RESEARCH ARTICLE Agricultural Scinece Digest, Volume 39 Issue 4: 311-315 (October-December 2019)

# Trends, Growth and Variability of Apple in Himachal Pradesh: 1973-2016

Shilpa, Ravinder Sharma and Ajit Sharma

10.18805/ag.D-5003


## ABSTRACT

The present study was undertaken with a view to analyse growth trends and variability of apple crop in two different period's i.e, Period-I (1973-74 to 1990-91) and Period-II (1991-92 to 2015-16) in potential and marginal apple growing areas in Himachal Pradesh. The results revealed highest growth rate in area of 3.78 percent per annum during P-I in potential areas. The growth rates in production in potential areas showed significant increase, while, marginal areas showed declining growth in all periods except P-II, that exhibit highest growth rates in production (5.86%/annum). Growth rates in productivity showed significant increase in P-II in all the apple growing areas with maximum growth in potential areas (3.88%/annum) except marginal areas where significant decline in productivity in P-I and overall period was observed. The decomposition analysis revealed that production variation in all areas in HP during P-I was due to area effect except marginal areas, whereas P-II was marked by yield effect in all apple growing areas on the account of varietal improvement. But, the overall increase in production was due to area expansion except marginal areas. Therefore, efforts should be made to improve the technology as well as extension of the technology to the farms through different research and extension agencies in the state to improve productivity of apple.


**Key words:** Apple, Area, Production, Decomposition analysis, Growth rates, Variability, Trends.

## INTRODUCTION

Horticulture is the prime mover of economic growth in Himachal Pradesh and the state is also known as "Fruit Bowl of Nation". The state department of Horticulture helps them in the economic upliftment of rural population and has also generated employment. Fruits, an important component of horticulture sector, are valued as a rich source of minerals and vitamins providing more energy per unit weight in addition to higher returns to the growers. Himachal Pradesh being primarily a temperate hilly state is known for the production of commercial temperate fruits crops (Kashirsagar, 2006) that includes apple, peach, plum apricot, walnut, strawberry and cherry etc. among these apple alone accounts for about 46 per cent of total area under fruit crops and more than 80 per cent of the total fruits production. Apple is one of the major fruit belonging to family Rosaceae, accounts for 50 per cent of the world's deciduous fruit production. (Anonymous, 2009) The state gets around 8 to 10 tonnes of apples per hectare against 35 to 40 tonnes of fruits in advanced countries. The demand of apple is immensely augmented in the last few years, with the incrementing population, which in turn, impels farmers of Himachal to grow apple in exuberant scales. The farmers of these areas are being inclined to adopt new integrated approaches to elevate the productivity of quality apples. (Kumar *et al*., 2017) However, the farmers are mainly customized to follow the traditional and age-old practices of cultivation. They are less aware about scientific agro-commercial practices, horticulture schemes and agri-inputs due to lack of communication facilities at high hills.

Keeping in mind the increasing importance of apples in the state and concern towards the declining productivity of apples in the state, the present study was taken up with the vision to bring out the trends and variability in apple area, production and productivity during 1973-2016.

Department of Social Sciences, College of Forestry, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan-173 230, Himachal Pradesh, India.

**Corresponding author:** Shilpa, Department of Social Sciences, College of Forestry, Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan-173 230, Himachal Pradesh, India. e-mail: dhatwaliashilpi@gmail.com

**How to cite this article:** Shilpa, R. Sharma and A. Sharma. (2019). Trends, Growth and Variability of Apple in Himachal Pradesh: 1973-2016. Agricultural Science Digest. 39(4): 311-315.

**Source of support:** Nil
**Conflict of interest:** None

**Submitted:** 23-07-2019 **Accepted:** 18-10-2019 **Published:** 06-12-2019

## MATERIALS AND METHODS

Secondary data on area and production were collected from the records of the State Horticulture Department for a duration of forty three years (1973-74 to 2015-16), were collected from state horticulture department of Government of Himachal Pradesh. The period was divided into two sub-periods i.e., Period-I (1973-74 to 1990-91) and Period-II (1991-92 to 2015-16). The time period has been divided into two sub periods on the basis of cultivation of standard and spurs type of cultivars of apple. Presently, apple is mainly grown in nine out of twelve districts of the state. The nine districts were classified into two categories i.e., potential areas and marginal areas. Potential areas include apple growing areas of Shimla, Kullu, Mandi, Chamba, Kinnaur and Lahul-Spiti districts which are mainly hilly and suitable for apple production. Marginal areas include districts like Solan, Sirmaur and Kangra where areas of production of apple is very less.

### Linear growth rate

For evaluating the trends in area/production/productivity of

apple, linear growth rates (LGR) were estimated as linear model is best fitted to the data as compared to any other model. The following equation was used to estimate growth rates.

$$Y = a + bt$$

Where,
Y = area/production/productivity
t = time variable in year (1, 2, .... 18)
a = constant
b = rate of change.

**The linear growth rate was calculated as:**

$$\text{Linear growth rate} = \frac{b}{\bar{Y}} \times 100$$

Where,
$\underline{b}$ = regression coefficient
$\bar{Y}$ = Mean value of the area/production/productivity

$$SE\ (\text{Linear growth rate}) = \frac{100}{\bar{Y}} \times SE\ (b)$$

Where,
$\bar{Y}$ = Mean value of the area/production/productivity
SE (b) = Standard error of b

Productivity for apple was calculated as $Y_t = P_t A_{t-8}$
Where,
$Y_t$ = Productivity of apple at time t
$P_t$ = Production at time t
$A_{t-8}$ = Area at time t-8

**Instability index**

The instability in area/production/productivity of apple was measured in relative terms by Cuddy- Della Valle index which was used by a number of researchers as a measure of variability in time series data. The simple coefficient of variation overestimates the level of variability in time series data whereas Cuddy- Della Valle corrects the coefficient of variation (Wasim, 2011).
Instability index was estimated as:

$$\text{Instability index} = CV \times \sqrt{1 - r^2}$$

Where,
CV = Coefficient of variation (in percent)
$r^2$ = Coefficient of determination from a time-trend regression

**Decomposition analysis**

Decomposition is a process of breaking up into constituent elements. To measure the relative contribution of area and yield to the total output change, component analysis model as given below was used. This model was given by Minhas and Vaidyanathan (1965) and developed by Sharma (1977). Similar technique was also used by Amod Sharma (2012), Dhakre, *et al.* (2010).

$$P = A * Y$$
$$(P + \Delta P) = (A + \Delta A)* (Y + \Delta Y)$$
$$\Delta P = \Delta A\ Y + \Delta Y\ A + \Delta A\ \Delta Y$$

Change in production = Yield effect + Area effect + Interaction effect

$\Delta A\ Y$ = Area effect
$\Delta Y\ A$ = Yield effect
$\Delta A\ \Delta Y$ = Interaction effect
$A_0$= Triennium average of area in base year
$A_1$= Triennium average of area in current year
$Y_0$= Triennium average of yield in base year
$Y_1$= Triennium average of yield in current year

## Results and Discussion

Apple is an important fruit/cash crop of the state, considering the vital role it has in the economy of Himachal Pradesh. The analysis is based on secondary data of apple area, production and productivity for a period of 43 years collected from various issues of horticulture statistics, published from department horticulture, Himachal Pradesh. The trends in apple area were analysed and results have been presented in Table 1. The results revealed that during P-I (1973-74 to 1990-91) average apple area (42.36 thousand ha) in potential areas was higher than average area (3.86 thousand ha) in marginal area and with a state average of 46.21 thousand hectares. In P-II, potential as well as marginal areas showed higher average as compared to P-I, however increase was more in potential areas (1.88 times) compared to 20 per cent increase in marginal areas. Potential areas showed an increasing trend during both the periods with highest growth of 3.78 percent per annum in P-I and 1.94 per cent per annum in P-II. But, the marginal areas showed non-significant growth in area.

The apple area in state showed significant increase in area in both P-I and P-II with an overall growth of 2.69 per cent per annum. The relative variability increases from P-I to P-II in all the apple-growing areas whereas, higher variability (14.98) in area was found in marginal areas as compared to (0.69) potential areas.

The trends in apple production were also analysed and presented in Table 2. The average production of apple has increased in all areas, except marginal areas in Period-II as compared to Period-I. The major factors which causes decline in production in marginal areas were climatic conditions and apple-growing areas in lower altitudes have reduced by as much as 77 per cent between 1981 and 2007 (Negi *et al*, 2012). The results of linear growth of production revealed that potential areas showed significant growth during P-II, however, it was non-significant in P-I. The overall growth of 3.38 per cent per annum was recorded during 1973-74 to 2015-16 in the state. It is interesting to note that production of apple recorded a significant growth of 5.35 and 5.86 per cent per annum in potential and marginal areas in P-II, however, production showed negative growth of 5.87 and 0.70 per cent per annum during P-I in the marginal areas and overall respectively. The relative variability in production increases from P-I to P-II in all the apple-growing areas whereas, it was found higher in marginal areas for both the periods.

The average productivity of apple in Himachal Pradesh increased in all areas except marginal areas in Period-II as compared to Period-I as presented in Table 3. Though the average area of apple increased in Period-II compared to Period-I, but average productivity in marginal areas decreased. The major factors which caused decline in

**Table 1:** Linear growth rate and instability indices of apple area in Himachal Pradesh during 1973-74 to 2015-16.

| Particulars | Period-I | | | Period-II | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|
| | Potential areas | Marginal areas | Total | Potential areas | Marginal areas | Total | Potential areas | Marginal areas | Total |
| Average area (000'ha) | 42.36 | 3.86 | 46.21 | 85.36 | 4.64 | 90 | 67.36 | 4.31 | 71.67 |
| Linear Growth rate (%/annum) | 3.78* (0.09) | 2.85 (1.60) | 1.54* (0.96) | 1.94* (0.19) | -0.24 (1.06) | 1.83* (0.2) | 2.83* (0.09) | 0.77 (0.39) | 2.69* (0.09) |
| Instability Index | 0.09 | 0.32 | 0.07 | 1.40 | 18.50 | 1.58 | 0.69 | 14.98 | 0.75 |

Period-I=1973-74 to 1990-1991 Period-II= 1991-92 to 2015-16
Figures in the parentheses are the standard errors of the linear growth rates.
*Significant at 10 per cent level of significance respectively.

**Table 2:** Linear growth rate and instability indices of apple production in Himachal Pradesh during 1973-74 to 2015-16.

| Particulars | Period-I | | | Period-II | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|
| | Potential areas | Marginal areas | Total | Potential areas | Marginal areas | Total | Potential areas | Marginal areas | Total |
| Average production (000'tonnes) | 255.52 | 1.4 | 256.91 | 457.05 | 1.18 | 458.22 | 359.16 | 1.28 | 360.44 |
| Linear Growth rate (%/annum) | 0.84 (1.56) | -5.87* (2.29) | 0.80 (1.55) | 5.35* (1.77) | 5.86* (2.29) | 5.36* (1.77) | 3.40* (0.69) | -0.70* (0.13) | 3.38* (0.69) |
| Instability Index | 15.15 | 18.46 | 15.10 | 15.06 | 20.84 | 15.15 | 15.36 | 27.41 | 15.37 |

Period-I=1973-74 to 1990-1991 Period-II= 1991-92 to 2015-16
Figures in the parentheses are the standard errors of the linear growth rates.
*Significant at 10 per cent level of significance respectively.

**Table 3:** Linear growth rate and instability indices of apple productivity in Himachal Pradesh during 1973-74 to 2015-16.

| Particulars | Period-I | | | Period-II | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|
| | Potential areas | Marginal areas | Total | Potential areas | Marginal areas | Total | Potential areas | Marginal areas | Total |
| Average productivity (tonnes/ha) | 20.35 | 1.22 | 21.57 | 21.92 | 1.19 | 23.1 | 7.08 | 4.22 | 1.11 |
| Linear Growth rate (%/annum) | -2.31 (1.38) | -9.86* (3.53) | -2.74 (1.40) | 3.88* (1.55) | 2.28* (1.03) | 3.81* (1.51) | 0.61 (0.59) | -0.92* (0.08) | 0.53 (0.58) |
| Instability Index | 12.76 | 27.81 | 12.28 | 14.11 | 13.79 | 13.81 | 16.97 | 30.88 | 17.00 |

Period-I=1973-74 to 1990-1991 Period-II= 1991-92 to 2015-16
Figures in the parentheses are the standard errors of the linear growth rates.
*Significant at 10 per cent level of significance respectively.

production and productivity of marginal areas were use of old cultivars, erratic moisture and climatic conditions and poor water use efficiency and climatic conditions and the percentage increase in area (20%) was also very low.

The productivity of area in potential as well as in state showed no significant change during 1973-74 to 2015-16, however it was found significant during P-II in both the areas. The non-significant growth may be due to expansion of apple cultivation to marginal areas, monoculture of delicious varieties, poor orchard management and fluctuating and abnormal climatic conditions. A study in relation to fruit production and meteorological data during past 5 years indicated the role of the abnormal climatic factors during flowering and fruit development in lowering apple productivity in state (Jindal *et al*. 2001).

The relative variability in productivity increased from P-I to P-II in all the apple-growing areas except in marginal areas where variability has decreased in P-II. Maximum variability in productivity was found in case of marginal areas for both the periods. Though, growth rate of productivity in potential areas was positive (3.38%/annum) in P-II but, yield has not shown any change in overall period. Some of the horticulturists have shown that current yield can be increased thorough adoption of modern orchard management practices, including improved moisture conservation and fertiliser application, use of colonial root-stocks and renewing pruning techniques etc. which are generally lacking at present.

The causes of production variations in potential areas were examined in different periods and results has presented in Table 4. During 1973-74 to 2015-16 production has been

increased (3.40%/annum) in potential areas, whereas, growth of area was found (2.83%/annum) which was lower than production growth rate but productivity was found non-significant. Therefore, when production was decomposed into area; yield and interaction effect, it was found that during overall period production mainly increased due to acreage expansion as it accounted for 78.34 per cent increase in production, whereas, productivity contributed only 8.21 per cent. Hence, production changes were mainly due to acreage expansion. Similar trend was observed during 1973-74 to 1990-91 (P-I) though potential areas recorded non-significant growth in production. There was significant growth (3.78%/annum) in area and non-significant increase in productivity was there. Therefore, the change in production was mainly due to area expansion. It was found that during P-I, production mainly increased due to increase in area of apple as it accounted for 2.24 times increase in production. The production variations in P-II (1990-91 to 2015-16) in potential areas showed yield effect as production and productivity recorded a significant growth of 5.35 per cent per annum and 3.88 per cent per annum respectively which were found higher than area growth of 1.94 per cent per annum. The decomposition analysis of production showed that yield contributed to 56.82 per cent of changes in production and area contributed only 25.08 per cent. It was found that productivity increase resulted in enhancing the production after 1990's during which spur type cultivars were planted with improved and better orchard management practices. Instability results revealed that in potential areas, area was more instable as compared to productivity during P-I, P-II and overall.

The results of decomposition analysis of production in marginal areas were presented in Table 5. Variation in production in marginal areas during 1973-74 to 2015-16 were due to yield effect. Because during overall period the production in these areas decreased at 0.70 per cent per annum due to significant decrease in productivity (0.92%/annum) and there was no significant change in area during this period. Decomposition of production into area, yield and interaction effect revealed that 189.05 per cent variation in production was on the account of yield, 59.05 per cent variation due to interaction effect. Similar results were observed in P-I. During P-I (1973-74 to 1990-91) production decreased at 5.87 percent per annum, while, productivity decreases by 9.86 percent per annum and there was a non-significant increase in area. Production was decomposed into area, yield and interaction effect and it was found that about 135.48 per cent variation in production was on the account of yield, whereas, 64.05 percent variation was due to interaction effect and -99.53 percent variation was due to area effect. Similarly, marginal areas also showed yield effect in P-II (1991-92 to 2015-16). Production increased at 5.86 per cent per annum, while 2.28 per cent per annum in yield was recorded and no significant change in area was there as period-II. Since, production and productivity showed significant increase resulting in yield effect. Decomposition of production revealed that 213.27 per cent variation in production was on the account of yield. Instability of area od marginal areas is less as compared to instability in productivity.

**Table 4:** Decomposition of apple production in potential areas Himachal Pradesh during 1973-74 to 2015-16.

| Particulars | Period-I | Period-II | Overall |
|---|---|---|---|
| Area effect | 224.73 | 25.08 | 78.34 |
| Yield effect | -75.87 | 56.82 | 8.21 |
| Interaction effect | -48.87 | 18.11 | 13.45 |

**Table 5:** Decomposition of apple production in marginal areas Himachal Pradesh during 1973-74 to 2015-16.

| Particulars | Period-I | Period-II | Overall |
|---|---|---|---|
| Area effect | -99.53 | -75.58 | -148.09 |
| Yield effect | 135.48 | 213.27 | 189.05 |
| Interaction effect | 64.05 | -37.69 | 59.05 |

**Table 6:** Decomposition of apple production in Himachal Pradesh during 1973-74 to 2015-16.

| Particulars | Period-I | Period-II | Overall |
|---|---|---|---|
| Area effect | 295.66 | 23.76 | 83.35 |
| Yield effect | -120.09 | 59.38 | 6.60 |
| Interaction effect | -75.58 | 16.86 | 10.05 |

The results of decomposition of production in HP have been presented in Table 6. The production increased at 3.38 per cent per annum during 1973-74 to 2015-16 and area at a rate of 2.69 per cent per annum. However, productivity growth was non-significant. Therefore, overall production increase in the state was due to acreage expansion because the impacts of high yielding cultivars or technological breakthroughs were not realized. When production increase was decomposed into area, yield and interaction effect, area was found to contributed 83.35 percent to the production, whereas, yield contributed only 6.60 per cent. Similar results were found for P-I. During P-I production increase was non-significant and positive growth in area of 1.54 percent per annum was recorded. The major increase in production in Himachal was due to area increase as productivity is not enhanced due to the used of traditional practices and low yielding varieties in P-I. Therefore, whatever change in production, it was due to area effect as it contributes 295.66 per cent to the total production change. The change in production during P-II was found due to the improvement in yield as both production and productivity showed significant growth. Yield was found to contribute 59.38 per cent variation in apple production, whereas, results validated the fact that about 23.76 per cent variation was due to area. Use of spur cultivars with the improved orchard management practices resulted in higher productivity. Instability of apple area in Himachal Pradesh is quite less as compared to instability in productivity therefore, the major production growth was on the account of area.

## CONCLUSION

There is a great potential of Himachal Pradesh for apple cultivation and it is evident from the above study that the

area and production of apple in the state increased in potential as well as marginal areas, however increase in area and production was quite low in marginal areas. Therefore there is a need to develop cultivars suitable to these areas because area expansion is not possible in potential areas due to lack of land for further expansion. As per the decomposition analysis, production of apple has increased in the state during the last four decades but, the increase was found mainly due to area expansion. Thus efforts should be made to improve the technology as well as extension of the technology to the farms through different research and extension agencies in the state. Government should prioritise high yielding varieties of apple, proper mechanisation, techniques like rain water harvesting for irrigation, Training and capacity building with engagement of national and International experts for specific inputs on apple orchard management and Establishment of Knowledge cum Recreational centre in order to raise apple productivity which is a cause of concern.

## REFERENCES

Amod Sharma. (2012). Trend of area, production and productivity of fruit crop in Nagaland state of North Eastern Hill Region of India. Economic Affairs, 57: 261-278.

Anonymous (2009). Horticulture development: facts and figures. Directorate of Horticulture, Himachal Pradesh.

Dhakre, D.S. and Sharma, Amod. (2010). Growth analysis of area, production and productivity of maize in Nagaland. Agriculture Science Digest. 30: 142-144.

Jindal, K. K., Chauhan, P, S. and Mankotia, M. S. (2001). Apple productivity in relations to environmental Components. In: "Productivity of Temperate Fruits" [eds. Jindal, K. K. and Gautam, D. R.], Dr YS Parmar UHF, Nauni, Solan. 12-20p.

Kirchgässner G, Wolters J and Hassler U. 2012. Introduction to modern time series analysis. Springer Science and Business Media.

Kumar, Arun, Sharma, N., Sharma, C. L. and Singh, Gopal. (2017). Studies on nutrient management in apple cv. Oregon Spur-II under the cold desert region of Himachal Pradesh in India. Indian Journal of Agriculture Research. 51(2): 161-166.

Minhas, B. S. and Vaidyanathan, A. (1965). Growth of crop output in India 1951-54 to 1958- 61: an analysis by component elements. Journal of the Indian Society of Agricultural Statistics. 17(2): 230-252.

Negi, G. C. S, Samal, P. K., Kuniyal, J. C., Kothyari, B. P., Sharma, R. K. and Dhayani, P. P. (2012). Impact of climate change on western Himalayan mountain system: an overview. Tropical Ecology. 53(3): 345-356.

Sharma, K. L. (1977). Measurement of the effects to Area, yield and prices in the increase of value of crop output in India. Agricultural Situation in India. 32(1-9): 348-350.

Wasim, M. P. (2001). Agricultural Growth and Instability in Major Crops Production: A Province Wise Analysis in Pakistan. The Asian Economic Review. 43(2): 294-314.

*Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit http://creativecommons.org/licenses/by/4.0/.© The Author(s) 2019.*

ISSN: 0976-0547 (Online), 0253-150X (Print), Naas Rating: 4.21