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Food security status in rural areas of Mizoram, Northeast India

Vishwambhar Prasad SATI* http://orcid.org/0000-0001-6423-3119; e-mail: vpsati@mzu.edu.in

Lalrinpuia VANGCHHIA http://orcid.org/0000-0001-5255-4978; e-mail:lalrinpuiavangchhia@gmail.com

** Corresponding author*

Department of Geography and Resources Management, School of Earth Sciences, Mizoram University, Aizawl 796004, India

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Abstract: Rural areas of the Mizoram state, India practice subsistence agriculture where shifting cultivation dominates the farming systems. As a result, output from crops is very low and thus, the rural areas suffer from food insecurity. This paper analyses food security status in the rural areas of Mizoram and suggests the measures to attain food security. A case study of 16 villages, lying in all the eight districts of Mizoram, was conducted in 2014 and 1527 households (76%) out of total 2010 households were surveyed through purposive random sampling method. Structured questionnaire was constructed and questions on three food security components and 13 indicators were asked. We used *Z* score technique to calculate data and finally got a composite score of all the components of food security. Our result shows that food availability in the study villages is very less as composite score stands for 0.003 whereas food accessibility is comparatively higher, mainly due to availability of fair price shops (mean value is one), high agricultural working population (40.1%) and high literacy rate (70.6%). Therefore, its composite score is 0.236. Food stability scores only -0.062 and finally overall food security stands for 0.178, which is inadequate. We have suggested that 'system rice intensification', which is already in practice, should be given priority. Adequate irrigation facilities, proper public distribution system, cultivation of fruits and vegetables, value addition in farm products and access to market may achieve food security.

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Introduction

Food security 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 (World Food Summit 1996). Feeding the future population of 10 billion by 2050 is increasingly challenging due to complex interplay of social and economic drivers (Hanjra et al. 2017). Global drivers including climate change, energy, financial crises, carbon economy, land use change and climate change pose further challenges (Hanjra and Qureshi 2010; Thenkabail et al. 2011; Qureshi et al. 2013). Local drivers impacting food security include floods and droughts, access to irrigation, salinity and land degradation, croplands, rural infrastructure, markets and credit, water supply and sanitation systems, gender issues, and public investment and subsidy policies (Narayanamoorthy and Hanjra 2006; Mu et al. 2009; Narayanamoorthy and Hanjra 2010; Thenkabail et al. 2010; Ward 2010; Kumar et al. 2012; Karimov et al. 2014; Pavelic et al. 2015; Drechsel and Hanjra 2016). The challenges to food security are complex and require renewed analysis and focus on food systems at global, regional and local levels, to sustainably deliver safe and nutritious food to all people at all times (Brown et al. 2012).

Local food security depends on production, procurement and distribution of food grains. It also depends on physical access, landscape vulnerability such as landslides, flash floods and road blocks and socio-economic factors – price hike, transportation to food supply and fuel. Availability, access, stability and utilization of food are believed as the four pillars and important dimensions that regulate food security. Access to food is another major factor which includes physical access of rural areas, market access, market price and institutional support. Access to food means that it is well distributed according to the demand. It further stabilizes economic, social and environmental sustainability. Both food availability and its proper distribution may achieve food security.

Von Braun et al. (2003) observed that global food production would be sufficient to provide everyone with his minimum calorie needs if available food was distributed according to the need. Further, price volatility, higher commodity prices and an increasingly inelastic demand in the rich world expose the poor to food insecurity and malnutrition risks (OECD - FAO 2011). Cline (2008) predicts that an average decline in global food production between 3% and 16% by 2080 is due to global warming. Tiwari and Joshi (2012) studied natural and social factors affecting food security in the Himalaya. According to them, food security situation has been deteriorating largely in developing and underdeveloped countries during the last decades mainly due to increasing population that lead the gap between demand and supply for food. Fullbrook (2010) states that economic recession which started in 2008 and large fluctuations in food prices have also adversely affected food security in developing and poor countries. Further, due to climate change, developing and underdeveloped countries, which practice subsistence agriculture and occupy large population, are likely to face more severe food crises than the developed countries (Aase et al. 2009). Food crises have more deepened in the mountainous areas (Huddleston et al. 2003) as they are highly critical to food security. This is because of the presence of many factors such as subsistence economies, undulating terrain, harsh climate, low yield of crops, high vulnerability to natural risks and limited infrastructure and access to markets (Tiwari and Joshi 2012).

Barrett (2010) observed that more than one billion people in the world do not have access to sufficient dietary and about two billion people are suffering from micronutrient deficiencies. FAO (2015) estimated that about 795 million people in the world were undernourished in 2014. At the same time, Sub-Saharan Africa has the highest prevalence of undernourishment where about 220 million people are hungry. South Asia has about 15.7% people unnourished. However, the drivers of food insecurity and undernourishment are quite different in Sub-Saharan Africa than Asia (Hanjra et al. 2009). In the Hindu Kush Himalaya, out of the total 200 million people, 31% live below poverty line (excluding China and Myanmar) (Hunzai et al. 2011). A report of C. Rangarajan Committee estimated poverty line in India as Rs. 47[1)]/person/day for urban poverty and Rs. 32/person/day for rural poverty. According to this estimation, 29.5% people live below poverty line in India (Planning Commission in India 2014). India ranks 63among the 78 countries who alarmingly suffer in food insecurity. Further, the changes in the climatic conditions are expected to cause a decrease of 30% agricultural productivity in India (Cline 2008; IPCC 2007; UNDP 2006). The Government of India adopted National Food Security Act (Right to Food Act) in 2013. The main objective of the Act is to subsidize food grain to reach out to 75% of rural population and 50% of urban area. However, its results have yet to come. National Rural Employment Guarantee Act of India (2005) also aims at increasing food security level. Under the scheme, every unemployed adult is given a token money of Rs. 150/day and in lieu of it, he/she works for a village level development work. However, in the rural areas, its implementation is not proper.

Livestock-forest (biomass) based subsistence agriculture in the Himalaya constitutes the main source of rural livelihoods (Tiwari and Joshi 2011) as about 70% of the total population depends on farming activities. Little access to productive agricultural lands (19.6%) (Tscharntke et al. 2012)

[1)] 1USD is equal to Rs. 68 (Feb 2017)

and undulating terrain limit the scale of productive activity (Tiwari 2008). However, economic viability of crop farming is comparatively less due to geo-environmental constrains. In the Himalaya, a major portion of farming land is un-irrigated (88%). Increasing needs as well as pressure of population on the arable land, the traditional farming has become unsustainable both economically and ecologically (ICIMOD 1996; Sati 2009). In the Himalayan region, average dietary energy intake is 2098 Kcal per capita per day, 50 units below the national average. It is further below in the study villages, where average per capita energy intake is 1700 Kcal (Sati and Rinpuia 2016).

The states of northeast India have above 15% poverty. In 2009-10, Manipur had the highest poverty (47%). Assam followed it (37.9%). Mizoram, a small and hilly state lying in the eastern extension of the Himalaya, characterizes abundance of natural resources – spectacular landscape abundant water and dense forests with high biodiversity. It recorded 15.4% poverty in 2004-05 which increased to 21.1% (1.91 hundred thousand people; 5.7%) in 2009-10(The Telegraph 2012). Comparatively low poverty rate in Mizoram as a whole is due to 52% urban population. However, in the study villages (rural), people living below poverty line are 33.7% and about 17.6% people live under chronic poverty (total 51.3%). High poverty and low nutrition consumption enhances high infant mortality rate as it is 35 in Mizoram and above 200 in Saiha district (Sati and Rinpuia 2016), which lies in the south part of Mizoram.

There is no substantial research done so far in the northeast India, in general and Mizoram, in particular, on food security related issues. This paper is an effort to present local food security status in Mizoram that represents the northeast India. Moreover, it will be a benchmark for further studies in the region or other similar regions. The main objective of this study is to analyze the food security status and to identify the key factors of food insecurity in Mizoram, Northeast India by analyzing the three components of food security viz. food availability, food accessibility and food stability and their 12 indicators. It further aims at suggesting policy measures to achieve food security in this hilly and remote state. These are illustrated with a case study of 16 villages of the eight districts of Mizoram, northeast India.

1 Methods and Materials

1.1 Study area

Mizoram lies in the north eastern part of India between 21°58' - 24°35' N and 92°15' - 93°29' E, covering an area of 21,087 km² and shares 0.64% of the country's area. It is a mountainous state (96.9%) and is also known as the eastern extension of the Himalaya. Myanmar in the east and south and Bangladesh in the west makes its international boundaries. Its national boundary is delimited by Tripura in the west, Assam in the north and Manipur in the northeast (Figure 1). All the neighboring countries and states that delimit its border area are socio-economically underdeveloped and they influence greatly the

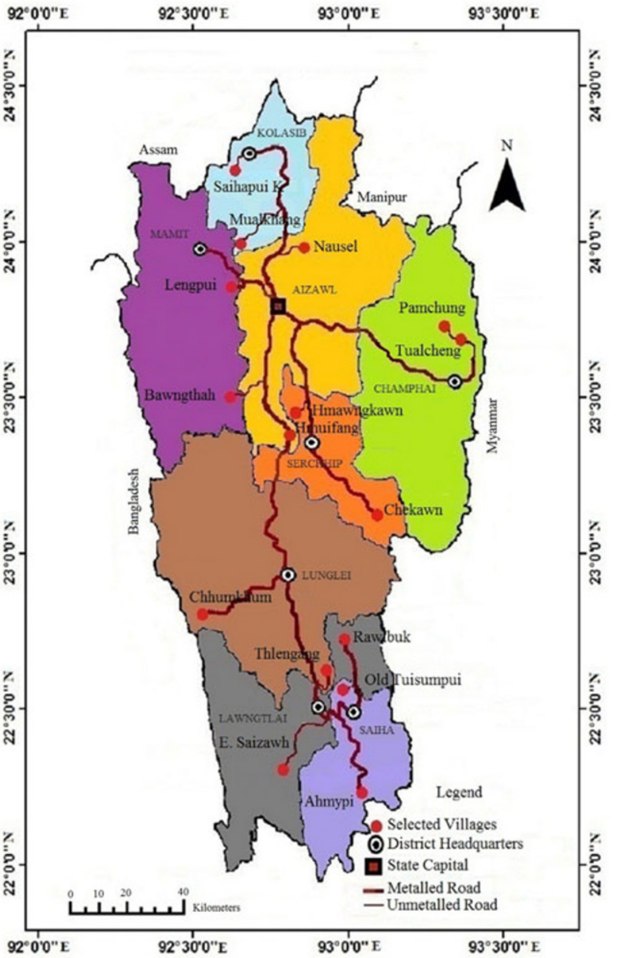

Figure 1 Location map of Mizoram and case study villages.

whole state of Mizoram in socio-economic and geo-political points of view. Mizoram possesses huge natural resources in terms of spectacular landscape, water and forest as it covers about 92% forest area and it has several perennial rivers. Terrain is undulating and slope gradient is high. Out of total 16 study villages, 12 villages have steep slope. Altitude of these villages ranges from 118 m (lowest) to 1513 m (highest) meanwhile, 12 villages lie above 500 m. Natural hazards mainly landslides and flash floods are very common as the whole state receives heavy downpour for about eight months in a year. Climatic conditions are suitable throughout the year with 23˚C average annual temperature and above 1278 mm average annual rainfall. It has eight administrative districts and its economy is based on the output from traditionally grown cereals through practicing shifting cultivation, although, about 52% population is urban. Total population is 1.09 million and population distribution is sparse as only 52 persons live per km^2 (2011). In the case study villages, total population is 9319; sex ratio is 956 women per thousand men and literacy is 70.53%.

Mizoram is an economically backward region. Its economy mainly depends on the practices of traditionally cultivated cereal crops with rice as the staple food. Total rice consumption is 180,000 MT whereas its production is only 44,950 MT (25% of the total consumption) (State Statistical Diary 2015). Arable land is only 4%, of which 32% area characterizes shifting cultivation with small land holdings whereas about 31.3% population is engaged in practicing agriculture. Under traditional farming system, shifting cultivation dominates mainly in the hill slopes, occupying the highest arable land while wet paddy grows in the valleys and floodplains. During the past decades, 58.1% area under shifting cultivation has decreased (from 68, 114 ha in 1997-1998 to 28, 562 ha in 2010-11). Meanwhile, area under wet paddy cultivation increased by 28.4% (from 9446 ha to 12,130 ha) in 2010-2011. In the study villages, the share of shifting cultivation in net sown area was calculated about 38.64%. Mizoram registers 0.58 indices and ranks fourth in agricultural development in the northeast India (Narain et al. 2004).

1.2 Methodology

The study was conducted using a mix-set of qualitative and quantitative approaches. Data was obtained mainly from the primary sources. A case study of 16 villages (two villages from each district) was carried out and a household level survey was conducted to gather first hand data between June and September, 2014 (four months). Selection of villages was based on their location such as flood plains, river valleys and structured hills; distance from the urban centers and roads; population size and the level of infrastructural facilities. Further, purposive random sampling method was employed to select the households. Out of total 2010 households of 16 villages, 1527 households (76%) were surveyed (Table 1). A structured questionnaire was framed and questions were asked on all the components of food security and their 13 indicators. Apart from it, a participatory rural appraisal was adopted to observe food security status through rapid visit of the villages (2014-2016). Finally, statistical methods such as descriptive statistics, correlation, regression and *Z* score were substantially used to calculate gathered data. Altitude and distance of the villages from district headquarter were gathered using GPS.

Food security has mainly three components i.e. food availability, food accessibility and food stability (Nayak and Narayankar 2009). Food availability is an important component of food security. The major indicators of food availability that we selected to conduct this study, based on their presence in the study villages, are food production/ha/annum (kg), per capita/day availability of rice (gram) and per capita availability of livestock (number). Subsequently, the different indicators of food accessibility and stability were selected and interpreted.

We analyzed food security components (three) and their 13 indicators. Primary data was transformed first into percentile and then we analysed them using *Z* score standardized techniques to find out the village level variations in food security and finally composite score was observed. To transform data matrix into scale matrix, indicators were standardized by subtracting the mean value from each individual variable and divided by their standard deviation, as:

Table 1 Description of surveyed households

Name of village	District where the village is located	Total households (2011)*	Households surveyed (2014)	% of surveyed households	Altitude (m)	Distance from district headquarter (km)
Tualcheng	Champhai	157	136	86.6	1513	60
Pamchung	Champhai	63	57	90.5	1167	70
Nausel	Aizawl	61	53	86.9	946	16
Hmuifang	Aizawl	62	62	100	1472	51
Mualkhang	Kolasib	106	65	61.3	507	46
Saihapui K	Kolasib	266	114	42.9	118	13
Hmawngkawn	Serchhip	36	36	100	1218	33
Chekawn	Serchhip	49	47	95.90	907	40
Chhumkhum	Lunglei	53	53	100	286	44
Thlengang	Lunglei	45	39	86.9	1094	70
Rawlbuk	Lawngtlai	119	119	100	1201	53
E.saizawh	Lawngtlai	107	81	75.7	358	60
Ahmypi	Saiha	42	37	88.1	1043	75
Old Tisopi	Saiha	35	35	100	1182	38
Bawngthah	Mamit	74	74	100	800	53
Lengpui	Mamit	735	519	70.6	412	30
Total		2010	1527	76.0		

*Census of India, 2011

$$Z_i = (X_{ij} - X_j)/SD \quad (1)$$

Where, Z_i is the Z-score for the i^{th} unit; X_{ij} is the X variable in the i^{th} unit and j^{th} variable; X_j is the mean of j^{th} variable and SD_j is the standard deviation of the j^{th} variable.

Finally we obtained Z-score for every indicator.

Composite score was obtained by adding up of all individual Z-scores or standard data as $C_i = \sum Z$; where, C_i is the composites cores and $\sum Z$ is the summation of Z-scores. Spearmen's rank method was applied to measure levels of road availability. We also used descriptive statistics to obtain mean value and standard deviation of all assessed data. Table 1 shows the list of case study villages, % of surveyed households and geographical indicators such as altitude and distance from district headquarters.

2 Results

2.1 Food security components and indicators

To understand the levels of food security in the study villages, we analysed 13 indicators of three components of food security. Firstly, we observed percentile scores of all the indicators under different components and then we calculated mean value and standard deviation (Table 2). Composite score of three components of food security was calculated (Table 3) and grouped into indices/ levels (five) from very high to very low according to food security status in the study villages (Table 4). Correlation analysis was applied to observe the direction of change (to correlate the variables) and a regression model was applied to find out the relationships of variables. The following paragraphs provide a detailed note on food security status in case study villages.

2.2 Levels of food availability

Mean value and standard deviation of all three indicators of food availability was calculated. Mean value of food production/person/annum (kg) was noted 44.5 while per capita/day availability of rice (kg) was observed 1.5 and per capita availability of livestock was 1.4.

Further, composite score of all indicators was analyzed and grouped into five levels from above 2.1 to below -2.1. The highest number of villages (43.75%) falls under medium level in food availability with score from 0 to 1. Villages that obtain low to very low score (-1.1 to -2 and below -

Table 2 Mean value and standard deviation of food security components and their major indicators (n=1527 households of 16 villages)

Security components	Indicators	Mean value	Std. Deviation
Availability	Food production*/person** /annum (kg)	44.5	67.8
	Per capita/day availability of rice (kg)	1.5	2.3
	Per capita livestock***	1.4	0.7
Accessibility	Road (in rank)****	33.4	12.2
	No. of agricultural workers (%)	42.1	12.6
	No. of fair price shop	1.0	0.4
	Literacy (%)	70.6	14.6
	Household income (farm and non-farm), (Rs.)	577888	1332571
Stability	Irrigated land (ha)	15.9	6.6
	Self-sufficiency in food stuff except rice (% of HHs)	5.4	7.1
	Self-sufficiency in rice (% of HHs)	12.2	13.2
	HHs not dependent on fair shops (%)	12.9	13.3
	Food stock more than five months (% of HHs)	7.4	8.8

*Rice, Maize, (80% crop area) and seasonal vegetables; **Individual;
***Pigs constitute 74% followed by poultry (20%) and cattle only 6%;
****Road: road condition is measured by Spearmen's rank method by using the four indicators like distance from nearest urban centre (km), distance from Aizawl in km (Aizawl is a capital city), distance from the main road (km) and type of road (i.e. metalled, unmetalled, jeep road and foot path). Then, Z-Score was calculated from the composite rank.

Table 3 Village wise composite score of food security (n=1527)

Villages	Availability	Accessibility	Stability	Composite score
Tualcheng	8.31	-0.72	6.87	14.46
Pamchung	4.03	-0.86	2.85	6.02
Nausel	-2.04	1.45	-2.88	-3.47
Hmuifang	0.07	1.53	-2.88	-1.28
Mualkhang	-2.07	0.04	0.04	-1.99
Saihapui K	-2.45	-2.55	2.86	-2.14
Hmawngkawn	1.38	1.01	0.1	2.49
Chekawn	-0.47	2.03	5.44	7
Chhumkhum	-1.28	1.22	-1.69	-1.75
Thlengang	-0.5	-1.1	-3.62	-5.22
Rawlbuk	-0.54	2.26	-2.54	-0.82
East Saizawh	-1.98	-5.01	-1.26	-8.25
Ahmypi	-0.51	-1.78	-2.8	-5.09
Old tuisumpui	-0.4	1.54	-2.87	-1.73
Bawngthah	0.57	1.45	1.02	3.04
Lengpui	-2.07	3.27	0.37	1.57
Mean value	0.003	0.236	-0.062	0.178
Std. deviation	2.74	2.12	3.17	5.54

2.1, respectively) represent 37.5% whereas only 18.75% villages have high to very high score (above 2.1). These figures show that food availability is very less in the study villages.

2.3 Levels of food accessibility

We selected five indicators of food accessibility such as road network (in rank), percentage of main agricultural workers, literacy rate, number of fair shops, household income (farm and nonfarm) and calculated their composite score. A regression model was implied to analyze altitude and per capita income. We observed that per capita income is high in high altitude (Figure 2), although, the transportation facilities are less in the high altitudes. It is because of this that the agricultural activity such as farming of crops and livestock is intensive in this area. Mean values of road connectivity and conditions were noted as 33.4%,

Table 4 Indices and levels of food security

Index	Level	Villages (%)
Levels of food availability		
Index	Level	Villages (%)
2.1 & above	Very high	Tualcheng, Pamchung (12.5)
1.1 to 2	High	Hmawngkawn (6.25)
0 to 1	Medium	Chekawn, Thlengang, Rawlbuk, Ahmypi, Old tuisumpui, Bawngthah, Hmuifang (43.75)
-1.1 to -2	Low	Chhumkhum, East Saizawh (12.5)
-2.1 & below	Very low	Nausel, Mualkhang, Saihapui K, Lengpui (25)
Levels of food accessibility		
2.1 & above	Very high	Lengpui, Rawlbuk, Chekawn (18.75)
1.1 to 2	High	Nausel, Hmuifang, Hmawngkawn, Chhumkhum, Bawngthah, Old Tuisumpui (37.5)
0 to 1	Medium	Tualcheng, Pamchung, Mualkhang (18.75)
-1.1 to -2	Low	Thlengang, Ahmypi (12.5)
-2.1 & below	Very low	Saihapui K, East saizawh (18.75)
Levels of food stability		
2.1 & above	Very high	Tualcheng, Pamchung, Saihapui K, Chekawn (25)
1.1 to 2	High	Bawngthah (6.25)
0 to 1	Medium	Mualkhang, Hmawngkawn, Lengpui (18.75)
-1.1 to -2	Low	Chhumkhum, East Saizawh (12.5)
-2.1 & below	Very low	Nausel, Hmuifang, Thlengang, Rawlbuk, Ahmypi, Old Tuisumpui (37.5)
Levels of food security		
5.1 & above	Very high	Tualchen, Pamchung, Chekawn (18.75)
1.1 to 5	High	Hmawngkawn, Bawngtah, Lengpui (18.75)
-1 to 1	Medium	Rawlbuk (6.25)
-1.1 to -5	Low	Nausel, Hmuifang, Mualkhang, Saihapui K, Chhumkhum, Old Tuisumpui (37.5)
-5 & below	Very low	Thlengang, East Saizawh, Ahmypi (18.75)

percentage of main agricultural workers stood for 42.1%, literacy rate was registered as 70.6%, number of fair price shops was 1 and household income was Rs. 577888 (Annually). Very high food availability with above 2.1 composite score was noted in 18.75% villages. The highest percentage of villages (37.5%) lies in high category of composite score i.e. 1.1 to 2, while under medium and very low categories (0 to 1 and below -2.1), 18.75% (in each category) villages fall. Villages that fall under low

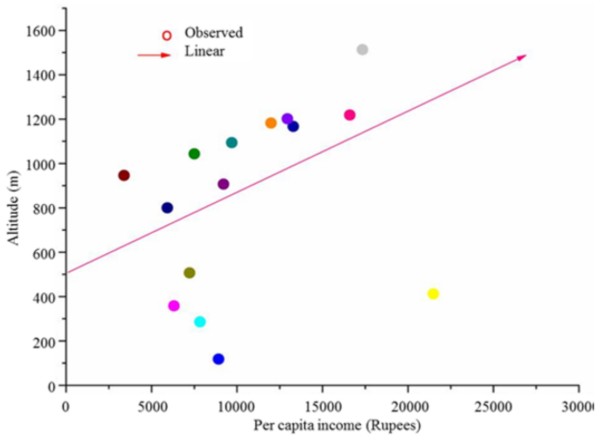

Figure 2 Regression between altitude and per capita income.

category of composite score (-1.1 to -2) stand for 12.5%.

2.4 Levels of food stability

We selected irrigated area (ha), self-sufficiency in food stuff except rice (% of households), self sufficiency in rice (% of households), households not dependent on fair shops (% of households) and households (in %) who have more than five months food stock as the major indicators of food stability. Mean value of all the indicators varies from 19.9 ha of irrigated land to 5.4% of self-sufficiency in food stuff except rice. Mean value of other indicators such as households not dependent on fair shops is 12.9%, self sufficiency in rice is 12.2% and 7.4% households have food stock for more than five months. After that, composite score was obtained. Our study shows that the highest number of villages (37.5) comes under very low level (below -2.1) of food stability. It is followed by very high (above 2.1) level where number of villages is 25%, medium level of food stability (0 to 1) is obtained by 18.75% villages, 12.5% villages have low level (-1.1 to -2) and 6.25% villages have high level of food stability (1.1 to 2).

Table 5 Correlation: food availability, accessibility and stability (*n*=16)

Variables	Correlation*	Food availability	Food accessibility	Food stability
Food Availability	Pearson Correlation	1	-0.042	0.574*
	Sig. (2-tailed)		0.877	0.02
Food Accessibility	Pearson Correlation	-0.042	1	-0.061
	Sig. (2-tailed)	0.877		0.823
Food Stability	Pearson Correlation	0.574*	-0.061	1
	Sig. (2-tailed)	0.020	0.823	

*Correlation is significant at the 0.05 level (2- tailed).

Table 6 Regression of food security components

Variables	SC	Standard errors	SC	*t*-values	*P*-values
Constant	-0.051	0.701	-0.037	-0.073	0.943
Food availability	-0.055	0.339		-0.162	0.874
Food accessibility	0.662	0.262	0.573	2.522	0.026
Adjusted *R*-square	0.228				
F-value and significance (ANOVA)	0.073[a]				
Dependent variables: Food security. SC= Standardized coefficients					

In terms of food utilization, rice and pork is the food staple of people in the study villages. Rice grows both as shifting cultivation in the hills and as wet rice cultivation in the river valleys and flood plains whereas its production is high only in the flood plains and the valley terraces. Rice consumption in Mizoram is 180,000 MT, four times higher than the production. In other food items, vegetables and fruits grow as shifting cultivation however, they have low production. Every household has piggery within the house premises.

2.5 Levels of food security

Mean value of composite score of three components – food availability, accessibility and stability was observed. This was followed by calculating overall composite score. We observed that food accessibility obtains the highest value (0.236), followed by food availability which is 0.003 whereas food stability's value is negative (-0.062) and overall composite score is 0.178.

Based on the composite scores of food security components and their overall composite score, the villages were categorized into food security levels (five); from very low (below -5) to very high (above 5.1). It was observed that the highest number of villages lie under low food security level (37.5%) while 18.75% villages come under very low food security level. Villages that obtain high to very high level of food security are 18.75% each, while only 6.25% villages lie in medium level of food security.

2.6 Correlation: food availability, accessibility and stability

We established a correlation among food availability, accessibility and stability (Table 5), and used Pearson correlation method where correlation is significant at the 0.05 level (2- tailed). The hypothesis was 'higher the food availability and accessibility, higher is the food stability' because food stability depends on food availability and accessibility and food security is output of all the three components. It was observed that food stability has a close relationship with food availability where r value is 0.02.

We have used linear regression to establish the relationship between food security variables (Table 6) and observed significant value (coefficients[a] 0.026).

It was observed that although average food availability is very less, yet it is higher in the high altitudes. It is because that most of the economic activities are carried out on the hill tops, settlements lie mostly in this area and proportion of arable land is higher in comparison to the valleys. The same situation implies to food accessibility and stability. We have also established the relationship between distance of villages from road and service centers and food security status but did not observe any relationship. Since, all the villages are located remotely, they have limited access to infrastructural facilities and their economic activities are not sound. Distance of the villages from road or urban centers, therefore, does not make any difference.

3 Discussions

The Himalaya is one amongst the most fragile ecosystems of the world and both natural and anthropogenic hazards are quite active in this region. Depletion of natural resources base has led to a significant disruption of ecosystem services and as a result, food productivity has decreased during the recent past. A loss of agro-biodiversity in terms of reduction in staple food-crops mainly due to changes in the food habits further accentuates food insecurity (Palni et al. 1998). Changing food habits, bio-fuel production and encroachment on productive agricultural land for construction activities have manifested food insecurity. Because of depletion of natural resources with the consequent ecosystem services and the potential impact of climate change, agricultural production is facing serious challenges (Robert 2009). Global climate changes have adversely affected food and livelihood security in the Himalaya region (ICIMOD 2007). Climate change was observed in northeast India as rainfall received by it in 2006 monsoon season stands to be the scantiest for a period of 25 years since 1982 (Das et al. 2006). ICIMOD (2008) noted that the year 2005 had prolonged dry period with many springs drying up accompanied by large landslides.

Food security status in the study villages was noted very inadequate and all food security components and their indicators were poor in nature. Our study revealed that food availability is limited as its composite score stands for 0.003. About 80% villages obtained its medium, low and very low levels. Food availability depends on the output from agricultural land, which is only 4% of total geographical area and which is not adequate to attain food security. Further, agriculture characterises traditional practices and shifting cultivation dominates it. Innovation in traditionally practiced shifting cultivation is limited due to undulating and fragile terrain and it has led to low production and productivity and thus, per capita/day availability of rice is very less (1.5 kg). Low composite score of food availability is also due to less food production, which is 44.5/person/annum (kg). Although, mean value of per capita availability of livestock is 1.4 yet, its economic value is not enough to attain food security because livestock is used only for meat.

However, in terms of food accessibility, about 50% villages have high to very high accessibility and it is higher than food availability. Public distribution system (PDS), which we mentioned here as fair price shop is quite impressive as the mean value of it is one; it means that every study village has a fair price shop and food is comparatively accessible. Further, two other food accessibility indicators i.e. literacy and working population (agriculture) have high scores i.e. 70.6% and 42.1%, respectively. Therefore, food accessibility composite score is higher (0.236).

Food stability depends on the status of food availability, accessibility, physical access, market access, landscape vulnerability and infrastructural facilities. As food availability status was noted very low, it has severe repercussions on food stability, therefore, composite score of which is -0.061. Because of very low food production, food stock availability is limited as only 7.4% households have food stock for more than five months. Rice is the staple food for people in Mizoram however, only 12.2% households have self sufficiency in rice production because arable land is less and a large proportion of arable land lies under shifting cultivation. Irrigation facilities are inadequate mainly because of undulating and fragile terrain of hills, and valleys have less arable land and thus, agriculture is rainfed.

Physical access is one of the constrain factors to food access. Further, natural hazards both terrestrial and atmospheric are very active in Mizoram, mainly landslides and flash floods. These factors often lead to food inaccessibility and thus, food instability prevails. Inadequacy in infrastructural facilities such as road connectivity, food storages and proper food distribution systems also poised serious threat to food security. Mizoram state is lacking in grasslands and a number of cattle population. Mainly pig and hens are reared. One of the reasons of food insecurity in Mizoram is its farming system that characterizes shifting cultivation with very low yield of crops and low economic viability.

Infrastructural facilities in Mizoram are lagging behind. About 50% rural areas are lacking in road connectivity. Further, only 33.4% roads are in good conditions. Except small single track railways, there is no railway line in Mizoram. Landslides are very common and flash floods are active during July-August in the valleys and small flood plains. Crops grow in the *jhumland* and output from it is insufficient. Due to growing population (2.3% annual growth rate), food demand is increasing and further public distribution system is not properly managed. Thus, food scarcity problem exists. All these drivers/ components together influence food security status. Overall composite score of all components of food security is only 0.178, which is very low to attain food security.

4 Conclusions

Mizoram state is facing the menace of food insecurity and malnutrition. Thus, a large population is living under chronic poverty line in rural areas. At the meantime, it is bestowed with plenty of natural resources and suitable climatic conditions. Our study reveals that a sustainable use of natural resources and suitable climatic conditions along with development of infrastructural facilities and proper institutional support may lead to enhanced food security. For example, agricultural production can be increased by using modern agricultural technique like system rice intensification (SRI) in the potential food producing areas. SRI is a modern cultivation technique to increase rice production and productivity and it has already been started in few areas, particularly in suburb areas of Mizoram. Further, irrigation facilities can be developed in the river valleys and flood plains for substantial rice production. More importantly, climate is feasible to cultivate a number of vegetables and fruits. Value additions in crop products, construction of cold storage and access to market will enhance food security. PDS can be made smooth through opening a number of fair price shops. Infrastructural facilities such as proper road connection to the villages located remotely, electrification and establishment of government institutions that promote development activities should be developed. Awareness programmes to increase food stock at household levels can be launched locally to secure food for the adverse conditions such as heavy rain triggered landslide that causes to road block. Development of tourism, micro-hydroelectricity and forest based small scale village industries are other important drivers that can lead to attain food security.

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