

# Food Security and Nutritional Availability of Farmers in Tribal Areas of India: The Complexity and Challenges

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## Authors' contributions

*This work was carried out in collaboration among six authors. Author SDM collected data and performed the statistical analysis. Author SG managed the literature searches and wrote the first draft of the manuscript. Authors AG, MH and AM helped in preparation of manuscript. Authors SKA and AB designed the study, managed the interpretation of the analyses and supervised the work. All the authors read and approved the final manuscript.*

## Article Information

DOI: 10.9734/CJAST/2020/v39i4531164

### Editor(s):

(1) Dr. Osama A.M. Ali, Menoufia University, Egypt.

### Reviewers:

(1) Marcia Carvalho de Azevedo, Universidade Federal de São Paulo, Brazil.

(2) Betty Yosephin Simanuntak, Health Polytechnic of Kemenkes Bengkulu, Indonesia.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/64028>

**Original Research Article**

**Received 25 October 2020**

**Accepted 30 December 2020**

**Published 31 December 2020**

## ABSTRACT

**Aims:** The major objectives of the study are to estimate and elucidate health, nutrition and calorie Intake of farmer in their perspectives of relation and interaction, the general status of the operating factors of the research locale in terms of nutrition and food accessed by the target respondents, the variables as well as factors, in the forms of dependent and interdependent variables and interaction amongst and between them.

**Study Design:** The locale was selected by purposive as well as simple random sampling techniques and the respondents following cultivation had been interacted and were selected by the simple random sampling method.

**Place of Study:** Villages Sidpur and Gobindapur of Purulia-1 block of Purulia district in West Bengal were purposively selected for the study.

**Methodology:** In this study 60 respondents following cultivation have been interacted and are

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selected by the simple random sampling method. A preliminary interview schedule has been administered to understand the knowledge, perception and attitude of the people towards nutritional availability concept, communication and extension system, challenges faced due to food insecurity. The collected data had been put into multivariate analysis. Statistical Package for the Social Sciences V20.0 (SPSS) of IBM was used for correlation analysis, multiple regression analysis, step-down regression analysis and path analysis.

**Results:** Independent variables family size (x3), family income (x5), family expenditure (x6) and health hazards (x7) have been found to exert strong and determining contribution to estimate dependent variable self-consumption of rice production (y) and the set of economic and ecological variables as selected for the study.

**Conclusion:** The present study has envisaged the nutritional availability and intake of calories and it should be conceived as one of the most important predicted factor and to be estimated through a set of predictor factors like family capability, home food access, personal resources etc. A nutrition professional advisory should be made to advice individuals, families, and groups on how to improve diet, lifestyle, and attitude to promote optimal health. These problems can be overcome by effective planning and allocating more funds.

*Keywords: Peasantry; tribes; nutrition; calorie; income; expenditure; health hazards; policy.*

## 1. INTRODUCTION

Indian peasantry, the largest body of surviving small farmers in the world, today faces a crisis of extinction. Two thirds of India makes its living from the land. The earth is the most generous employer in this country that has farmed this land for more than 5000 years. However, as farming is delinked from the earth, the soil, the biodiversity, the climate are linked to global corporations and global markets, and the generosity of the earth is replaced by the greed of corporations; the viability of small farmers is destroyed [1]. Agriculture has undergone profound changes and farmers are facing a wide range of stressors [2]. Unpredictable climate changes jeopardize food production and food security globally and, in the poorer countries especially in India. Being a tropical country, India is more vulnerable to this frequently changing pattern characterized by irregular and untimely rainfalls along with extended summers and winters [3].

India is shifting from 'Agriculture for subsistence' to 'Agriculture for quality of life through income security.' Food security and nutritional security, the other issues are coming in a big way across the globe. In 2025, approximately 44 mha of irrigated rice areas in Asia would face 'economic water scarcity' (Expensive water), and additional 17 mha may confront 'physical water crisis' (Dry up). Indian agriculture needs 'Inclusive growth' which includes social justice, equity, balanced growth and economic wellbeing of the farmers [4]. There is a wide gap between scientific know-how and field levels do-how. Emphasis is to be

given on the demand driven production system to supply driven production system. Adoption of improved and newer technology requires decision by farmers [5].

India with 2.5 per cent of the global land mass and 16 per cent of the global population [6] recognized the importance of human resources as the engines powering national development and gave high priority to improvement of the health and nutritional status of the population. Article 47 of the Constitution of India [6] states that, "the State shall regard raising the level of nutrition and standard of living of its people and improvement in public health among its primary duties". India's Five-Year Plans enunciated the policies, laid down multi-pronged strategies, outlined multi-sectoral programmes to improve food security and nutritional status of the population, laid the goals to be achieved in a specified time frame, and provided the needed funds to implement the interventions [7].

As a result of all these interventions, famines and severe food insecurity are no longer a threat but even today seasonal food insecurity is seen in different pockets of the country. There has been a substantial reduction in severe grades of under nutrition and micronutrient deficiencies and some improvement in the nutritional status of all the segments of population. However, in the last five decades the rate of decline in under nutrition has been slow; the mortality rate has come down by 50 per cent and the fertility rate by 40 per cent but the reduction in underweight rate is only 20 per cent [6].

The last two decades have witnessed rapid economic growth, increasing mechanization of the transport, work and household activity domains and consequent steep reduction in physical activity in all segments of population. Reduced physical activity and unaltered dietary intake have led to the increasing prevalence of obesity and associated non-communicable diseases. In affluent segments of population inappropriate dietary choices and increasing sedentary life-style have aggravated the problem. Henceforth the country has to gear itself up to prevent and combat the dual burden of under nutrition and over nutrition and associated health problems [8].

Issues of malnutrition, hunger and social deprivation are so prominent in marginal communities in India that do not wait for any further clarification. The access to food and nutrition has certainly been attributed by income, expenditure and family size and other relevant predictors amongst the poverty hit communities. Purulia, owing to some geo-social and socio-ecological factors, are classically hit by poverty. This district of West Bengal, dominant by tribal population, also offers a score of opportunities which need to be transformed into strength and social capital. We need to go deeper to extract hard evidences to estimate the reasons and levels of nutritional availability amongst the rural and tribal people of Purulia.

The study offers a comprehensive descriptive analysis, and uses a parametric approach that consists of estimating jointly both efficiency as a function of farmers' characteristics and a stochastic production frontier as a function of agricultural inputs. Traditionally, first a stochastic frontier production function, from which the agricultural efficiency index is computed, and then the efficiency index are regressed on farmers' characteristics.

The major objectives of the study is i) to estimate and elucidate health, nutrition and calorie intake of farmer in their perspectives of relation and interaction; ii) to estimate the general status of the operating factors of the research locale in terms of nutrition and food accessed by the target respondents; iii) to estimate the variables as well as factors, in the forms of dependent and interdependent variables and interaction amongst and between them; iv) to elicit a micro-level policy as applicable to dealing with the issues of nutrition and hunger as rein amongst

the target respondents and v) to throw lights on creating a resilient model for better socialization of technology by a new genre of extension research.

This paper addresses some policy relevant questions, such as (i) what is the impact of illness on agricultural technical efficiency? (ii) how different are the effects of health improvements on inputs productivity, output and income? (iii) how does illness affect the distribution of labor supply within households? (iv) is the impact of health impediments similar across different sources of income?

## **2. MATERIALS AND METHODS**

### **2.1 Respondents**

The number of respondents selected for this study is 60. Respondents are mainly cultivators.

### **2.2 Research Locale**

The ongoing study was conducted in Purulia district. The villages Sidpur and Gobindapur of Purulia-1 block in the mentioned district of West Bengal state were selected for the study by random sampling method. The area had been selected for the experienced, well versed and venturesome respondents.

### **2.3 Sampling Design**

Purposive as well as simple random sampling techniques were adopted for this study. For selection of state, district and block purposive sampling techniques were adopted because the area was ideal for cultivation, convenient for researcher and it had the infrastructural facilities. In case of selection of village and respondents simple random sampling technique was taken up.

### **2.4 Pilot Study**

Before taking up actual fieldwork a pilot study was conducted to understand the area, its people, institution, communication and extension system and the knowledge, perception and attitude of the people towards nutritional availability and the issues regarding this. An outline of the socio-economic background of the farmers of the concerned villages, their opinion towards different types of technologies, socialization process, natural resources, ecology,

**Table 1. Sampling technique and sampling design**

Step	Items	Level	Approach
1	State	West Bengal	Purposive
2	District	Purulia	Purposive
3	Subdivision	Purulia Sadar	Purposive
4	Block	Purulia-1	Purposive
5	Village	Sidpur and Gobindapur	Random
6	Respondents	60	Random
<b>Total number of respondents: 60</b>			

farm entrepreneurship concept, conflict and confusion helped in the construction of reformative working tools.

## 2.5 Preparation of Interview Schedule

On the basis of the findings of pilot study a preliminary interview schedule was formed with the help of literature and by the assistance of Chairman of Advisory Committee. The interview schedule consisted of three major parts according to the specific objectives of the study.

## 2.6 Techniques of field Data Collection

The respondents were personally interviewed during 2019. The items were asked in Bengali version in simple terms so that the respondents could understand easily. The entries were done in the schedule by student investigator at the time of interview.

## 2.7 Variables and their Measurements

Several researchers pointed out that the behavior of an individual could be understood more in depth if one has the knowledge of some variables, which comprised the constructed world of reality within which an individual received the stimuli and acts. The socio personal, agro economic, socio-psychological and communication variables are such type of variables, which determine the behavior of an individual. Appropriate operation and measurement of the variables help the researcher to land upon the accurate conclusion. Therefore, the selected variables for this study had been operated and measured in following manner.

Variables in the present study have been categorized into two main categories.

- i) Independent variable
- ii) Dependent variable

### 2.7.1 Independent variables

The independent variables and their empirical measurements are as follows.

**1. Age (x1):** In all societies, age is one of the most important determinants of social status and social role of the individual. In the present study, the number of years rounded in the nearest whole number the respondent lived since birth at the time of interview, was taken as a measure of age of the respondent.

**2. Functional literacy (x2):** Education can be operationalized as the amount of formal schooling attained/literacy acquired by the respondent. Education is instrumental in building personality structure and helps in changing one's behavior in social life. Functional literacy is a term which can be defined as training of adults to meet the reading and writing demands independently. The judgments were given on a 10-point scale by assessing mastery over the reading and writing capability and some other functional tasks.

**3. Family Size (x3):** The influence of family members on the decision-making process of farm operation is inevitable. Although the head of the households generally make the final decision on farming operations, the members of his/her family often act as consultants in reaching such decisions. It refers to the number of members present in the family of farmers. Generally up to five members are regarded as a small size and more than 5 members are regarded as a large size family. Large size family, which has more work forces, may be more conducive to better management of farm enterprises. Haque (1981) discussed about the significant relationship between adoption and family size of farmers. Some kind of relationship is expected in case of family size and adoption, rejection, discontinuance of agricultural innovation [9].

**4. Size of holding (x4):** This is the total size of lands one family has. It is taken as total size of both farm and homestead land but who have no

agricultural land of their own i.e. who share cropper or landless agricultural laborers, the size are of only homestead land has been taken. So, the size of the holding can depict the land status and main source of income of the respected farm family. It is calculated in katha.

**5. Family income (x5):** The annual income of a family is an important parameter to assess the economic status of the family in the society. It was operationally defined as the gross income from all the viable source of income in a single year. It is measured in terms of rounded of rupees. The gross income is constituted by the total income generated from agriculture, dairy, poultry, fishery enterprises, business and services. Family income can reveal their status in the society and their access to the total family income as well as resources. It is expressed in rupees.

**6. Family Expenditure (x6):** This is the outcome of the family annual income. It expresses the respondent's power in buying decisions within the family. It is expressed in rupees.

**7. Health hazards (x7):** According to World Health Organization (WHO), health is a state of complete physical, mental and social well-being and not merely the absence of disease. In the

present study family health problems of the respondent is considered as Health hazards. The judgments were given on a 10-point scale.

**8. Cultivated land (x8):** This is total cultivated land one family has. It is calculated in katha.

**9. Uncultivated land (x9):** This is total area of the land under homestead, barren and pond. It is calculated in katha.

**10. Cropping intensity (x10):** Cropping intensity refers to Gross crop area per unit of the net crop area. As it is a ratio, it has no unit.

### 2.7.2 Dependent Variables

**Nutritional availability (y):** Nutrition is the science that interprets the nutrients and other substances in food in relation to maintenance, growth, reproduction, health and disease of an organism. In the present study total calorie intake per day of the respondent is considered as Nutritional availability (y). It is calculated as follows-

$$\text{Nutrition} = (a+b+c)$$

Whereas, a = Calorie intake from carbohydrate per day, b = Calorie intake from protein per day, c = Calorie intake from fat per day.

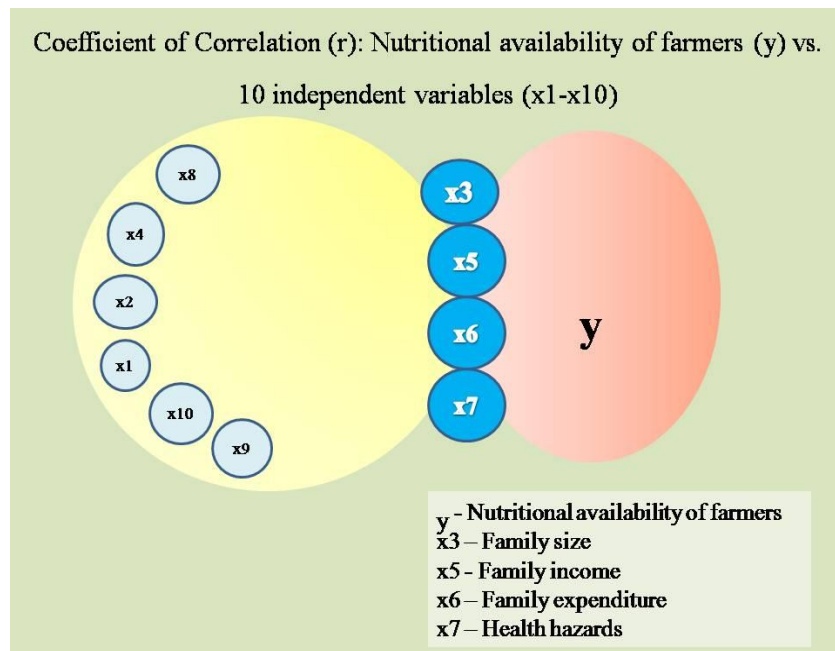


Fig. 1. Correlation analysis between nutritional availability (y) and 10 independent variables

### 3. RESULTS

The qualitative data is quantified by using specific numerical procedure. Then the quantified data were put under four statistical analysis i.e. correlation analysis, multiple regression analysis, step-down regression analysis and path analysis. The findings and the revelations are discussed below-

#### 3.1 Correlation Analysis

The co-efficient of correlation was calculated to assess the linear relationship between Nutritional availability (y) and 10 independent variables. Table 2 presents:

- The independent variables Family size (x3), Family income (x5), Family expenditure (x6) and Health hazards (x7) have recorded significant correlation with the dependent variable Nutritional availability (y) for farmers.
- Family size (x3) has been recorded to have the highest r-value for farmers in association with Nutritional availability (y).

#### 3.2 Multiple Regression Analysis

Table 3 presents the multiple regression analysis where in 10 causal variables have been regressed against the consequent variable Nutritional availability (y) to estimate the functional impact of 10 causal variables on the

consequent variable Nutritional availability (y). Table 3 exerts that-

- For farmers, the R square value is 82 per cent, which implies that by the conglomeration of 10 causal variables, 82 per cent of variance in the consequent variable, Nutritional variability (y) has been explained. In other side, per unit change in Family size (x3), Family income (x5), Family expenditure (x6) and Health hazards (x7), positively or negatively, have a reciprocal impact of (-.569), (.207), (.179) and (-.131) unit of change in nutritional status of farmers.

#### 3.3 Stepwise Regression Analysis

Table 4 presents the stepwise regression analysis to isolate the variables from 10 causal variables, having dominance of effect on consequent variable, Nutritional availability (y). It has been found that, 2 variables Family size (x3) and Family expenditure (x6) have been retained in the last step of stepwise regression analysis which implies its critical and effective contribution to the resultant behavior of the variable Nutritional availability (y). So, these 2 causal variables are very important in optimum resource allocation or strategic importance in management of nutritional aspect of farmers. It has explained 76.4 per cent of the variance from 10 causal variables.

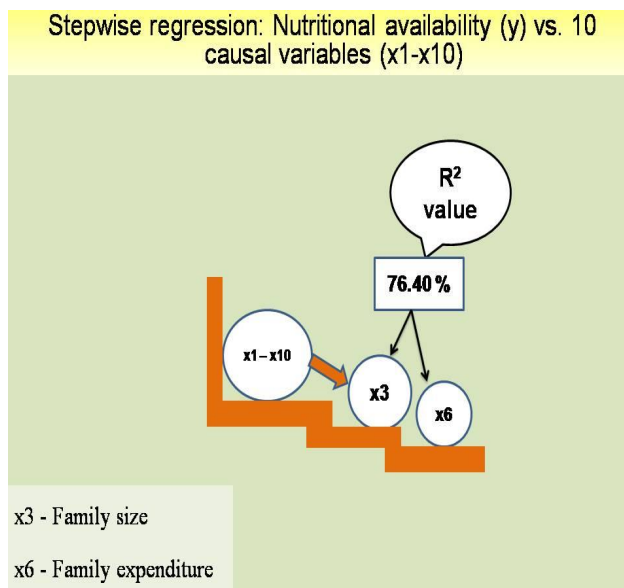


Fig. 2. Step-down regression analysis between nutritional variability (y) and 10 independent variables

**Table 2. Correlation analysis among Nutritional availability (y) vs. 10 independent variables (x1-x10)**

Sl. No.	Variables	'r' value	Remarks
1	Age (x1)	.071	
2	Functional literacy (x2)	.106	
3	Family size (x3)	-.818	**
4	Size of holding (x4)	.185	
5	Family income (x5)	.783	**
6	Family expenditure (x6)	.679	**
7	Health hazards (x7)	-.294	*
8	Cultivated land (x8)	.198	
9	Uncultivated land (x9)	.142	
10	Cropping intensity (x10)	.047	

\*\*Correlation is significant at the 0.01 level

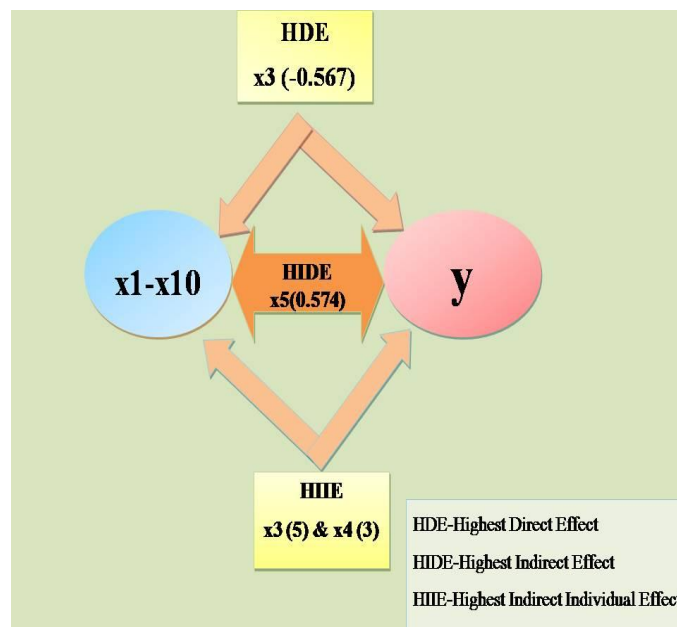
\*Correlation is significant at the 0.05 level

**Table 3. Multiple regression analysis among Nutritional availability (y) and 10 causal variables (x1-x10)**

Sl. No	Variables	Reg. Coef. B	S.E. B	Beta	t Value
1	Age (x1)	.140	.107	.140	1.311
2	Functional literacy (x2)	.198	.103	.198	1.927
3	Family size (x3)	-.569	.102	-.569	-5.582
4	Size of holding (x4)	.322	.294	.322	1.094
5	Family income (x5)	.207	.132	.207	1.571
6	Family expenditure (x6)	.179	.114	.179	1.565
7	Health hazards (x7)	-.131	.077	-.131	-1.706
8	Cultivated land (x8)	-.095	.294	-.095	-.325
9	Uncultivated land (x9)	-.270	.143	-.270	-1.891
10	Cropping intensity (x10)	-.030	.079	-.030	-.378

R square: 82.00%

The standard error of the estimate: 0.476



**Fig. 3. Path analysis between physical hygiene of farm women and 20 independent variables**

### 3.4 Path Analysis

Table 5 presents the path analysis where in coefficient of correlation (r) of Nutritional availability (y) vs. 10 independent variables is being decomposed into the direct, indirect and residual effect.

- For farmers, Family size (x3) has exerted the highest direct and Family income (x5) has exerted the highest indirect effect. So, the functional and operational contribution of Family size (x3) and Family income (x5) have been the highest on Nutritional availability (y) of farmers. The residual effect being 18.0 per cent, it is to conclude that even with a combination of 10 exogenous variables, 18.0 per cent of variance in consequent variable Nutritional availability (y) of farmers could not be explained.

### 4. DISCUSSION

It has been observed that an increasing number of people are falling below the recommended levels of total calorie intakes over 1993-94 to 2009-10 [10]. Table 6 shows that quantity consumption of different food groups like cereals, pulses and vegetables as well as protein intake has been declined over the period of 1993-94 to 2009-10. It also shows the proportions of these food items in total food. These average figures

support the notion that as calorie intake declines over time, people have moved away from basic foods to high-value foods [11]. On the other hand, quantity consumption of high value food items (non-veg food items and fruits) has either remained same or has increased (as in case of milk) [12].

Independent variable Family size (x3) has come out as one of the prime determinant of nutritional status by analyzing the data collected from farmers in correlation, stepwise regression and path analysis. Increased family size may adversely affect the nutritional status of every member of the household because it may be associated with decreased per capita human inputs. Increased household size also implies acceptance of lower quality/ quantity models of fertility decision [16]. The prevalence of food insecurity among households with large family size is high and these families with poor child care practices are more likely to have malnourished children [17].

Independent variables family income (x5) and family expenditure (x6) are coming up as prime determinants of nutritional status by analyzing the data collected from farmers. The inter-relationships between poverty and nutrition are well known; poverty restricts access to food required to meet daily requirements or ensure dietary diversity and thus leads to malnutrition,

**Table 4. Stepwise Regression Analysis: Nutritional Availability (y) Vs. 10 causal variables (x1-x10)**

Sl. No	Variables	Reg.coef.B	S.E. B	Beta	t value
1	Family size (x3)	-.638	.082	-.638	-7.771
2	Family expenditure (x6)	.356	.082	.356	4.340

*R square: 76.40%*

*The standard error of the estimate: 0.496*

**Table 5. Path Analysis: Nutritional availability (y) vs. exogenous variables(x1-x10)**

Sl. No	Variables	Total Effect	Direct Effect	Indirect Effect	Highest Indirect Effect
1	Age (x1)	0.071	0.141	-0.070	-0.143 (x2)
2	Functional literacy (x2)	0.106	0.199	-0.093	-0.101 (x1)
3	Family size (x3)	-0.818	-0.567	-0.251	-0.148 (x5)
4	Side of holding (x4)	0.185	0.307	-0.122	-0.232 (x9)
5	Family income (x5)	0.783	0.209	0.574	0.400 (x3)
6	Family expenditure (x6)	0.679	0.178	0.501	0.287 (x3)
7	Health hazards (x7)	-0.294	-0.133	-0.161	-0.080 (x3)
8	Cultivated land (x8)	0.198	-0.078	0.276	0.297 (x4)
9	Uncultivated land (x9)	0.142	-0.273	0.415	0.261(x4)
10	Cropping intensity (x10)	0.047	-0.030	0.077	-0.119 (x4)

*Residual effect: 18.0 per cent*



**Table 6. Average intake of calories (kcal) from different food groups and total protein intake, 1993-94 to 2011-12**

Food groups	Rural				Urban			
	1993-94	2004-05	2009-10	2011-12	1993-94	2004-05	2009-10	2011-12
Total	2154	2047	2020	2099	2073	2020	1982	2058
calories	(60)*	(56)*	(54)*	(57)*	(57)*	(55)*	(53)*	(56)*
Cereals	1534	1385	1298	1285	1216	1135	1072	1065
Pulses	92	81	76	90	105	95	92	105
Vegetables	83	85	78	84	89	87	78	80
Non-veg	15	16	15	17	21	21	20	23
Milk	132	131	137	148	166	174	184	187
Oil	115	151	172	189	182	214	232	250
Fruits	20	23	20	24	37	36	34	36
Snacks etc	26	30	98	123	85	76	119	147

Source: NSS data [13,14,15]

\* Figures in parentheses show protein content in g.

while malnutrition can adversely affect educational and economic attainments, thus perpetuating poverty. Therefore, in the existing scenario of unequal growth and poverty, it is not surprising that the burden of malnutrition in India remains high; there is therefore no surprising paradox in the coexistence of relatively high aggregated growth rates and high rates of malnutrition [18]. Micronutrient deficiencies are commonly encountered in India, exemplified by iron deficiency manifesting as anemia. Inadequate dietary iron, low folate and vitamin B-12 intake and poor bioavailability of dietary iron from the fibre and phytate rich Indian diets are some important factors associated with the high prevalence of anemia in India [19,20,21]. Expenditure on food is a mirror image of a household's income and resources. With improvement of household income, absolute expenditure on food is likely to go up, as is the calorie and protein intake of the household [22]. However, if the household has limited purchasing power, the per capita intake will be less.

Independent variable health hazards (x7) is coming up as prime determinant of nutritional status by analyzing the data collected from farmers. Health hazard can be defined as a condition of premises, a substance, thing, plant or animal other than man, or a solid, liquid, gas or combination of any of them, that is likely to have an adverse effect on the health of any person. As pointed by the World Bank (2007) [23], illness and death from malaria, tuberculosis and other diseases are associated with low nutritional availability, reduced agricultural productivity, productive adults' knowledge and assets to cope with illness. The failure of

agriculture and health departments to coordinate their policymaking undermines efforts to overcome ill-health among the rural poor and hampers agriculture's role in alleviating many of the world's most serious health problems.

## 5. CONCLUSION

The present study has envisaged the nutritional availability and intake of calories and it should be conceived as one of the most important predicted factor and to be estimated through a set of predictor factors like family capability, home food access, personal resources etc. However, many initiatives have been taken recently for the growth of public health in India, which include National Rural Health Mission (NRHM). The priority is to ensure access, availability and utilization of primary healthcare to all tribal population for which there is a need to strengthen the nutritional availability, food security, healthcare infrastructure, increase public health work force with a dedicated public health cadre, enhancing public-private partnership. The issue is compounded by the acute and persistent shortage of personnel to deliver these services to tribal areas.

The challenges faced now in the nutrition sector of tribal areas are much more complex. The complexities of culture and customs, economic situations, geography, ethnicity, and political situations make the challenges related to public health specific, for every state of the nation. The problems faced by Indian tribal like high incidence of communicable diseases, low performance of maternal and child health indicators, and nutritional problems, especially

that of women and children, are the issues that persist in almost all parts of the country even today apart from the burden of chronic and communicable diseases and other economic and social factors. These issues are basically emphasized by large family size (due to lack of literacy, knowledge of family planning and birth control), low income, more expenditure etc. These problems can be overcome by effective planning and allocating more funds.

Despite tribal malnutrition being a persisting concern over the years, there is no specific policy yet to address the issues. The efforts of Governments are fragmented and lack effective implementation and don't sufficiently address the larger issues of poverty, food insecurity at household level, landlessness and shrinking livelihoods. A nutrition professional advisory should be made by the Government to play a more proactive role and to form a policy for coordinated actions i.e. tribal affairs, agriculture and rural development, drinking water and sanitation, human resource development etc and to advise individuals, families, and groups on how to improve diet, lifestyle, and attitude to promote optimal health.

### CONSENT

As per international standard, respondents' written consent has been collected and preserved by the authors.

### ETHICAL APPROVAL

All experiments have been examined and approved by the appropriate.

### ACKNOWLEDGEMENTS

My deepest sense of respect and heartfelt gratitude to my guide Prof.S.K.Acharya, Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia for suggesting the topic, guiding me in every possible way, sustained interest, valuable suggestions, encouragement, inspiration and constructive criticisms during the course of investigation and also during the preparation of the manuscript. I would like to express my profound gratitude to Prof. Amitava Biswas, Department of Agricultural Extension, BCKV, member of my advisory committee, for his advice, supervision and crucial contribution, which made him a backbone of my work. I

would like to thank Mr. Sankar Dayal Mahato, Mr. Monirul Haque, Ms. Anwesha Mandal, Mr. Arindam Ghosh, Department of Agricultural Extension, B.C.K.V for their support and contribution during the preparation of manuscript.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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