facility</td>
<td>4 for own flush toilet, 2 for public or shared flush toilet or own pit toilet, 1 for shared or public pit toilet, 0 for no facility</td>
</tr>
<tr>
<td>3</td>
<td>Source of lighting</td>
<td>2 for electricity, 1 for kerosene, gas, or oil, 0 for other sources of lighting</td>
</tr>
<tr>
<td>4</td>
<td>Main fuel for cooking</td>
<td>2 for electricity, liquid petroleum gas, or biogas, 1 for coal/coke/lignite, charcoal, or kerosene, 0 for other fuel</td>
</tr>
<tr>
<td>5</td>
<td>Source of drinking water</td>
<td>2 for pipe, hand pump, or well in residence/yard/plot, 1 for public tap, hand pump, or well, 0 for other water sources</td>
</tr>
<tr>
<td>6</td>
<td>Separate room for cooking</td>
<td>1 for yes, 0 for no</td>
</tr>
<tr>
<td>7</td>
<td>Ownership of house</td>
<td>2 for yes, 0 for no</td>
</tr>
<tr>
<td>8</td>
<td>Ownership of agricultural land</td>
<td>4 for 5 acres or more, 3 for 2.0.4.9 acres, 2 for less than 2 acres or acreage, 0 for no agricultural land/not known</td>
</tr>
<tr>
<td>9</td>
<td>Ownership of irrigated land</td>
<td>2 if the household owns at least some irrigated land, 0 for no irrigated land</td>
</tr>
<tr>
<td>10</td>
<td>Ownership of livestock</td>
<td>2 if owns livestock, 0 if does not own livestock</td>
</tr>
<tr>
<td>11</td>
<td>Ownership of durable goods</td>
<td>4 each for a car or tractor, 3 each for a moped/scooter/motorcycle, telephone, refrigerator, or colour television, 2 each for a bicycle, electric fan, radio/transistor, sewing machine, black and white television, water pump, bullock cart, or thresher, 1 each for a mattress, pressure cooker, chair, cot/bed, table, or clock/watch</td>
</tr>
</tbody>
</table>

Source: Adapted from NFHS 2, Available at http://rchiips.org/nfhs/pub_nfhs-2.shtml
### Appendix 1.7: Categorisation of the Level of Food Security based on Food Security Index

<table>
<thead>
<tr>
<th>Food Security Index Value</th>
<th>Level of Food Security</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ≤ FSI ≤ 0.20</td>
<td>Very Low</td>
</tr>
<tr>
<td>0.21 ≤ FSI ≤ 0.40</td>
<td>Low</td>
</tr>
<tr>
<td>0.41 ≤ FSI ≤ 0.60</td>
<td>Medium</td>
</tr>
<tr>
<td>0.61 ≤ FSI ≤ 0.80</td>
<td>High</td>
</tr>
<tr>
<td>0.81 ≤ FSI ≤ 1</td>
<td>Very High</td>
</tr>
</tbody>
</table>

Source: Authors Classification