Food Security among Kandhas of Kandhamal, Odisha, India: A Mixed Method Study[1]

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Abstract

Given the global commitment to zero hunger and in the backdrop of Asian enigma, this paper looks into nutritional deprivation among Kandhas, a tribal community from Odisha, India. Based on fieldwork during a harvest period, the pervasive household-specific and nutrient-specific deprivation is intriguing. An inverse relationship between the number of nutrient deficiencies and the number of food groups consumed is observed. Food intake among pregnant and lactating mothers at homes is lower than that at *Maa Gruha*, a care facility. The fieldwork coincides with the initial days of a millets intervention and could serve as a baseline for future comparison.

Keywords: Adult equivalent scale, Food group, Food security, India, Kandha, Mixed method, Nutrient deficiencies, Odisha

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1. Introduction

Globally, 821 million people (or, one-in-nine) are undernourished in 2017 and what is worrying is that our commitment towards zero hunger, the second sustainable development goal, seems to have been reversed as the number and proportion of undernourished have increased since 2015 (IFPRI, 2016). In 2011-12, the estimated number of undernourished people in India is 472 million (39 per cent of its population) and that for Odisha is 17 million which is around 40 per cent of its population (Rawal et al., 2019). As per 2011 census, 40 per cent of Odisha's population are from vulnerable social groups (23 per cent scheduled tribe, and 17 per cent scheduled caste) and in Kandhamal district, our study district, 70 per cent of its population are from these vulnerable social groups (54 per cent scheduled tribe, and 16 per cent scheduled caste) and 90 per cent of its population are rural (Census of India, 2011). The politics and economics of coexistence between these two vulnerable social groups, in the context of Kandhamal, have received scholarly attention since the 1950s (Bailey, 1964; Rao, 1985; Patnaik & Bag, 2019). In recent times, Kandhamal has been identified as one of the 117 aspirational districts of India because of relative non-performance in development indicators on five aspects with one aspect being health and nutrition (NITI Aayog, 2018).

There is also an increasing concern on the double burden of malnutrition with countries, sub-national regions, social groups, families or even individuals suffering from this; for instance, being adequately nourished in terms of calorie but having other nutritional deficiencies (FAO et al., 2018; Gonme & Toteja, 2018; Gupta et al., 2018). The outcome indicators are dependent on intake and it is for this that being adequately fed and not remaining hungry has been an important parameter in our understanding of poverty since the early twentieth century (Riches, 1997).

The discourse on measurement of poverty in the Indian context, has gone a step ahead, and used calorie norms and a commensurate purchasing power to arrive at poverty lines (Mishra, 2014). These use food item wise conversion to obtain specific amount of calorie consumed, and the age-sex-occupation distribution to arrive at a normative requirement that is separate for rural and urban areas (NIN, 2011). Independent of its link to estimating a poverty line, attempts at calorie, protein, fat and other nutrient deficiencies for different sub-groups of population is equally important (Sen, 2005).

Nutritional deficiencies or even double burden of malnutrition could indicate an absence of diet diversity indicating that the food items consumed are from fewer food groups and even perhaps fewer items within each food group. In fact, a study across four districts and three states of India including in Kandhamal of Odisha using one-day recall of food items consumed indicates that the median number of food groups consumed is less than four reflecting low dietary diversity (Gupta, 2018). The access to and intake of food among some communities is also reduced during the lean season (Viswanathan et al., 2015). In fact, a study among tribal communities of Odisha indicates that 59 per cent of those surveyed have only one meal a day with limited food items during the lean season and the reasons identified for this situation were poor employment opportunities, non-availability of forest products, and financial constraint (Patel, 2016).

The health of Indian women is among the worst in the world (WHO, 2009). Compared to men, women are at much greater risk of being both overweight and underweight (Mukherji et al., 2010). Adolescent girls and adult females are severely anaemic in Odisha (Bulliyya, 2004; International Institute of Population Sciences, IIPS, 2008& 2017). Poverty, poor infants feeding practices, neglect of the girl child and social customs such as eating after the men and the boys have been fed, leave the females undernourished (Ramalingaswami et al.,

1996; Nestle et al., 1998; Kalita, 2006; Kehoe, 2019), which also has implications in our understanding of Asian enigma.

The issues of concern are nutrient-specific deficiency, diet diversity understood through the number of food groups consumed, and its implications on nutritional intake or food security in general and that on the health of mothers in particular. Given these, the paper has three objectives.

First, to evaluate food security through an estimate of nutrient-specific intake and whether the intake meets the dietary requirements among households of Kandha community surveyed. Second, to analyse the relationship between the number of nutrient deficiencies and the number of food groups consumed. And, third, to examine whether pregnant and lactating mothers consume adequate nutritional food. The rest of the paper is divided into data and methods, results and discussion, and conclusions.

2. Data and Methods

Fieldwork was conducted across fourteen villages in the Phiringia and Daringbadi blocks of Kandhamal district, Odisha shown in Figure 1 from December 2018 to January 2019, a harvest period. The selection was guided by a natural experiment, the intervention under the Odisha Millets Mission, which also happened to be an area inhabited by the Kandha tribes. In the villages the household selection was restricted to Kandhas with at least one household having a lactating or pregnant mother. Data collection at the village followed a mixed method (Claasenet al., 2015): 53 interviews to 23-70 year old adults using one-day recall of household-level food consumption and also about their sources of food in their recent past, four focused group discussions including one on village health and nutrition day involving all pregnant and lactating mothers and all village-level health service providers (Anganwadi *didi*, Accredited Social Health Activist worker, and Auxiliary Nurse Midwife) shown in Figure 2

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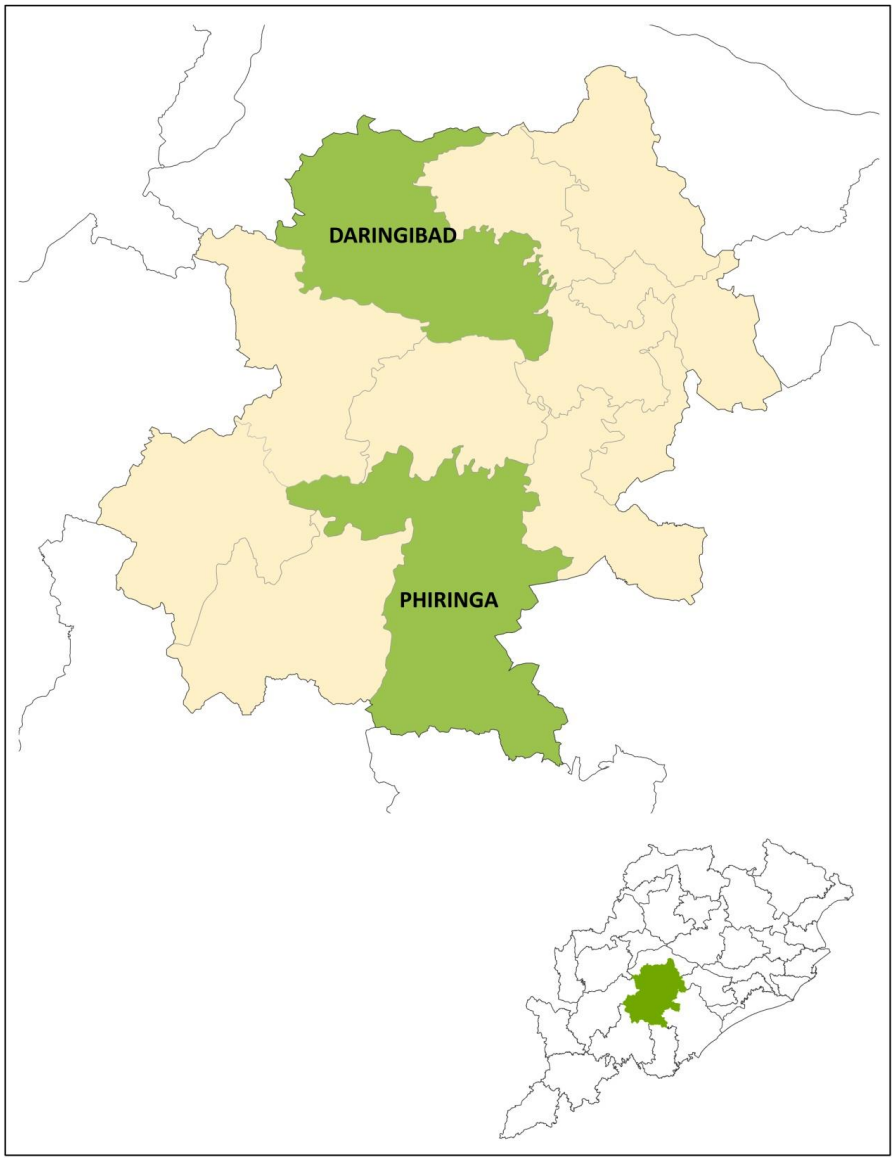
to get a broad perspective on the community food pattern, case study on *Maa Gruha* (Maternity Waiting Home) was conducted in one of the studied villages to have an understanding of their functioning which also include food for pregnant and lactating mothers that and are guided by rules laid down by the government, and interaction with other stakeholders. The respondents agreed to interact and helped in the collection of the data by seeing the recommendation letter provided by our institute and the theme of research, which was explained to them in Odia before starting any interaction and their consent was verbal.

Figure 1: Kandhamal district map and studied blocks



Source: Collated from https://www.diva-gis.org/gdata and https://gisodisha.nic.in/.

Figure 2: VHND Meeting

Source: Field work, Kandhamal

For each of the fifty-three households interviewed, to obtain household-specific and nutrient-specific deprivation information the following steps were followed. First, for each household, the nutrient-specific requirement was arrived at for five nutrients (calorie, protein, fat, calcium, and iron) as per the recommended dietary allowances of NIN by taking into consideration the households nutrient-specific adult equivalent scale (AES) based on age, gender, occupation composition and pregnant/lactating status of all the members of the household. Second, for each household, nutrient-specific consumption was obtained for the five nutrients by using data from one-day recall of food consumption to arrive at items consumed in the household and converting the same to their nutritive equivalence as per Gopalan et al. (2016). In addition, for children of the household, it was assumed that they ate food at the Anganwadi (for 3-6 year olds, under the Integrated Child Development Scheme,

ICDS) and at schools (for 7-14 year olds in classes 1-8 under the Mid-day Meal, MDM scheme) and their nutrient equivalent as per norms was added to the consumption from one-day recall (Government of India, 2014 &2016). Third, for each household, we obtained nutrient-specific normalized gaps, which is raised to a factor of αthat gives greater weight to greater values of normalized gap (or,nutrient deprivation) as α increases, and then multiplied with the household-specific reference population (the household itself, the family size or the adult equivalent scale) that gives us an adjusted normalized gap. Fourth, we take the sum of adjusted normalized gap for all households and divide it by the sum of the reference population for all households or the sum of the reference population for deprived households, as the case may be. The household-specific, nutrient-specific α-class of deprivation measure is proposed as,

(1) $m_{j,\alpha} = \sum g_{ij}{}^{\alpha} x_{ij} / \sum y_{ij}$;

where i denotes i^{th} household; j denotes the j^{th} nutrient (calorie, protein, fat, calcium and iron); $g_{ij} = \left[r_{ij} - \min_{ij}(c_{ij}, r_{ij})\right] / r_{ij}$ is a household-specific, nutrient-specific normalized gap such that $g_{ij} \in [0,1]$; $r_{ij}$is the requirement of the i^{th} household for the j^{th} nutrient; c_{ij} is the consumption of the i^{th} household for the j^{th} nutrient; $r_{ij} \leq c_{ij}$implies that consumption of i^{th} household for j^{th} nutrient is more than or equivalent to the requirement such that $g_{ij} = 0$; $\alpha = 0,1, \dots, n$ (when $\alpha = 0$ then all deprived households get a value of 1 each, when $\alpha = 1$ then a deprived household gets a value equal to the normalized gap, g_{ij}, and when $\alpha > 1$then it implies higher weight to greater values of normalized gap); x_{ij} the is reference population that could be the household itself ($h_{i\bullet} = 1 \; \forall i$) or family size of the household ($f_{i\bullet}$of i^{th}household) or nutrient-specific adult equivalent scale of the household (e_{ij} of i^{th} household for j^{th} nutrient); and $\sum y_{ij}$refers to the sum of the reference population for all

observations when $y_{ij} = x_{ij}$, or, for the deprived only when $y_{ij} = x_{ij} d_{ij}$ (where $d_{ij} = 1$ if $g_{ij} > 0$, and $d_{ij} = 0$ if $g_{ij} = 0$). Our class of nutrition-deprivation measure is an improvement over α–class of poverty measure, as the deprivation value (or, poverty line) is not fixed but is household-specific and nutrient-specific (Foster et al., 1984; Hari & Mishra, 2019; Sarkar, 2020). Besides, we allow the reference population to be either from the total population or from the deprived among them.

The food items consumed by households have also been used to derive the number of food groups that a household consumed (a measure of diet diversity for the household). Following the categorization/norms on food groups by the NIN and FAO we have ten food groups, viz., cereals, pulses and legumes, fruits, green leafy vegetables, other vegetables, milk and milk products, meat and meat products, fats and sugar, spices and condiments, and beverages including alcohol (Gopalan et al., 2016; Kennedy et al., 2013).

This paves the path to examine a relationship between diet diversity (the number of food groups consumed by a household) and nutritional deprivation (the number of nutrients that a household is deficient in), which is evaluated through a chi-square test. Further, to have an item-wise detailing on food diversity, the composition of each food group during the one-day recall and in other times was probed. One also looked in the distribution across sources of food by food groups. Care was taken to avoid conducting household surveys on festive occasion, as the purpose was to know their consumption during normal days of a peak harvest season, which is considered as a relatively better-off period for availability of food.

We have used mixed methods to examine food consumption among the Kandha tribe of Odisha, their food security through nutritional status and its dynamics. In this perspective, we discuss nutrient deprivation, number of deficiencies by number of food groups consumed and food diversity. Food items consumed in households where pregnant and lactating mothers

live are compared with all households and with a standard menu in *Maa Gruha* for lactating and pregnant mothers

3. Results and Discussion

3.1 Socio-Economic Characteristics

Socio-economic characteristics of the respondents interviewed, Table 1, indicates the following. All respondents are Kandha tribals in the 23-70 age group and all, except one, are married. Farming is their main source of occupation (876.8 per cent) and their subsidiary occupation is largely as wage labourers (62.3 per cent).They are mostly Christians (69.8 per cent)and the remaining are Hindus, but some among the latter follow the *Mahima* sect. More than 81 per cent have completed primary education or above.

Fuelwood from common property resource (CPR) is collected by 98.1 per cent of households and excluding one household the number of food items that any household collected from CPR in the recent past during our survey ranges from one to five, but, across households, a total of eight items were collected. Fruit-bearing trees were there in 96.2 per cent of households with the number of fruit trees in these households being from one to six, but across households, there were nine types of fruit-bearing trees. All had their own kitchen garden and all had access to tube well for drinking water. Almost all the households (51 out of 53) availed ration under the public distribution system (PDS). Nearly 84.9 per cent households suffer from shortage of food during the months of June-October. Further, 34.0 per cent of the respondents are either pregnant or lactating mothers, and more than two-fifth (41.5 per cent) are the participants under Odisha Millets Mission.

Table 1: Socio-Economic Characteristics of Respondents

Indicators	*Sub-Indicator*	*No.*	*%*
Category	Kandha, Scheduled Tribe	53	100.0
Age-group	23-70 years	53	100.0
Marital Status	Married	52	98.1
	Single	1	1.9
Occupation (Main)	Farming	46	86.8
	Salaried job	5	9.4
	Wage labour	1	1.9
	Truck owner/driver	1	1.9
Occupation (Subsidiary)	Wage labour	33	62.3
	NTFP collection	3	5.7
Religion	Christian	37	69.8
	Hindu	16	30.2
Education (Respondent)	No Education	10	18.9
	Primary	24	45.3
	Upper Primary	10	18.9
	Secondary	6	11.3
	Senior Secondary	1	1.9
	Graduation	2	3.8
Drinking water source	Tube well	53	100.0
Kitchen garden	Have	53	100.0
Collection from CPR	Fuelwood and NTFP including food	52	98.1
Fruit bearing trees	Have	51	96.2
PDS Ration	Availed	51	96.2
Shortage of food	Lean period	45	84.9
Mothers	Pregnant	2	3.8
	Lactating	16	30.2
OMM Participant	As millet producer	22	41.5

Notes: CPR is Common Property Resource. NTFP is Non-Timber Forest Product, OMM is Odisha Millets Mission. PDS is Public Distribution System. Wage labour and NTFP under subsidiary occupation are not mutually exclusive.
Source: Primary data

3.2 Nutrient-Specific Deprivation

Using our class of nutrition-deprivation measure, nutrient-specific deprivation is given in Table 2 for three categories of the population: households, persons and adult-equivalent scale.

The patterns of deprivation are broadly similar across the three categories of population. For identification and targeting, deprivation at the level of household or person may be better, but from the perspective of conceptualizing shortfalls or deprivations, adult equivalent would be appropriate, as this also formed the basis for arriving at a household-specific requirement. For

this reason, we provide more details for the results on the adult equivalent scale. For the five nutrients under analysis, the proportion of adult equivalent deprivation from the least deprived to the most deprived is as follows: protein (24.9 per cent), calories (43.0 per cent), iron (47.5 per cent), fat (98.7 per cent) and calcium (100 per cent). However, when it comes to normalized gap (either based on the deprived adult equivalent scale or per the adult equivalent scale) fat deprivation is higher than calcium deprivation.

Table 2: Nutrient-specific Deprivation: Households, Persons and Adult Equivalent Scale

(per cent)

Category	*Indicator*	*Protein*	*Calorie*	*Iron*	*Fat*	*Calcium*
HH	Deprived HH	24.5	39.6	49.1	98.1	100.0
	Normalized Gap/Deprived HH	12.7	17.1	24.6	75.3	53.7
	Normalized Gap/HH	3.1	6.8	12.1	73.9	53.7
Person	Deprived Persons	22.1	40.7	47.1	98.9	100.0
	Normalized Gap/Deprived Person	13.4	17.6	27.2	75.6	53.4
	Normalized Gap/Person	2.9	7.1	12.8	74.7	53.4
AES	Deprived AES	24.9	43.0	47.5	98.7	100.0
	Normalized Gap/Deprived AES	13.5	17.5	26.6	75.9	54.3
	Normalized Gap/AES	3.3	7.5	12.6	75.0	54.3

Note: AES is Adult Equivalent Scale, HH is Household
Source: Primary data

All the households have suffered from calcium deprivation and all, except one, household suffer from fat deprivation. This is worrying. In fact, for these two nutrients, the normalized gap at adult equivalent scale is higher than that measured at the household or the population level.

The normalized gap for calcium, a greater requirement for mothers, is a matter of concern. This is compounded by the fact that for religious and cultural reasons, Kandha's do not consume milk and milk products (see Table 5), an important source of calcium. As a matter of curiosity, we did calculate the nutrient-specific deprivation for lactating and pregnant mothers, for such households the normalized gap per adult equivalent scale turns out to be 12.6 per cent (protein), 18.2 per cent (calorie), 23.5 per cent (iron), 73.0 per cent (fat), and

61.9 per cent (calcium). This indicates that the greater requirement (NIN, 2011; Venkatachalam & Rebello, 2011) in such households may be compensated by greater consumption, but deprivations are pervasive and do not seem to differ much from the general population.

3.3 Food Groups Consumed and Nutrient Deficiencies

Table 3 represents two major components of household's food consumption: the number of food groups consumed and the deprivation in intake for five nutrients. Their cross tabulation and the resultant chi-square suggest that the number of food groups and the number of nutrient deficiencies are not independent of each other. Table 4 is a further explanation of Table 3.

Table 3: Cross Tabulation of Number of Nutrient Deficiencies by Number of Food Groups Consumed

Number of food groups consumed	*Number of nutrient deficiencies*						
	1	*2*	*3*	*4*	*5*	*Row Total*	*(Share)*
3	0	5	6	1	6	18	(34.0)
4	0	6	5	4	3	18	(34.0)
5	0	8	2	2	2	14	(26.4)
6	0	2	0	0	0	2	(3.8)
7	1	0	0	0	0	1	(1.9)
Column Total	1	21	13	7	11	53	(100.0)

Note: Pearson chi^2 (df: 16)= 62.8552, Pr = 0.000.
Source: Primary data

A matter of concern is that 18 (34 per cent)households who in the one-day recall consumed three of the ten defined food groups fail in the minimum dietary diversity, as food consumed should be from four or more groups (Kennedy et al., 2013). In fact, these households mostly consume rice (a cereal) with *dal* (a pulse) and other vegetables (mostly chillies, onion and brinjal among others), or *dal* and tomato (technically, a fruit), or *saga* (a green leafy vegetable) with chillies, or some other combination. These households' consumption of *dal*,

dalma (curry-like dish made up of pulses and other vegetables) or roasted vegetables/tomato did not have oil or spices in their one-day recall. These households suffer from deficiencies in two-to-five nutrients. One-third (or, six out of eighteen) of them have deficiencies in all the five nutrients under analysis. Across the number of food groups, from those with deficiencies in all the five nutrients, the maximum are from those with three food groups (six out of eleven, 54.5 per cent).

Table 4: Distribution across Number of Nutrient Specific Deficiencies by Number of Food Groups Consumed

Number of food groups con-sumed	*Number of nutrient-specific deficiencies*							*Total*
	1	*2*	*3*		*4*		*5*	
	Ca	*Ca, Fat*	*Ca, Fat, Fe*	*Ca, Fat, Kcal*	*Ca, Fat, Kcal, Fe*	*Ca, Fat, Kcal, Protein*	*Ca, Fat, Fe, Kcal, Protein*	
3	0.0	27.8	22.2	11.1	0.0	5.6	33.3	100.0
4	0.0	33.3	22.2	5.6	22.2	0.0	16.7	100.0
5	0.0	57.1	14.3	0.0	7.1	7.1	14.3	100.0
6	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0
7	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
All	1.9	39.6	18.9	5.7	9.4	3.8	20.8	100.0

Notes: Ca is calcium, Fe is Iron, Kcal is calories
Source: Primary data

Another 18 (34 per cent) households have consumed food items from four food groups only. One observes that seven of these households include lactating/pregnant mothers, in the one-day recall all of them ate *chattua* (take-home ration provided by Anganwadi centres under ICDS and it is a roasted flour comprising of wheat, bengal gram, peanut and sugar, that is, four items from three food groups). Further, all households consumed either *dal* (15 households) or *dalma* (three households). Compared to the households consuming food items from three food groups, these households also had more vegetables, such as raw papaya and snakebeans. Some of these households also consumed pickle and *chatni*. These households

also suffer from deficiencies in two-to-five nutrients, but a maximum of six (or, one-third, 33.3 per cent) were with two deficiencies and a minimum of three (or, one-sixth, 16.7 per cent) were with five deficiencies. From the remaining nine (or, one-half), five (27.7 per cent) had deficiencies in three nutrients and four (22.2 per cent) had deficiencies in four nutrients. There were 14 (26 per cent) households that consumed five food groups. All these households consumed cereals, other vegetables and pulses, and thirteen households consumed fats and sugar and one household consumed spices. Green leafy vegetables were consumed by nine households, and fruits by five households (four had tomatoes and one bananas). Their breakfast had items with three food groups (cereals, pulses, and fats). Some of them also added either oil or spices in their *dalma*. There were some that consumed either *chattua* or puffed rice/flattened rice with peanuts in their evening snacks. These households have also two to five nutrient deficiencies. Two (or, one-seventh) households each have three to five nutrient deficiencies. Eight (or, four-seventh, 57.1 per cent) have two nutrient deficiencies. Across food groups consumed, eight out of 21 (38.1 per cent) is also the maximum number with two nutrient deficiencies.

There are two household consuming six food groups and they have two nutrient deficiencies each. Their breakfast is like that of those who consumed five food groups. They had *dalma* with oil and spices either for lunch or dinner. And, for the other meal they either consumed *dal* with green leafy vegetables or stir-fried vegetables. Their snacks are boiled corn and puffed rice.

Only one household that has consumed seven food groups is deficient in only one nutrient, calcium. This household also seems to be an outlier as they own a truck and are economically relatively better off.

Our analysis also shows that calcium deprivation is the highest with all the fifty-three households suffering from its deficiency. The households do not consume calcium-rich food in adequate amounts. In fact, milk and milk products are a cultural taboo, as it is meant for the calf (Almerico, 2014). The outlier household does consume milk products like *paneer* (cottage cheese) occasionally, but did not consume it during one-day recall. The availability of finger millet, a rich source of calcium, which is currently being revived under the Odisha Millets Mission, had reduced over time (Government of Odisha, 2015 & 2016; Jena & Mishra, 2022). From one-day recall, only four households consumed finger millet. Its revival may address calcium deficiencies among Kandha households.

All except the outlier household that consumed food items from seven food groups suffer from fat deficiency. This is so because of limited consumption of oil and fat-rich food. Iron deficiency is there among nearly half of the households: at least three-fifths each for households that consumed either three or four food groups and at least one-third for households that consumed five food groups.

Calorie deficiency exists among two-fifth of the households: half of the households that consumed three food groups, four-ninth of households that consumed four food groups and two-seventh of households that consumed five food groups. Protein deficiency exists among nearly one-fourth of households: nearly two-fifth from households that consumed three food groups, one-sixth from households that consumed four food groups and more than one-fifth from households that consumed five food groups.

The discussion of number of food groups consumed and the number of nutrient deficiencies suggest that there is an inverse relationship, that is, households that consume a greater number of food groups have a smaller number of nutrient deficiencies. This also substantiates our chi-square result rejecting independence between the two in favour of an alternative

hypothesis suggesting possible association. Given this, we now take up an analysis of diversity of food items per se and particularly within each group.

3.4 Diversity within Food Groups

Table 5 provides details of food items consumed under each of the ten food groups based on one-day recall and at other times, and Table 6 provides the distribution across source of food available during the survey period by food groups. The food groups consumed fall under eight of the ten food groups. These are cereals (the maximum being rice from all fifty-three households and a few instances of corn and millets also), pulses and legumes (the maximum being pigeon pea in forty-four households and one instance each of horse gram and a locally grown pulse), fruits (tomatoes in thirty-six households and banana in one instance), green leafy vegetables (mustard leaves, a seasonal item, from twenty-six households), other vegetables (green chilly from fifty-two households, as also potato, brinjal, papaya, frenchbeans, onion, pumpkin and others),fats and sugar (mustard oil in twenty-seven households for fat, sugar as an ingredient in *chattua* for 12 households and in tea for one household), milk and milk products (only one with tea), and spices and condiments (few instances). No food items were consumed from meat and meat products, and alcohol during our one-day recall.

Rice was the predominant cereal. In fact, all the households consumed rice at least once in our one-day recall. All the households cultivated and also sold paddy. What is intriguing is that except for two households, rice obtained through PDS has become an indispensable part of their daily diet. Other cereals were cultivated by 36 (67.9 per cent), of which 27.8 per cent cultivated both and the rest were equally divided (36.1 per cent each) in cultivating either only maize or only millets. The 18 (34.0 per cent) households with lactating/pregnant mothers also received under ICDS *chattua*, which also had wheat as an ingredient.

Table 5: Food Items Consumed across Food Groups during One-day Recall and Additional Items Not Captured during One-day Recall

Food group	*One-day recall (no of households)*	*Varieties*	*Additional items not captured in one-day recall*	*Varieties*
Cereals	Rice (53), wheat (12, as ingredient in *chattua*), ragi/finger millet (4) maize/corn (4), jowar/sorghum (3)	4	Little millet	1
Pulses and legumes	Pegion pea (44), bengal gram (12, as ingredient in *chattua*), horse gram (1), local pulse *kaulka*(1)	3	Black gram, green gram, red lentil, soyabeans, dried peas and other legumes	8
Fruits	Tomato (36), banana (1)	2	black plum, dates, guava, jackfruit, mango, orange, papaya, local berries (*bhalia, kantei*)	8-9
Green Leafy Vegetables	Mustard leaves (26)	1	Moringa, pumpkin leaves, wild varieties	3-5
Other Vegetables	Chilly (52),potato (45), brinjal (35), papaya (30), frenchbean (17), onion (14),pumpkin (11),field bean (5), cauliflower (4),jackfruit (3), lady finger (1), snake bean(1), jackfruit seed (1)	13	Cabbage, drumstick, roots and tubers including yam, wild vegetables including bamboo shoots, wildmushrooms, peas and other legumes	5
Fat and Sugar	Mustard oil (27), peanut (3), sugar (13, as an ingredient in *chattua* for 12 and with tea for 1)	2	Gara oil (mahua seed), refined oil	2
Milk and Milk Products	Milk (1, with tea)	1	*Paneer*, milk powder	2
Meat and Meat Products	-	0	Mutton, pork (one/twice a year, [chicken, egg, fish/dry fish (once in a few months)]	5
Spices and condiments	Turmeric (7),garlic (6), local spice *dhulia*(6),mango pickle (4), cumin seeds (2)	6	Mustard	1
Alcohol	-		Locally brewed *mahula* and *tadi*	2

Source: Primary data.

For millets, the recent revival under the Odisha MilletsMission has had some impact, particularly in Daringbadi. In fact, from the seven cases of millets consumption in one-day recall, six are from Daringbadi and 17 of the 18 households who cultivated millets took up new agronomic practices under the mission. The baseline report under the mission does indicate that households in our survey areas have been consuming millets, perhaps relatively

more in summer in the form of *mandia jau* (finger millet porridge) or *torani* (fermented gruel made up of *mandia*/finger millet or rice), and with a larger number of recipes in Daringbadi when compared with Phiringia (NCDS, 2019). The field notes and focus group discussions also indicate that the households consumed *janha khai* (pop sorghum) and *suan jau*/*kheeri* (little millet porridge). The diversity within cereals is limited and one hopes that the Odisha Millets Mission, which was in its second year during our survey, will be able to address this to some extent.

Table 6: Distribution of Source of Food by Food Groups

Food groups	Production	CPR	Market	PDS/ICDS	None
Paddy/rice	100.0	0.0	0.0	96.2	0.0
Other cereals	67.9	0.0	0.0	34.0	18.9
Pulses and legumes	75.5	0.0	79.2	34.0	7.5
Fruits	90.6	56.6	0.0	0.0	1.9
Green leafy vegetables	54.7	92.5	0.0	0.0	3.8
Other vegetables	98.1	67.9	54.7	0.0	0.0
Fats and sugar products	34.0	17.0	100.0	34.0	0.0
Milk and milk products	0.0	0.0	3.8	0.0	96.2
Meat and meat products	18.9	0.0	20.8	34.0	39.6
Spices and condiments	79.2	0.0	100.0	0.0	0.0
Alcohol/Mahua flowers	0.0	7.5	0.0	0.0	0.0

Note: CPR is Common Property Resource, PDS is Public Distribution System, ICDS is Integrated Child Development Scheme. Mahua flowers are used for preparing alcoholic beverages.
Source: Authors' calculation based on primary data.

The consumption of pulses and legumes during one-day recall was largely *kandula* (pigeon pea), bengal gram as an ingredient in *chattua* and there was one instance each of *kolatha* (horse gram) and *kaulka*. In our focus group discussions and other interactions, another six-to-eight varieties of pulses and legumes were indicated.These were either cultivated (75.5 per cent)or purchased (79.2 per cent) and those in both categories (43.4 per cent) did that for different varieties/crops. Like in the case of paddy, households sell the produce without keeping adequate amounts for self-consumption or for the household's nutritional security. There were also a few who purchased, particularly *masoora dal* (red lentil), which is

relatively cheaper, for consumption. It is a matter of concern that seven households did not consume any pulses during one-day recall and these are the households that consumed food items from three food groups.

Consumption of fruits in one-day recall was tomatoes, which is technically a fruit but for all purposes is consumed as a vegetable. Only one household during our one-day recall consumed bananas. Another eight-to-nine varieties of fruits, which are seasonal in nature and locally produced were also consumed during different times of the year (during our survey period, 90.6 per cent had some fruit trees or cultivated plants that yielded fruits and 56.7 per cent had collected plums or berries from CPRs). However, during our one-day recall, if one excludes tomatoes, there was hardly any consumption of fruits. What is more, from the fieldwork one observed that gooseberries were being transported in truck loads to outside the district/state for being processed into value-added health products. These berries and other fruits were also available in the nearby urban centres, but, unfortunately, these were not consumed by any of the households surveyed.

Access to green leafy vegetables during the season was on own cultivation in kitchen garden (54.7 per cent, either moringa or mustard leaves) or collection from CPRs in forests (92.5 per cent, *barada*, wild leaves). Overall, 96.2 per cent had access to either own cultivation or CPRs and 50.9 per cent had access to both these sources. Our focus group discussions and interactions also revealed consumption of pumpkin leaves and other wild varieties at other times. Since the availability of these green leafy vegetables are seasonal, a prevalent practice of the region is to sundry, pound to flour and preserve them for use when vegetables are in short supply. In spite of all these, it is intriguing the green leafy vegetable that the households consumed during one-day recall was mustard leaves only.

Other vegetables were available through cultivation (96.2 per cent), CPRs (67.9 per cent) and market (54.7 per cent). Overall, 43.4 per cent availed all three sources, 34.0 per cent had availed two sources (of which, two-thirds being cultivation and CPR), 22.6 per cent availed only one source (all, except for one, being only cultivation). Seventeen varieties of other vegetables were cultivated and from these the district as also the villages surveyed would be deficient in potato and onion. The household also indicated collection of wild varieties of roots/tubers, shoots, and mushrooms from CPRs. Other vegetables is the food group with the maximum number of items, but in our one-day recall the average number of other vegetables consumed per household is about 4.1 and its median is 4.

For fats and sugar, as per one-day recall, 50.9 per cent consumed mustard oil that they had purchased. Other households also purchased oil occasionally and some from Phiringia also consumed *gara* oil or butter which is mahua butter (extracted from mahua seeds, Figure 3, collected from CPRs).There were three household that consumed peanut, as part of evening snacks, during one-day recall. Black sesame, nijer, mustard and peanut seeds are produced by 52.8 per cent of households for selling and, as per our focus group discussions, are not generally consumed by the households. This is intriguing, as these seeds are fat-rich (Gopalan et al., 2016) and fat-deprivation as shown earlier was pervasive. Sugar is occasionally consumed if they may prepare sweetmeats, but during one-day recall it was consumed by 13 (24.5 per cent) households (12 as an ingredient of *chattua* and another one with tea). Besides, six (11.3 percent) households collected honey from CPRs to sell.

Figure 3: Mahua butter

Source: Field work, Kandhamal

There was only one household that consumed milk and that was with tea. As per Kandha cultural traditions, milk and milk products are not consumed, as it is meant for the calf. This thinking was substantiated in the focus group discussions by the limited availability of fodder. Whatever be the reason, milking of cows has not been a practice among Kandhas, unlike the Hindu (*Gauda*) community who reside in some nearby villages. The exceptions being the outlier household that consumes *paneer* and milk occasionally, and also uses milk powder when someone in that household become unwell. As Kandhas have cultural and functional reasons to not consume milk, and acculturation of milk consumption is still yet to

happen, the consumption of other calcium-rich foods like millets need to be encouraged (Almerico, 2014).

None of the households consumed meat and meat products during one-day recall. As per focus group discussions, meat is consumed on special occasions, once or twice a year. On such occasions, they may consume either mutton or pork. Birds and small ruminants are reared by 10 (18.9 per cent) households (of which, six only hens, three only goats, and one with pigs and hens) to be sold, but few among them may consume eggs or chicken occasionally. There are 11 (20.8 per cent) households who indicated of having purchased meat and meat products for their consumption recently with one indicating three items and the remaining persons indicating one item only. Children (3-6 years) and pregnant and lactating mothers get eggs for three days in a week under ICDS. However, for mothers it ends up being given as take-home ration (34.0 per cent), but it was not reflected in our one-day recall. These indicate that their consumption of animal-based protein is limited. This is a matter of concern, as their consumption of plant-based protein through pulses, a major source, is also limited.

Spices and condiments are hardly consumed. Turmeric (Figure 4), a local product that is famous across the country and with a Geographical Indicator tag was consumed by only seven households during one-day recall. Six (11.3 per cent) households consumed garlic and six also added a local spice *dhulia* (Figure 5, a black coloured powder like spice) to their *dalma* preparation. Four households consumed mango pickle and only two used cumin seeds in their food preparations. All households purchased salt and 42(79.2 per cent) produced spices (of these, 32 cultivated turmeric, 19 only and 13 in combination with other spices. In these, ginger and garlic were produced in kitchen garden for household consumption and the rest were for selling.

Figure 4: Local turmeric

Source: Field work, Kandhamal

Figure 5: *Dhulia*, a local spice

Source: Field work, Kandhamal

Consumption of alcohol is not captured in the one day-recall. However, twenty-eight households mentioned consuming locally brewed *mahula* (made up of mahua flower) and *tadi* (from date palm) during other times.

Our one-day recall refers to thirty-two food items and another forty food items from focus group discussions and other interactions. However, more than two-thirds consumed items from three-to-four food groups only during one-day recall. This is a matter of concern, as one-day recall took place during the month of December and January, a post-harvest period, when food availability is relatively better.

The lean period is from June to October when some households may not have sufficient food to eat, which also occurs in other parts of Odisha (Patel, 2016). This could have adverse implications on lactating and pregnant mothers. In such lean periods, people collect some jungle food or uncultivated forest food like leafy vegetables, roots and tubers, honey, mango seeds, berries and jackfruit to cope with scarcity. Some even migrate to other nearby states. This is the case with other tribal areas also, for instance, studies done by Living Farm (a non-governmental organization in Odisha) across three districts of Odisha, found that reliance on forest food depends on the availability of other source, almost all the households are into it but the proportion of households relying on forest food varies from village to village. Some studies indicate that the requirements of several of micronutrients are obtained from these forest foods (Deb, 2014& 2017).

It is observed that, fruits like gooseberry that grows in the region, shown in Figure 6 and is known for its nutritional value, oilseeds like black sesame seed shown in Figure 7 with greater fat and calorie content, spices like the famed turmeric of Kandhamal known for its medicinal values with a global market, and meat and meat products that are reared by households in the region and is also considered as one of the fastest growing products in

terms of value addition to the national income seems to be absent in the food items consumed based on our one-day recall. The focus group discussions and others interactions indicate that these products, through a series of transactions, perhaps go out of the region, in a manner akin to grain drain (Mishra, 1996 & 1999).What is troubling is that though the households surveyed (or, even the region taken as an entity) produce sufficient amounts that could meet the food and nutrition security of the people almost all of them face some or the other nutritional deprivation. Their production and the supply chains for the market takes away more than it gives.

Figure 6: Truck loads of Indian gooseberry

Source: Field work, Kandhamal

Besides, the focus group discussions also point to people cultivating non-food cash crops like marijuana in parts of Phiringia, which is an open secret as it is not legally permitted, and eucalyptus in Daringbadi, for the paper industry, even when people know that such fast-growing trees reduce the water table. All these will have adverse implications on the availability of food and nutrition security. In this context, the cash versus in-kind debate (Khera, 2014; Satapathy et al., 2021) calls for the evaluative space to go beyond economic

considerations. We now examine an initiative to address the nutritional wellbeing of mothers.

Figure 7: *Tila*, local sesame seed

Source: Field work, Kandhamal

3.4 Nutritional Well-Being of Mothers

There are a several initiatives to address the nutritional health of pregnant and lactating mothers. One of them is a home for expectant mothers (or, *Maa Gruha*) to have *Susta Maa O Susta Pila* (healthy mother and healthy baby). One such *Maa Gruha*, which is managed by an organization that is also a partner under the Odisha Millets Mission and operates in a different location, was visited during fieldwork and has been taken up as a case study. This *Maa Gruha* caters to expectant mothers from the neighbouring villages who stay there for about seven to ten days prior to their due date of delivery and for another seven to eight days

after the delivery of their child. It is the responsibility of the auxiliary nurse midwife and coordinator to get the pregnant mothers to *Maa Gruha* and then take them to the nearest hospital to facilitate institutional delivery. During their stay, all mothers are provided with balanced and nutritious meals. This *Maa Gruha* had a kitchen garden where vegetables and green leafy vegetables were cultivated without pesticides. These vegetables were included in their diet and their menu at times also had *mandia* (finger millet), which is rich in iron and calcium (Gopalan et al., 2016).

Table 7: Meals Consumed by the Pregnant and Lactating Mothers Households as per One-day Recall and Meals served for Pregnant and Lactating Mothers at *Maa Gruha*

Meals	*One-day recall*	*Menu of Maa Gruha*
Breakfast	Fermented rice (with onion, chilli and salt), roasted vegetables	Upma/bread, channa curry/potato curry, ragi kheer/corn kheer/wheat flour kheer/ vermicelli kheer/milk with banana/seasonal fruit
Lunch	Rice, dal and green leafy vegetables/stir fried vegetables; or, rice with *dalma*	Rice, dalma/dal, fish/chicken/egg curry/paneer curry, stir fried green leafy vegetable/stir fried vegetable, and green salad
Evening Snacks	*Chattua*/puffed rice/boiled corn/peanuts/left over lunch	Puffed rice/fried flatten rice/popcorn, and roasted peanut/roasted chickpeas
Dinner	Rice, dal, boiled vegetables/fried vegetables; or, rice with *dalma*	Rice/chapattis with *dalma*/ potato soyabean curry, milk, green salad

Note: One-day recall is from 18 lactating and pregnant mothers. Six out of 18 reported that they have not taken any evening snacks in the one-day recall. At *Maa Gruha*, *paneer* is served to vegetarian mothers when there is chicken/fish/egg curry for non-vegetarians. *Dalma* is a local recipe made up of pulses, vegetables and spices.
Source: Primary Survey

In an interaction with the coordinator of *Maa Gruha,* it is reported that with the support of *Maa Gruha,* institutional delivery in the area of Phiringia has increased and the number of gravida (number of pregnancies) which was ten to eleven**,** has reduced to gravida four or five to para (number of birth that a woman had) four to five**.** However, it is a matter of concern that the diet that these mothers get at *Maa Gruha* is not available in their homes.

In fact, from the fifty households surveyed, there were eighteen households with pregnant and lactating mothers and the food they consumed at home seems to be much less when compared to meals at *Maa Gruha,* as shown in Table 7. In fact, the food composition of households with lactating and pregnant mothers is not very different from the other households surveyed.

Kandha women, as is also the case among many other communities, take care of family and farm. Further, because of anticipatory socialization (Lane & Ellis, 1968), or, adaptive preference (Sen, 1985), the prioritization of work in favour of family and farm may lead to a neglect of personal health by these women. They may eat less than their requirement during normal times as also when they are pregnant, avoid taking supplements and additional food during pregnancy for fear of gaining weight that would come in the way of their ease of mobility, work late into pregnancy with instances of childbirth in agricultural fields, and have long work hours that makes exclusive breastfeeding difficult. The activities of fetching firewood and water can also add to their burden (Goodwin et al., 2005; Mitra & Rao, 2019). All these can have adverse implications on the health of mothers and children (Kehoe, 2019).

Given these factors, the provisioning of *chattua* and eggs as take-home ration through Anganwadi centres under ICDS to pregnant and lactating mothers is praiseworthy. Nevertheless, as some of our focus group discussions indicate, there were instances of the mothers not consuming *chattua* because what was provided to them was of poor quality and not fit for consumption. This is not only a serious drawback of the programme but is also a criminal waste (Mishra, 2012). Besides, as the mother prioritizes family and work over her personal health, she may end up sharing this food with other family members. This is largely because of limited awareness on the importance of the nutrition and health of the mother on the child, particularly during the first 1000 days of the child that is from conception till two

years after birth (WHO, 2013). Our visit to a *Maa Gruha* and our interaction with their staff and other care providers like the auxiliary nurse midwife and Anganwadi worker as also participation in a *Gaon Swasthya O Poshan Dina* (village health and nutrition day) meeting, which is held once every month with all pregnant and lactating mothers as also all adolescent girls, indicates that there has been an increase in awareness on the implication of a mother's health and nutrition on the development of a child.

4. Conclusion

Given the global commitment to zero hunger and in the backdrop of Asian enigma, this paper looks into nutritional deprivation among Kandhas, a tribal community from Odisha, India. The results are based on fieldwork during a post-harvest season, which also happens to be a natural experiment setting of the Odisha Millets Mission, in the initial days of the programme, as it was being initiated. Thus, the results could also serve as a benchmark for future comparison.

To examine deprivation, this paper, first, proposes a measure where the norm for deprivation line (or, poverty line) is household-specific and nutrient-specific. Second, it uses a mixed method to obtain field level data using one-day recall and other tools to collect information on household consumption. The consumed items are converted to nutrient-equivalents and the shortfall is computed at the household, persons and adult equivalent scale levels to measure deprivation in five nutrients (calorie, protein, fat, calcium and iron). From the fifty-three households surveyed, all are calcium deficient, and all excluding one are fat deficient. Further, it is observed that there is an inverse relationship between the number of food groups consumed and the number of nutrient deficiencies. The study area has seasonal lean periods, but it is worrying that the pervasive deprivations are observed during a period of relative abundance. One also observed that the higher the number of food groups consumed, the

lower the nutrient deficiency denotes that food diversity not only throughout the year but also in the platter on a daily basis (normal days) is a need of the people to combat deficiencies on macro nutrients and addressing hidden hunger. This, along with calcium, fat and iron deficiencies should be a matter of concern, particularly for mothers and children.

One should be cautious in generalizing from a sample from a particular tribal community. Nevertheless, the tell-tale signs, including the broader indicators provided in the introduction, do suggest an important policy implication for the district or even beyond that.In particular, we would like to point out that the cash versus in-kind debate should go beyond economic considerations with process, participation and convergence. In this context, the role of *Maa Gruha*, and its convergence with the recently initiated Odisha Millets Mission as a local initiative in our study area has important lessons. It also suggests that broad basing the PDS to a nutritionally diverse basket along with specific interventions that are locally relevant are likely to have a greater advantage. *Maa Gruha'*s scope needs to be extended beyond 15 days before and after delivery and should cover longer periods. Further, inclusion of locally available nutritious food like millets (ragi with high calcium and iron content), black sesame seeds, gooseberry, and local mustard oil into their diet needs to be encouraged. This will be an important step towards *Susta Maa O Susta Pila* (healthy mother and healthy baby).

The study has provided with important lessons that have policy implications for addressing zero hunger and in unravelling the puzzle of Asian enigma among Kandhas of Odisha, India. This will also have a bearing in similar setting or among other communities of South Asia and elsewhere.

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