A critical review of food security, unique challenges and niche opportunities under mountain specificities

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ABSTRACT

The present study is an attempt to study food and nutrition insecurity in hill and mountain states of India. A comparison of the SDG 2 (zero hunger) Index Score of 2018 and 2019 shows that only Arunachal Pradesh, Mizoram and Nagaland out of 11 selected hill and mountain States have improved their SDG 2 Index Score. Mizoram and Nagaland are the top-performer, but Meghalaya has the lowest SDG Index Score for Goal 2 (index score of 35). The average calorie intakes, protein intakes and fat intakes in the rural areas of most of the hill and mountain states were found to be less than national average. However, the nutritional status of the children in hill and mountain states of India is far better than that of plain parts of the country. The percentage of anaemic pregnant women (15-49 yrs age group) in Tripura and Meghalaya is more than the national average. The various biophysical and socioeconomic challenges were found to affect the food and nutrition security. However, it was also observed that hills and mountain offer enough opportunity to create food sovereignty which is harnessed by the resilient characteristics of indigenous mountain people. Hill and mountain region provides excellent opportunity in the form of wild edible plants, wild medicinal plants, wild edible insects, ethnic food system, traditional farming practices and rich indigenous knowledge. In policy designs the balance between food self-sufficiency and market dependency should be ensured. The ecology and diversity in the cropping pattern should be maintained.

1. Introduction

Mountains cover 22 percent of the world's land surface and are home to some 915 million people, representing 13 percent of global population (FAO, 2015). Mountains and hills are often regarded as ecologically more fragile than fertile plains (Jodha, 1990; Sati, 2015; Yin, Fang & Yun, 2009). Its shallow soil, slopes with steep and differing elevations which are also limited and unsuitable for mass agricultural production, poor infrastructure, poor market access coupled with occurrence of extreme climatic events make people living in mountain areas particularly vulnerable to food insecurity (FAO, 2015; Jenny & Egal, 2002). A study done by FAO with Mountain Partnership Secretariat reported 39 percent of mountain population in developing countries as vulnerable to food insecurity in 2012, a 30 percent increase in the number of vulnerable mountain people in the 12 years since 2000, while the mountain population itself has increased just 16 percent.

Along with challenges, the hill and mountain regions of the world do also enjoy comparative advantages over plains. The hills and mountains have excellent scope for revitalizing local food systems, developing mountain niche products and services, and promoting non-farm livelihood alternatives. The local food systems, the neglected and underutilized plant species and the local breeds of livestock have a huge prospect in diversifying the access and supply of nutritious food in the mountains along with enhancing farmers' incomes (Rasul *et al.*, 2019). If managed and

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harnessed sustainably, the available natural resources of the mountains and hills do also offer opportunities to increase household income and food security. All these may lead to sustainable food and nutrition security in the mountains through food sovereignty Bharucha & Pretty, 2010; Rasul & Hussain, 2015; Xu *et al.,* 2015).

The present study is an attempt to revisit the issue of food and nutrition insecurity in the country from the perspective of hill and mountain states of India so that the policy makers can be informed regarding the unique challenges of hill and mountain people to food security, so that, in turn, effective policies and programmatic activities could be formulated to answer the needs and challenges faced by hill and mountain people. Along with documenting the present situation of food and nutrition security, the study also explored the unique challenges and niche opportunities in addressing food security issue of indigenous hill and mountain people so that it can be supplemented with food security schemes to minimize the vulnerability and improve food security of hill and mountain people.

2. Methodology

The present study is based on the secondary data pertaining to following hill and mountain States of India. The data were taken from SDG India Index & Dashboard, 2019-20 (NITI Ayog, 2019); SDG India Index, Baseline Report, 2018 (NITI Ayog, 2018); NSS 68th Round: July 2011 – June 2012) and Natioal Family Health Survey 2015-16 (NFHS-4), GoI, 2017 and Food and Nutrition Security Analysis, India, 2019 (MOSPI & WFP, 2019). Descriptive analytical tools were used to analyse data. Information's were also compiled from the published scientific literatures.

3. Results and Discussion

Performance of Hill and Mountain States on SDG 2 (Zero Hunger)

Food and nutrition security is one of the building blocks towards achievement of Sustainable Development Goal (SDG) 2. Other SDGs such as SDG 1 (no poverty), SDG 3 (good health and wellbeing), SDG 6 (clean water and sanitation), SDG 12 (responsible consumption and production), and SDG 13 (climate action) are also dependent on food and nutrition security. A comparison

of the SDG 2 Index Score in Table 1 shows that only three out of 11 selected hill and mountain States have improved their SDG 2 Index Score from 2018 to 2019, however, the magnitude of change has been varied. These States are Arunachal Pradesh, Mizoram and Nagaland. Arunachal Pradesh has improved its overall score from 58 in 2018 to 66 in 2019, and is the highest gainer among the hill and mountain States of India. Mizoram stands second in improvement, with an increase of 6 points, from 69 to 75. Nagaland is the third best State in improvement: from a score of 69 to that of 70, indicating an increase by only one point. Assam and Himachal Pradesh has shown highest fall in their SDG 2 Index Score from 53 to 39 and 58 to 44 respectively.

Performance of Hill and Mountain States on Indicator for SDG 2 (Zero Hunger)

To measure India's performance towards the goal of zero hunger, the 2018 methodology of NITI Ayaog identified four national level indicators which captured three out of the eight SDG targets for 2030 outlined under this goal (2.1., 2.2 and 2.3). In 2019-20 methodology, seven national-level indicators were identified to capture three out of the eight SDG targets for 2030 outlined under this Goal (Table 2). As per the latest SDG Index published by NITI Ayaog in December, 2019 (Table 2), the SDG Index Score for Goal 2 ranges between 35 and 75 for of hill and mountain States of India. Mizoram and Nagaland are the top-performing among of hill and mountain States of India. Five States were classified as front runners, whereas six States were put under the aspirants category. Among the hill and mountain States Meghalaya has the lowest SDG Index Score for Goal 2 (index score of 35). Regarding indicator "food subsidy" i.e. ratio of rural households covered under public distribution system to rural households where monthly income of highest earning member is less than Rs.5,000, Manipur and Nagaland have recorded best performance at 1.36 and 1.14, respectively among hill and mountain States of India. With respect to indicator "stunting", the lowest stunting rates are observed in Jammu and Kashmir (15.5 per cent) and Sikkim (21.8 per cent). The percentage of children under 5 years of age who are stunted is the highest in Meghalaya (40.4 %). With respect to indicator "anaemia among women", i.e. percentage of pregnant women aged 15-49 years who are anaemic, Sikkim and Mizoram among the hill and mountain States have reduced this rate to below the national target of

25.15 percent. Manipur is very near to achieving this target with current rate at 26 percent. Regarding percentage of children aged 6-59 months who are anaemic, Nagaland and Manipur among the hill and Mountain States have reduced this rate below the national target of 14 percent. With respect to indicator "percentage children aged 0–4 years who are underweight", Meghalaya has the highest percent of children under this age group who are under weight (30 %). With respect to the indicator "agricultural productivity", against the target of 5,033.34 kg/ Ha by 2030, none of the hill and Mountain States has achieved this target yet. In fact none of the hill and mountain States is nearing the targeted productivity. Against the targeted Gross Value Added (GVA) in Agriculture per worker set at 1.36 lakhs in accordance with UN target 2.3, among the hill and mountain States, Arunachal Pradesh with a GVA in agriculture per worker at 1.32 lakhs and Mizoram at 1.29 lakhs are the leading performers. Manipur with a GVA in agriculture per worker at 0.39 lakhs and Meghalaya at 0.51 lakhs are the worst performers.

Food and Nutrition Security in the Mountains States of India

The average calorie intake in Hill and mountain States observed to be lower than the national average primarily in Manipur, Meghalaya, and Nagaland (NSS 68th Round: July 2011 – June 2012). In Meghalaya, the average calorie intake in urban and rural areas is lowest among all the hill and mountain States of India. The average calorie intakes in the rural areas of most of the hill and mountain states (Arunachal Pradesh, Assam, Manipur, Meghalaya, Nagaland and Sikkim) were found to be less than national average. Protein intake in rural areas of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Sikkim and Tripura was less than the national average. Similarly, fat intake in rural areas of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura was less than the national average. The situation in urban areas is also similar to rural areas (Table 3).

Table 1: Performance of Hill and Mountain States on SDG 2 (Zero Hunger)

Sl. No.	States/UTs	SDG 2 Index Score		Changes in SDG 2 Index Score Over Preceding Years
		2018	2019-20	
1	Arunachal Pradesh	58	66	8
2	Assam	53	39	-14
3	Himachal Pradesh	58	44	-14
4	Manipur	74	69	-5
5	Meghalaya	43	35	-8
6	Mizoram	69	75	6
7	Nagaland	69	70	1
8	Sikkim	67	66	-1
9	Tripura	58	49	-9
10	Uttarakhand	53	45	-8
11	Jammu & Kashmir	60	55	-5
12	India	48	35	-13
13	Target	100	100	

Note: Achiever (100)   Front Runner (65-99)   Performer (50-64) Aspirant (0-49)

Source: SDG India Index & Dashboard, 2019-20 (NITI Ayog, GoI, 2019); SDG India Index, Baseline Report, 2018 (NITI Ayog, GoI, 2018)

Table 2: Performance of Hill and Mountain States on Indicator for SDG 2 (Zero Hunger)

Sl No.	States/UTs	Ratio of rural households covered under public distribution system (PDS) to rural households where monthly income of highest earning member is less than Rs.5,000	Percentage of children under age 5 years who are stunted	Percentage of pregnant women aged 15-49 years who are anaemic	Percentage of children aged 6-59 months who are anaemic (Hb<11.0 g/dl)	Percentage children aged 0–4 years who are underweight	Rice, wheat and coarse cereals produced annually per unit area (Kg/Ha)	Gross Value Added in Agriculture per worker	Ratio of rural households covered under public distribution system (PDS) to rural households where monthly income of highest earning member is less than Rs.5,000	Percentage of children under age 5 years who are stunted	Percentage of pregnant women aged 15-49 years who are anaemic	Percentage of children aged 6-59 months who are anaemic (Hb<11.0 g/dl)	Percentage children aged 0–4 years who are underweight	Rice, wheat and coarse cereals produced annually per unit area (Kg/Ha)	Gross Value Added in Agriculture per worker	SDG 2 Index Score
		Raw Data							Index Score							
1	Arunachal Pradesh	0.92	28	33.8	28.3	16	Null	1.32	54	35	80	64	64	Null	97	**66**
2	Assam	1.09	32.4	44.8	33.7	29.4	1663	0.58	76	24	54	50	32	6	29	**39**
3	Himachal Pradesh	1.05	28.4	50.2	29.7	22.6	2300.5	0.61	70	34	41	60	48	24	31	**44**
4	Manipur	1.36	28.9	26	10	13	Null	0.39	100	33	98	100	71	Null	12	**69**
5	Meghalaya	1.04	40.4	53.1	32.9	30	Null	0.51	69	4	35	52	31	Null	23	**35**
6	Mizoram	1.06	27.4	24.5	24.4	11.3	Null	1.29	72	37	100	74	75	Null	94	**75**
7	Nagaland	1.14	26.2	28.9	8	16.3	Null	0.71	82	40	91	100	63	Null	41	**70**
8	Sikkim	1.04	21.8	23.6	33	11	Null	0.79	68	51	100	52	76	Null	48	**66**
9	Tripura	0.94	31.9	54.4	33	23.8	Null	1.2	56	26	32	52	45	Null	85	**49**
10	Uttarakhand	1.03	29.9	46.5	32.4	18.7	2142	0.69	67	31	50	53	58	20	39	**45**
11	Jammu & Kashmir	0.94	15.5	38.1	27.1	13	1567.5	0.84	56	67	70	67	71	4	53	**55**
12	India	1.01	34.7	50.3	40.5	33.4	2516.67	0.68	65	18	41	33	23	30	38	**35**
13	Target	1.29	2.5	25.15	14	0.9	5033.34	1.36	100	100	100	100	100	100	100	**100**

Note: Achiever (100)   Front Runner (65-99)   Performer (50-64)   Aspirant (0-49)

Table 3: Food and Nutrition (In) Security in Mountain States of India

Schedule type	Schedule type I data of NSS 68th Round						Schedule type II data of NSS 68th Round					
Indicators	Calorie intake (kcal/capita/day)		Protein intake (g/capita/day)		Fat intake (g/capita/day)		Calorie intake (kcal/capita/day)		Protein intake (g/capita/day)		Fat intake (g/capita/day)	
Rural/ Urban	Rural	urban	Rural	urban	Rural	urban	Rural	urban	Rural	urban	Rural	urban
National	2099	2058	56.5	55.7	41.6	52.5	2233	2206	60.7	60.3	46.1	58
Himachal Pradesh	2502	2512	71.4	70.7	59.3	66.3	2668	2631	75.5	74	66	69.6
Jammu and Kashmir	2357	2353	63.3	62.9	54.9	61.6	2482	2466	68.1	67	59.6	66.4
Uttarakhand	2436	2379	68.2	66.2	52.8	57.7	2548	2363	71	66.4	57.7	59
Arunachal Pradesh	1876	2083	47.4	53.3	18.2	28.2	2068	2255	55.9	61.2	27	37.9
Assam	2010	2038	49.3	52.1	26.1	37.1	2170	2110	55.1	54.9	29.6	39.2
Manipur	1974	1914	46.7	45.9	15.5	17.4	2097	1960	51.8	47.8	19.8	20.3
Meghalaya	1686	1755	41.6	46	21.6	27.8	1774	1862	46	49.7	23.6	30.9
Mizoram	2037	2166	48.1	53.5	25.4	38	2297	2313	56.5	59.8	33.3	43.5
Nagaland	1901	1970	51.5	54	14.2	18.5	2068	2042	61.3	60	19.9	22
Sikkim	2015	1958	51.1	50.8	44.6	46.6	2095	1984	53.9	52.7	44.8	47.5
Tripura	2256	2252	54.5	56.9	27.4	35.1	2366	2363	59.5	62.1	28.4	38.6

Note: *Schedule Type 1:* For certain categories of relatively infrequently purchased items, including clothing and consumer durables, it collected information on consumption during the last 30 days and the last 365 days. For other categories, including all food and fuel and consumer services, it used a 30-days reference period. *Schedule Type 2*: It used „last 365 days" (only) for the infrequently purchased categories, last 7 days" for some categories of food items, as well as pan, tobacco and intoxicants, and „last 30 days" for other food items, fuel, and the rest.
Source: GoI (2014) (NSS 68th Round: July 2011 – June 2012)

Meghalaya is the only mountain state where the prevalence of stunting among children under 5 years of age (45.0 %) is significantly higher than the national average (41.2 %) (National Family Health Survey 2015-16 (NFHS-4), GoI, 2017). Among the rest of the hill and mountain states, on a positive note, the prevalence of stunting among children under 5 years of age is less than the national average. Again on a positive note, the prevalence of wasting among children under 5 years of age is less than the national average. In fact in some states like Manipur and Mizoram, it is as low as 7.1% and 7.8% respectively. However, the prevalence of severe wasting among children under 5 years of age is more than the national average (7.4%) in States like Uttarakhand (9.7%) and Arunachal Pradesh (8.9%). In rest of the states, the percentage of children under 5 years who are severely wasted is less than the national average. Among the hill and mountain States of India, Assam and Meghalaya has the highest percentage of children under 5 years who are underweight (30.8 percent and 29.9 percent, respectively). However, again on positive note, the percentage of children who are underweight is less than the national average of

38.3%. Thus, in contrary to the general perception, the nutritional status of the children in hill and mountain states of India is far better than nutritional status of the children's living in the plain parts of the country (Table 4).

As per the National Family Health Survey 2015-16 (NFHS-4) data, 26.7% of women in India has below normal Body Mass Index (BMI). As a positive picture, except Assam, in the remaining states, the percentage of women population having below normal BMI is less than the national average. In Sikkim, only 5.8% women have below normal Body Mass Index (BMI). The National Family Health Survey 2015-16 (NFHS-4) data also shows that 23.0 % of men in India have below normal Body Mass Index (BMI). Importantly, in all the hill and mountain states, the percentage of men population having below normal BMI is less than the national average. In Sikkim, only 3.3% men have below normal Body Mass Index (BMI). The National Family Health Survey 2015-16 (NFHS-4) data also reveals that among the hill and mountain states, Tripura and Meghalaya has the highest percentage of

pregnant women of age 15-49 years who are anaemic (55.8% and 54.8 % respectively) which is more than the national average (52.2 %). In fact, Meghalaya has the highest percent of women of the age 15-49 years who are anaemic (59.6 %) which is again more than the national average (54.3%) (Table 5). Though we lack proper evidence or reasons for this scenario, it may be due to shift towards commercial farming, mono-cropping, modernization, non-food crops etc. which has changed the production and consumption pattern in the State, ultimately leading to decline in food diversity, affecting nutritional security (Behera *et al.,* 2016).

Unique Challenges of Food Security across Indian Mountains
The mountain States, in general, are characterised by slopes, step elevation, subsistence farming, and poor infrastructure coupled with occurrence of extreme climatic events. Roy *et al.,* 2015 reported non-availability of adequate quantity of quality seeds of improved varieties and lack of use of inputs like fertilizers, weed control and disease and pests protection chemicals as the major constraints in food grain production in the north-east part of India. In Uttarakhand, the major portion of land is devoted in cultivating subsistence crops but the production and productivity of

these crops are comparatively lower than that of the cash crops (Sati, 2017). In Kashmir division the deficit in production is mainly due to geographical and climatic conditions as most of the area is mono cropped and land holding is small and fragmented. Moreover, conversion of agricultural land for horticulture and other non-agricultural purpose is also contributing to this deficit (Bhat, 2019). In Mizoram, poor use of natural resources, subsistence farming, heavy dependency on forests, poor implementation of rural development programmes, shifting cultivation, irregular PDS, natural hazards including landslides and flash floods have been the region for poor food security scenario of the State (Sati and Lalrinpuia, 2017). World Bank, 2019 reported presence of hidden hunger in Nagaland with around 50% of household studied reported facing food insecurity at least once or twice in a month and in contrast with the general perception, most households, especially in remote areas; do not regularly consume meat or other high-protein foods. Though, the above findings are state specific, but, they can be generalised for all the hill and mountain regions of the country. Subsistence farming coupled with difficult terrain and poor infrastructure make availability and accessibility of food difficult for the indigenous hill tribe of the mountain regions

Table 4: Key Indicators Nutritional Status of Children in Mountain States of India

States	Children under 5 years who are stunted (height-for-age)[1] (%)	Children under 5 years who are wasted (weight-for-height)[1] (%)	Children under 5 years who are severely wasted (weight-for-height)[2] %)	Children under 5 years who are underweight (weight-for-age)[2] (%)
Himachal Pradesh	26.7	13.3	3.8	21.6
Jammu & Kashmir	28.8	11	4.8	16.5
Uttarakhand	34	19.9	9.7	27.1
Arunachal Pradesh	30.7	18.8	8.9	20.9
Assam	38	17.5	6.4	30.8
Manipur	31.4	7.1	2.4	14.2
Meghalaya	45	15.6	6.5	29.9
Mizoram	33.7	7.8	3.4	15.7
Nagaland	30.9	11.7	4.3	17.9
Sikkim	32.9	14.7	6	15.4
Tripura	26.8	18	6.7	25
India	41.2	21.5	7.4	38.3

Note: [1]Below -2 standard deviations, based on the WHO standard; [2]Below -3 standard deviations, based on the WHO standard.
Source: National Family Health Survey 2015-16 (NFHS-4), GoI, 2017

Table 5: Nutritional Status of Adults and Anaemia among Children and Adults

Mountain States (Rural)	Nutritional Status of Adults (age 15-49 years)				Anaemia among Children and Adults[2]				
	Women whose BMI is below normal (BMI < 18.5 kg/m2)[1] (%)	Men whose BMI is below normal (BMI < 18.5 kg/m2) (%)	Women who are overweight or obese (BMI ≥ 25.0 kg/m2)[1] (%)	Men who are overweight or obese (BMI ≥ 25.0 kg/m2) (%)	Children age 6-59 months who are anaemic (<11.0 g/dl) (%)	Non-pregnant women age 15-49 years who are anaemic (<12.0 g/dl) (%)	Pregnant women age 15-49 years who are anaemic (<11.0 g/dl) (%)	All women age 15-49 years who are anaemic (%)	Men age 15-49 years who are anaemic (<13.0 g/dl) (%)
Himachal Pradesh	16.7	17.9	27.6	21	53.3	53.5	50.5	53.4	20.2
Jammu and Kashmir	14.1	13.6	24.1	15.8	55.6	48.4	49	48.5	21.5
Uttarakhand	20	18.5	16	14.1	59.1	46.1	47.5	46.2	15.9
Arunachal Pradesh	8.5	8.1	16.3	18.4	55	44.3	38	44	19.7
Assam	27	21.7	10.9	10.5	36.5	46.3	45.7	46.3	26.8
Manipur	9	10.9	22.4	18.5	23.4	26.5	24.8	26.4	9.9
Meghalaya	12.3	11.1	10.2	8.1	48.8	60	54.8	59.6	36
Mizoram	9.6	9.2	12.5	10	24.5	29.9	30.5	29.9	15.6
Nagaland	11.8	10.6	13.3	12.1	28	29.3	33.1	29.5	12.1
Sikkim	5.8	3.3	23.1	29.7	52.7	35.6	19.6	35.1	18.2
Tripura	20.1	17	12.8	14.9	49.2	54	55.8	54.1	27.5
India	26.7	23	15	14.3	59.5	54.4	52.2	54.3	25.3

Notes: [1]Excludes pregnant women and women with a birth in the preceding 2 months; [2]Haemoglobin in grams per decilitre (g/dl). Among children, prevalence is adjusted for altitude. Among adults, prevalence is adjusted for altitude and for smoking status; **Source:** National Family Health Survey 2015-16 (NFHS-4), GoI, 2017)

Niche Opportunities of Food Sovereignty in Indian Mountains

The hills and mountain, do also offer enough opportunity to create food sovereignty which is harnessed by the resilient characteristics of indigenous mountain people.

- *Wild Edible Plants (WEPs):* Wild edible plants are integral part of the culture of mountain people. It provides balance to the local food system. Some wild edible plants in fact more nutritious than conventional crops. As a source of earning, the indigenous population can be seen selling these plants one the roadsides. These plants are very well documented in literatures viz. Pfoze *et al.,* 2012 reported 32 wild edible plants from Senapati district, Manipur. Sikkim is reported to harbour 190 food plants that grown in wild habitats (Sundriyal and Sundriyal, 2003). Sawian *et al.,* 2007 investigated 249 species of wild edible plants in Meghalaya. Saha *et al.,* 2014 investigated 289 plants species used by selected tribal communities of north-east India. Seal and Chaudhuri, 2014 analysed the nutritional potential of five wild edible fruits of the plant *e.g. Debregeasia longifolia, Helicia erratica, Ilex venulosa, Rhus semialata* and *Spondias axillaris,* collected from Meghalaya. The nutritional values and mineral contents of these fruits were richer than that of the commercial fruits.

- *Wild Medicinal Plants (WMPs):* The climatic conditions of mountains are also conducive for growing good quality medicinal plants. The tribals of Panchamalai Hills are well known for their knowledge of medicinal properties used for treatment of various animal diseases, crop pest management and human care (Rani, 2010). Majumdar *et al.,* 2019 documented 25 traditional hepatoprotective herbal medicine of Koch tribe in the South- West Garo hills, Meghalaya. Jamir, 1999 provided information on 36 plant species used to relieve ailments like gastro-intestinal, dermal, respiratory,

cardiac, dental, etc. Rawat and Vashistha, 2011 documented 150 common herbal plant in Uttarakhand, used in the popular medicinal preparation in Ayurveda. Jamir and Tsurho, 2016 documented 71 medicinal plants and its uses by Phom tribe of Longleng district, Nagaland. Perme *et al.,* 2015 in Arunachal Pradesh recorded 101 medicinal plants species used for treating a total of 156 different diseases/ailments. With more and more urban population moving towards natural medicine and treatment, with some scientific inputs, these medicinal plants can help the indigenous families economically

- *Wild Edible Insects (WEIs):* Mainly consumed by the tribal communities, the wild edible insects are proven good source of nutrition with high content of carbohydrates, protein, fats, minerals as well as vitamins. According to one estimate, there are almost 255 insects which are used as food in India by different tribes. Sangma *et al.,* 2016 reported that insects belonging to the family *Coleoptera* (34%) are highly consumed in India followed by *Orthoptera* (24 %), *Hemiptera* (17 %), *Hymenoptera* (10%), *Odonata* (8%), *Lepidoptera* (4 %) and *Isoptera* (2 %). In Arunachal Pradesh, Hazarika (2018) listed about 158 species of edible insects. In Meghalaya the commonly used insects are lepidopteron caterpillars such as Bombyx mori (Niang ryndai), Niang phlang and Niang tnum (Dey, 2013). The entomophagy among the tribal's provide them option of alternate source of protein, carbohydrate etc. Though entomophagy among tribal's have got some fare documentation, more studies are needed to understand the key factors like ecology, management and conservation implications. In some later phase, based on demand, its industrialization and marketing can also be seen.

- *Traditional Food of Ethnic Tribes:* The traditional food of the indigenous population living in the hills and mountains is not only source of nutrition, but an essential element of their culture, tradition and lifestyle used in festivals and rituals. They are mostly prepared from the natural resources available in the region. These traditional foods are basically boiled foods, fermented foods, beverages prepared from various indigenous crop plants, forest products and meat of wild and domesticated animals. The traditional foods of the Manipuries comprise Iromba, Champhu, Kangshoi, Hawaichar, sticky rice chapatti/bread, etc. Alcoholic beverages made up of rice are very common in almost

all the festivals of the tribal peoples of Manipur locally called as Yu (Devi and Kumar, 2012). Tungrymbai- A traditional fermented soybean food of the ethnic tribes of Meghalaya (Sohliya *et al.,* 2009) is reported to be a good source of protein and nutrients. *Tungtap* is a popular fermented fish (Puntius spp. and/or Danio spp.) product, commonly prepared and consumed by the Khasi and Jaintia tribes of Meghalaya, is a way of traditional processing of fish (Rapsang and Joshi, 2012). Recently, a great demand is seen towards ethical foods among the urban population, which can be harnessed to provide livelihood and income generating options to indigenous tribal communities of hills and mountains.

- *Traditional Farming Practices:* Due the difficult terrains and remoteness of the hills and mountains, the indigenous population is still seen practicing traditional farming practices. Rathore, Karunakaran and Prakash 2010 reported about Alder (*Alnus nepalensis*) based farming system, a traditional farming practices in Nagaland for amelioration of jhum land. Goat farming under traditional system of management in Uttarakhand was found to be profitable venture (Khadda *et al.,* 2018). Shifting cultivation and terrace (bun) agriculture are two major farming systems of Meghalaya (Jeeva, Laloo and Mishra, 2006). Debnath *et al.,* 2014 documented traditional farming systems of Dhalai district of Tripura, an excellent approach for family nutrition, income generation and employment generation for the rural farmers of Dhalai. These practices are sustainable in terms of land use pattern, locally available materials, and family labour and can be practised without any specialized skills.

- *Traditional Knowledge:* Resilience is reported to be innate in culture and indigenous knowledge of hill and mountain people. The folk people of Tripura plan their agroforestry and disaster prevention on their own traditional knowledge of phonological indicators (Acharya, 2011). Joshi *et al.,* 2011 documented the traditional knowledge of natural disaster mitigation and ethno medicine practices of Sikkim. Chinlampianga, 2011 documented the traditional knowledge, weather prediction and bio indicators based mainly on the recognition of unique situations, the behaviour of insects, birds and mammals, characteristics of plants, and the location, timing and pattern of clouds, lightning, wind, moon, sun and stars in Mizoram. Traditional indigenous knowledge has over the years played a significant role in solving several major social- ecological problems including those related to climate change and variability.

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5. Conflict of interest

The author declares that there is no conflict of interest.

6. Conclusion

A comparison of the SDG 2 Index Score shows that only Arunachal Pradesh, Mizoram and Nagaland out of 11 selected hill and mountain States have improved their SDG 2 Index Score from 2018 to 2019. Mizoram and Nagaland are the top-performing among of hill and mountain States of India. Among the hill and mountain States Meghalaya has the lowest SDG Index Score for Goal 2 (index score of 35). The average calorie intakes, protein intakes and fat intakes in the rural areas of most of the hill and mountain states were found to be less than national average. However, in contrary to the general perception, the nutritional status of the children in hill and mountain states of India is far better than nutritional status of the children's living in the plain parts of the country. The percentage of anaemic pregnant women in Tripura and Meghalaya is more than the national average (15-49 yrs age group). The various biophysical and socioeconomic challenges were found to affect the food and nutrition security in hill and mountain states. However, it was also observed that hills and mountain offer enough opportunity to create food sovereignty which is harnessed by the resilient characteristics of indigenous mountain people. Resilience is innate in traditional culture and indigenous knowledge of hill and mountain people. It is evident that people living in the mountainous areas are highly vulnerable to food insecurity due to biophysical and socio-economic constraints. Though many potential are identified in mountain areas in contributing nutritional security, optimum utilisation of potentials could not be met. Evidently there is reduction of nutritional intake leading to persistent malnutrition in mountain and hill areas.

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