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Research Article

Determinants on Household Food Security Among Indigenous Population of Nagaland, India

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Abstract

Food being a primary subject of concern for social development as well a vital indicator of well being of citizens in a state, it is more important when 'last mile food security' is given due priority. In developing major economy like India, tribal population across the country act as the last mile and it is ought to be studied with better methodologies.

The current study conducted during the early part of the year 2017 delves into the food security indicators and identifying the factors responsible for food (in) security of Chakhesang and Pochury tribes of Phek district of Nagaland. In this regard, a household survey comprising of 80 households, was conducted in Phek district of Nagaland during early 2017. Based on multistage random sampling, two rural development blocks namely Kikruma and Pfutsero block were sampled from the district and four villages were sampled as second stage.

Using the relevant parameters observed from the survey, the components of food (in)security developed for the study region [1] and household Food Security Index (FSI_p) was computed and further descripted and statistically analyzed. A multinomial logistic regression analysis was applied to identify the odds of status of household food security given villages, categories of family size, primary occupation, income level, possessions of agronomic crops, vegetables and fruits and livestock. It was observed from the study that the distance of regular markets, family size and livestock possession of the families played a critical role in food security of a household in the region.

Keywords: Food Security Indicators; Tribes; Household; Food Possession; Multinomial Logistic Regression; Odds Ratio

Introduction

India is a country of tribal population mostly residing in forest and hilly regions. Each indigenous tribe has unique food habits and socio-cultural norms and lifestyles. The northeastern region of the country is mostly tribal dominated and relatively remote and hilly terrains. Agricultural food production of the northeastern region

is characterized largely by CDR (Complex diverse risk-prone) type, low cropping intensity, and faulty land-use pattern leading to huge soil loss [2]. Nagaland is a northeastern tribal state of India which comprises of sixteen major tribes. The state is remotely located as border state sharing international border with Myanmar in the east. All the tribal communities of the state have been residing on the hill tops surrounded with thick vegetations. With sparse population, poor infrastructure and limited access to outside world along with issues of insurgency and unrest in most parts of the state, the present study focused on food security indicators [1] of local tribal population and its analysis. The food and nutrition status of Chakhesang and Pochury tribes of Phek district [3] showed that large families in the study region remain at the brink of food and nutrition shortage corroborating findings of Olayemi [4] in Osun state of Nigeria.

Research Methodology

The exploratory cross sectional study was conducted in Phek district of Nagaland during early 2017. Based on multistage random sampling, two rural development blocks namely Kikruma and Pfutsero block were sampled from the district. Four villages namely Phusachodu and Kikruma (Kikruma block), Kami and Lekromi (Pfutsero block) were sampled as second stage. Overall eighty (80) respondent households were randomly sampled as last stage unit for the study.

The six food (in) security components of the households [1] were the Household Diet Diversity Score ($HDDS_p$) for Phek; the Food Consumption Score (FCS_p); the Coping Strategy Index (CSI_p; Self Assessed Food Security ($SAFS_p$); the Household Food Insecurity Access Scale ($HFIAS_p$); the Household Hunger Scale (HHS_p). Finally, the Food Security Index (FSI_p) for Phek district was calculated with concept of difference between minimum of four food security measurements and maximum of two food insecurity measurements. It was developed in order to empirically measure and classify each household on the path to food security [1]. The present study analyzed the inter-relationship of six indicators and FSI_p along with its significance with ten socio-economic and possession variables of households.

To understand determinants of household food security status of Bangladesh households, an econometric assessment was undertaken by Faridi and Wadood [5]. Logistic Regression is useful for classifying household food security [6,7], hence in the present study multinomial logistic regression model was used to identify the main determinants of household food security. The regression analysis studied relationship of four food security status based on Food Security Index (FSI_p) scores with ten independent variables viz., village, family size, literacy, occupation, household income, and household expenditure, possessions of livestock, field crops, vegetables and fruits.

In the present study the dependent variable Food Security Index (FSI_p) was calculated for each household and then categorized with k = 4 categories viz. High (H), medium (M), Low (L) and Unsecured (US). Using MLR model, z_{ik} which represent unobserved continuous variable to assess the "propensity toward" particular k category, were calculated. Larger values of z corresponded to higher probabilities of that category (assuming all other z's remain constant).

Mathematically, the relationship between the z's for k categories measured for i^{th} responding households and the probability of a particular outcome is described as

$$\pi_{ik} = \frac{e^{z_{ik}}}{(e^{z_{i1}} + e^{z_{i2}} + \cdots + e^{z_{ik}})}$$

Where

πik is the probability the ith case falls in kth category (i =1,2,…, 80 and k = 1,2,3,4)

z_ik is the value of the kth unobserved continuous variable for the ith case. It is log transformation of odds ratio (πik/(1-πik)), where πik is probability of ith household in kth food security category i.e., z_ik = log(πik/(1-πik)).

zik is assumed to be linearly related to the predictors or set of independent variables as formulated below:

z_ik=bk0+bk1xi1+bk2xi2+...+bkjxij

Where

xij is the jth independent variable for the ith household, (j = 1,2,…,10)

bkj is the jth coefficient for the kth unobserved food security category

j is the number of independent variables.

To solve the problem of non-identifiability, z_k is (arbitrarily) set to 0 where the k^{th} category (Unsecured (US)) was the reference category.

Results

The socio-economic and demographic characteristics of the selected households are an important parameter for understanding food security. The demography of the sample households in the study region is showed in table 1.

Category	Male	Female	Total
Young (<12 years)	64	60	124
Adult (12-59 years)	170	161	331
Old (> 59 years)	8	17	25
Overall	242	238	480

Table 1: Age and gender wise distribution of sample household members.

Source: Field survey (2017).

The study found that illiteracy was at 26.25 % of total households (Table 2). It was also observed that illiteracy among head of the households indicated lower occupation levels and hence low income levels. Also, smaller families and larger families were observed to be having higher literacy rate of head of households (> 80%) compared to medium families (~70 %).

Family size	Illiterate	Literate
Small (Less than 5 members)	3(3.75)	10(12.50)
Medium (5 to 7 members)	16(20.00)	37(46.25)
Large (8 or more members)	2(2.50)	12(15.00)
Overall	21(26.25)	59(73.75)

Table 2: Frequency distribution of literacy level of household heads in Phek district.

Source: Field survey (2017); Note: figure in parentheses indicates % to total households).

Traditionally, the concept of food security revolves around livelihood and occupation. Larger family had the highest average household monthly income of INR 20714 compared to INR 17923 for small family.. However, household income level as well as monthly expenditure of three different family sizes was found to be statistically non-significant at 5% level of significance [3].

Components of household food security and Food Security Index for Phek district

Four of six scores viz., FCS_P, $HDDS_P$, CSI_P and $SAFS_P$ were considered food security measurement scores, and HHS_P and $HFIAS_P$ were measures of food insecurity score. Overall Food Security Index (FSI_P) was calculated with concept of difference between minimum of four food security measurements and maximum of two food insecurity measurements [1]. Table 3 showed the six dimensions of food security and overall food security index. Analysis of variance (ANOVA) for categorical independent variables under study was applied for six household food security/ insecurity measurements (Table 3). The block Kikruma was farther from Pfutsero town (distance of 8 to 12 km) compared to Pfutsero block (distance of 4 to 5 km from the town), hence it was observed that the Coping Strategy Index (CSI_P) showed significant difference among villages. Phusachodu and Kikruma villages in Kikruma block were statistically at par but Phusachodu village had significantly lower CSI_P than Kami and Lekromi villages of Pfutsero block. It indicated that the villages that are closer to regular market and larger town had better coping strategies for food access. It was observed that smaller family sizes had significantly higher food security indicator scores (FCS_P, $HDDS_P$, $SAFS_P$), lower HHS_P as well as FSI_P score compared to medium or large family sizes.

Discussion

The linear inter-relationship among six food (in) security components and correlation with Food Security Index (FSI_P). is studied using correlation matrix (Table 4). The finding is in consonance with the finding of Maxwell., *et al.* [8]. The study assessed inter-correlations among seven food security indicators to analyze whether the different measures detected similar or different dimensions of food insecurity. They observed a strong inter correlation among the indicators existed.

In addition, the FSI_P score was observed to be significantly linked with the explanatory variables like family size and household income (Table 5). The FSI_P score was observed to be negative significant link with household size and positively significant with household income levels indicating larger family size with constant income type faced larger risk of food deprivation and hunger.

Levels	Count	FCS_P	$HDDS_P$	HHS_P	CSI_P	$HFIAS_P$	$SAFS_P$	Food security Index (FSI_P)
Villages								
1. Phusachodu	20	-0.310	-0.255	0.209	-0.441	0.171	0.126	-1.599
2. Kikruma	20	-0.064	0.067	-0.212	-0.292	0.227	-0.202	-1.292
3. Kami	20	0.276	0.056	0.205	0.415	0.022	-0.032	-1.351
4. Lekromi	20	0.093	0.135	-0.203	0.322	-0.419	0.101	-0.827
LSD (p = 0.05)		NS	NS	NS	0.684	NS	NS	NS
Family size								
1. Small	13	1.051	1.107	-1.045	1.609	0.025	0.081	-0.362
2. Medium	53	-0.093	-0.121	0.147	-0.133	-0.054	0.051	-1.262
3. Large	14	-0.618	-0.570	0.415	-0.991	0.186	-0.274	-2.125
LSD (p = 0.05)		0.600	0.595	0.613	0.433	NS	NS	0.723
Occupations								
1. Cultivators	23	-0.195	-0.152	0.096	-0.381	0.468	0.059	-1.781
2. Cultivators and business	26	0.271	0.271	-0.203	0.316	0.016	0.149	-1.021
3. Government, Agri, business	31	-0.082	-0.115	0.098	0.018	-0.361	-0.169	-1.093
LSD (p = 0.05)		NS	NS	NS	0.669	0.655	NS	0.773
Food Possess Livestock (Numbers of types of livestock)								
1	5	0.159	-0.106	0.335	-0.301	0.049	-0.911	-2.321
2	42	0.024	0.065	-0.155	-0.019	0.068	0.035	-1.225
3	28	-0.030	-0.029	0.134	0.161	-0.199	0.111	-1.084
4	5	-0.196	-0.273	0.217	-0.446	0.492	-0.006	-1.594
LSD (p = 0.05)		NS	NS	NS	NS	NS	NS	NS
Food Possession - Crops (Number of types of agronomic crops)								
2	40	-0.081	-0.140	0.107	-0.108	0.021	-0.177	-1.551
3	40	0.071	0.128	-0.079	0.093	0.007	0.190	-1.030
p-value		0.264	0.127	0.242	0.204	0.474	0.045	0.034
Food Possession - Vegetables (Number of types of vegetables)								
3	3	-0.507	-0.572	0.167	-0.613	0.258	0.031	-1.518
4	25	-0.316	-0.333	0.176	-0.045	-0.348	-0.405	-1.541
5	52	0.181	0.193	-0.094	0.057	0.153	0.193	-1.121
LSD (p = 0.05)		NS	0.543	NS	NS	NS	0.542	NS
Food Possession - Fruits (Number of types of fruits)								
2	9	0.117	0.183	-0.481	-0.009	0.322	-0.215	-1.355
3	46	0.104	0.113	-0.062	-0.009	0.067	-0.020	-1.144
4	21	-0.117	-0.153	0.195	0.004	-0.078	0.164	-1.395
5	4	-0.845	-0.908	0.773	0.107	-1.086	-0.146	-1.806
LSD (p = 0.05)		NS	NS	NS	NS	NS	NS	NS

Table 3: Comparison of indicators based on independent variables.

Source: Estimated figures; Note: LSD: Least Significant Difference; NS: Non Significant; p: probability

	FCS_P	$HDDS_P$	HHS_P	CSI_P	$HFIAS_P$	$SAFS_P$	FSI_P
FCS_P	1.00						
$HDDS_P$	0.93**	1.00					
HHS_P	-0.57**	-0.80**	1.00				
CSI_P	0.58**	0.64**	-0.61**	1.00			
$HFIAS_P$	0.54**	0.46**	-0.16NS	-0.16NS	1.00		
$SAFS_P$	0.17NS	0.22*	-0.20NS	0.17NS	0.11NS	1.00	
FSI_P	0.20NS	0.36**	-0.57**	0.58**	-0.43**	0.40**	1.00

Table 4: Correlation matrix of food security indicators with FSI. Source: Estimated figures; Note: * Significant at p = 0.05 and ** Significant at p = 0.01; NS= Non-significant.

	Family size	Income (INR)	Expense (INR)	FSI_P score
Family size	1.000			
Income (INR)	0.103	1.000		
Expenditure (INR)	0.182	0.888**	1.000	
FSI_P score	-0.496**	0.226*	0.194	1.000

Table 5: Inter-relationship of socio-economic variables with FSI_P score. Source: Estimated figures; Note: * Significant at p = 0.05 and ** Significant at p = 0.01; NS= Non-significant.

Factors affecting food security index of Phek district

To understand relationship function and odds ratio of four categories of FSI_P as dependent variable with selected socio-economic parameters, a multinomial logistic regression analysis was performed As per the analysis with four categories of food security index (Unsecured (US: ≤ -2), Low security (L: -1.5 to -2), Medium security (M: -0.5 to -1.5) and High security (H: ≥ -0.5)) was taken as dependent variable explained by nominal variables viz., villages, occupation, literacy levels and family size. Other scale and ordinal based variables like monthly household income, monthly household expenditure, weekly food possession of Livestock, Crops, Vegetables and Fruits acted as covariate variables in the model.

The model fit was observed to be statistically significant (p = 0.007) by likelihood ratio test. From the model it was observed that household income (p = 0.069), occupation (p = 0.031) and family size (p = 0.000) were identified in likelihood ratio test to have relevance in studying FSI_P category. The odds ratio equal to one represent 50% chance that favorable food status prevailing over unfavorable status. The ratio above one indicated higher chance of getting particular condition over the reference status and vice-versa. If the ratio showed zero, it represented no chance that particular condition would occur over reference category.

The table 6 showed the result of multinomial logistic regression model with Unsecured (US) FSI_P category as reference category.

Using Likelihood ratio test, household income and family size were identified to have significant chi-square value indicating relevance of the two parameters in studying FSI_P index. The coefficients of parameters estimated through multinomial logistic regression model showed significance only for household income ($p < 0.05$) and for livestock possession ($p < 0.10$) for High FSI_P category. It indicated that the classification of the households with higher food security status over unsecured category (US) can be predicted using income level and livestock possession.

Classification of households based on food security index categorization (Table 7) showed small family sizes are mostly medium to high food secured. From the analysis, it was observed that 18 families identified as unsecured (US) whereas 19- High, 28-Medium and rest 15-Low food secure families. Larger families were mostly classified as Unsecured (US) or Low (L) food secure with 78% of households in two categories.

The multinomial regression model was able to correctly classify a minimum 50 percent for unsecured households and 73.7 percent for highly secured houses. Overall 60% was correctly classified through the no intercept multinomial regression model compared to classification based on observed food security index.

Conclusion

It was observed from FSI_P calculation that 18 families were categorized as unsecured (US), 15 as Low food secured, 28 as Medium and 19 as High food secured households. Large and medium size families together comprised about 97% of overall Low and Unsecured households. The empirical analysis on the factors effecting food security showed that household size was the most fundamental determinant for improving household food

Explanatory variables	Chi-square (Likelihood ratio)	Coefficients of food security FSI_p categories		
		Higher (H)	Medium (M)	Lower (L)
HH_Income	7.583*	0.001**(1.001)	0.000 (1.000)	0.000 (1.000)
HH_Expenditure	2.088NS	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)
Family_size Small Medium Large	23.684***	 -6.160 (0.002) -10.161 (0.000) -11.843 (0.000)	 -1.303 (0.272) -2.064 (0.127) -4.414 (0.012)	 1.386 (3.998) 14.284 (L) 13.106 (L)
Literacy 0 1	1.014NS	 -0.803 (0.448) 0.000 (R)	 0.049 (1.050) 0.000 (R)	 -0.613 (0.542) 0.000 (R)
Occupation 1 2 3 4 (Dummy)	13.559NS	 -6.092 (0.002) -3.015 (0.049) -4.949 (0.007) 0.000 (R)	 -1.497 (0.224) -0.229 (0.796) -0.473 (0.623) 0.000 (R)	 -17.479 (0.000) -16.553 (0.000) -14.723 (0.000) 0.000 (R)
Village 1 2 3 4	12.610NS	 -2.350 (0.095) -0.084 (0.919) 0.002 (1.002) 0.000 (R)	 0.068 (1.071) -0.142 (0.868) 0.159 (1.172) 0.000 (R)	 0.326 (1.385) -2.175 (0.114) 1.181 (3.257) 0.000 (R)
Livestock_possess	4.172NS	1.466* (4.331)	0.239 (1.270)	0.219 (1.244)
Crop_possession	3.231NS	1.244 (3.469)	1.061 (2.891)	1.869 (6.479)
Vegetable_possess	2.611NS	0.925 (2.523)	-0.358 (0.699)	-0.644 (0.525)
Fruits_possession	1.696NS	-0.407 (0.666)	0.340 (1.404)	-0.095 (0.909)
Pseudo-R^2 = 0.326 (McFadden)				

Table 6: Factors affecting food security index (MLR model)

Source: Estimated figures; Note: *Significant at p = 0.10 and *** Significant at p = 0.01; parenthesis represents exponential of coefficient which is odds ratio over reference group Unsecured (US), "R" is redundant parameter.

Family size	Food security category			
	US	L	M	H
Small	1(1.25)	0(0.00)	4(5.00)	8(10.00)
Medium	11(13.75)	10(12.50)	22(27.50)	10(12.50)
Large	6(7.50)	5(6.25)	2(2.50)	1(1.25)
Total	18(22.50)	15(18.75)	28(35.00)	19(23.75)

Table 7: Classification of households based on FSI_p category. (Note: The figure in parentheses indicates percentage to the total households).

security index. Using Likelihood ratio test, household income ($p < 0.05$) and family size were identified to have significant chi-square value indicating relevance of the two parameters in studying FSI_p category. The findings in resonance with findings of Bogale and Shimelis [9] that improvement in food security situation is possible by building assets, improving financial security and promoting family planning. The coefficients of parameters estimated through multinomial logistic regression model showed significance for livestock possession ($p < 0.10$) for High FSI_p category indicating relevance of livestock rearing as important component of food security of the tribal communities [10-12].

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