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Crop Diversification & Nutrition Availability: A Case Study of Rohtak District

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ABSTRACT

The study was carried out in Rohtak district to understand how crop diversification and nutritional intake were linked with food security at the household level. Haryana was already known as a food-surplus region because of high production of wheat and rice, but still many issues related to access and nutrition were seen. So, the main aim of this study was to look beyond production and check real conditions in villages. The objectives were simple. To study socio-economic condition, to see cropping pattern, and to understand how diversification and nutrient intake affected food security. The study was mainly based on primary data. Around 450 households were selected from five blocks using stratified random sampling. A structured schedule was used. Information about food consumption, income, landholding and other factors was collected. The methodology was not very complicated, but it was systematic. Data was analyzed village-wise and block-wise. Some comparisons were also done. The findings showed mixed situation. Crop diversification was present but not equal in all villages. Wheat and rice were still dominant, but some farmers also grew bajra, jowar and mustard. This helped in improving income and reducing risk. Villages with more diversification showed better food and nutrition condition. Nutrient intake data showed that most households consumed above the required calorie level, but still some villages were lagging behind. So, it was clear that only food production was not enough. Income, education and farming practices also played an important role. Finally, the study showed that food security was not same everywhere, and better planning was needed for sustainable improvement.

Keywords: Crop Diversification; Nutritional Intake; Integrated Nutrient Management

INTRODUCTION

Food security in Haryana was mostly seen through food production and procurement. That was the common way. The state was producing a lot of wheat and rice, so it was called food-surplus. Sounds good. But still, everything was not okay. High production did not always mean people were getting proper food. Access and use of food were sometimes ignored, and that created gap (Government of India, 2017; Swaminathan, 2013). Some studies had also looked at district level situation. They used indicators like availability, access and utilization. Results were not same everywhere. Northern and central parts were doing better, mainly because of irrigation and income. But southern side was weak. Soil was not good. Water problem also there. Economic condition was also low (Kumar & Kaur, 2018). Food access was checked through PDS and NFSA. These systems were important, but not perfect. Many issues were reported. Some people were left out. Supply was not regular. Food basket was also limited. Even after wide coverage, poor groups like landless labourers and small farmers were still facing problems. So, system was there, but not working equally. This type of situation was also reflected in Table 1, where variation in conditions can be clearly understood (Planning Commission, 2014; Dreze & Khera, 2015).

At the household level in Haryana, food security was studied using things like consumption, calorie intake and diet diversity. Simple measures. But important. Many studies had shown that even in rich farming districts, women and children were still undernourished. That was surprising. It clearly showed that production alone was not enough. Nutrition, health and sanitation also mattered a lot (IIPS, 2021).

Groundwater was going down. Soil was getting weak. Not good for future. So, they suggested that sustainability should be included along with social and economic factors (Sharma et al., 2019; NABARD, 2020). Other studies had used combined indicators to understand district-level situation. They looked at availability, access and utilization together. This gave a better picture. Still, differences between districts were very clear. Not same everywhere. Some areas were better, some were struggling. Even though Haryana contributed a lot to the national food pool, the dominance of wheat and rice raised concern. Monocropping was risky. Long-term availability could be affected. So, experts said

environmental factors like soil degradation, waterlogging and salinity should also be included in analysis. At the same time, PDS and NFSA were checked for food access. These systems were helping, but not equally. Some areas had better coverage, some had issues. Urban and peri-urban areas sometimes showed weaker access. Household studies also showed gaps.

Objectives

i. To study the pattern and extent of crop diversification in selected villages.
ii. To assess the impact of crop diversification on household income and food security.

Database & Methodology

The present work was examined the socio-cultural condition of Haryana, taking Rohtak district as a case study. It was mainly based on primary data. The data was collected through field survey. A structured schedule was used, covering socio-economic details and food consumption, so that nutrient intake could be understood. The sampling was done in a simple way, but also systematic. First random selection was done, then stratified sampling was used based on factors like landholding and education level. In total, 450 households were surveyed from 5 blocks of the district. It was a bit time taking work. But it helped in getting real ground information. The method was not very complex, but it was useful for understanding the actual situation.

RESULT & ANALYSIS

Crop diversification had played an important role in improving food security in Haryana. It was not just about growing more crops. It helped in income also. Farmers who were growing only wheat and rice were facing many problems. Price change. Climate issue. Soil problem. All this made farming risky. So, diversification was seen as a better option. Crops like pulses, oilseeds, vegetables and fruits were included. This gave some stability to farmers' life (Joshi et al., 2007; Chand, 2012). Farmers who adopted diversification had better and more stable income. That was clear. With more income, households could buy better food. Diet improved. Not only cereals, but protein and micronutrient food also increased. Small and marginal farmers were getting more benefit from this change, especially when they also used allied activities (Birthal et al., 2014; NABARD, 2020).

Studies had also shown that diversified farming improved dietary diversity. Women and children were getting better nutrition. That was important. So overall, diversification was helpful. Not perfect everywhere, but still better than monocropping. This kind of improvement was also reflected in Table 1, where different crop combinations can be seen across villages (Pingali, 2015; Ruel et al., 2018). Environmental sustainability had emerged as a major theme in studies on crop diversification and food security in Haryana. Researchers had warned that intensive monocropping had led to groundwater depletion, soil degradation, and declining factor productivity, which threatened long-term food security.

Table 1: Spatial Pattern of Crops Diversification of the Family in Sampled Villages, 2023

S. No.	Sampled Villages & Blocks	Crops Combination
1.	Chamaria	W R B R/M J
2.	Bhalot	W R B
3.	Kahni 12 ½	W R B R/M J
Rohtak Block		**W R B R/M J**
4.	Atail	W R
5.	Karor	W R R/M
6.	Mor Kheri	W R R/M
Sampla Block		**W R R/M**
7.	Bhaini Chanderpal	W R R/M
8.	Basana	W R R/M
9.	Girawar	W R J
Meham Block		**W R R/M**
10.	Titoli	W R J
11.	Gugaheri	W R B R/M J
12.	Chandi	W R B
Lakhan Majra Block		**W R B R/M J**

13.	Kakrana	W R B
14.	Manjha	W R J
15.	Anwal	W R J
Kalanaur Block		**W R J**
Rohtak District		W R B R/M J

Note: Wheat-W, Rice-R, Bajra-B, Jowar-J, Rapeseed & Mustard-R/M **Source:** Field Survey, 2023

Studies had argued that diversification towards less water-intensive crops could conserve natural resources and sustain agricultural productivity, thereby supporting stable food availability in the long run (Sharma et al., 2018; OECD, 2017). Evaluations of agricultural policies in Haryana had shown that assured procurement and price support for wheat and rice discouraged diversification, despite its food security benefits. Scholars had recommended reforms such as market incentives, extension services, and infrastructure development for alternative crops to ensure that diversification translated into improved and sustainable food security outcomes (Kumar et al., 2016; Government of India, 2020).

The pattern of crop diversification in the sampled villages of Rohtak district revealed that wheat and rice formed the core cropping system, with varying degrees of diversification through coarse cereals and oilseeds. In Chamaria village, farmers practiced a relatively diversified cropping pattern consisting of wheat, rice, bajra, rapeseed–mustard, and jowar, indicating a multi-crop strategy aimed at reducing risk and supplementing food availability. A similar diversified pattern was observed in Kahni 12½ and Gugaheri, where wheat, rice, bajra, rapeseed–mustard, and jowar were cultivated, reflecting higher levels of crop diversification among farming households. In Bhalot village, crop diversification was moderately developed, with farmers cultivating wheat, rice, and bajra. This pattern suggested partial diversification beyond the wheat–rice system, primarily through the inclusion of coarse cereals. Chandi and Kakrana also followed a similar pattern of wheat, rice, and bajra cultivation, indicating limited but notable diversification focused on foodgrain security rather than high-value crops (Table 1).

Villages such as Karor, Mor Kheri, Bhaini Chanderpal, and Basana exhibited diversification through wheat, rice, and rapeseed–mustard cultivation. This pattern highlighted the integration of oilseed crops into the dominant cereal-based system, which not only contributed to income diversification but also supported household-level edible oil availability. The inclusion of rapeseed–mustard indicated a shift towards market-oriented as well as nutrition-supportive cropping choices. In contrast, Atail village showed the least diversified cropping pattern, where cultivation was largely confined to wheat and rice only. This reflected a strong dependence on the traditional wheat–rice monoculture, which ensured staple food availability but limited crop diversity (Table 1).

The villages of Girawar, Titoli, Manjha, and Anwal demonstrated diversification through wheat, rice, and jowar cultivation. The inclusion of jowar indicated adaptation to local agro-climatic conditions and a preference for coarse cereals, which played an important role in fodder supply and dietary diversity. This pattern suggested moderate diversification aimed at both subsistence and livestock support (Table 1). Table 1 showed the spatial pattern of crop diversification of the family in blocks of Rohtak in 2023, and it reflected different crop combinations followed in each block. In Rohtak village, the crop combination was W R B R/M J, which indicated wheat, rice, bajra and mixed crops like rabi and maize/jowar, so diversification was quite high. This happened because farmers tried to reduce risk and increase income by growing multiple crops. In Sampla, the pattern was W R R/M, which showed less diversification, mainly wheat and rice with some mixed crops, possibly due to better irrigation and preference for major crops only. In Meham, the pattern was also W R R/M, again indicating moderate diversification, as farmers focused more on main crops due to market demand and assured returns. In Lakhan Majra, the combination was W R B R/M J, similar to Rohtak, showing higher diversification, which may be because of variable land conditions and need to balance income sources. In Kalanaur, the pattern was W R J, which showed least diversification, mainly wheat, rice and jowar, possibly due to limited resources or traditional practices. The district average also followed W R B R/M J pattern, indicating that overall diversification was present but not uniform (Table 1).

Integrated Nutrient Management (INM) was widely recognized in earlier studies as a holistic approach to maintaining soil fertility and ensuring sustainable food security. INM referred to the judicious and combined use of chemical fertilizers, organic manures, crop residues, green manuring, bio-fertilizers, and soil amendments to supply plant nutrients in balanced proportions. Researchers had emphasized that INM helped in sustaining crop productivity while minimizing environmental degradation and input-related risks. The integrated application of organic and inorganic nutrient sources had increased nutrient-use efficiency, improved water-holding capacity, and enhanced microbial activity in soils. These improvements had resulted in higher and more stable crop yields over time, which was essential for ensuring reliable food production, particularly in intensively cultivated regions (FAO, 2014; Singh et al., 2017).

By reducing over-dependence on costly chemical fertilizers and utilizing locally available organic inputs such as farmyard manure and crop residues, INM had lowered production costs. Studies had reported that this cost efficiency,

combined with yield stability, improved farm profitability and strengthened household purchasing power, thereby enhancing access to food, especially for small and marginal farmers (Chand & Tiwari, 2010). Crops grown under integrated nutrient regimes were found to have better nutrient content, including higher micronutrient availability. This had positive implications for dietary quality and nutritional security, particularly in rural areas where diets were closely linked to local food production (Swaminathan, 2013). Environmental sustainability had been identified as a key dimension linking INM to long-term food security. Excessive reliance on chemical fertilizers had led to soil degradation, nutrient imbalance, and declining factor productivity in many regions. INM practices had helped restore soil health, reduce nutrient losses, and mitigate environmental pollution, thereby safeguarding the resource base needed for future food production (Sharma et al., 2018).

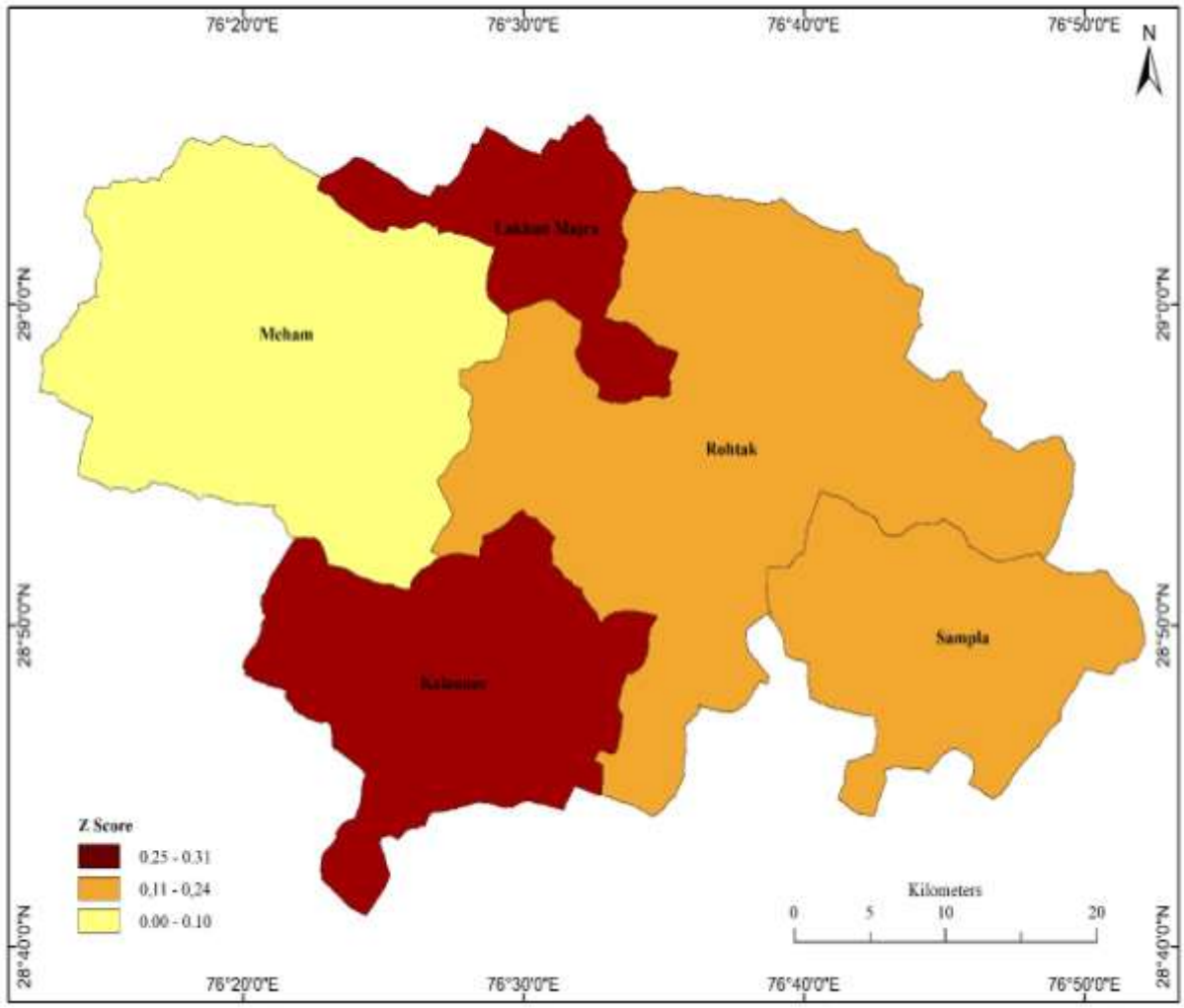
Table 2: Spatial Pattern of Integrated Nutrient of the Family in Sampled Villages, 2023

S. No.	Sampled Villages & Blocks	>2401K	Z Score
1.	Chamaria	90.98	0.31
2.	Bhalot	94.50	0.48
3.	Kahni 12 ½	81.94	-0.12
Rohtak Block		**89.14**	**0.22**
4.	Atail	98.44	0.67
5.	Karor	80.03	-0.21
6.	Mor Kheri	90.27	0.28
Sampla Block		**89.58**	**0.24**
7.	Bhaini Chanderpal	90.84	0.30
8.	Basana	87.03	0.12
9.	Girawar	81.87	-0.12
Meham Block		**86.58**	**0.10**
10.	Titoli	88.79	0.21
11.	Gugaheri	93.57	0.43
12.	Chandi	89.61	0.25
Lakhan Majra Block		**90.66**	**0.30**
13.	Kakrana	85.59	0.05
14.	Manjha	92.23	0.37
15.	Anwal	95.20	0.51
Kalanaur Block		**91.01**	**0.31**
Rohtak District		89.39	0.24

Source: Field Survey, 2023

The spatial pattern of integrated nutrient intake (above 2401 Kcal) indicated that a very high proportion of families in most sampled villages met the minimum calorie requirement, though variations were observed across villages. Atail village recorded the highest proportion, with 98.44 per cent of families consuming more than 2401 Kcal per day, followed by Anwal (95.20 per cent), Bhalot (94.50 per cent), and Gugaheri (93.57 per cent). These villages also recorded higher positive Z-scores, indicating relatively better nutritional status compared to the study area average (Table 2).

Map 1: ***Spatial Disparities of Integrated Nutrient of the Family in Sampled Villages, 2023***



Source: Based on Table 1

Villages such as Chamaria (90.98 per cent), Mor Kheri (90.27 per cent), Bhaini Chanderpal (90.84 per cent), and Chandi (89.61 per cent) also showed a high share of families achieving the threshold level of integrated nutrient intake. Their Z-scores ranged between 0.25 and 0.31, suggesting moderately better-than-average nutritional conditions. These findings indicated that the majority of households in these villages were able to meet basic energy requirements.

Moderate levels of integrated nutrient intake were observed in Titoli (88.79 per cent), Basana (87.03 per cent), and Kakrana (85.59 per cent). The Z-scores for these villages were positive but relatively low, ranging from 0.05 to 0.21, reflecting near-average nutritional conditions. Although a large proportion of households crossed the minimum calorie threshold, the lower Z-scores indicated comparatively weaker nutritional performance than the higher-ranked villages.
In the other hand, Kahni 12½, Girawar, and Karor recorded comparatively lower proportions of families consuming more than 2401 Kcal, at 81.94 per cent, 81.87 per cent, and 80.03 per cent respectively. These villages showed negative Z-scores ranging from –0.12 to –0.21, indicating below-average integrated nutrient intake.

This pattern suggested the presence of relatively higher nutritional vulnerability in these villages, despite a majority of households still meeting the minimum calorie requirement (Table 2). Table 2 showed the spatial pattern of integrated nutrient status of the family in sampled villages of Rohtak in 2023, and it indicated that most households were consuming more than 2401 K calories, which is considered adequate.

In Rohtak village, about 89.14% households were in this category, with a Z score of 0.22, showing moderate nutritional level. In Sampla, the percentage was slightly higher at 89.58% and Z score also increased to 0.24, indicating a little better condition. In Meham, the value dropped to 86.58%, which was lowest among all villages, and Z score was also low at 0.10, suggesting comparatively weaker nutritional status. In Lakhan Majra, the percentage increased to 90.66% with Z score of 0.30, so condition looked improved here. Kalanaur showed the best situation, with highest 91.01% households above 2401 K calories and highest Z score of 0.31, indicating better nutritional intake. The district average showed that 89.39% households were getting adequate calories, with Z score of 0.24.

CONCLUSION

The analysis clearly demonstrated that food security was a multidimensional phenomenon, influenced not only by food availability but also by access, utilization, and sustainability. The findings revealed notable spatial variations among villages, reflecting differential development levels and livelihood opportunities across the study area. Education emerged as an important indirect determinant of food security. The analysis of educational levels showed that primary and middle education had relatively wider coverage, especially among females in several villages, indicating improved access to basic schooling. However, participation declined sharply at matriculation, senior secondary, and higher education levels, particularly among females. Limited access to higher education constrained skill development and employment diversification, thereby affecting income generation and long-term food security. Villages with comparatively higher educational attainment exhibited better awareness regarding nutrition, health, and livelihood choices, which positively influenced household food security. Literacy levels varied significantly across villages, with male literacy consistently higher than female literacy. Villages with higher literacy rates generally demonstrated better socio-economic conditions and improved food access. Villages with low literacy rates were characterized by economic vulnerability and higher dependence on low-paying agricultural labour. The findings confirmed that literacy enhanced households' capacity to access information, government schemes, and income opportunities, thereby strengthening food security outcomes.

Income was identified as a critical determinant of food security. The spatial pattern of income revealed that agriculture remained the dominant source of livelihood, supplemented by agricultural labour, services, and limited non-farm activities. A large proportion of households fell into the lowest monthly income category, indicating widespread economic vulnerability. Villages with diversified income sources and higher non-farm participation exhibited relatively better food access and nutritional outcomes.

The results highlighted that income stability, rather than mere food availability, played a decisive role in ensuring household food security. Agriculture continued to form the backbone of rural livelihoods and food availability in the study area. High levels of land ownership and self-cultivation supported household food production, while livestock ownership provided supplementary income and nutritional support. However, unequal land distribution and dependence on leased cultivation in certain villages created disparities in agricultural income and food security. The findings emphasized that agricultural productivity alone was insufficient without sustainable practices and equitable access to resources. Crop diversification was found to enhance food security by reducing production risks, stabilizing income, and improving dietary diversity. While the wheat–rice cropping system dominated all villages, several villages diversified into bajra, jowar, and rapeseed–mustard. Villages with diversified cropping patterns exhibited greater resilience and better food security outcomes, whereas villages dependent solely on wheat and rice showed higher vulnerability to environmental and market risks.

The study reaffirmed that crop diversification was essential for sustainable food security in Haryana. Integrated Nutrient Management (INM) contributed significantly to household nutritional security. The majority of households across sampled villages consumed more than the minimum recommended calorie requirement, though spatial disparities persisted. Villages with higher income levels, diversified agriculture, and better resource management showed higher integrated nutrient intake and positive Z-scores. In contrast, villages with lower income and limited diversification recorded comparatively weaker nutritional performance. These findings underscored the importance of balanced diets, sustainable farming practices, and income security in achieving nutritional adequacy.

The food security in the sampled villages of Rohtak district was shaped by the interplay of education, literacy, income, agriculture, crop diversification, and nutritional management. Although Haryana remained a food-surplus state, household-level food security varied considerably due to socio-economic and spatial inequalities.

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