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An empirical analysis of growth, instability and decomposition of rapeseed and mustard cultivation in the Dhubri district of Assam

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ABSTRACT

Globally, rapeseed and mustard are major oilseed crops. In India, they are important cash crops. They increase farmers' income, strengthening the Indian economy. It also provide protein and nutrients to the human and livestock population. This study aims to estimate the growth rates, instability of area, production and yield of rapeseed and mustard, and the decomposition of rapeseed and mustard production among the area effect, yield effect and interaction effect. The study is based on secondary data, covering the period from 1997-98 to 2024-25. The compound annual growth rates were estimated using the exponential growth function. The instability of area, production and yield was examined by the Cuddy-Della Valle Instability index. The changes in production of rapeseed and mustard were examined by the additive decomposition model. The study found that the positive compound annual growth rates (CAGRs) of harvested area, production and yield were 2.17%, 4.51% and 2.29%, respectively. Further, it was also found that production (25.60%) is relatively medium instable as compared to area and yield. The area effect (44.51%) was marginally higher than the yield effect (39.98%) of production of rapeseed and mustard.

Keywords: Rapeseed and Mustard, CAGRs, Instability Index, Decomposition analysis

1. Introduction

Globally, India is the third-largest producer of rapeseed and mustard after Canada and China, with a production of about 12.67 million tonnes in 2024-25 (1, 2, 3). In Assam, Rapeseed and mustard are dominant oilseed crops, accounting for 87.76% of total oilseed area and contributing 94.26% of total oilseed production in 2024-25 (4). The crop holds a significant position in the state's agricultural economy, as it is the primary source of edible oil, which is mostly used for household consumption as well as industrial use. Due to its short duration and adaptability to diverse agro-ecological environments, the crop is suitable for existing cropping systems. During 2024-25, the percentage share of Assam in all-India rapeseed and mustard area was 3.54%, and the production share was 1.91%. Despite being a major state of rapeseed and mustard cultivation, the yield of rapeseed and mustard in Assam remains low at 788 kg/ha compared to the national average of 1463 kg/ha. This persistent yield gap is a concern for the state's production efficiency as well as meeting the domestic demand for edible oil (2, 4, 5).

In Assam, major rapeseed and mustard-growing districts are Lakhimpur, Dhubri, Sonitpur, and Nagaon, Jorhat, etc. Dhubri occupies the first place in terms of area (21366.96 ha) and production (13413.33 tonnes) in the Lower Brahmaputra Valley (6, 4). Against this background, the present study attempts to examine the growth rate, instability of area, production and yield of rapeseed and mustard, and sources of change in rapeseed and mustard production in Dhubri district of Assam for the 28 years from 1997-98 to 2024-25.

2. Materials and Methods

2.1 Study area

Dhubri is the leading district in rapeseed and mustard production in the Lower Brahmaputra Valley zone in Assam. It accounts for about 6 per cent of the area and 7 per cent of rapeseed and mustard production among the districts of the Lower Brahmaputra Valley zone in Assam (4). Therefore, the major rapeseed and mustard district, Dhubri, was selected purposively on the basis of the highest area of cultivation.

2.2 Data sources and study period

The secondary time series data related to area, production and yield of rapeseed and mustard for the district of Dhubri in Assam were collected from the various publications of the Directorate of Economics and Statistics of Assam and the Indiatat district-level database for a period of 28 years from 1997-98 to 2024-

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25. The collected data are systematically and logically arranged in MS Excel to examine the growth performance, decomposition analysis and instability index. Various statistical tools and techniques were employed to examine the objectives of the study.

2.3 Analytical tools and techniques

To examine the growth rate of rapeseed and mustard, the compound annual growth rates (CAGRs) was employed. The additive decomposition analysis was used to examine the sources of rapeseed and mustard production. Likewise, the Cuddy-Della Valle instability index was used to examine the instability in area, production and yield of rapeseed and mustard.

2.3.1 Compound annual growth rates (CAGRs)

The growth rates of area, production and yield of rapeseed and mustard were analysed using the following exponential growth function (7,8)

$$Y = abte \quad (1.1)$$

Where Y is the dependent variable for which growth rate is to be estimated (area, production and yield), a is the intercept/constant, b is the regression coefficient, and t is the time period; e is the error term or random disturbance. To estimate the compound annual growth rates (CAGRs), the above exponential growth function is transformed into natural logarithmic form

$$\ln Y = \ln a + t \ln b \quad (1.2)$$

The regression coefficient (Ln b) is estimated using the ordinary least squares technique.

Further, the per cent compound annual growth rate was estimated using the following relationship.

$$\text{CAGRs} = (\text{Antilog } b - 1) \times 100 \quad (1.3)$$

2.3.2 Instability analysis

The Cuddy Della Valle's Instability Index is one of the most widely accepted measures to examine the instability variation in area, production and yield in agricultural economics (7,8) The algebraic form of the index is given as follows:

$$\text{CDVI} = \text{C.V} \times \sqrt{1 - \bar{R}^2} \quad (1.4)$$

Where;

$\bar{R}^2$ is the coefficient of determination adjusted by the degrees of freedom.

C.V. is the simple coefficient of variation, which is calculated as:

$$\text{C.V. (\%)} = \frac{\text{S.D}}{\bar{x}}$$

S.D. is the standard deviation, $\bar{x}$ is the arithmetic mean.

The criteria for determining the level of instability were:

- Low Instability (between 0 -15)
- Medium Instability (between 15 -30)
- High Instability (Greater than 30).

2.3.3 Decomposition analysis

The additive decomposition analysis model was used to measure the relative contribution of area and yield to the total change in production in an individual crop. In the present study, the relative contribution of area, yield and interaction effect to the total change in production of rapeseed and mustard was calculated in the following way (9). Let, $P = A \times Y$ (1.5)

Where;

P is the production of rapeseed and mustard

A is the area of rapeseed and mustard

Y is the yield of rapeseed and mustard

Then,

$$P_0 = A_0 \times Y_0 \text{ and } P_t = A_t \times Y_t$$

Where;

A_0 , P_0 and Y_0 denote the base year area, production and yield respectively. Whereas, A_t , P_t and Y_t denote the current year area, production and yield respectively.

Therefore, the additive decomposition model was

$$\Delta P = \Delta Y \cdot A_0 + \Delta A Y_0 + \Delta Y \cdot \Delta A \quad (1.6)$$

Change in Production = (Yield effect) + (Area effect) + (Interaction effect)

The per cent contribution of each effect was estimated in the following way

$$P = \frac{A_0 \Delta Y_t}{\Delta P} \times 100 + \frac{Y_0 \Delta A}{\Delta P} \times 100 + \frac{\Delta Y \Delta A_t}{\Delta P} \times 100 \quad (1.7)$$

3.1 Result and Discussion

Growth rates of area, production and yield of rapeseed & mustard in Dhubri district

Table 1.1 represents the compound annual growth rates of area, production and yield of rapeseed and mustard in Dhubri district of Assam during 1997-98 to 2024-25

Table 1.1. Compound annual growth rates of area, production and yield of rapeseed and mustard in Dhubri district of Assam during 1997-98 to 2024-25

Variables	CAGRs (%)
Area	2.17*** (4.17)
Production	4.51*** (6.01)
Yield	2.29*** (6.29)

Sources: Author's self-estimates based on the Directorate of Economics and Statistics, Assam and the Indiatat district-level database

Note: ***, **, * refer to significance at the 1%, 5%, and 10%, levels, respectively. Figures in the parentheses are the t values of the respective coefficients.

During the 28-year study period, the compound annual growth rates of area for rapeseed and mustard crops in Dhubri district were found to be positive (2.17%). The area growth rate was statistically significant at the 1% level. The technical development, increased profitability of mustard cultivation, proper utilisation of rice fallow land for mustard, short-duration varieties and the government programme (10, 11, 12). The compound annual growth rate (CAGRs) of production of rapeseed and mustard was also positive (4.51%), which was statistically significant at the 1% level. The technological intervention, efficient utilisation of the rice fallow land for mustard, proper nutrient management, and government schemes may be attributed to the positive growth of mustard cultivation (12, 13, 14, 15). Similarly, the yield growth rate of mustard cultivation was also found to be positive (2.29%). It was also statistically significant at the 1% level. Timing of sowing, adoption of new agricultural techniques such as improved varieties, increased use of fertilisers, and agricultural extension services may be associated with a positive growth rate of mustard yield in Dhubri district of Assam (14, 16, 5,17).

Instability in area, production and yield of rapeseed and mustard in Dhubri

The estimated Cuddy-Della Valle Instability Index (CDVII) of area, production and yield of rapeseed and mustard in Dhubri district are presented in Table 3.3

During the 28-year study period, the instability index for rapeseed and mustard area was found to be medium instability (19.33%). The medium instability of the area may be attributed to the utilisation of rice fallow land for mustard cultivation, farmers' crop allocation deci

sions due to competing crops, and changing suitability of land for rabi mustard cultivation (15, 17). The production of rapeseed and mustard was also found to be medium instability (25.60), which is higher than area and yield instability. The comparatively higher instability of production may be associated with fluctuations in cultivated area and yield, along with variability in rainfall and temperature (18, 19). Further, the yield of rapeseed and mustard also revealed medium instability (17.77), which is lower compared to the area and production. The adoption of improved varieties, relatively consistent crop-management practices, input use, and agricultural extension may be associated with low instability of yield in terms of rapeseed and mustard (14,16,17).

Table 3.3. Instability Index of area, production and yield of rapeseed and mustard in Dhubri district during 1997-98 to 2024-25

Particulars	CDVII (%)	Instability Range of CDVII
Area	19.33	Medium instability
Production	25.60	Medium instability
yield	17.77	Medium instability

Decomposition analysis of rapeseed and mustard production in Dhubri district of Assam

Table 1.2 represents the percentage contribution of area, yield and the interaction effect of area and yield of rapeseed and mustard.

Table 1.2. Percentage Contribution of area, yield and interaction effect of rapeseed and mustard production in Dhubri district during 1997-98 to 2024-25

Attributes	Contributions (%)
Area effect	44.91 %
Yield effect	39.98 %
Interaction effect	15.09 %

Source: Author's self-estimates based on the Directorate of Economics and Statistics, Assam and the Indiatat district-level database

The area effect played a major role in the growth of rapeseed and mustard production in Dhubri district of Assam during 1997-98 to 2024-25. The area effect was found to be positive (44.91%), which was substantially higher than the yield effect. The positive area effect could be due to greater utilisation of rice fallow land and adoption of short-duration mustard varieties (12). The yield effect was also found to be positive (39.98%) during the study period. The improved varieties, better production technologies, nutrient management and extension support may be attributed to the positive yield effect (12, 5). Further, the study also found the positive interaction effect of area and yield (15.09%). The area expansion of rice fallow area to mustard, improved varieties and management practices may enhance simultaneously the area and yield effect (12).

4. Conclusion

The overall study revealed that the compound annual growth rates of area, production and yield of rapeseed and mustard were positive. The CAGRs of production were comparatively higher than those of area and yield of rapeseed and mustard. Further, it was also found that the area effect (44.91%) was marginally higher than the yield effect (39.98%) in the production of rapeseed and mustard during the study period in Dhubri district. The area effect is high due to proper utilisation of rice fallow land for mustard cultivation and higher profitability. Despite positive production growth in rapeseed and mustard, production instability was comparatively moderate compared with area and yield. Although various government agricultural extension and schemes are implemented from time to time to sustain the growth rate of rapeseed and mustard cultivation in Dhubri district, it is necessary to implement more government schemes and policies.

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6. Conflict of interest

The author declares that there is no conflict of interest related to this research work.

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