



Growth and variability in area, production and productivity of major fruits in Himachal Pradesh

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ABSTRACT

Horticulture plays an important role in the hill economy of Himachal Pradesh. Therefore, a study was conducted to examine growth rates and variability in three parameters of fruits viz; area, production and productivity for 2005-06 to 2019-20. The results revealed that apple, mango, kagzi lime, plum and orange have emerged as the important fruit crops accounting for 79.93 per cent of area and 93.01 per cent of fruit production during 2019-20 in the state. Kagzi lime and plum fruit crops showed positive and significant growth rates in area, production and productivity. Along with this, the results revealed that all fruits had positive and significant growth in area (1.39% p.a.) with minimal variability (1.08%). In contrast, the productivity and fruit output (3.16% p.a.) exhibited great variability and non-significant growth rates. The findings drew the attention of planners, policy makers and research & extension agencies to focus on enhancing the production and productivity of all selected fruits as the productivities of all the selected crops were quite lower than the national and world averages.

1. Introduction

Fruits being an invaluable gift of nature are considered an excellent source of nutrients that improve the quality of food and are also necessary for optimum health. They are not only delicious and energising but also rich in proteins, vitamins and minerals which are essential for normal physiological well-being and aid in the development of pathogen resistance, which further aids in the maintenance of a healthy body. The fruit contains mineral salts as well and our bodies may have metabolic issues as a result of a lack of these, which might result in illness. Carbohydrates and lipids are the primary sources of energy and are hence necessary for optimal health. The increased income and changing dietary pattern of the population has made diversification of agriculture in favour of horticultural crops (Krishan B and Chanchal A, 2014). Therefore, during the few decades the fruits production has increased in India (Chaudhari et al., 2018)

Himachal Pradesh is popularly known as the 'Apple State of India'. Farmers have engaged themselves highly in the fruit and vegetable cultivation and it has been proved to be a great change as fruit crops give high

productivity and more scope of export. Different kinds of by-products are prepared from fruits and the farmers get more income from the field by growing fruit crops. From 792 ha in 1950-51 to 230605 ha in 2019-20, the state's total area under fruits has increased nearly by 300 times. A continuous increase in gross cropped area has led to an increase in production by over 700 times from 1200 metric tonnes to 845422 metric tonnes in the same period (Sharma, 2019). While apple production for the year 2019-20 was recorded as 715253 metric tonnes with average productivity of 6.36 t/ha (Anonymous, 2020-21). Negi (2020) found that the production and productivity of apples in low-altitude districts have shown a constant decline while high altitude districts have shown a progressive increase over years mainly due to the climate change. The rise in temperature in low altitude area has adversely affected whereas it has become favourable in high altitude area for its cultivation. The apple producing districts revealed various degrees of instability in three important parameters of area, production and productivity while Kinnaur was the only district which has shown constant decline in instability in area, production and productivity during the study period. Studies conducted in Western

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Himalayan Region including Himachal Pradesh by Krishan and Chanchal's (2014) and Sood and Kumar (2020) have depicted a high growth rate with high instability in the production of horticulture crops. According to Hassan et al. (2021), apple was discovered to be the most stable crop in terms of both growth and variability in Jammu and Kashmir and overall, horticultural crops were well-established in this state contributing significantly to the state's GDP. Among these crops, apple and walnut together accounted for 80 per cent of the horticultural output value in the state. Similar results were found by Sood and Kumar (2020) in the state of Himachal Pradesh where the area, production and productivity under fruits have increased. Resultantly, the contribution of the horticulture sector to agricultural gross value added has grown significantly.

Jha et al. (2018) in their study carried out for the period 1993-94 to 2011-12 observed that the consumption of selected fruits increased by 18 to 23 per cent in rural areas, yet the quality of consumption has been rated below recommended dietary requirements. Fruits and vegetables accounted for 19.2 per cent of the overall growth rate of 3.56 per cent in agriculture during 2000 to 2011. The contribution of the horticulture sector in the total export of agricultural commodities has reported about 37 per cent and the export has registered a sustained rising trend. Birthal and Joshi's (2008) study showed that the gross value of fruits and vegetables increased at an annual rate of 5.6 per cent during 1995-96 to 2004-05. They also observed that agriculture growth slowed dramatically from 1995-96 to 2004-05, and would have decelerated even more if it hadn't been picked up by significant growth in fruits and vegetables. In terms of overall agriculture growth, fruits and vegetables made up for nearly 64 per cent of total during 1995-96 to 2004-05. It has been well proved that agriculture diversification towards horticulture crops has the potential to significantly accelerate agricultural growth and finally, the small farmers can increase their income through horticulture-led growth. Fruit and vegetable production has a high potential in the country due to the diverse agro-climatic conditions. However, infrastructure facilities such as processing facilities, market facilities, credit and so on, did not correspond to the production potential available in various states (Viswanathan and Satyasai, 1997). Horticulture is being promoted by the state government of Himachal Pradesh under National Horticulture Mission (NHM). Similarly, the National Horticulture Board (NHB) provides farmers with a variety of programmes and financial help in the areas of infrastructure, irrigation, greenhouses and other agricultural inputs. Keeping in view the significant contribution of fruit cultivation in the rural economy of Himachal Pradesh and ongoing horticulture development programmes, a study was undertaken to examine its status in

terms of growth and variability in parameters such as area, production and productivity.

2. Materials and Methods

A state wise study with secondary data on growth and variability in area, production and productivity of major fruits was purposively fetched from the Statistical abstract of Himachal Pradesh for all the districts of the state. The time series data on area and production of fruits were collected for the period from 2005-06 to 2019-20. The methods used for estimating the growth rate and variability have been described below:

The Compound Growth Rates (CGRs) for the selected parameters were calculated over a period of 15 years following the procedure given below:

$$Y_t = Y_0 (1+g)^t$$

where, Y_0 (constant) is the initial value of Y (Area, production and yield) and g (regression coefficient) is the rate at which Y (area, production and yield) grows every year in relation to its value in the preceding year and 't' is time variable.

The following specific exponential growth function form as used by (Dhakre and Bhattacharya, 2013) was used to estimate the growth rates:

$$Y_t = a b^t$$

where, $a = Y_0$ and $b = (1+g)$

The log linear form for the above function is:

$$\text{Log } Y_t = \text{Log } a + \text{Log } b * t$$

The CGR = $[(\text{Antilog } b) - 1] \times 100$

Standard error of CGR =

$$(100b / 0.43429) * \sqrt{(\sum \log y^2 - \text{log} b \sum t \log y) / (N-2) \sum t^2}$$

Student's t- test was used to determine the significance of the values of compound growth rates obtained for the selected parameters for different time periods.

$$t_{\text{cal}} = \frac{\text{CGR}}{\text{S.E (CGR)}}$$

When, $t_{\text{cal}} > t_{\text{tab}}$ the values of compound growth rates were marked significant at various levels.

Coefficient of variation is denoted by CV and for selected parameters as area, production and yield these were computed for the study period. Crop specific Coefficient of Variation (CV) was calculated using the formula given below.

$$CV = \frac{\sigma_x}{\bar{X}} \times 100$$

OR

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

$$= \frac{\sqrt{\frac{\sum(X_i - \bar{X})^2}{N-1}}}{\frac{\sum X_i}{N}} \times 100$$

where, $i = (1, 2, 3, \dots, N)$

N = Number of observations

$\sum X_i$ = Sum of observations

X_i = Value of i^{th} observation

\bar{X} = Mean value of observations

The variability in area, production and productivity of selected crops for chosen periods were also computed by using Cuddy Della Valle Index (Cuddy-Della Valle 1978). Since the simple coefficient of variation, over estimates the level of instability of time series data characterized by long term trends, this index was used to correct the coefficient of variation. The variability was computed for all the selected parameters for the chosen periods by using Cuddy Della Valle Index as mentioned below:

The values for Cuddy Della Valle Index (CV*)

$$CV^* = (CV) \sqrt{(1-r^2)}$$

where, r^2 is the estimated coefficient of determination.

3. Results and Discussion

The status of area production and productivity of important fruits in Himachal Pradesh for 2019-20 is depicted in Table 1. It can be noticed that fruits were grown on an area of 230605.50 ha with production level of 8.45 lakh metric tonnes, which accounted for 3.40 and 0.60 per cent at national level, respectively. In comparison to the national average of 15.07 metric tonnes, the productivity of the state was lower at 3.67 metric tonnes. Fruits listed in the table are produced

essentially in every district of the State, with apples (48.78%) area accounting for the majority of production, followed by mango (18.68%), kagzi lime (4.99%), orange (3.79%), and plum (3.69%). However, production wise these crops followed the positions as apple (84.60%) with first rank followed by second position of mango (3.77%), third of orange (1.85%), fourth of plum (1.72%) and with fifth rank of kagzi lime (1.07%) in the State. It is clear that apples exhibited the highest productivity of 6.36 t/ha, followed by orange (1.79 t/ha) and plum (1.71 t/ha). The lowest productivity was observed in case of mango (0.70 t/ha).

Growth & Variability in Area, Production and Productivity

Table 2 reveals the growth and variability in area, production and productivity of major fruits in Himachal Pradesh for the period 2004-05 to 2019-20. The study observed significant annual growth in the area of selected fruits appeared to be maximum as 1.79 per cent in kagzi lime with mean area of 10461.99 ha followed by apple with 0.13 per cent significant annual growth having mean area of 104089.60 ha, while plum showed minimum as 0.02 per cent significant growth with mean area of 8560.71 ha. The coefficient of variation was estimated to be the most stable of 0.42 per cent in plum while large variation appeared in the area under apple as 1.75 per cent. The area under all fruits in Himachal Pradesh has been found growing with 1.39 per cent significant compound growth rate with low variability of 1.08 per cent. The same trend was observed in production as significant positive growth was found to be 4.80 per cent in kagzi lime followed by non-significant for apple as 3.73 per cent while least growth rate was found in mango with

Table 1. Area, production and productivity wise ranking of important fruits in Himachal Pradesh (2019-20)

Sr. No.	Crop	Area (ha)	Rank	Production (mt)	Rank	Productivity (t/ha)	Rank
1	Apple	112481.05 (48.78)	1	715253.00 (84.60)	1	6.36	1
2	Mango	43078.25 (18.68)	2	31879.00 (3.77)	2	0.74	5
3	Kagzi Lime	11501.30 (4.99)	3	9063.00 (1.07)	5	0.79	4
4	Orange	8747.15 (3.79)	4	15676.00 (1.85)	3	1.79	2
5	Plum	8505.17 (3.69)	5	14575.00 (1.72)	4	1.71	3
6	All above (1 to 5)	184312.92 (79.93)	-	786446 (93.01)	-	4.27	-
7	Other fruits	46292.58 (20.07)	-	58976.00 (6.99)	-	1.27	
8	Total fruits	230605.50 (100.00)		845422.00 (100.00)		3.67	

Note: Figures in parenthesis are percentages of total

negative and non-significant compound growth rate of 1.53 per cent. The variability in production was the highest of 33.73 per cent each in apples followed by orange (32.49%) and mango (27.02%). It was the lowest of 16.58 per cent for kagzi lime. For all fruits, the production variability of 28.92 per cent was much higher than the variability in area (1.08).

Growth in productivity appeared to be maximum & statistically significant in kagzi lime as 2.97 per cent followed by plum with 2.52 per cent significant at 1 per cent level of confidence and least in mango with negative compound growth rate of 2.48 per cent. In terms of productivity, the state of Himachal Pradesh has witnessed a non-significant growth of 1.74 per cent per annum higher than a growth in area (1.39% p.a) but lower than production (3.16% p.a) with variability of 29.89 per cent. On the whole all the selected fruits in the study area exhibited significant higher growth rates but non-significant in production followed by productivity.

4. Conclusions

The major five fruits such as apple, mango, kagzi lime, orange and plum in Himachal Pradesh have shown significant annual compound growth rate ranging from 0.36 per cent in plum to 1.79 per cent in kagzi lime with overall of 1.39 per cent in area for all fruits over a period of 15 years, however, the production and productivity revealed a depressing picture with positive but non-significant growth rates with high variability and less stability in most of the crops. However, kagzi lime and plum emerged as two important crops with positive and significant growth rates in area, production and productivity. Apple being the most important crop of the state has exhibited non-significant growth in production (3.73%) and productivity (1.95%), though its area grew significantly over the study period. Mango, which is considered the next important crop of the state, has shown negative compound annual growth rates of 1.53 per cent for production and 2.48 per cent for productivity, with a very meagre growth rate in area of less than one per cent per annum.

5. References

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Table 2. Growth rate and instability in area, production and productivity of major fruits in Himachal Pradesh

Sr. No.	Crops	Area (ha)			Production (mt)			Productivity (t/ha)		
		Mean area	CGR	CV%	Mean production	CGR	CV%	Mean productivity	CGR	CV%
1	Apple	104089.60	1.74* (0.1300)	1.75	527981.87	3.73 (2.2463)	33.73	5.07	1.95 (2.2165)	34.37
2	Mango	39966.91	0.97* (0.0405)	0.61	37771.00	-1.53 (1.6107)	27.02	0.95	-2.48 (1.5835)	27.46
3	Kagzi Lime	10461.99	1.79* (0.0745)	1.14	5819.77	4.80* (1.2070)	16.58	0.56	2.97* (1.1803)	16.79
4	Plum	8560.71	0.36* (0.0252)	0.42	12731.90	2.90* (1.0802)	18.94	1.49	2.52* (1.0859)	19.16
5	Orange	8560.04	0.51* (0.0729)	1.14	12834.27	2.09 (2.4805)	32.49	1.50	1.58 (2.4682)	33.28
6	All fruits	215966.00	1.39* (0.0749)	1.08	651839.20	3.16 (1.9467)	28.92	3.02	1.74 (1.9249)	29.89

Note: Figures in parentheses are standard errors

*Means significant at 1% level of probability