

# Impact of crop diversification on farmers income in Ballia District of Eastern Uttar Pradesh

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## ABSTRACT

In this study, impact of crop diversification on farmers income of Ballia district. The primary data were collected from Ballia district through personal interview methods by using a pre-tested schedules and questionnaire. Multi stage stratified random sampling technique was used to select the block, the villages and cultivars. Nawanagar and Baria Block were taken purposively on the criterion of higher population pressure on land. Finally 120 respondents were selected randomly for study purpose and the study showed impact of crop diversification on income and factors affecting of crop diversification. A multiple linear regression model revealed that Annual Income, Transportation, Market Distance negative impacted diversification, whereas seed availability had a positively effect. In the present study, respondent land holding are classified on the basis of criteria laid down by National Commission on Agriculture, Government of India.

**Key Words:** Education status, age, sex, factor affecting, impact of crop diversification

## INTRODUCTION

Agriculture remains the backbone of India's rural economy, particularly in eastern Uttar Pradesh, where farming sustains a significant portion of the population. In this region, however, persistent challenges such as declining soil fertility, climate variability and economic instability threaten livelihoods due to over-reliance on traditional cropping systems (Birthal *et al.*, 2015). Ballia district, located in the eastern Gangetic Plains, exemplifies these issues, with over 82% of its cultivable land dedicated to rice-wheat monoculture, leading to diminishing returns, groundwater depletion, and reduced farm profitability (Kumar *et al.*, 2019; ballia.nic.in). Despite its potential, diversification into high-value crops accounts for less than 8% of operational holdings, leaving farmers vulnerable to risks related to pricing, production uncertainty, and input supply challenges. The term "diversification," derived from "diverge," implies a shift away from a singular focus (Jha *et al.*, 2000). In agriculture, diversification is defined as a transition from the dominance of a single crop to the production of a wide variety of crops to meet diverse demands, often encompassing non-agricultural activities

as well (Start, 2001). Ballia district in eastern Uttar Pradesh exemplifies this, with its agro-climatic suitability for multiple crops overshadowed by persistent socio-economic barriers to diversification. Over-reliance on rice-wheat monoculture, coupled with fragmented landholdings, inadequate market linkages, and limited access to credit and extension services, hinders the transition to diversified systems, despite their recognized benefits (Singh et al., 2020; Chand *et al.*, 2015). The present study was conducted in the Ballia District of Uttar Pradesh with a purpose to identify impact of crop diversification on farmer incomes in the study areas. In India, agriculture is the primary source of income and employment, supporting livelihoods for approximately 65–70% of the population and employing 52% of the workforce (NITI Aayog, 2020). However, the sector faces evolving challenges, with the employment share in agriculture projected to decline from 56% to 40% by 2020, reflecting a need for adaptive strategies (NITI Aayog, 2020). Ballia district in eastern Uttar Pradesh exemplifies this, with its agro-climatic suitability for multiple crops overshadowed by persistent socio-economic barriers to diversification. Over-reliance on rice-wheat monoculture, coupled with fragmented landholdings, inadequate market linkages, and limited access to credit and extension services, hinders the transition to diversified systems, despite their recognized benefits (Singh et al., 2020; Chand *et al.*, 2015).

We are following objectives:

1. To the study the Impact of crop diversification.
2. To the study the Factor affecting of Crop Diversification in the study area.

## METHODOLOGY

The primary data for the study were collected from Ballia district eastern region of Uttar Pradesh. A survey of farmers was conducted through personal interview technique using a pre-tested schedules, questionnaire was adopted of relevant information from heads of household. For selecting the household three stages stratified random sampling technique was used during present study to select the block, the villages and cultivars or households. A list of the 17 block of Ballia district was prepared arranged in ascending order of area under production holding size. Nawanagar and Bairia Block were taken purposively on the criterion of higher pressure of people on land. Finally 120 respondent were selected randomly from twelve selected villages namely Sikiya, Mahro, Issar, Jajauli, Rasri, chandi, Mirzapur, Sonbarsa, Bhagwanpur, Cheta chhapra, Madhubani and Bhikha chhapra were six village selected from each block for the study purpose and total number of the sample farms were equally distributed. Secondary data was collected from the Government records, newspapers, magazines, journals etc. the present study is pertaining to the Agricultural year 2021-2024.

Impact of crop diversification and Factor affecting of Crop Diversification was examined with the help of mathematical tool as given below:

Sl. No.	Total land holding (acre)	Range
1.	Marginal	Less than 1 ha
2.	Small	1-2 ha

3.	Semi Medium	2-4 ha
4.	Medium	4-10 ha
5.	Large	More than 10 ha

Land holding is the operational size of land, the farmer actually put into cultivation. In the present study, respondent are classified on the on the basis of criteria laid down by National Commission on Agriculture, Government of India. The land holding is categorized as follows

**Analytical tools**

$$\beta^1 \text{ Annual income} + \beta^2 \text{ Trans.} + \beta^3 \text{ Market dis.} + \beta^4 \text{ Seed availability}$$

Where,

$\beta^1$  Annual = Annual income of respondent.

$\beta^2$  Tran. = transportation.

$\beta^3$  Market dis. = Distance of Market.

$\beta^4$  Seed = Availability of seed.

**Impact on crop diversification**

$$\text{Regression model } Y_j = \alpha^0 + \alpha^1 DI_j + \alpha^2 X_j + \mu_j$$

Where:

$Y_j$  : Farm income of the  $j^{\text{th}}$  household

$DI_j$  : Diversification index (e.g., Simpson Index or Entropy Index) of the  $j^{\text{th}}$  household

$X_j$  : Vector of control variables (e.g., education, landholding, irrigation access, input use, etc.)

$\mu_j$  : Error term

$\alpha^1$  : Measures the marginal effect of diversification on income

$\alpha^2$  : Coefficients for control variables

**RESULT AND DISCUSSION**

The respondents are categorized into three age groups: young (less than 36 years), middle-aged (37-42 years), and old (more than 42 years). Among them, 61% of the respondents belong to the old age group, indicating that half of the sample consists of older individuals. The middle-aged category accounts for 46% of the respondents, representing those in their mid-years. Meanwhile, the young age group comprises 13% of the sample, showing that a relatively smaller proportion of respondents are above 36 years. This distribution

suggests that the majority of respondents are old age, followed by middle-aged individuals, while the least number of respondents fall into the young age category.

Sr. No.	Age	Frequency (n=120)
1.	Young (Less than 36)	13
2.	Middle aged (37-42)	46
3.	Old (More than 42)	61

The table represents the gender distribution of respondents in a study with a total sample size of 120. The majority of the respondents, 85%, are male, while 15% are female. This indicates a significant male predominance in the sample, suggesting that men are more actively involved or represented in the study compared to women.

Sex	Frequency (n=120)
Male	102
Female	18

The table presents the educational level distribution of respondents in a study with a total sample size of 120. The highest proportion of respondents, 30%, are illiterate, indicating a significant portion of the sample lacks formal education. Functionally literate individuals make up 22%, suggesting they have basic reading and writing skills but may not have completed formal schooling. Among those with formal education, 13% have completed primary school, 22% have studied up to middle school, and 20% have attained high school education. A smaller proportion, 5%, has reached the intermediate level, while 8% are graduates. Notably, none of the respondents have pursued education beyond graduation.

Educational level (Categories)	Frequency (n=120)
Illiterate	30
Functionally literate	22
Primary School	13
Middle School	22
High School	20
Intermediate	05
Graduate	08
Above graduate	0

Crop diversification refers to the process by which farmers increase the variety of crops they cultivate rather than focusing on a single or a few major crops. In districts like Ballia situated in eastern Uttar Pradesh and characterized by fertile alluvial soil, monsoon-dependent agriculture, and a predominantly rural population crop diversification holds significant potential for improving farm income, reducing risk, and promoting

sustainable agricultural practices. However, the degree of diversification in Ballia is influenced by a complex interplay of socio-economic, infrastructural, institutional, and agro-ecological factors. One of the most critical factors affecting crop diversification in Ballia is access to technical knowledge and extension services.

**Annual Income:** Annual income appears to have a negative and highly significant impact on the dependent variable. The coefficient of -0.000024 implies that, holding all other variables constant, an increase of one unit in annual income (assumed to be in currency units such as dollars or rupees) results in a decrease of 0.000024 units in the dependent variable. Despite the small magnitude of the coefficient, the t-value of -7.045 suggests an extremely strong relationship, and the p-value of  $1.65 \times 10^{-10}$  confirms this with overwhelming statistical significance. A p-value this small is far below commonly accepted significance thresholds (e.g., 0.05, 0.01), meaning we reject the null hypothesis that the coefficient is zero. This negative relationship could suggest that as farmers earn more annually, they may either diversify away from the crop or activity being studied, or perhaps become less reliant on external agricultural interventions.

**Transportation:** The Transportation variable has a negative coefficient of -0.237, suggesting that improvements in transportation (e.g., access to roads or vehicles) are associated with a reduction in the dependent variable. However, the standard error of 0.829 is quite large relative to the coefficient, which is reflected in a very low t-value of -0.286. The corresponding p-value of 0.775 indicates that this relationship is statistically insignificant. In other words, we cannot confidently claim that transportation, as measured in this model, has any impact on the dependent variable. This insignificance could arise due to poor measurement of the transportation variable, low variability in the data, or because transportation genuinely does not have a direct effect in the context considered. From a policy or research standpoint, this finding does not necessarily negate the importance of transportation infrastructure but rather suggests that it may not be a strong direct predictor in this specific model or sample.

**Market Distance:** Market Distance has a coefficient of -0.051, indicating a negative relationship between distance to market and the dependent variable. This means that as the distance to the nearest market increases, the value of the dependent variable slightly decreases. The rationale behind this could be that greater distance creates logistical challenges, higher costs, and reduced market participation.

However, the standard error of 0.068 results in a t-value of -0.756, which, like the transportation variable, is too low to achieve statistical significance. The p-value of 0.451 is considerably higher than the common 0.05 threshold, meaning we cannot reject the null hypothesis that the effect is zero.

**Seed Availability:** The variable Seed Availability has a positive coefficient of 0.450, suggesting that greater access to quality seeds is associated with an increase in the dependent variable. This aligns well with agricultural theory, which emphasizes the importance of quality inputs in improving productivity and yield. However, the standard error is 0.910, leading to a t-value of only 0.494, which is well below the critical t-values needed for significance. The p-value of 0.622 confirms the result is statistically insignificant.

Variable	Coefficient	Std_Error	t_value	p_value
Const	13.841274	4.231834	3.270751	1.429262e-03***
Annual Income	-0.000024	0.000003	-7.044867	1.648729e-10***
Availability of transportation	-0.237441	0.829439	-0.286267	7.752070e-01***
Market Distance	-0.051148	0.067636	-0.756215	4.511222e-01***

Seed Availability	0.450138	0.910306	0.494491	6.219365e-01***
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\*\*\* Significant at 0.05 % level of significance

### Impact on crop diversification

The relationship between crop diversification and farmer income is essential for developing inclusive and sustainable agricultural policies. Diversification, in this context, refers to the variety and integration of different economic, social, and demographic elements within a community, often captured by a Community Diversification Index (CDI). A diversified community may offer farmers enhanced market access, labor mobility, resource-sharing opportunities, and resilience against external shocks. To quantify this relationship, a linear regression analysis was conducted using CDI as the independent variable and farmer income as the dependent variable.

The coefficient of determination ( $R^2$ ) indicates that nearly four-fifths (79.19%) of the variability in farmer income can be explained by differences in the diversification index. This high  $R^2$  value suggests that the model has a strong explanatory power, affirming the strength of the relationship. The p-value ( $< 0.0001$ ) further reinforces the statistical significance of the slope. This value is far below common thresholds (e.g., 0.05 or 0.01), allowing us to reject the null hypothesis that the slope is zero. In simpler terms, the relationship between CDI and income is not due to random variation, but represents genuine and strong association. The results of this analysis carry important implications for rural development and agricultural policy.

	( $\beta_1$ )	( $\beta_0$ )	$R^2$	P-Value
Diversification	13,441.96	299,010.08	0.7919	$<0.0001$

### Conclusion

The Transportation variable has a negative coefficient of -0.237, suggesting that improvements in transportation (e.g., access to roads or vehicles) are associated with a reduction in the dependent variable. Market Distance has a coefficient of -0.051, indicating a negative relationship between distance to market and the dependent variable. The variable Seed Availability has a positive coefficient of 0.450, suggesting that greater access to quality seeds is associated with an increase in the dependent variable. The regression output provides valuable insights into the economic and logistical challenges faced in the agricultural context. While the negative and significant impact of Annual Income opens up important questions for future research and policy design, the statistically insignificant results for Transportation, Market Distance, and Seed Availability highlight the complexity of agricultural systems and the need for multifaceted analysis. The findings suggest that interventions targeting income dynamics may have more immediate impacts, but enhancing transportation and input access may still be crucial in broader, indirect ways. The relationship between crop diversification and farmer income is essential for developing inclusive and sustainable agricultural policies. The p-value ( $< 0.0001$ ) further reinforces the statistical significance of the slope. This value is far below common thresholds

(e.g., 0.05 or 0.01), allowing us to reject the null hypothesis that the slope is zero. In simpler terms, the relationship between CDI and income is not due to random variation, but represents genuine and strong association. The results of this analysis carry important implications for rural development and agricultural policy.

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