RESEARCH ARTICLE Agricultural Science Digest, Volume 41 Issue 2: 334-337 (June 2021)

# An Analysis on Area Production and Productivity of Banana in Assam

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10.18805/ag.D-5219


## ABSTRACT

**Background:** Banana (*Musa Paradisicia*) is considered as one of the most important fruit crop across the globe. India is the largest producer of banana in the world with an output of 29 million tons per year on average. Assam, a state in the north eastern region of India, is one of the major banana producing state in the country. Banana is an important horticulture crop grown in Assam with some significant socio cultural importance. The production of banana in Assam accounts for 2.4 per cent of its total production in the country.

**Methods:** The paper is an attempt to study the rate of growth and instability of area, production and productivity of banana cultivation in Assam and to compute the relative contribution of area, productivity and their interaction to the change in production of banana in the state. The study is based on secondary data for the period of 2003-04 to 2017-18. Compound annual growth rates are computed for estimating the growth trends of area, production and productivity of banana in Assam whereas Cuddy-Della Valle index of instability is used to estimate the instability.

**Result:** The results of this study revealed positive growth in area, production and productivity of banana with low instability in the state. The productivity effect has been found marginally greater than the area effect on production of banana in the state during the reference period.


**Key words:** Area, Banana, Growth, Instability, Production, Productivity.

## INTRODUCTION

Banana (*Musa paradisicia*) is one of the most important fruit crop across the world. It is also considered as one of the oldest fruits known to mankind. Banana, having its origin in tropical region of South East Asia, is a very popular fruit all over the world. Apart from its taste, it carries several health benefits. Banana contains vitamins, minerals and anti-oxidants. It is a rich source of potassium and fair source of phosphorus, calcium and magnesium. In addition to the nutritional and medicinal aspects of banana, its year round availability, low price, varietal range and taste makes it a favorite fruit among all classes of people irrespective of poor or rich. The fruit is also easy to digest, free from fat and cholesterol. Banana is known as the “fruit of the wise men” (Angles and Sundar, 2012). It is consumed in fresh or cooked form both as ripe and raw fruit.

Banana, basically a tropical crop, grows well in a temperature range of 15°C - 35°C with relative humidity of 75-85%. Tropical humid lowlands are preferred for banana cultivation. Although banana is cultivated across the globe, the main production zones are Asia, Latin America and Africa. India, the second largest producer of fruits and vegetables in the world, is the largest producer of banana which produces 29 million tonnes per year on average. Other leading banana producer countries are China, Uganda, Phillipines, Bazil, Ecuador, Colombia, Indonesia, Rwanda and Nigeria. While India is the largest producer of Banana in the world, the chief exporter this fruit is Ecuador. Other large exporters are Philippines, Costa Rica, Guatemala and Colombia (FAO, 2018). Out of the total production of Banana, only 15 per cent of banana is traded in the international market and the rest is consumed locally, most importantly in large producing countries such as India, China and Brazil and in some African countries.

Banana is the most important fruit crop grown in India next to mango. The cultivated area of banana is 858 thousand hectare in the country during 2016-17(Anonymous, 2017). Banana is cultivated widely all over the country. The major banana producing states of India are Tamil Nadu, Maharashtra, Karnataka, Gujarat, Andhra Pradesh, Assam and Madhya Pradesh. Tamil Nadu is the largest producer of banana in India.

Assam is a state in the north eastern region of India. The state is the gateway of this remote region of the country. About 15 percent of the gross cultivated area of Assam is occupied by Horticulture crops (Anonymous, 2015). Banana

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**How to cite this article:** Hazarika, M., Sarma, R. and Phukon, K.K. (2021). An Analysis on Area Production and Productivity of Banana in Assam. Agricultural Science Digest. 41(2): 334-337. DOI: 10.18805/ag.D-5219.

**Submitted:** 19-05-2020 **Accepted:** 28-09-2020 **Online:** 30-12-2020

is an important horticulture crop grown in Assam with some significant socio cultural importance (Sangolkar, 2012). The production of banana in Assam accounts for 2.4 per cent of its total production in the country. The production of the crop has been recorded as 9,13,272 tonnes during 2017-18 which covers a total area of 53,082 hectare (Anonymous, 2018) The main banana cultivars in Assam are Jahaji (Dwarf Cavendish), Chenichampa, Malbhog, Bar Jahaj (Giant Cavendish), Manohar and Kach Kal which are cultivated in different districts of the state. However, Goalpara, Nagaon, Sonitpur North Lakhimpur and Cachar are considered as the major banana growing belts of the state. It is worth mentioning that the largest banana market of Asia is situated in a place called Darangiri which falls under Goalpara district in Assam.

**Objectives of the study**

1. To study the growth trends of area, production and productivity of banana in Assam.
2. To study the instability in area, production and productivity of banana in Assam.
3. To compute the relative contribution of area, productivity and their interaction to the change in production of banana in Assam.

## MATERIALS AND METHODS

The study area selected for this paper is the state of Assam. It is a state in the north eastern region of India. Assam is the gateway of this remote region of the country. The present study is based on secondary data collected from various publications of Directorate of Economics and Statistics, Govt. of Assam. Year wise time series data on area, production and productivity (Average yield/hectare) of banana in Assam have been collected for a period of 15 years from 2003-04 to 2017-18. The growth trends of area, production and productivity of banana in Assam have been studied using compound annual growth rates (CAGR). For estimating the CAGR we have considered the following functional form to be fitted to the collected data set.

Functional forms:

1. Linear function: $y = a + bx$
2. Quadratic function: $y = a + bX + cX^2$
3. Exponential function: $y = ab^x$

Where,

Y = The area/production/productivity.

X = Time variable in years.

a = Intercept.

b = Slope coefficient.

The functional form having the highest Co-efficient of Determination ($R^2$) is selected for fitting the trend (Sharma, 2012). In our analysis we have found that the $R^2$ values of the exponential function of area, production and productivity of banana in Assam for the period of 2003-04 to 2017-18 are higher than the $R^2$ values of linear and quadratic functions. Hence the exponential functional form has been selected for fitting trend of area, production and productivity of banana in Assam for this said period. The compound annual growth rate is estimated using the following exponential function as explained below.

$$y = \alpha b^x$$

taking the logarithm on both the sides it takes the linear form

$$\log y = \log \alpha + \log b$$

which can be written as

$$\log y = b_0 + b_1 x \qquad \text{.....(i)}$$

Where $b_1$ is the regression coefficient of the linear regression equation (i).

The Compound Annual Growth Rate (CAGR) is calculated as:

$$CAGR(\%) = (Anti \log b_1 - 1) \times 100$$

Instability analysis in the area, production and productivity of banana in Assam is done by using Cuddy-Della Valle index of instability. John Cuddy and Della Valle developed this index for measuring the instability in time series data (Cuddy and Della Valle, 1978). Although Coefficient of Variation (C.V) is the simplest measure of instability, there are some limitations in its use in time series data. It over-estimates the level of instability in time-series data which exhibits any trend. Cuddy-Della Valle index is considered as a better measure to evaluate instability in time series data. A low value of this index indicates low instability and vice-versa. The Cuddy-Della Valle index is given by

$$\text{Cuddy - Della Valle Instability Index (CDVI)} = CV \times \sqrt{1 - R^2}$$

The ranges of Cuddy - Della Valle Instability Index (Rakesh Sihmar, 2014) are as stated below:

Low instability = 0 < CDVI< 15
Medium instability = 15<CDVI<30
High instability = CDVI>30

The coefficient of variation (C.V.) is obtained by dividing the standard deviation by the mean and expressed in percentage as

$$\text{Coefficient of variation (CV)} = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

We have observed in this study that more area has been brought under banana cultivation during the last few years in Assam. It has been increased from 42,982 hectare in 2003-04 to 53082 hectare in 2017-18. Similarly, productivity also has increased from 13.837 tonnes/hectare to 17.205 tonnes/hectare during this last fifteen year. Eventually the production of banana is also increased over the years from 594645 tonnes in 2003-04 to 913272 tonnes in 2017-18. An attempt is also made to study the relative contribution of area, productivity and their interaction in increased production of banana in the state. The relative contribution of area, productivity and their interaction in increased production of banana is estimated with the help of the following measures (Sharma, 2015).

$$\Delta P = Y_0 \Delta A + A_0 \Delta Y + \Delta A \Delta Y \quad .....(ii)$$

Where,

$\Delta P = A_n - A_0$

$\Delta Y = Y_n - Y_0$

$\Delta P = P_n - P_0$

$A_0$, $P_0$ and $Y_0$ represent the area, production and productivity in the base year and $A_n$, $P_n$ and $Y_n$ represent the corresponding area, production and productivity in the $n^{th}$ year. The first term, $Y_0\Delta A$ the second term $A_0 \Delta Y$ and the third term $\Delta A\Delta Y$ in the above equation (ii) represents productivity effect, the area effect and the interaction effect respectively. The total change in production can thus be decomposed into three effects *viz*. productivity effect, area effect and the interaction effect due to the changes in productivity and area.

## RESULTS AND DISCUSSION

As we have considered three different functional forms *viz*. linear, quadratic and exponential, the coefficients of determination ($R^2$) is computed separately for each functional form and are presented in the following Table 1.

**Table 1:** $R^2$ value of linear, exponential and quadratic function for area, production and productivity of banana in Assam during 2003-04 to 2017-18.

| Aspect | Linear | Quadratic | Exponential |
|---|---|---|---|
| Area | 0.904 | 0.906 | 0.909 |
| Production | 0.890 | 0.897 | 0.903 |
| Productivity | 0.820 | 0.870 | 0.877 |

**Table 2:** Results of the fitted trend (exponential) for area, production and productivity of banana in Assam during 2003-04 to 2017-18.

| Aspect | Constant ($b_0$) | Coefficient ($b_1$) |
|---|---|---|
| Area | 40.91 | 0.017 |
| Production | 519.6 | 0.037 |
| Productivity | 12.79 | 0.021 |

**Table 3:** Compound annual growth rate (CAGR) (%) of area, production and productivity of banana in Assam.

| Aspect | Compound annual growth rate (CAGR) % |
|---|---|
| Area | 1.71 |
| Production | 3.76 |
| Productivity | 2.12 |

It is revealed from the Table 1 that the $R^2$ values of exponential function of area, production and productivity of banana in Assam for the period 2003-2004 has been found higher than the linear and quadratic functions. Hence the exponential functional form has been selected for fitting trend of area, production and productivity of banana in Assam for the said period.

The values of $b_1$ in the fitted exponential trend for area, production and productivity of banana in Assam are found positive as shown in the Table 2. This indicates the acceleration of growth in area, production and productivity of banana cultivation in the state which further implies a better prospect of banana cultivation in near future. With the help of this fitted exponential trend the compound annual growth rates are calculated for area, production and productivity of banana in Assam for the period 2003-04 to 2017-18 as shown in the following Table 3.

The table 3 depicts that there is an increase in the area of banana cultivation in Assam with a compound annual growth rate of 1.17% during 2003-04 to 2017-18. The production and productivity of banana in the state also show an upward trend at the rate of 3.76% and 2.12% respectively. Highest growth rate has been observed in case of production.

Since the instability indices for area, production and productivity as depicted in Table 4 are found low in case of banana cultivation in Assam, growing of banana crop in the state can be considered as less risky for the crop growers. The lowest instability has been observed in the productivity of the crop compared to area and production.

A further perusal of Table 3 and Table 4 is indicative of the fact that the state Assam falls under the category of 'Positive growth and low instability (Dharke and Sharma, 2009) in case of banana cultivation in the state.

The production of banana has increased from 594.6 thousand tonnes in 2003-04 to 913.2 thousand tonnes in 2017-18. Relative Contribution of Area and Productivity on Production of Banana in Assam during 2003-04 to 2017-18 are calculated as shown below:

$\Delta P = Y_0 \Delta A + A_0 \Delta Y + \Delta A \Delta Y$

$= (13.8) \times (10100) + (42982) \times (3.4) + (10100) \times (3.4)$

$= 139380 + 146139 + 34340$

$= 319.9$ thousand tonnes

The area effect and productivity effect on the total production of banana is more than their interaction effect. The productivity effect is marginally greater than the area effect on production of banana in the state during the reference period.

**Table 4:** Measures of instability in area, production and productivity of banana in Assam.

| Measures of instability | Area | Production | Productivity |
|---|---|---|---|
| Coefficient of variation(CV) | 7.796 | 18.014 | 10.436 |
| Cuddy - Della Valle Instability Index | 2.35 | 5.60 | 1.28 |

## CONCLUSION

The above discussion reveals the fact that the growth of area, production and productivity of banana in Assam during 2003-04 to 2017-18 is positive. The present study shows that the area of banana cultivated land has increased with a compound growth rate of 1.71% in the state. The production and productivity of banana also demonstrate an increase at the rate of 3.76% and 2.12% respectively during the reference period. The instability indices of area, production and productivity of banana in this study indicate less jeopardy in adopting banana cultivation in the state. The results also highlighted the fact that both area effect and productivity effect have significant contribution in the increased production of banana in the state although productivity effect has shown marginally larger contribution. Since the banana production in the state depicts a positive growth with low instability during the study period farmers can be encouraged for area extension of this fruit crop as well as for adoption of modern scientific production technologies in the coming seasons.

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