CHAPTER THREE

CONCEPTUAL FRAMEWORK AND METHODOLOGY

3.1 Conceptual Framework:

Food Security: In the present study, we have adopted the definition of food security given by FAO (1996) and IFPRI (2002) which states that food security exists when " all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life." Food security, in this broad sense, has three dimensions – food availability, food accessibility and utilization or absorption of food.

Food Availability: The availability of food essentially encompasses domestic agricultural production and food imports. However due to lack of reliable data on food imports in the present study we have focused only on the domestic agricultural production.

Food Accessibility: Access to food has two dimensions viz. physical and economic, of which the latter is more important. Economic access to food is largely determined by the households' purchasing power and food subsidies.

Utilization of Food: The utilization dimension of food security is concerned with the nutritional requirements of household members, based on their age and sex. The pattern of food utilization at the household level generally depends on cultural factors, (diet preferences, nutritional knowledge and caring practices), distributional factors (intra-household distribution of food and other reasons), and absorption possibilities

(depending upon quality of water and sanitation, health, and the quality of food itself) (Sharma, 2010).

Safe Drinking Water: Water is defined as safe if it is free from biological contamination like cholera, typhoid etc and chemical contamination like excess iron, arsenic, nitrate, backishness etc. (M S Swaminathan Research Foundation, 2008). As per the definition given by the Census of India, if a household has access to drinking water supplied from a tap, hand pump/tube well within or outside the premises it is considered as having access to safe drinking water. Such access may be more notional than real where the concerned source has either being dried up or is not functioning. Besides this, water from open wells drunk after boiling can also be considered as safe drinking water by any reasonable means (M S Swaminathan Research Foundation, 2008). However data on the later just mentioned is not available at macro level and hence we have to rely on the definition of safe drinking water provided by Census like that of the other studies.

Major State: The term major state refers to a state which had a population of 20 million or more (Census, 2001).

Public Distribution System (PDS): It is a Government's policy designed to meet the objective of price stabilization and to serve as a key instrument of household food security.

Off take: It refers to the amount of food grain that the states take from the FCI for distribution through PDS

Diversion of Food Grain: The difference between off take and total purchase of food grains provides an estimate of the amount of grain that is diverted (Khera, 2011).

3.2 Methodology:

3.2.1For the First Objective:

To analyse the first objective, we have tried to construct a composite Food Security Index (FSI) for rural India. The methodology of this index has been developed as an attempt to fill up the research gaps of the earlier attempts at the construction of food security indices. The available literatures on food security, in the context of India, have mostly addressed the issue by analysing the dimensions of food security separately but much work has not been done on the construction of a composite food security index which would be of great help in analysing the status of food security under the combined umbrella of all the dimensions. The advantage with a single composite index which is constructed from a number of indicators is that it is a more readily comprehended decision-support tool. In case of India, till date Institute for Human Development (2008) and M S Swaminathan Research Foundation (2008) have only attempted to construct Food Security Index (FSI). Institute for Human Development (2008) has constructed a food security index for the rural Chhattisgarh by following Max-Min approach adopted by UNDP for constructing Human Development Index. However the index does not have a reference period and no mention is made about the normative values of dimensional indicators. M S Swaminathan Research Foundation (2008) tried to develop a FSI for rural India for two time periods viz. 1998-2000 and 2004-06. The limitation of this index is that it mostly deals with the outcome indicators like percentage of anaemic ever-married women in the age group of 15 – 49 years,

percentage of anaemic children in the age group of 6-35 months, percentage of women in the age group of 15-49 with chronic energy deficiency, percentage of children (0-35 months) who are suffering from stunting. The problem with an outcome based FSI is that it is less likely to represent the status of food security of a state or region rather it reflects the probable effects of food security/food insecurity.

The present study attempts to analyse the status of inter-state food security in rural India in terms of Food Security Index (FSI) for two cross sections viz. 2001-05 and 2007-11, which we have constructed by overcoming the limitations of the works of Institute for Human Development (2008) and M S Swaminathan Research Foundation (2008). The reference years for all the dimensional indicators are not related to a particular year rather it is different for different indicators in most of the cases between the time period 2001 to 2005 and 2007 to 2011 as it is reflected from Table 1.2 of Chapter 1. Hence the FSI, constructed in the present study is designated pertaining to the period 2001-05 and 2007-11 respectively. The reference for such an exercise would be found in M S Swaminathan Research Foundation (2008) where food insecurity indices for the major states of rural India have been constructed for the period 1998-2000 and 2004-06. It is further to be noted that all variables taken into consideration for the construction of FSI are for rural areas, unless otherwise specified. This is due to the fact that our present study is related to the analysis of food security in the rural context.

3.2.1.a Food Security Index and its Indicators:

Food security index is a composite index along the axes of food availability, food accessibility and food absorption indicators. It is a summary measure which shows the

average achievement of a country on the front of three dimensions of food security. A total of twelve indicators are considered for the construction of food security index for rural India, out of which four are availability indicators, six are accessibility indicators and two are absorption indicators. These indicators along with their justifications are given in the following subsections.

Indicators of Food Availability:

1. Per capita Food grain Production: The concern for food availability stems from production and related aspects that sustain a desired level of food production. Food grains are considered to be of prime significance for food security because cereals and pulses are staple foods and there are no perfect substitutes for them (Chand, 2007). Moreover, food grains are also the cheapest source of energy as compared to other foods and are indispensible for food security of low income classes (Chand and Kumar, 2006). To account for variations in populations across states, per capita production of food grain has been considered.

2. Irrigation Intensity: It is defined as the ratio between net sown area and net irrigated area. This indicator is incorporated as it is expected to have a positive association with food security position by raising agricultural productivity.

3. Percentage of Non-Forest Area to Total Geographical Area: The inclusion of this indicator is justified on the ground that forest area is likely to have negative association with food security as it limits the extension of agricultural production while non-forest area is expected to have positive association with food security as it widens the scope of agricultural production.

4. Percentage of Inhabited Villages having Access to Paved Road: Access to paved roads reduces transport costs as well as transaction costs and thus it has a positive influence upon the prices realised by farmers. Moreover, it can also increase the options available to rural producers, connecting them with larger national, regional and even international markets.

Indicators of Food Accessibility:

Access to food has been considered as the most important factor determining food security. A household's access to food depends on its own production of food and the food it can acquire through sale of labour power or commodities produced by it. These are linked to what Amartya Sen calls endowment and exchange entitlements (Institute for Human Development, 2008). The following indicators are chosen for taking into account the aspect of food accessibility.

1. Percentage of Non-Agricultural Labourers to the Total Labourers: Agricultural labourers as compared to the non-agricultural labourers are characterised by extremely poor physical and human capital and are also experiencing the highest poverty levels (NCEUS, 2007). Hence, it is expected that the more the non-agricultural labourers, the more better will be the food security situation in a region.

2. Percentage of Scheduled Caste (SC) and Scheduled Tribe (ST) to Total Population: The SC and ST households are known to be generally more food insecure, largely on account of their economic and social deprivation. Thus, it is assumed that the higher the SC and ST population in a state, the lower will be the level of food security and vice versa.

3. Share of Working Age Population: It is defined as rural population in the age group (15-59) divided by the sum of the (0-14) child population and 59 + population. A ratio higher than unity represents a positive situation, with more productive population as compared to the dependent population. This working age population if effectively utilised may raise the purchasing power in the society and hence food security (Chandrasekhar, et al. 2006).

4. Per Capita Monthly Consumption Expenditure on Food: The NSS estimates of per capita consumption expenditure, adjusted for inequality, is a proxy for per capita income reflecting a significant dimension of access to food.

5. Rural Female Literacy rate: A higher literacy rate for women is more likely to enable rural women to enhance their roles in family decision making and increase their share of household consumption. It is also likely to create better knowledge of nutrition and improved health practices in the household.

6. Wage Rate of Casual Rural Workers: Casual wage workers constitute about one-fifth of the workers in the unorganised non-agricultural sector while almost all agricultural labourers are casual workers (NCEUS, 2007). Casual workers tend to be the least protected and have the lowest level of earnings. Thus, it is expected that a low wage rate of casual rural workers will be associated with a low level of food security.

Indicators of Food Absorption:

1. Percentage of Households Having Access to Safe Drinking Water: Access to safe drinking water is crucial for ensuring effective biological utilisation of food taken by an individual. Thus, it is expected to have a positive association with food security.

2. Percentage of Inhabited Villages Having Access to Primary Health Centres (PHCs): In rural areas, all the health services like sanitation and vector control, child immunisation**,** health education etc are pivoted around the PHCs and hence access to them is considered as an indicator determining food absorption.

3.2.1. b Construction of Food Security Index (FSI):

The construction of FSI involves the following three steps.

Step I. The individual indicators/ variables chosen for the construction of FSI are measured in different units and hence, in general, cannot be added directly. It is therefore becomes necessary to convert them to some standard units so that the initial scale chosen for measuring the indicators do not bias the results. This is done by calculating the following index based on UNDP's Max-Min approach for each variable.

$$\text{Variable index} = \frac{X_{ij} - X_{min}}{X_{max} - X_{min}} \; ; \; 0 \leq \text{Variable Index} \leq 1$$

Where X_{ij} = Actual value of the jth variable for the ith state

X_{min} = Minimum value of the jth variable

X_{max} = Maximum value of the jth variable.

This variable index is free from units of measurement and it lies within the range 0 to 1.

Step II. Here we will calculate an index for each dimension of food security. Dimensional Index for food security is calculated as the simple average of all the variable indices for that respective dimension. Symbolically,

$$DI^F = \frac{1}{n}\sum_{j=1}^{n} V_{ij} \; ; 0 \leq V_{ij} \leq 1$$

where, DI^F = Dimensional Index for food security

V_{ij} = Value of the jth variable index of a particular dimension of food security for the ith state

n = No. of variables / indicators of that particular dimension of food security

Step III. Finally the Food Security Index (FSI) has been constructed by taking the simple average of dimensional indices i.e

$$FSI = \frac{Availabilty\ Index + Accessibility\ Index + Absorption\ Index}{3} \quad ; 0 \leq \text{FSI} \leq 1$$

Table 3. 1 Classification of the Level of Food Security using FSI

FSI	Level of Food Security
0 ≤ FSI ≤ .20	Very Low
.21 ≤ FSI ≤ .40	Low
.41 ≤ FSI ≤ .60	Moderate
.61 ≤ FSI ≤ .80	High
.81 ≤ FSI ≤ 1	Very High

Source: Researcher's own estimation

3.2.1. c Normative Values (Max and Min Values) of different Dimensional Indicators of Food Security in the context of Rural India:

This subsection shows the various normative values of the dimensional indicators of food security considered by the present study in the context of rural India. These

normative values actually serve as the goal posts as stated by various human development reports of UNDP. Closer to such normative values is the indication of a good status of any dimensional indicator and vice versa.

Table 3.2 Normative Values (Max and Min Values) of different Dimensional Indicators of Food Security in the context of Rural India

Indicators / Variables	Time Point 2001-05		Time Point 2007-11	
	Max Value	Min Value	Max Value	Min Value
(a) Food Availability				
1.Per capita production of food grains	1000	10	1000	10
2. Irrigation intensity	100	0	100	0
3. Percentage of non-forest area to total geographical area	100	0	100	0
4.Percentage of inhabited villages having access to paved road	100	0	100	0
(b) Food Accessibility				
1.Percentage of non-agricultural labourers to total labourers	100	0	100	0
2.Percentage of SC and ST population to total population	100	0	100	0
3.Share of working age population	3	1	3	1
4.Per capita monthly consumption expenditure on food (inequality adjusted)	800	200	1000	200
5. Wage rate of casual workers	150	20	300	50
6. Rural female literacy rate (7+)	100	0	100	0
(c) Food Absorption				
1.Percentage of households having access to safe drinking water	100	0	100	0
2. Percentage of inhabited villages having access to Primary Health Centres (PHCs)	100	0	100	0

Source: Researcher's own estimation

3.2.2 For the Second Objective:

The methodology for the second objective is almost same like that of the first one with the only difference that while analysing inter-district food security status of rural Assam, we have selected nine variables in lieu of twelve used in the context of inter-state analysis of food security in rural India. This is due to the fact that the district level data on three accessibility indicators viz. share of working age population, monthly per capita consumption expenditures and wage rate for casual labourers are not available for rural Assam. Apart from this, the other things like the methodology of construction of FSI for various districts of Assam and the classification of the district wise food security status are quite synonymous with that used for analyzing the first objective.

3.2.2. a Normative Values (Max and Min Values) of different Dimensional Indicators of Food Security in the context of Rural Assam:

This subsection shows the various normative values of the dimensional indicators of food security considered by the present study in the context of rural Assam. These normative values actually serve as the goal posts as stated by various human development reports of UNDP. Closer to such normative values is the indication of a good status of any dimensional indicator and vice versa.

Table 3.3 Normative Values (Max and Min Values) of different Dimensional Indicators of Food Security in the context of Rural Assam:

Indicators / Variables	Time Point 2001-05		Time Point 2007-11	
	Max Value	Min Value	Max Value	Min Value
(a) Food Availability				
1.Per capita production of food grains	500	50	500	50
2. Irrigation extent	100	0	100	0
3. Percentage of non-forest area to total geographical area	100	0	100	0
4.Percentage of inhabited villages having access to paved road	100	0	100	0
(b) Food Accessibility				
1.Percentage of non-agricultural labourers to total labourers	100	0	100	0
2.Percentage of SC and ST population to total population	100	0	100	0
3. Rural female literacy rate (7+)	100	0	100	0
(c) Food Absorption				
1.Percentage of households having access to safe drinking water	100	0	100	0
2. Percentage of inhabited villages having access to Primary Health Centres (PHCs)	10	0	15	0

Source: Researchers own estimation

3.2.3For the Third Objective:

We have used Khera's framework (2011) to assess the role of PDS in meeting the goal of food security in rural Assam. Khera opines that the effectiveness of PDS can be examined in terms of per capita purchase of food grains and their diversion from PDS. On the basis of per capita purchase of food grains, Khera has categorized three types of states as shown in Table 3.4.

Table 3.4 Classification of states regarding the per capita purchase of PDS food grain

Type of States	Criteria of Identification
Languishing states	Per capita purchase of food grain is below 1 kg/month
Reviving states	Per capita purchase of food grain is below 1 kg/month initially but showing an increase of purchase of greater than 1 kg/month in the subsequent periods
Functioning states	Per capita purchase of food grain greater than 1 kg/month through out

Source: Khera (2011)

The difference between official off-take and purchase of food grains, on the other hand, provide an estimate of the diversion of PDS food grains to the open market (Khera, 2011). Based on the analysis of per capita purchase and diversion of grains made by Khera (2011), the following criteria as shown in Table 3.5 have been made operational for identifying the status of PDS in a state.

Table 3.5 Identification of the Status of PDS

Type of States	Status of PDS
Languishing states with high diversion of food grain[6]	Very poor
Reviving states with high diversion of food grain	Poor
Reviving states with a decline in diversion of food grain	Moderate
Functioning states with low diversion	Good

Source: Researcher's own classification

It is to be noted that with a view to analyse the purchasing and diversion of food grains from PDS, we have considered two commodities only viz. rice and wheat. In this

[6] Diversion of food grain by more than 50 % is considered as high diversion in the present study

analysis, the other important items like sugar, kerosene oil are not incorporated because although the data are available on the purchasing of these items but information on their diversion is not available. Thus to facilitate the purpose of comparison, we have considered only rice and wheat in our analysis. The purchasing of food grains is analysed both for rural and urban areas. We have done so to see whether there is any significant difference in the purchase of PDS food grain between rural and urban Assam. However, the analysis of diversion in this context is limited at aggregate level only, as the data on the diversion figures at disaggregate level i.e. for rural and urban areas separately are not available. It is further to be noted that due to the non-availability of relevant secondary data, intra-state analysis of the status of PDS in Assam could not be made. Thus the analysis of third objective in the present study pertains to the exploration of the status of Assam in relation to the other major states of India and that of Assam in subsequent time periods only.

For analytical purpose, we have calculated rank and mean for per capita purchase of food grain and diversion of food grain. Student's t test is conducted in order to test the significance of the mean difference between per capita purchases of rice and wheat in rural Assam and rural-urban mean difference in respect of rice and wheat separately. Pearson's Correlation Coefficient is calculated to look into the degree of association between diversion of rice and wheat and that between purchase and diversion of rice and wheat separately.

3.2.4 Household Level Food Security:

3.2.4.a Sampling Design:

So far as the fourth objective is concerned, our ultimate unit of study has been the rural households. Thus our first task is to select the district and then the village from it under

certain criteria. It is well-established fact that an intensive village study helps in identifying the economic and social status of households and problems that poorer classes face in gaining economic access to food (Harris, 1990). The selection of village is made in the present study on the basis of the following criteria.

(i) The village should belong to a district which is neither highly food secure nor experiencing a low level of food security. This eliminates the two extremes of highly food secure and extremely low level of food secure districts and presents an average situation (Sridevi, 2005).

(ii) The village must be the home of both high caste and marginalised section of people, which helps in analysing food security across all the social groups (Sridevi, 2005).

(iii) There must be more than 500 households in the village so that it can analyse the prospect of food security form a broader perspective.

(iv) The village must be situated at least 10 km away from its nearest town otherwise it gets attached to most of the urban characters.

Sample Area:

Keeping in mind the above criteria, we have purposively selected two villages, one from Kamrup District and the other from Cachar district in order to study the status and determinants of household level food security in rural Assam. The village selected from Cachar district is Irongmara and the village selected from Kamrup district is Digarugaon. Since Assam consists of mainly two regions viz. Brahmaputra Valley and Barak Valley, we have selected the villages from both the valley. Both these villages have satisfied the criteria as mentioned above. This is clear from the following facts.

a) Both these villages belong to moderately food secure districts, which is the average picture of rural Assam on the matter of food security as found from the analysis of second objective, shown in Table 5.9 and 5.12 of Chapter 5.

(b) There is presence of all the social groups in these villages (Census, 2011).

(c) Both are situated at least 10 km away from their nearest town (Census, 2011)

(d) The total number of households in case of both the villages is more than 500; to be precise it is 981 for Digarugaon and 1253 for Irongmara (Census, 2011).

Determination of Sample Size:

Yamane's (1967) mathematical formula is used to determine the sample size for two villages. The formula is

$$n = \frac{N}{1+N.e^2}$$

where, n = sample size , N = Population size, e = level of precision or sampling error

By choosing confidence level at 90 per cent with precision level 10 per cent, we get n = 91 for Digarugaon and n = 93 for Irongmara. Thus the total number of sample households in the present study is 184 out of which 91 belong to Digarugaon of Kamrup district and 93 belong to Irongmara of Cachar district.

3.2.4 b Conceptual Framework of Household Level Food Security:

The motivation behind analysis of Household Level Food Security in the present study comes from the earlier research works by Mallick and Rafi (2010) and Rammohan et.al. (2011) who put emphasis on the respondent's own perception in characterising the status of household food security. However there works have not made any attempt to

conceptualise food security at household level under the combined shed of the various dimensions of food security i.e availability, accessibility and absorption of food. They have rather tried to classify different levels of food security based on the respondent's perception about their food security status.

In the present study the household level food security has been analysed through the axes of availability, accessibility and absorption of food. Information from the respondents related to various dimensions of food security has been collected through a structured questionnaire. Based on the information, we have classified different aspects of the dimensions of food security and accordingly scores have been provided. The better the situation confronting various dimensions of food security, the higher scores have been attached accordingly. Based on these scores, dimensional indices of food security have been constructed and ultimately a composite index of household food security estimated.

Food security at household level is said to exist when the following three conditions are satisfied.

I. Three main categories of food viz. cereals, pulses and vegetables are available in the household in adequate amount during the last six months.

II. A household can afford to purchase food.

III. Food absorption is ensured.

The above definition covers the dimension of availability, accessibility and absorption of food at household level.

3.2.4 c Construction of Household Level Food Security Index:

The construction of this index involves the following three steps.

Step 1: First some scores have been assigned to the various dimensions based on self-selection approach and value judgment. The scoring procedure is outlined in Tables 3.6, 3.7 and 3.8.

Table 3.6 Scoring of the various aspects of Food Availability Dimension

Food Availability	
Various aspects of food availability	Scoring of the aspects
1. If three main categories of food viz. cereals, pulses and vegetables are available for all the members of the household during the last six months	3
2. If three main categories of food viz. cereals, pulses and vegetables are available for most of the members of the household at least for a single day in the last six months	2
3. If three main categories of food viz. cereals, pulses and vegetables are available for some of the members of the household at least for a single day in the last six months	1
4. If three main categories of food viz. cereals, pulses and vegetables are not available for the entire household at least for a single day in the last six months	0

Source: Researcher's own classification

Table 3.7 Scoring of the various aspects of Food Accessibility Dimension

Food Accessibility	
Various aspects of food accessibility	Scoring of the aspects
1. If the household can access food out of his own income exclusively in the last six months	3
2. If the household can access food out of his own income with partial dependence on PDS in the last six months	2
3. If the household can access food with major dependence on PDS and partial dependence on friends and relatives in the last six months	1
4. If the household can access food with major dependence on friends and relatives, borrowing from others etc in the last six months	0

Source: Researcher's own classification

Table 3.8 Scoring of the various aspects of Food Absorption Dimension

Food Absorption	
Various aspects of food absorption	Scoring of the aspects
1. Access to drinking water supplied from a tap , hand pump/tube well within or outside the premise after boiling or filtering[7]	3
2. Access to drinking water supplied from a tap , hand pump/tube well within or outside the premise without boiling or filtering	2
3. Access to drinking water from river or canal after boiling or filtering	1
4. Access to drinking water from river or canal without boiling or filtering	0

Source: Researcher's own classification

Step 2: Then dimensional indices are constructed by following the UNDP's Max-Min approach as shown below.

$$\text{Dimensional index} = \frac{X_{ij} - X_{min}}{X_{max} - X_{min}};\ 0 \leq \text{Dimensional Index} \leq 1$$

Where X_{ij} = Value of the jth dimension for the ith household

X_{min} = Minimum value of the jth dimension

X_{max} = Maximum value of the jth dimension

Step III. Finally the Household Food Security Index (FSI) has been constructed by taking the simple average of dimensional indices i.e

[7]At household level we can gather information about whether the water irrespective of any source is drunk after boiling or not. Hence unlike the definition of safe drinking water used by Census (2011) at macro level, we attach more score to that situation where drinking water supplied even from a tap, hand pump/tube well is drunk after boiling or filtering.

$$HFSI = \frac{\text{Availabilty Index+Accessibility Index+Absorption Index}}{3} \quad ; 0 \leq HFSI \leq 1$$

Table 3.9 Classification of the Level of Household Food Security using HFSI

HFSI	Level of Food Security
$0 \leq$ HFSI $\leq .20$	Very Low
$.21 \leq$ HFSI $\leq .40$	Low
$.41 \leq$HFSI $\leq .60$	Moderate
$.61 \leq$ HFSI $\leq .80$	High
$.81 \leq$ HFSI ≤ 1	Very High

Source: Researcher's own classification

3.2.5 Specification of the Econometric Model for Identification of Determinants of Household Level Food Security:

We have tried to regress Household Food Security Index on the explanatory variables viz. dependency ratio, assets of the households (measured by Asset Index), age of the head of the household, sex of the head of the household, level of education of the head/knowledgeable member of the household (measured in years of education), caste of the household and type of occupation by using a multiple regression model. It is to be noted that for incorporating caste and type of occupation as determinants of household food security, we have made use of the dummy variables. One dummy is used for the caste variable where the variable takes the value 1 for general category of people while it takes the value 0 for the marginalized social groups like SC, ST and OBC. Two dummies are used for the type of occupations. The first occupational dummy takes the value 1 for the households which are mainly associated with non-agricultural activities, otherwise 0. The second occupational dummy takes the value 1

for the households which are mainly associated with agricultural and allied plus non-agricultural activities, otherwise 0. In case of the occupational dummies, the bench mark or the reference category is those households whose main occupation is agricultural or allied activities. Since the dependent variable Household Food Security Index (HFSI) is bounded by 0 and 1, we have specified our model in the following non-linear form to avoid the unboundedness problem (Ramanathan, 2008).

We take a non-linear model of the form

$$Y = \frac{1}{1+ e^{-z}} \quad \text{..... (1)}$$

$$\text{Where} \quad Z = \beta_0 + \sum_{i=1}^{k} \beta_i X_i + u_i \text{..... (2)}$$

Here Y stands for HFSI ($0 \leq Y \leq 1$), X_i's are the factors influencing household level food security,β_i' s are the parameters to be estimated and u_i is the random disturbance term .

Equation (1) can be re-written as:

$$Y = \frac{e^z}{1 + e^z}$$

$$\text{Or, } \frac{Y}{1-Y} = e^Z$$

$$\text{Or, } \log\left(\frac{Y}{1-Y}\right) = Z$$

$$\text{Or, } \log\left(\frac{Y}{1-Y}\right) = \beta_0 + \sum_{i=1}^{k} \beta_i X_i + u_i \quad \text{[Using equation (2)]}$$

$$\text{Or, H} = \beta_0 + \sum_{i=1}^{k} \beta_i X_i + u_i \text{..... (3)}$$

$$\text{[Let, H =log } \left(\frac{Y}{1-Y}\right)\text{]}$$

Now, incorporating the explanatory variables as mentioned earlier the final functional form of the model to be estimated by the Ordinary Least Square Method (OLS) becomes

$$H_i=\beta_0 + \beta_1 DR_i + \beta_2 AIH_i + \beta_3 AHH_i + \beta_4 EHH_i + \beta_5 D_{1i} + \beta_6 D_{2i} + \beta_7 D_{3i} + \beta_8 D_{4i} + u_i$$

$$i = 1, 2,\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots,184$$

Where,

$H_i = \log\left(\frac{Y}{1-Y}\right)$, Y stands for the value of the HFSI for the ith household

DR_i = Dependency ratio of the ith household

AIH_i = Asset Index of the ith household

AHH_i = Age of the head of the ith household

EHH_i = Education level of the head of the ith household measured in terms of years of education

D_{1i} = 1 , if the household is headed by female, otherwise 0

D_{2i} = 1, if the household belongs to General category, otherwise 0

D_{3i} = 1, if the occupation of the household is non − agricultural, otherwise 0

D_{4i} = 1, if the occupation of the household is agriclutural plus non − agricultural, otherwise

u_i = Random disturbance term

β_0 = Constant term

β_i's are the slope coefficients of the model to be estimated

3.2.5. a Descriptions of the Explanatory Variables used in the Regression Model:

I. Dependency Ratio: It is defined as the total number of dependents out of the total members in a household.

II. Asset Index of the Household: It is a composite index showing the average asset holdings of a household. In constructing asset index, we have considered six assets viz.

ownership of land, type of housing, consumer durables, vehicles, livestock and financial assets. All these assets are attached scores based on self-selection approach and value judgment. After attaching the scores, an index in line with UNDP's Max-Min approach is constructed for each and every asset. Finally, we take the simple average of all these asset indices, which gives rise to the generation of the composite asset index of the household. The scoring procedure adopted for the household's assets is shown in the Tables 3.10 to 3.15.

Table 3.10 Scoring of the Land Ownership

Ownership of Land	Score
More than 1 hectare	3
Between 0.5 to 1 hectare	2
Less than 1 hectare	1
No ownership of land	0

Source: Researcher's own classification

Table 3.11 Scoring of the type of Housing

Type of House	Score
Pucca	3
Semi pucca	2
Kutchha	1
Very kutchha	0

Source: Researcher's own classification

Table 3.12 Scoring of the Consumer Durables

Consumer durables	Score
Radio/music system, TV and mobile	3
Any two out of radio/music system, TV, mobile	2
Any one out of radio/music system, TV, mobile	1
No consumer durables	0

Source: Researcher's own classification

Table 3.13 Scoring of the Vehicles

Vehicles	Score
Bus/Car/Truck	5
Auto Rickshaw/Power tiller	4
Motorcycle	3
Rickshaw/Thela	2
Bicycle	1
No vehicle	0

Source: Researcher's own classification

Table 3.14 Scoring of the Livestock

Live stock	Score
Cow/Buffalo	3
Goat/Pig	2
Hen/Dove?Duck	1
Nothing	0

Source: Researcher's own classification

Table 3.15 Scoring of the Financial Assets

Financial Assets	Score
Bank/Post office savings account plus other financial products like recurring deposits, LIC etc	3
Only bank/post office savings account	2
SHG membership	1
No financial asset	0

Source: Researcher's own classification

III. Age of the Head of the Household: It is defined as the total numbers of years completed by the head of the household at the time of the interview during the field survey.

IV. Education Level of the Head of the Household: It means the total years of education completed by the head of the household at the time of the survey.

V. Sex of the Head of the Household: It means whether the household is headed by a male or a female.

VI. Social group or Caste: It is represented by a dummy variable which takes the value 1 for general category of people while it takes the value 0 for the marginalized social groups like SC, ST and OBC.

VII. Households with Non-Agricultural Occupation: It is represented by a dummy variable which takes the value 1 for the households which are mainly associated with non-agricultural activities, otherwise 0.

VIII. Households with both Agricultural and Non-Agricultural Occupation: It is represented by a dummy variable which takes the value 1 for those households some of whose members are associated with agricultural and allied activities while the rest are associated with non-agricultural activities.

3.2.5. b Expected Signs of the Slope Coefficients of the Explanatory Variables:

I. Dependency Ratio: It is expected to influence food security at household level in a negative way. This is because with higher number of dependents, a household may find it difficult to meet the food requirements of all the members. Hence a high dependency

ratio may result in a decline in the level of household's food security. Thus the expected sign of β_1 is negative.

II. Asset Index: It is expected to have a positive association with household level food security. This is because higher asset holdings are the indicators of higher economic status and households of higher economic status can avail the necessary food for them and thus are expected to be more food secure. This means that the expected sign of β_2 is positive.

III. Age of the Head of the Household: The inclusion of this variable is justified on the ground that an older individual demands more health inputs and nutrition (Grossman, 1972) and (Kumar et al, 2012). This means that age of the household is expected to be positively associated with food security at household level. Thus the expected sign of β_3 is positive.

IV. Education Level of the Head of the Household: A higher level of education seems to be positively correlated with food security. This is because a household-head with higher education is likely to be associated with higher category of occupation and hence may be confronted with more income and knowledge about nutritional and absorption aspects of food security. The higher income of the household-head increases the possibility of food affordability, while enhancement of knowledge helps to improve the absorption dimension of food security at household level. Thus the expected sign of β_4 is positive.

V. Sex of the Head of the Household: This variable is included with a view to understand whether the gender of the household-head has any significant impact upon

household level food security or not. Hence the expected sign of β_5 may be positive or negative, meaning both the signs of β_5 are theoretically possible.

VI. Social Group or Caste: This variable captures the effect of household's social background upon its food security. It is expected that household belonging to the marginalized sections i.e SC, ST and OBC are likely to be less food secure in comparison to their general counterparts. This means that higher the number of households belonging to the marginalized sections in an area, the lower will be the level of household food security in that area and vice versa. Thus the expected sign of β_6 is negative.

VII. Households with Non-Agricultural Occupation: Households with non-agricultural occupations like service, business, self-employment etc are observed to be associated with higher incomes in relation to their counterparts. Hence higher the number of households with non-agricultural occupations, the more likely is the higher level of food security at household level. Thus the expected sign of β_7 is positive.

VIII. Households with agricultural plus Non-Agricultural Occupation: It is expected to have a positive association with household level food security. Hence the expected sign of β_8 is positive.

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