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Investigating food insecurity: An Analysis of incidence and severity among tribal households in Gujarat

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Abstract
United Nations General Assembly (UNGA) set up 17 Sustainable Development Goals (SDGs) in 2015 and are intended to be achieved by the year 2030. One of the various SDGs is to achieve zero hunger, which is directly connected to end hunger, achieve food security and improved nutrition. Present study attempted to analyse dimensions of food insecurity among tribal households in Gujarat with the help of Foster, Greer and Thorbecke (FGT) index. The head count ratio, the food insecurity gap (short-fall), and the squared food insecurity gap (severity of food insecurity) were estimated to be 81 per cent, 14 per cent, and 3 per cent, respectively. The survey result has showed that from 150 sample households, 121 (80.67%) households were food insecure and only 29 (19.33%) were found food secure. The average dietary energy available for food secure households and food insecure households was 3178.25 Kcal and 2272.44 Kcal, respectively. Promotion of family planning, enhancing household's farm income-earning opportunities through provision of sufficient input to enhance agricultural production and productivity and creation of rural employment opportunities are recommended.

Keywords: Food insecurity, FGT, tribal, severity

1. Introduction
According to FAO (2001), food security is a situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

The concept of food security basically stands on three pillars, food availability, food stability and food accessibility. Availability of food is associated with purchasing power and food insecurity is caused by poverty. If people do not have purchasing power, they have substitute of food reserves. Food security and poverty are directly related to each other. So the needs of the poor should be protected by improving their purchasing power, through employment and income generation programmes. A large proportion of the world's underfed population starves not because of general food shortage but because of insufficient access to food supplies or insufficient consuming power of people. Availability of food will be of no use, until and unless people have means to buy the available food (Ghosh, 2000) [7].

India ranked 94 among 107 countries in the Global Hunger Index 2020 and is in the 'serious' hunger category with a score of 27.2. India features behind Nepal (73), Pakistan (88), Bangladesh (75), and Indonesia (70) among others despite of various initiatives by Government of India like Integrated Child Development Services (ICDS) Scheme, National Food Security Act, POSHAN Abhiyaan etc.

In Gujarat, NFSA implementation began on April 1, 2016, and 3.41 crore people have been identified for subsidized ration (per person 5 kg) along with 8 lakh most poor (Antyodaya) families (42 lakh people), to whom 35 kg of ration is given per month per family. Thus 3.82 crore people are being covered under NFSA with the support of the Government of India.

Gujarat, ranked fifth by per capita income in the country, is ranked 17 among 29 states on infant mortality, with 34 of every 1,000 infants dying every year, worse than much poorer Meghalaya (30), and lower than India's average infant mortality rate (IMR: deaths per 1,000 births) of 41. Gujarat government has implemented the much needed Food Security Act in 2016 after almost 3 years of passing the act at the Center. The state has come under repeated flak for its bad record of malnutrition among children.

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In 2014, the Comptroller and Auditor General (CAG) had said in its report that every third child in the state was underweight and that the supplementary nutrition programmes had failed to cover all beneficiaries. However, in December, 2015, a survey conducted under the Gujarat government's own Kuposhan Mukt Gujarat Maha Abhiyaan identified more than 1.45 lakh children of the 43 lakh screened till then, under the age of six years in the state in the worst category of malnutrition — Severe Acute Malnutrition (SAM), according to state health officials.

Dang which is one of six backward districts in Gujarat primarily tribal district– 95% belong to the scheduled tribes– 48.1% of children under five years were stunted, 72.2% of women were anaemic and only 44.3% of children under two were fully immunized, according to the latest National Family Health Survey of 2015-16 (NFHS - 4), even as the district has made investments in health infrastructure. Most people in Dang are dependent on rain-fed subsistence farming of rice, millet, and pulses. Agricultural productivity here is low with 31% of the area under cultivation and 13% of it irrigated. Gujarat's per capita income is Rs 122,502, 39% higher than the Indian average of Rs 82,269, but 75% of Dang's residents live below the poverty line. Hence, this is very important to study the status of food insecurity among the tribal households and the possible available coping options with them to minimize losses of food insecurity.

2. Methodology
2.1 Description of the Study Area
The prime aim of the present study is to understand the level of food security among the farmer, agricultural labour, and non-agricultural workers in the study area. Without examining the physical, social, and economic characteristics of the study area in question, any research study is incomplete. It will assist in determining the research's validity. As a result, interpreting the study's findings requires a detailed view of the study area. Hence, an attempt has been made in this section to present a comprehensive account of various characteristics of the study area, such as geographical features, environment, rainfall, land use pattern, cropping pattern, irrigation facilities, demographic information, and infrastructural facilities.

2.2 Primary Data
The Study was carried out in Dang district which is having highest scheduled tribe (ST) population in Gujarat. The study primarily relied on primary data which was collected by using a semi-structured questionnaire. The primary data was collected by the semi-structured questionnaire focus mainly on those factors hypothesized to have an effect on the food insecurity status of households. The survey questionnaire covered issues such as socioeconomic and institutional characteristics and identification of the quantities of the different types of crops, livestock meat and other by-products that come to and go out of the given household's possession over the period of study through own production, purchase, sale, transfer, kept in reserve and post-harvest loss to calculate dietary food energy intake. Secondary data were sourced from published and unpublished literature to describe the area under study, population size, nutritional equivalent of unit food item consumed by households and other recommended food bench-marks and major economic activities in the Dang district.

2.3 Sampling Design
The Dang has a population of 2,28,291 with 44,699 households in the district. Dang is composed with three administrative blocks. Multistage random sampling with proportional to size was used to select 150 sample households. In first stage two tehsils Waghai and Ahwa were selected randomly. In second stage, out of each tehsil, randomly three village panchayats selected. Finally, a sample of 150 households was drawn randomly from villages come under selected six village panchayats. Sample households were selected on the basis of their frequency distribution in each land size category i.e. landless, marginal, small, medium, large.

2.4 Statistical Technique
2.4.1 Estimation of incidence, gap and severity of food insecurity of households in study area
In order to identify food secure and insecure households, food items consumed were obtained from respective households for 7 days' recall period. Household caloric acquisition used to measure food security in the study area. Then after it was converted to kcal/day basis and it would be made ready to calculate kcal/day/AE, the results obtained was compared with the minimum requirements per day per adult equivalent (A.E). Accordingly, the household whose caloric consumption greater than or equal to 2730KCal/day/AE would categorize as food secure; on the other hand, households whose consumption less than 2730 KCal/day/AE would categorize as food insecure.

The threshold of 2730 KCal/day is taken based on Indian Council of Medical Research (ICMR) recommendation. Various methods are used in the calculation of food security status in literature. However, Direct Calorie Intake (DCI) method is adopted for this study. This method estimates the number of calories available for consumption by adult equivalent household members over a defined period of time.

2.4.1.1 Consumption unit
A consumer unit is a metric for calculating the energy needs of a group of people of various sexes and ages. The average calorie requirements of males and females in various age groups are expressed as a ratio to the calorie requirements of an average male in the age range 20-39 conducting sedentary labour as the norm. As a result, a family of two guys, 35 and 65 years old, has 1.8 consumer units while a household with one woman aged 28 and a child aged 3 has only 1.25 consumer units. It was essential to aggregate these members of the family into comparable standardized consumption units as Adult Consumption Unit (ACU).

The role of numerous other parameters such as body weight, height, nature of job, and condition of health is overlooked when determining a person's calorie demand based on age and/or sex, which is a simplification of the true situation. In reality, the calorie need per consumer unit is a variable that is determined by all of these factors.

2.4.1.2 Measuring the extent of food insecurity
To estimate incidence, food insecurity gap and to assess the severity of household food insecurity the Foster, Greer and Thorbecke (FGT) index was employed.

$$FGT_\alpha = \frac{1}{N} \sum_{i=1}^{H} \left(\frac{z - y_i}{z} \right)^\alpha$$

Where,
N = Number of sample households

H = Number of food insecure households

Z = cut-off between food security and food insecurity (2730kcal//day/AE)

yi = a measure of per adult equivalent food calorie intake of the ith household

α = weight attached to the severity of food insecurity (take values 0, 1 and 2)

The household is food secure when Yi>Z for this model. Within this FGT index, three most commonly employed indices: head count ratio, food insecurity gap and squared food insecurity gap were computed. The head count ratio indicated the number of households whose caloric intake is less than the minimum requirements. On the other hand, food insecurity gap measure, on average, how far the food insecure households are below the cut off value; and square food insecurity gap is a measure closely related to severity of food insecurity gap but giving those further away from the minimum level a higher weight in aggregation than those closer to the subsistence level.

The food insecurity aversion parameter 'α' reflects the concern attached to the proportionate shortfall from the food insecurity line. If α=0 then, FGT measures corresponds to the head count index (incidence of food security) in which no concern for the depth of the shortfall is shown. In other words, it is the share of sample households whose food expenditure per adult equivalent falls below the food insecurity line. If α=1 then, FGT refers to the mean distance that divorces the food insecure household from the food insecurity line, commonly called the depth of food insecurity. It provides information regarding the distance between the food insecurity line and each household's food expenditure per adult equivalent thereby reflecting the per capita cost of eliminating food insecurity. If α=2 then, FGT measures the severity of food insecurity. It takes into account not only the distance separating the food insecure from food insecurity line, but also inequality among the food insecure households.

3. Empirical Results
Measure the Incidence, Extent and Degree of Food Insecurity
The well-known Foster, Greer and Thorbeck (FGT) formula satisfies that the axioms of transfer and monotonicity axiom was employed. The ∝ is the parameter for the measurement of food poverty in a given population. ∝ =0 measures head count, ∝= 1 measures the depth of food insecurity and ∝=2 is the severity food insecurity of food insecure households. The situation when the ∝= 0 yields a distribution of individual food poverty levels in which each poor person has poverty level 1; the average across the entire population is simply the headcount ratio poor. The situation when α= 1 that is the normalized gap gi as a poor person's food poverty level, thereby differentiating among the poor; the average becomes the poverty gap measure. The case where ∝=2 squares the normalized food poverty gap and thus weights the gaps by the gaps; this yields the squared gap measure α= 2. As α tends to infinity, the condition of the poorest poor is becoming worse of. The parameter ∝ is an indicator of "poverty aversion".

To determine the Household's Food security Status (HFS), the Direct Calorie Intake (DCI) method was used. The survey result has showed that from 150 sample households, 121 (80.67%) households were food insecure and only 29 (19.33%) were found food secure. This section tries to examine the extent of food insecurity among food insecure sample households using an adapted Foster-Greer- Thorbecke

(FGT) class of food insecurity measures. The finding of this study revealed that the head count ratio, the food insecurity gap (short-fall), and the squared food insecurity gap (severity of food insecurity) were estimated to be 81%, 14%, and 3%, respectively in the study area. This implies 81 percent of the sample households was unable to meet the minimum energy requirement recommended for healthy and active life.

Similar study was done on an Empirical Examination of the Determinants of Food Insecurity among rural farm households in Kindo Didaye district, Ethiopia. The finding from FGT index revealed that 70.62 percent of households in the study area were found food insecure. The depth and severity of food insecurity were found 37% and 25.6%, respectively.

Table 1. shows that FGT1 or P1 index shows the gap (depth) of food insecurity or the average short fall of food energy from the minimum amount of deity energy required for food insecure households. In other words, it measures the total amount of kilocalorie necessary to remove the food insecurity. In the present study, each food insecure household needs, on an average, 14% extra daily caloric consumption to bring them up to the minimum recommended daily caloric requirement level. The FGT2 or P2 index of food insecurity indicates the severity of food insecurity by giving more weight for the more deprived households; i.e., households with higher amount of food energy deficit from the recommended minimum allowance are given more weight in the computation of average level of shortfall of per capita kilocalorie consumption. As such, it takes more resource to lift those households which are more impoverished than those which are closer to the minimum recommended kcal per capita per day. The survey result has identified that the relative deficiency among food insecure households is 3%. Hence, FGT2 index shows food consumption inequality in a generic sense.

Table 1: Overall FGT class of food insecurity of sample households

FGT0 [P0]	FGT1[P1]	FGT2[P2]
Incidence of food insecurity	Depth of food insecurity	Severity of food insecurity
0.81	0.14	0.03

Decomposing the incidence, depth and severity of food insecurity indices across different household characteristics is a critical part of food insecurity analysis such that it is believed to help policy makers to better understand the existing variation in the extent of food insecurity among households and hence for targeting. Table 2 below presents the computed value of head count index, food insecurity gap (short- fall or depth of food insecurity) and severity of food insecurity by the demographic and socio-economic characteristics of households. The socio-economic variables considered are education of household head, occupation of household head, land size, livestock owned, access to credit, and poverty line.

Accordingly, the result has revealed that food insecurity was high for illiterate household head with the headcount index, short-fall index and severity of 90, 16, and 4%, respectively. The incidence of food insecurity was found to be lower for literate household head it was 73%, 11%, and 2%. This implies education as a social capital impact positively to the households' ability to take good and well-informed production and nutrition decisions and enhance food security by improving household food accessibility. Similar conclusion was found.

Table 2. provides the highlights of the occupational distribution of the households. Based on the primary occupation, the incidence, depth and severity is 78%, 13% and 3% respectively for household whose primary occupation is cultivation. While the incidence, depth, and severity is 94%, 20% and 5% respectively for household who engaged in labour activity in agriculture. The incidence of food insecurity was found to be lower among household who were employed in services other than agriculture. The households that diversified their portfolios into multiple income generating activities besides farming are likely to be more food secure than those that rely on farming as the only source of income. Diversified income sources by a particular household means an increase the household's purchasing power, hence, the likelihood of being food secure. Households with relatively more diverse sources of farm income tended to have a lower probability being poor than those with relatively less diverse enterprises and income sources, given other factors.

Table 2: Decomposition of FGT indices by selected by socio-economic characteristics of households

Variables	Incidence of food insecurity (Head count index)	Food insecurity gap (Short-fall index)	Squared food insecurity gap (Severity index)
FGT class of food insecurity	0.81	0.14	0.03
Household Head Education			
Literate	0.73	0.11	0.02
Illiterate	0.90	0.16	0.04
Occupation of household head			
Self-employed in Agriculture	0.78	0.13	0.03
Agricultural Labour	0.94	0.20	0.05
Employee in services other than agriculture	0.73	0.08	0.01
Land Size			
Landless	0.83	0.18	0.05
Small& Marginal	0.89	0.15	0.03
Large	0.70	0.09	0.02
Livestock Owned			
Household having livestock	0.71	0.11	0.02
Household not having livestock	0.84	0.14	0.03
Access to Credit			
Yes	0.88	0.18	0.04
No	0.79	0.13	0.03
Poverty			
Above poverty line	0.74	0.08	0.01
Below poverty line	0.83	0.15	0.04

Another important aspect of analysis is looking the variation in household's food security status in terms of land size. Household having large holding of land was found more food secure with incidence (70%), depth (9%) and severity (1%) than household having small and marginal land holding. Landless household having an estimated head count ratio, short-fall and severity index is 83%, 18% and 5% respectively were found more food insecure than household having large holding of land.

Furthermore, the study revealed that households not having livestock were found more prone to severe food insecurity with the estimated food insecurity head count, short-fall and severity indices of 84%, 14%, and 3%, respectively. For their counterpart's household having livestock, the head count index of 71%, short-fall index of 11%, and the severity index of 2% was computed. Similar result was found.

The result shows that household having access to credit had the incidence (88%), depth (18%) and severity (4%). Whereas household having access to credit had the headcount index, short-fall index and severity of 79%, 13%, and 3%, respectively. Similar result obtained in the study.

Table 2 further provides the highlights of the household who were above poverty line which ensure a basic living standard with enough money for things such as food. Household above poverty line had better access to food with the incidence (74%), depth (8%) and severity (3%). whereas household below poverty line were more prone to food insecurity with the incidence (83%), depth (15%) and severity (4%).

Table 3: Average Intake of Nutrients per capita per day

Household	Energy (Kcal)	Protein (g)
Total household	2447.56	60.63
Food secure household	3178.25	80.92
Food insecure household	2272.44	55.76

Household average dietary energy consumption per capita is an indicator that estimates calorie consumption based on the total amount of food acquisition or consumption by the household. Consuming an adequate number of calories is necessary (but not sufficient) for proper growth, development, and cognitive and physical functioning. Trends in household average per capita energy acquisition or consumption can provide early warnings of where there may be problems for population-level under nutrition or overweight/obesity for specific regions within a country or for the country as a whole.

Table 3 shows the average dietary energy available for food secure households and food insecure households was 3178.25 Kcal and 2272.44 Kcal, respectively. Recommended dietary allowances (RDA), the daily dietary intake level of a nutrient is 2730 Kcal and 60 g protein to meet the requirements of healthy individuals in each life- stage and sex group. The results shows that food insecure households cannot meet recommended dietary allowance because of various reasons like less income to spend on food, large number of family members, lack of knowledge of recommended diet etc as they did not have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs.

Table 4: Average values of food consumption per capita per day according to education status

Education of household head	Energy (Kcal)	Protein (g)
Illiterate	2323.19	56.71
Literate	2547.96	63.79

Table 4. shows that the average dietary intake of energy of selected household per capita per day belonging to illiterate and literate household head is given. Family belonging to literate household group have more intake of dietary energy than those who were illiterate. It was found that household heads with education have greater access to non-farm jobs and the capacity to adopt better strategies in their farming, which in turn increases their production and contribution to food security for those household. Still there was gap to meet recommended dietary energy intake.

Table 5: Average consumption per capita per day according to land size

Land size (Acre)	Energy (Kcal)	Protein (g)
Landless	2342.30	57.09
Small & Marginal	2389.77	59.95
Large	2587.23	64.05

Land ownership has been shown to strongly influence incomes and livelihoods of household. It can be seen from table 5. that household holding large size of land have average daily per Capita calories supply of 2587.23 Kcal and protein was 64.05 g. Whereas small and marginal holders of land get 2389.77 Kcal average energy per capita per day. Large and small land holders getting sufficient amount of protein which is 64.05 g and 59.95 g. Households which did not possess land found to be most food insecure household in study area their average daily per capita calories supply was 2342.30 Kcal and 57.09 g of protein. Majority of household engaged in farm activities had income from on farm activities and easy availability of food by own production. Whereas landless households engaged in labour activities were prone to seasonal unemployment which might be the reason for food insecurity.

Table 6: Average consumption per capita per day according to livestock owned

Livestock owned	Energy (Kcal)	Protein (g)
HH having livestock	2548.37	62.50
HH not having livestock	2413.36	59.99

Households who owned livestock had average daily per capita calories and protein supply of 2548.37 Kcal and 62.50 g. Livestock can have positive impact on food security by providing milk products to household and supplementary income. Households not having livestock was found highly food insecure with high calorie deficit.

Table 7: Average consumption per capita per day among ration card holder

Poverty	Energy (Kcal)	Protein (g)
Above poverty line	2704.46	69.28
Below poverty line	2372.27	58.09

Table 7. shows that household above poverty line card holders intake average 2704.46 Kcal calories and 69.28 g protein that means income affects individual access to food. Poverty is a particular strong predictor of household food insecurity. Above poverty line households have economic access to sufficient, safe and nutritious food. Below poverty line household mainly consume food like rice and sugar and wheat from public distribution system at subsidised rate. It was found that majority of household fulfil their diet from rice. Public distribution system should include various other commodities to fulfil daily recommended dietary requirement of Below poverty line household.

Table 8: Average consumption per capita per day according to age

Age of household head	Energy (Kcal)	Protein (g)
Less than 50	2444.95	61.07
Above 50	2450.24	60.17

Table 8. shows that Average daily per capita calories supply of aged household head was slightly higher than young household head. This might be due to better understanding of traditional farming. In both the cases average per capita supply of energy that was 2444.95 Kcal in young household head and 2450.24 Kcal in aged household head which was less than recommended dietary allowances.

4. Conclusion
Food insecurity and poverty are critical and persistent problems faced by most of the Indian today. In an effort to reverse the incidence of these problems, different studies recommended that improving the livelihood of the rural poor plays a key role. The improvement programs in the welfare of rural community to be effective, they need to be supported by empirical evidences that provide important input on households' food security for concerned bodies. Thus, urgent actions directed towards reducing and/or eliminating rural households' food insecurity in the study area should focus on awareness creation on effective family planning and the impact of large family size on ensuring food security, and awareness creation and capacity building for elder households through ensuring the availability and dissemination of accurate information should be strengthened.

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