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Effect of diversification of agriculture and income on household's food security in Udham Singh Nagar Uttara Khand State

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Abstract
Effect of diversification of agriculture on income of marginal and small farms was examined by selecting 50 marginal and 50 small farmers in U.S. Nagar district of Uttarakhand. The result indicated that there was positive correlation between the degree of diversification and level of farm income. The increase in income led to increased consumption and better food intake. Along with crops, milch animals contributed significantly to farm income ranging between 13 to 18 per cent. 38 per cent marginal and 34 per cent small farmers were solely dependent on agriculture for their livelihood. Rice and wheat were main cereals produced for family consumption. Production of pulses and vegetables was done by a very small percentage of farmers. The per capita per day availability of cereals on marginal and small farms were 402.82 and 413.52 grams respectively which were lower than recommended quantity (420g). Similarly, availability and consumption level of pulses, vegetables and milk were also found to be quite lower compared to recommended quantities by ICMR.
The overall results indicated that subjects were unsecured from view point of food security and nutritional status.

Keywords: Diversification, food security, ICMR, nutritional status

Introduction
India is a country of about one billion people. More than 70 percent of India's population lives in rural areas where the main occupation is agriculture. Indian agriculture is characterized by small farm holdings. The average farm size is only 1.57 hectares. Around 93 percent of farmers have land holdings smaller than 4 ha and they cultivate nearly 55 percent of the arable land. On the other hand, only 1.6 of the farmers have operational land holdings above 10ha and they utilize 17.4 percent of the total cultivated land. Due to diverse agro-climatic conditions in the country, a large number of agricultural items are produced. Broadly, these can be classified into two groups–food grains crops and commercial crops. Due to the challenge of feeding our vast population and the experience of food shortages in the pre-independence era, 'self-reliance' in food grains has been the cornerstone of our policies in the last 50 years. Around 66 percent of the total cultivated area is under food grain crops (cereals and pulses).

Whereas food security describes adequate access to enough food at all times ensuring a healthy active life, food insecurity basically measures hunger.

The framework comprises a physical determinant (the first three elements) and a temporal determinant (the fourth). Food might be available but that does not determine access; similarly, access might be viable but does not guarantee utilization and all three can be disrupted by a lack of stability caused by climate change, conflict, unemployment, disease or other factors. Stability or the lack of it can affect any or all of the other three components of the food insecurity framework.

Materials and method
The study was conducted in the Udham Singh Nagar district of Uttarakhand State. Udham Singh Nagar district comprises 7 development blocks.

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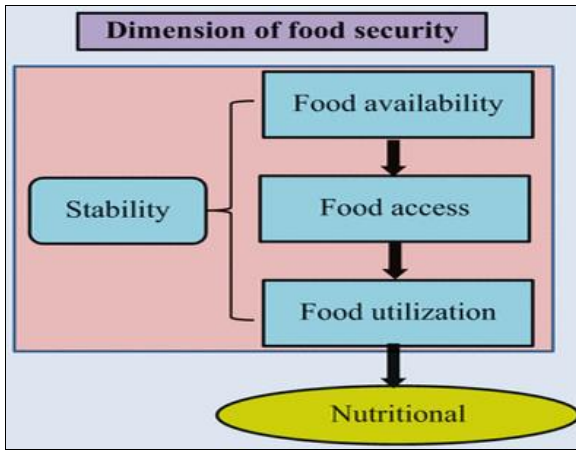
Fig 1: Food Security Framework (FAO)

Selection of the villages and farmers
There are 89 revenue villages in the Rudrapur block. Out of 89 villages, 6 villages were selected randomly.
For each selected village, a complete list of all the farmers belonging to marginal (having cultivated land up to one hectare) and small farmers (possessing cultivated land greater than one hectare and up to 2 hectares) was prepared. 50 farmers under both the size group i.e. marginal and small were selected from all the 6 villages in probability proportional to their numbers, based on 100 farmers (50 marginal and 50 small).

Analytical tools
To measure the extent of diversification of agricultural production and level of farm income on marginal and small farms, diversification index of each selected farm was computed by using composite entropy index (C.E.I.) in revenue form (monetary value). The proportion of each enterprise (crop and livestock) in total farm income was computed using following formula.

$$Pi = \frac{Ai}{\sum\limits_{i=1}^{n} Ai}$$

Where, Pi = proportion of income of ith crop or livestock in the total farm income
Ai = net income from i^{th} crop or livestock in total farm income
Total farm income generated by all crops and live stocks were calculated using the formula:

$$\sum\limits_{i=1}^{n} Ai$$

Where, i = 1, 2------------n
n = number of crops and live stocks.
Finally, the composite entropy index was calculated by using following formula:

$$C.E.I. = \left[\sum\limits_{i=1}^{n} \log_n Pi\right]\left[1-\frac{1}{n}\right]$$

The composite entropy index increases with increase in diversification and approaches zero with complete or perfect specialization in the type of crop or livestock production. The value of C.E.I. increases with increase in number of crops and

livestock enterprises taken on the farm. The value of C.E.I. ranges between 0 and 1. Since index uses log 'n' as weight, it assigns more weight to lower quantity and less weight to higher quantity.
For computing farm income, per capita income, family size, simple descriptive statistics like average and percentage were employed.
Relationship between level of diversification (C.E.I.) and level of farm income, the correlation coefficient was computed by using the following product moment formula of coefficient of correlation:

$$r = \frac{\sum xy}{\sqrt{\sum x^2 . \sum y^2}}$$

Where, x = value of composite entropy Index
y = level of farm income (Rs)

$$\sum xY = \sum xy - \frac{(\sum x)(\sum y)}{n}$$
$$\sum x^2 = \sum x^2 - \frac{(\sum x)^2}{n}$$
$$\sum y^2 = \sum y^2 - \frac{(\sum y)^2}{n}$$

Depending upon the sign of correlation coefficient (positive or negative) the conclusion was drawn whether level of farm income was positively or negatively correlated with degree of diversification of agricultural production.

Methodology
Household's Food Security
The problem of malnutrition and thereby food security is more acute for low income group of people. The selected households belonged to marginal and small farmer's categories. These, farmers has produced some food materials like cereals, pulses, vegetables and also milk and did not depend entirely on market purchases. In view of this fact, the per capita availability of various food items was computed by using the following methods.

i. Per capita availability of cereals and pulses (g)

$$= \frac{\text{Total farm production} - (\text{quantity sold} + \text{quantity retained for seeds} + \text{quantity used as feeds for milk animals}) + \text{quantity purchased from market}}{\text{Number of consumption units}}$$

ii. Per capita availability of milk (g)

$$= \frac{\text{Total production} - (\text{quantity sold} + \text{quantity converted in to curd and ghee}) + \text{quantity purchased}}{\text{Number of consumption units}}$$

Twenty four hours dietary recall and food frequency questionnaire was used to assess the dietary intake of the farm families.

24 Hours dietary recall
24 hours dietary recall method was used to collect information on food consumption of subjects of farm families. The cooked amount of food items consumed by the subjects was then converted into raw amounts in the following way:

$$\text{Amount of raw stuffs consumed by the individual} = \frac{\text{Total raw quantity of food used in the preparation} \times \text{Individual intake of cooked amount of preparation}}{\text{Total cooked quantity of the food prepared}}$$

For calculating nutrient intake, firstly recipes were standardized and tn nutritive value of item i.e. energy (K calorie), protein (g), ß-carotene (mg), riboflavin, ascorbic acid (mg) per unit/day were calculated by using nutritive value of Indian food and then comparison was made with RDA given by ICMR (1990) [8]. Daily intake of all subjects were converted into percentage of RDA or per cent adequacy.

Food frequency questionnaire
Food frequency questionnaire contained the frequency with which certain food items or food groups were consumed by subjects during a specified time period i.e. daily, twice/weekly, weekly, frequently and monthly. The selected families were asked about the frequency of food items or food groups.

Result and conclusion

Table 1: Per cent adequacy of various nutrients among family members of marginal and small farms

Nutrients	Marginal farm family (n = 275)				Small farm family (n = 323)			
	< 50 %	50 – 75	75 – 100	> 100 % RDA	< 50 %	50 – 75	75 – 100	> 100 % RDA
Energy	8.7	38.9	36.7	15.7	5.9	23.2	43.9	27.0
Protein	2.2	17.8	21.1	58.9	1.9	9.6	25.7	62.8
Calcium	4.7	9.8	17.1	68.4	1.9	4.6	7.7	85.8
Iron	55.7	32.0	8.7	3.6	47.1	38.7	7.4	6.8
Carotene	74.2	1.8	2.2	21.8	69.3	4.0	5.6	21.1
Thiamine	3.6	9.1	17.1	70.2	1.9	2.8	11.1	84.2
Riboflavin	13.5	37.5	23.2	25.8	3.7	18.0	24.1	54.2
Niacine	7.6	26.2	34.2	32.0	4.3	12.1	32.2	51.4
Vitamin C	3.3	6.5	7.6	82.6	2.5	2.8	3.1	91.4

Level of Diversification of Agricultural Production and Farm Income on Small Farms
The results pertaining to degree of diversification of agricultural production and level of farm income for small farms, have been presented in Table.

Table 2: Degree of diversification of agricultural production and level of farm income (Rs.) on marginal farms

S. N.	Size of farm (ha)	No. of crops taken	No. of milch cows raised	No. of milch buffaloes raised	Diversification index	Farm income over variable cost from crops	Farm income over variable cost from milch animals	Total farm income (crops + milch animals)
1.	0.4	3	1	-	0.7291	17400	4500	21900
2.	0.4	3	-	-	0.5816	19100	-	19100
3.	0.4	2	-	1	0.6618	15500	5100	20600
4.	0.4	3	2	-	0.5134	11000	10000	21000
5.	0.4	2	1	-	0.6570	13400	4500	17900
6.	0.4	3	1	-	0.7298	16200	4200	20400
7.	0.4	3	1	-	0.7283	15700	4000	19700
8.	0.4	3	1	1	0.7446	20100	11000	31100
9.	0.6	3	1	1	0.7582	30400	11850	42250
10.	0.6	3	1	1	0.7816	26580	12400	38980
11.	0.6	3	2	-	0.7226	26590	9000	35590
12.	0.6	3	2	-	0.7173	24420	10200	34620
13.	0.6	4	1	-	0.7063	28040	4850	32890
14.	0.4	2	1	-	0.6211	19740	3740	23480
15.	0.6	4	-	-	0.6468	26700	-	26700
16.	0.6	4	3	-	0.7535	28240	12000	40240
17.	0.6	4	2	-	0.7559	27895	9000	36895
18.	0.6	4	-	1	0.7468	27080	7820	34900
19.	0.6	4	1	-	0.7050	25700	5410	31110
20.	0.6	5	1	1	0.7820	31090	11320	42410
21.	0.8	4	-	-	0.6588	36750		36750
22.	0.8	4	1	-	0.7136	38060	4210	42270
23.	0.8	3	1	-	0.7008	38450	4920	43370

Conclusion
The relationship between degree of diversification of agricultural production and level of farm income was found positive on both the categories of farm indicating that there was scope of raising more farm income through more diversification of agricultural production.
Correlation coefficients indicated that on all categories of marginal and small farms, the farm income increased with increase in the diversification of agricultural production.

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