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Growth and Instability of Mango and Guava Fruit Crops of Uttar Pradesh, India

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ABSTRACT

Fruit production contributes significantly to food security and economic empowerment in Uttar Pradesh State of India. To ensure sustainable economic contribution of the commodities, understanding the growth and instability trends in crop area and production is imperative. The study analyzed growth and instability in area and production of mango and guava in the State. Time series data from 2005-06 to 2020-21 of the of mango and guava crops area and production of U.P. State were analyzed using semi log function. Result of the growth analysis indicated that growth rate of area and production of mango and guava were positive. The mango and guava fruits crop area and production data were analyzed to determine the instability and growth rates in area and production of these two fruit crops of Uttar Pradesh State covering the most recent period from 2005-06 to 2020-21 by using coefficient of variance (CV) compound growth rates (CGR). It was found that mango registered variability of 3.67% and 18.98%, and compound growth rates of 0.55% and 4.16% in crop area and production, respectively during 16 years period (2005-06 to 2020-21). Similarly, guava registered variability of 62.36% and 6.16%, and compound growth rates of 15.13% and 18.86% in crop area and production, respectively during 16 years period (2005-06 to 2020-21). It is found that growth rates in crop area of mango and guava are lower than growth rate of production in these two crops. This indicates that area has marginal impact on production of these two crops; however, technological interventions such as improved varieties, integrated nutrient and water management, canopy management, integrated pest management, etc., might have more impact on fruit product. This type of study is useful for policy makers/ government in improving fruit production.

KEYWORDS

Horticulture, mango, guava, Compound Growth Rate (CGR), trend, instability, Uttar

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INTRODUCTION

The horticulture sector is perhaps the most profitable venture of all farming activities (Mahesh *et al*, 2000). Importance of fruit crops in food and nutritional security and environmental protection is well documented (Konuma, 2014). These crops are best source for providing antioxidants, vitamins and minerals. India is the second largest producer of fruits in world. Among Indian states, Uttar Pradesh is the third largest state for quantum of fruit production. Among a wide range of fruit crops, mango and guava are the main fruit crops grown in Uttar Pradesh. Mango (*Mangifera indica*) also referred as King of fruits, is a fruit of Indian origin.

It thrives well in almost all the regions of the country from sea level to an altitude of 600 m. The ideal temperature range for mango is 24 -30^{o} C during the growing season, along with high humidity. A rainfall range of 890-1,015 mm in a year is considered as ideal for growing mangoes. Guava (*Psidium guajava*) is a fruit of tropical American origin but grown well in tropical and subtropical areas worldwide. Presently India is the largest producer of guava with a share of 21.8 % of global production. Among Indian states, Uttar Pradesh ranks first in guava production with a share of 22.93 % of national production (APEDA, 2017-18). Horticultural crops are protective foods and promote health of the population and better environment; have high potential to accelerate economic growth and employment (Singh and Rani, 2013). Area expansion under any agricultural commodity or fruit crop is often explained as a direct consequence of the increase in food and energy requirements at local and global markets due to continuing population growth (Athens, 1990). It also depends on profitability from the crop and government support system for marketing or value chain management. Area and production are also affected by availability of genuine quality planting material, production technologies and advisory services. The budgetary and policy interventions for production enhancement needs to be supplemented by other measures like strengthening and developing system for increased absorption, wastage prevention, processing of horticultural commodities into other value-added products under the challenge of technology advancement vs. environmental protection Anonymous (2011). Horticulture promotes agro-industries development and value addition as well. The government has already identified horticulture crops as a

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means of diversification for making agriculture more profitable through optimum utilization of natural resources (soil, water and environment) and creating employment for rural masses especially for women folk.

Adeoye *et al* (2019) have studied growth and trend analysis of area, production and yield of major fruits in Nigeria. They recommended that dissemination and adoption of technologies will enhance productivity without increasing or with minimal increase in the area cultivated. Landge and Ingle (2018) have studied growth and instability of orange in India. Similarly, Kumar and Singh (2014) studied the trends in growth rates in area, production and productivity of sugarcane in Haryana. The relative importance of horticultural crop is well established in human nutrition as source of foods. They are highly remunerative and are generally considered as high value crops with ample export potential. (Gogoi and Borah, 2013).

Mango, Banana and Guava are major fruits produced in UP. The State is endowed with a wide range of agro ecologies suitable for the production of fruits. Fruits play very significant role in human nutrition, especially as sources of vitamins, minerals and dietary fibre (Jamaluddin *et al*, 2016). Additionally, fruit production is a veritable means of providing, income, employment as well as ensuring food security for the citizen (Ibeawuchi *et al*, 2015). Analyzing the growth rate trends in the horticulture crop area and production has significant concern for researchers as well as policy makers. It has been argued that analysis of the growth rate help to identifying the changing pattern of crops and land use pattern under different crop and rate of change in area production of a crop. It also helps in designing the appropriate agricultural policy for a region or state. (Kumar and Singh, 2014). This study has been taken up to find the growth rate and instability in the area and production of mango and guava fruit crops of U.P.

MATERIALS AND METHODS

Study Area

This study is conducted on Uttar Pradesh(U.P.) State of India. Uttar Pradesh, with a total area of 243,290 square kilometres (93,935 sq mi), is India's fourth-largest state in terms of land area of India. There are 75 districts in Uttar Pradesh(Fig.1). It is located in the north –central part of the country between parallels of 23^o 52′ N and 31^o 28′ N latitudes and 77^o 3′ E and 84^o 39′ E longitudes Anonymous (2022).

The average temperature varies in the plains from 3 to 4 °C in January to 43 to 45 °C in May and June. There are three distinct seasons - winter from October to February, summer from March to mid-June, and the rainy season from June to September. The annual average rainfall in U.P. vary from an of 170 cm in hilly areas to 84 cm in Western U.P. Anonymous (2022).

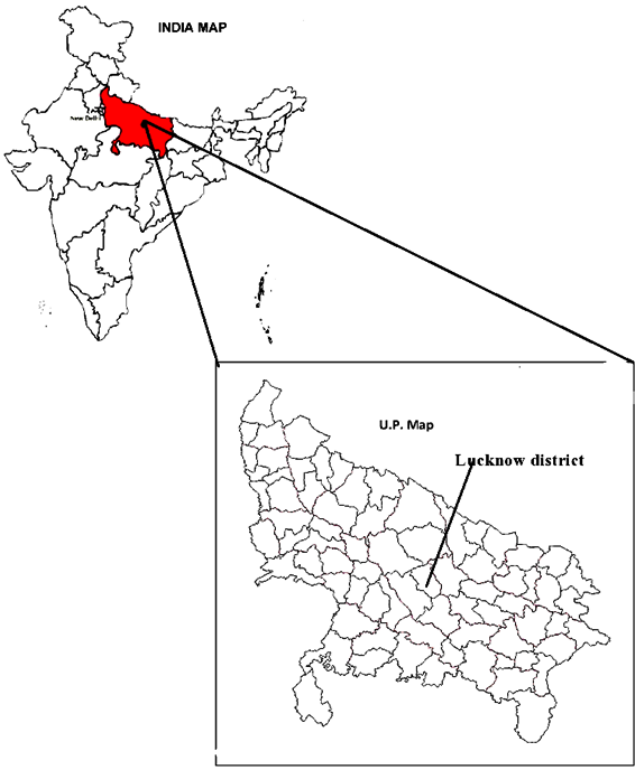

Fig. 1: Study area map

Data Used

In this study, the area and production data of mango and guava fruit crops for 16 years from 2005-06 to 2020-2021 of Uttar Pradesh was used. These data were collected from Department of Horticulture and Food Processing, Lucknow (UP).

Data Analysis

Compound Growth Rate (CGR)

In this study compound growth rate (CGR) analysis was done. It is usually estimated by fitting a semi-log trend equation (repeated) of the following form CGRs of mango crop area:

$$Y = ae^{bt_i} \qquad \text{(Eq.1)}$$

Taking ln of both sides:

$$\ln(Y) = \ln(a) + bt_i$$

$$\ln(Y) = A + bt_i$$

Where,

A = ln(a)=Intercept

Y = Quantity of major fruits production, area and production b = Growth rate in ratio scale and when multiplied by 100, it express % age growth i.e, annual growth rate t_i = Time, i= 1,2, 3,……, n years ln = Natural log of the variable

The slop coefficient 'b' measures the instantaneous rate of growth. The compound growth rate 'r' may be calculated as follow:

$$CGR(r) = (Anti\ \log(b) - 1) \times 100 \qquad \text{(Eq.2)}$$

Magnitude of Variability

To measure the magnitude of variability in area and production of mango a and guava of UP, Coefficient of Variation (C.V.) as shown in Eq.(2) was used. It is also called the instability analysis.

$$CV = \left(\frac{S\tan dard\ Deviation}{Mean}\right) \times 100$$

Where, CV =Coefficient of variation (%) that was used as measure of instability.

RESULTS AND DISCUSSION

The mango crop area and production of mango and guava fruit crops of Uttar Pradesh State are plotted and shown in Figures 2 and 3.

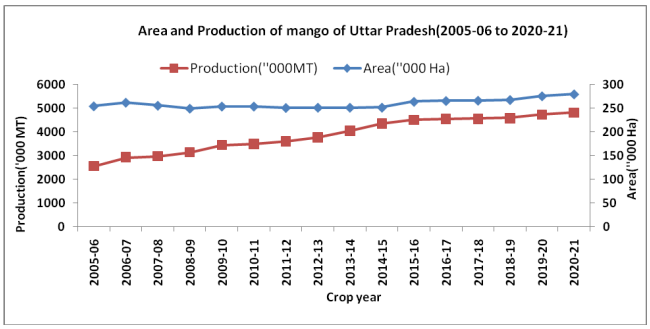

Fig. 2: Area and Production of mango in UP during 2005-06 to 2020-21.

It is observed that there is continuous growth in area and production of mango crop in U.P.(Fig.2). On statistical analysis, the R^2 value between area and production of mango crop was found to be 0.43, which is quite low and it may be inferred that change in mango area and production are loosely associated. However, in case of guava crop of U.P., it is observed that there is very high growth in area and production (Figure 3). On statistical analysis, the R^2 value between area and production of guava crop was found to be 0.997, which is very good (near to 1) and it may be inferred that change in mango area and production are closely associated.

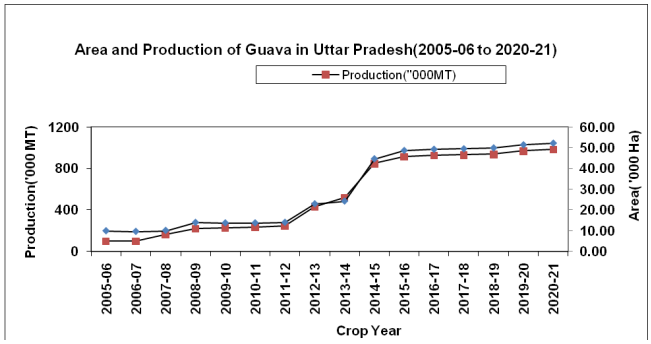

Fig. 3: Area and Production of guava in UP during 2005-06 to 2020-21.

Compound Growth Rate and Instability of mango and guava fruit crops area and production in UP are calculated by using Eq.(2) and Eq.(3). The results of this study about the instability and growth rates in the area and production of mango and guava fruit crop show interesting results in Uttar Pradesh as shown in Table 1.

Table 1: Crop growth rate and covariance of mango and guava area and production in U.P. during 2005-06 to 2020-21

Crop	Area			Production		
	CGR (%)	R^2	CV (%)	CGR (%)	R^2	CV (%)
Mango	0.55	0.53	3.67	4.16	0.95	18.98
Guava	15.13	0.84	62.36	18.86	0.88	6.16

From the results of Table 1, it is observed that mango crop area attained very marginal compound growth rate of 0.55%. However, production attained satisfactory compound growth rate from 2005-06 to 2020-21. It shows that apart from area, some other factor(s) affecting the mango production. It may be due to effect of HYV, good biotic management practices, favourable weather conditions, etc. Similarly, the compound growth rate of guava crop area is15.13% and compound growth rate of production is 18.86. It indicates that crop production depends on crop area. .In crop area guava recorded higher variability than that of mango crop; however mango crop production recorded higher variability than guava crop production. It increases the risk and affects orchardists' income and decisions to adopt high paying technologies and make investments in farming. Instability in crop area affects the production that increases vulnerability of low income households to market (Anjum and Madhulika, 2018). While the need for increasing horticultural growth is desirable, the increase in instability in horticultural growth is considered adverse for several reasons. Instability is a very essential characteristic of Horticulture. It is the fact that Horticulture is dependent on weather conditions, the crop area and production are subject to significant variations over time.

CONCLUSION

In this paper, an analysis has been conducted to monitor the trends in instability and compound growth of mango and guava production in Uttar Pradesh state. After conducting the rigorous analysis, it is found that guava registered highest instability of 62.36% in crop area and mango registered highest instability of 18.98% in crop production during 16 years period (2005-06 to 2020-21). Similarly mango crop area registered growth rate of 0.55% and production registered growth rate of 4.16% during 16 years period (2005-06 to 2020-21). Similarly, and guava crop area registered growth rate 15.13%. The growth rate in the area of mango and guava crop was found noticeably positive in the UP. Furthermore, it is found that growth rates in crop area of mango and guava are lower than growth rate of production in these two crops. This indicates that area has marginal impact on production of these two crops; however, technological interventions such as improved varieties, integrated nutrient and water management, canopy management, integrated pest management, etc., might have more impact on fruit product. This type of study is useful for policy makers/ government in improving fruit production.

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