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Research Paper

Estimation of Growth Rates and Decomposition Analysis of Major Fruit Crops in Punjab, India

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ABSTRACT

Horticulture has been increasingly significant in supplying key elements to Punjabis' diets. From 2010-11 to 2018-2019, the study examines the trends and variations in area, production, and yield of fruit crops in Punjab. The state's trends in fruit area, production, and yield tend to be good for key fruits (citrus, mango, guava, and pear) in practically all areas. The decline in production of guava during the year 2016-17 and in production of pear during the year 2015-16 & 2016-17 was due to downward growth in area in during these years. Results of Cuddy-Della Valle Index indicates that fluctuations in production of major fruits i.e. constantly increasing over time (from 2010-2019); however, instability in their area mounted and reached to the highest levels for guava, mango and pear again in 2017-18 and 2018-19. While, disparity in pear production were the highest in 2015-16 followed by 2016-17. On the basis of growth rate data these can be ascribed to expansion in area to a great extent and remarkably in productivity improvement. During the study period, fruit production differs due to area in guava and pear, though productivity is not changed greatly. The results of decomposition analysis specify comparably intense stimulus of area expansion in production of guava and pear. Due to the scarcity of agricultural land, there are few opportunities to expand the area of fruit crops. As a result, improvements in fruit crop output levels are essential to maintain healthy growth in fruit output.

Highlights

- The trends of growth in area, production and yield of fruits in the state appears to be positive behavior for major fruits.
- During the research period, the state's fruit output was aided by increased area and improved yields.
- Based on the findings, it is determined that the chances of expanding the area of fruit crops are limited due to the scarcity of agricultural land. As a result, improvements in fruit crop output levels are essential to maintain healthy growth in fruit output.

Keywords: Cuddy-Della Valle Index, fruit Crops, variability, decomposition analysis, Punjab

In developing countries like India, fruits are having important position in human nutrition, and fruit production helps to improve the social and economic status of rural people. Despite significant advances in irrigation and other technology, agricultural productivity in general, and fruit output in particular, is vulnerable to year-to-year changes, disrupting farmers' livelihoods and having a detrimental impact on their farming investment decisions. Furthermore, these variances jeopardise the agricultural sector's profitability and ability to innovate. Furthermore, these variances put the agricultural sector's viability and capacity to contribute to the country's economic growth, as well as food and nutritional security, under threat. Trend and variability analysis for fruit production and yield are critical for understanding the nature

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of food and nutrition security, as well as farmer income stability, in the country. Furthermore, labour intensive nature of fruit farming helps to accommodate ample labor force in developing countries (Wasim, 2011). Overtime, agricultural sector has developed in terms of technologies and irrigation infrastructure. Regardless of such improvement, horticulture sub-sector is still facing seasonal variations in growth which adversely affect the farmers living and disturb their saving behavior. Therefore, these fluctuations are posing big challenges for the agriculture sector (Ali and Jabbar, 2015). Attaining significant output growth while maintaining a low degree of volatility is the key to achieving long-term success in the agriculture industry. Technological development is considered as an important reason for increasing fluctuations in agricultural production. Sen was the first to see a link between agricultural productivity development and new technologies (1967). He claims that substantial variability in agricultural productivity is caused by the heavy use of inputs on marginal soils. Similarly, empirical work done by Mclntire and Fussell (1985) explained that modern technology is a cause of low variability in production of wheat in 57 countries. Singh and Byerlee (1990) also coded few research studies in favor of adoption of modern technology in agricultural production.

Growth is a key factor for the achievement of development in agriculture. According to Singh (1981) yield and area are extremely important factors in agricultural growth, while Ranade (1980) stated that investment in agricultural activities helps to boost the growth. Along trend and variability, decomposition analysis has remarkable significance for researchers and policy makers. These help them in understanding nature and reasons of fluctuations in production of fruit crops and enable them to appropriate measures for steady growth of the subsector.

Punjab is located in India's northwestern quadrant, with a subtropical climate, 400-1000 mm of annual rainfall concentrated between July and October, with soil pH ranging from 7.5 to 8.5. India's granary is the name given to this state. In the post-green revolution period, earnings have shrunk, the state has just begun rapidly migrating to its high-value section of horticulture, which accounts for 4.83 percent of total cropped land and contributes 12.43 percent of Horticultural GDP to agricultural output. In Punjab, the total area under fruit cultivation is 90416 hectares, with a total production of 1941137 MT (Anonymous, 2020). Major fruits produced in the region include Kinnow, Guava, Mango, Pear, Sweet Orange, Litchi, Peach, and Ber, while smaller fruits include Limes/Lemons, Amla, Grapes, Plum, Banana, Pomegranate, Phalsa, Sapota, Papaya, and others. To investigate the growth, variation in the growth and factors responsible for the growth in production of fruits crop during 2010-11 to 2018-19 were ascertained. The purpose of this study is to examine the growth trends in the area, output, and yield of Punjab's fruit crop; examine the variation in area, productivity and production of fruits crop; and to determine contribution of sources of output growth in fruits production.

MATERIALS AND METHODS

The current study is based on secondary data from 2010-11 to 2018-19 on the area, production, and yield of kinnow, guava, mango, and pear fruit in Punjab. Data has been taken from Anonymous 2018. Growth rate and decomposition analysis are carried out from 2010-11 to 2018-19 and 2010-19 respectively. Growth of fruit crops measured by using the following equation obtained from time trend regression equation (1).

$$Log\ (X_t) = \beta + \gamma.t \qquad \ldots(1)$$

Where,

X_t = Area, production and yield of fruits crops

β = Constant term

γ = Parameter/slope of variable or growth rate of interest variable

t = time

The Cuddy-Della Valle Index (CDVI) is a tool for determining how much a fruit crop varies in terms of acreage, production, and productivity. Kathale *et al.* (2015), Chatterjee (2014) Sitarambabu and Paul. (2014), Bairwa *et al.* (2012) also used CDVI to determine instability in production of gram, pulses, groundnut and fruit crop in India, respectively. Ali and Jabbar (2015), Rani *et al.* (2012) and Wasim (2007, 2011) applied CDVI in their research works.

$$CDVI = C.V^* (1 - R^2) \quad \ldots(2)$$

Where,

CDVI = Cuddy Della-Valle Index

C V = Standard deviation/mean*100

R^2 = Determined by the time trend regression equation's coefficient of determination (1)

In agriculture, growth is primarily defined as a rise in agricultural output over time. The rise in overall agricultural output can be attributed to three factors: (a) a rise in the overall amount of land planted in diverse crops (b) increased crop yields and (c) crop diversification, though area and productivity are seen as more essential. As a result, the component analysis model (equation 3) is utilised to determine the proportional contribution of area and yield to total output change for each crop. The overall change in production is split into three effects in this model: area impact, yield effect, and the interaction impact related to yield and area changes. Most of the researchers used this technique to check the growth performance in agricultural production; like Dhakre and Bhattacharya (2013) and Bairwa *et al.* (2012) used the analysis to check the growth performance of vegetable cultivation and fruit crops in India, respectively. Rehman *et al.* (2011) also employed component analysis technique to analyze production of the agricultural crops in Pakistan.

$$\Delta P = A_0 \Delta Y + Y_0 \Delta A + \Delta A \Delta Y \quad \ldots(3)$$

Where,

ΔP = Change in production

A_0 = Area in base year

ΔY = Change in yield

Y_0 = Yield in base year

ΔA = Change in area

RESULTS AND DISCUSSION

Area, Production and Productivity Growth in Fruit Crops

The green revolution, which began in the early 1960s, was marked by the use of high-yielding seed types, pesticides, fertilizers, and agricultural automation. All of these characteristics contributed significantly to India's agricultural prosperity. Farmers were also enticed to embrace new technology packages by significant agricultural input subsidies and increased pricing incentives. Major production grew positively in most of the years, except of guava and pear in 2016-17 and 2015-16 & 2016-17, respectively (Fig. 1).

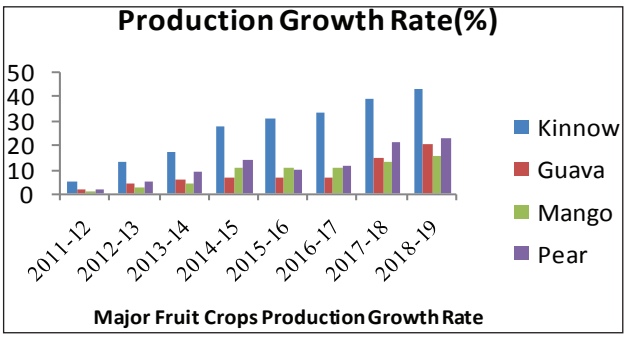

Fig. 1: Graphical representation of yearly production growth rates of major fruit crops

The decrease in output was caused by negative area growth in 2016-17 and 2015-16 and 2016-17, respectively (Fig. 2 and 1). Pear ranked second by volume of production after Kinnow in the state, its production exhibited an increasing trend after 2016-17 due to continuous area expansion and improvement in productivity. Pear production growth reached at its peak (22.61% per annum) during 2018-19.

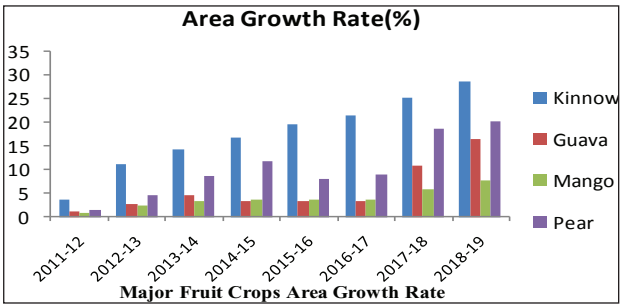

Fig. 2: Graphical representation of yearly area growth rates of major fruit crops

Over the study period (2010-11 to 2018-19) production of major fruits (kinnow, guava, mango and pear) improved primarily due to continuous expansions in area under production (Fig. 1) whereas average yield growth rate for all the major fruit crops was also constantly showing positive increasing trend (Fig. 3).

Combined evaluation of average growth performance of major fruits showed in Fig. 1 that it was relatively low in 2010-11 as compared to 2018-19.

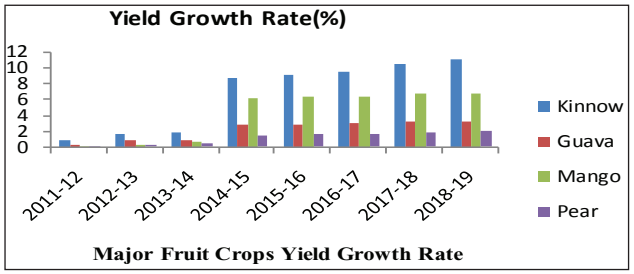

Fig. 3: Graphical representation of yearly yield growth rates of fruit crops

Same growth behavior has been noticed in area, although productivity of major fruits also improved a lot till 2018-19. Data showed that production of kinnow, guava, mango and pear increased mainly due to area expansion (Fig. 4).

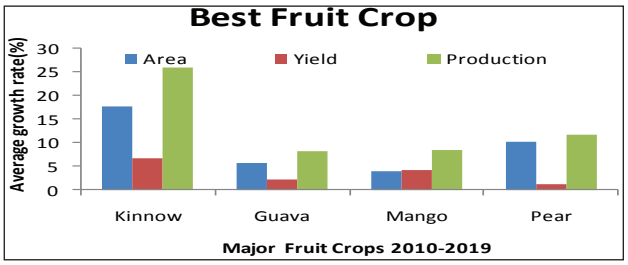

Fig. 4: Graphical representation of yearly average growth rates of major fruit crops

Decomposition of Growth Production of Fruit Crops

Remarkably profound stimulus of area expansion has been noticed in production of Kinnow, Guava and Pear. (Fig. 5).

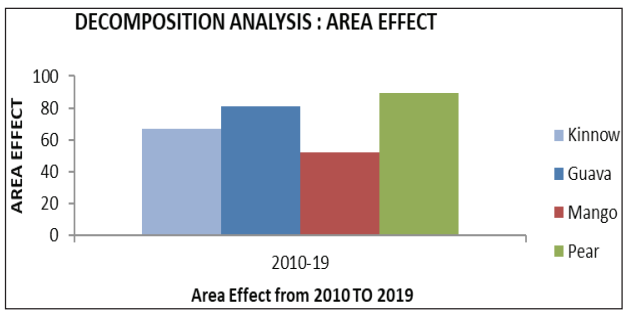

Fig. 5: Decomposition Analysis w.r.t Area Effect

While Yield Effect and Area Effect (Fig. 6 & Fig. 5) both influenced in production of mango during the study period. This means that throughout the research period, both area growth and yield enhancement contributed to the state's fruit production. The kinnow area effect dominated yield until 2013-14 (Fig. 5), after which the yield influence shifted. In guava yield impact gained dominance from 2014-15 to 2016-17 and but in 2017-18 and 2018-19 area impact occurs over yield.

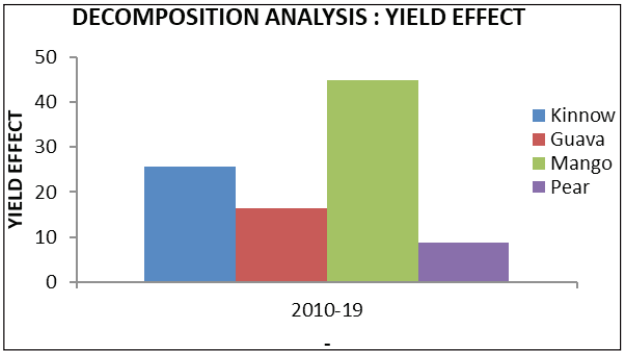

Fig. 6: Decomposition Analysis w.r.t Yield Effect

In mango area impact was prevalent till 2018-19. Interaction effect of area and yield also varied overtime; however, did not change much as compared to individual effects of area and yield (Fig. 7).

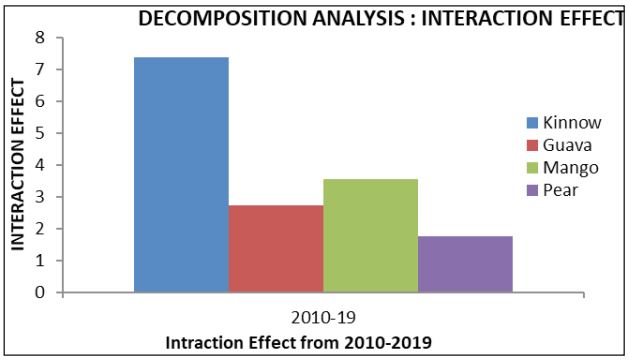

Fig. 7: Decomposition analysis w.r.t Interaction Effect

CONCLUSION

Fruits production has grown positively overtime in the state. Production and area has increased constantly. Production of fruits varied mainly due to changes in area, though productivity also altered considerably. Production of major fruits increased due to yield improvements which means that future increase in production will also depend on productivity enhancement; though, area expansion is also possible to some extent by sparing excess area from cereal crops in wake of low international prices and bringing it under fruit crops. Furthermore, productivity can be enhanced by developing true to type nurseries of high yielding fruit varieties, management of fruit orchards on scientific lines and by building capacity

of farmers in pre and post-harvest management of losses in fruits production. Agricultural extension department and community support organizations can play an instrumental role by establishing fruit plant nurseries, organizing farmer's field days and trainings in orchard management and pre & post-harvest management of production losses. Moreover, productivity of fruit crops can also be enhanced by teaching farmers scientific management of fruit orchards through effective utilization of various modes of communication, especially electronic and print media.

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