

# **VOLATILITY IN APPLE PRODUCTION AND PRODUCTIVITY IN HIMACHAL PRADESH: AN EMPIRICAL ANALYSIS**

**Manoj Sharma\***

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## **Abstract**

*Volatility in the production and productivity of apple affects the economy of Himachal Pradesh as the apple is the most dominating fruit of the state. The fluctuations in the apple will cause major changes in economic activities and income of the state. Among various aspects, volatility in the production and productivity of apple have assumed utmost importance due to its adverse consequences on income, expenditure, consumption and investment of the apple growers in particular and economy of Himachal Pradesh in general. The present paper is an attempt to calculate the compound growth rate of apple production and productivity in Himachal Pradesh and to measure the magnitude of volatility (instability) in apple.*

**Keywords:** *Compound Growth Rate, Instability, Production, Productivity, Volatility.*

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## **I Introduction**

Fruits and vegetables account for nearly 90% of total horticulture production in the country. India is now the second largest producer of fruits and vegetables in the world and is the leader in several horticultural crops, namely mango, banana, papaya, cashew-nuts, areca nut, potato and okra. However, the nature of horticulture crops being such, it's not easy to make an assessment of their production. These crops, especially vegetables (grown in small plots, fields or in the back of the houses) do not have single harvesting in most of the cases which make their assessment difficult. Many

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\*Assistant Professor, Department of Management & Humanities, National Institute of Technology, Hamirpur, Himachal Pradesh, India. email: manoj.nith@gmail.com

horticulture crops have multiple pickings in a single season. Similarly, many fruit trees are scattered, which do not count for assessment (Horticulture Statistics Division, 2017).

The Himachal Pradesh offers vast scope for the development of fruits like apple, nuts, citrus, temperate fruits and other sub-tropical fruits. Himachal Pradesh is primarily a temperate region. So, besides some tropical fruits, temperate fruits such as apple, pear, plum, almond, raisin grapes, walnut, apricot etc. are grown in abundance. The vast tracts of land in Himachal Pradesh are suitable only for growing fruits because of soil texture and the degree of slope do not permit their use for any other agricultural use (Balokhra, 2015). Apple is so far the most important fruit crop of Himachal Pradesh, which constitutes about 49 per cent of the total area under fruit crops and about 85 per cent of the total fruit production. The economy of Himachal Pradesh is predominantly dependent upon agriculture and horticulture production. In the absence of a strong industrial base; any fluctuations in the agriculture or horticulture production will cause major changes in economic activities and income of the state. Among various aspects, apple production and productivity volatility have assumed utmost importance due to its adverse consequences on income, expenditure, consumption and investment of the apple growers in particular and economy of Himachal Pradesh a whole.

## **OBJECTIVES AND METHODOLOGY**

### **2.1 Objective of the Study**

Keeping in view the importance of apple production in Himachal Pradesh, it is important to find the status of volatility in apple production and productivity. The objectives of the present study are: (a) to calculate the compound growth rate of apple production and productivity in Himachal Pradesh; (b) to measure the magnitude of volatility (instability) in production and productivity of apple in Himachal Pradesh.

## 2.2 Source of Data

The present study is based on secondary data obtained from various issues of Annual Season and Crop Reports published by the Directorate of Land records, the Statistical Outline of Himachal Pradesh, Economic Survey of Himachal Pradesh published by the Department of Economics and statistics, Shimla, Government of Himachal Pradesh. The websites of various relevant departments of Government of India, Government of Himachal Pradesh has been explored also. The study broadly covers time series data of 36 years i.e. from 1981-82 to 2016-17.

## 2.3 Tools and Techniques for Data Analysis

### 2.3.1 Estimation of Growth Rate

The compound growth rate has been worked out by an exponential function of the form

$$\text{Log } Y = A + BT$$

Where:

Y = Production/Productivity of Apple

T = years (time)

$$r = [(\text{antilog } B - 1) * 100] = \text{Compound Growth Rate (in per cent)}$$

### 2.3.2 Measurement of Volatility/Instability

There are various methods used to measure the extent of instability. In this paper for the analysis, an exponential index (IXEXP) has been utilized. The equation of the exponential trend is:

$$X_{it} = a_i e^{bit} u_{it}$$

$$\text{Log } (X_{it}) = \text{Log } a_i + bit + \text{log } u_{it} \quad (t = 1, 2, \dots, n)$$

Where (X<sub>it</sub>) is the apple output of district 'I' in time 't', 't' represents time and 'u' is the disturbance term. Ordinary Least Square is then used to estimate the equations. IXEXP measures deviations from the constant growth rate trend line.

$$IXEXP = \frac{100}{\bar{X}} \left[ \frac{\sum_{t=1}^n (X_{it} - \hat{a}e^{\hat{b}t})^2}{n-2} \right]^{\frac{1}{2}}$$

$\bar{X}$  being the mean of Xi.

Instability Index (I) is

$$I = \frac{1}{\log \bar{X}} \times \sqrt{\frac{\sum_{t=1}^n \log x^2 - \frac{(\sum_{t=1}^n \log x_i)^2}{n} - \log \beta^2 \sum_{t=1}^n t_i^2}{n-2}} \times 100$$

#### IV. RESULT AND DISCUSSION

##### 4.1 Compound Growth Rate of Apple Production in Himachal Pradesh

The compound Growth rate in the production of apple have been presented in Table 1. The compound growth rate in the production of Apple reveals that it increased tremendously during Period-II. During Period-I, the production of apple increased at the rate of 1.69 per cent, while during Period-II, it increased at the rate of 7.55 per cent. Overall from the year 1981-82 to 2016-17 the production of apple increased at the rate of 3.07 per cent. Mandi, Solan and Sirmaur districts registered negative growth during Period-I, that is, -2.13 per cent, -6.39 per cent and -6.41 per cent respectively.

Table 1: Compound Growth of Apple Production

Sr. No.	District	P I	P II	Total Period
1	Bilaspur	#	#	#
2	Chamba	2.18	6.54	4.11
3	Hamirpur	#	#	#
4	Kangra	3.86	0.52	3.81
5	Kinnaur	8.08	8.08	7.30
6	Kullu	1.67	7.60	2.35
7	Lahaul & Spiti	#	#	#
8	Mandi	- 2.13	5.54	3.50
9	Shimla	1.42	8.09	2.86
10	Sirmaur	- 6.41	11.77	- 0.89

11	Solan	-6.39	- 9.38	- 7.34
12	Una	#	#	#
<b>Total HP</b>		<b>1.69</b>	<b>7.55</b>	<b>3.07</b>

**Note:** i) # value cannot be calculated.

ii) P I period from 1981-82 to 1998-99; P II period from 1999-00 to 2016-17; Total Period from 1981-82 to 2016-17.

*Source: i) Basic data obtained from Annual Season and Crop Report (various issues), Directorate of Land Record, Himachal Pradesh.*

*ii) Department of Horticulture, Government of Himachal Pradesh, Shimla.*

Solan district was the only district which registered negative growth rate (-9.38 per cent) during Period-II. Kinnaur district has the highest growth rate in the state during Period-I. While the production of apple in Sirmaur district registered highest growth rate (11.77 per cent) in the state during Period-II. The production of apple in Kullu district increased at a rate of 1.67 per cent during Period-I and at 7.60 per cent during Period-II. While the production of apple in Shimla district increased at a rate of 1.42 per cent during Period-I and at 8.09 per cent during Period-II. It is clear from the table that Kullu and Shimla district show a good sign in the production of apple in the state.

#### 4.2 Compound Growth Rate of Apple Productivity in Himachal Pradesh

The compound growth rate in the production of apple has been presented in Table 2. The data related to productivity (yield) show a discouraging trend during Period-I. But during Period-II, the growth rate in all the apple growing districts becomes positive, which is a good sign. Kinnaur district shows a positive growth rate during both the period. During Period-I the growth rate in yield was 2.26 per cent which increased to 4.15 per cent during Period-II. Chamba, Mandi, Sirmaur and Solan district were the worst district during Period-I. Their growth rate during this period was -6.32 per cent, -6.16 per cent, -7.97 per cent and -7.11 per cent respectively. It gives an impression that the yield of apple during the period from 1981-82 to 1998-99 remained negative which lead not only reducing the income of the apple growers but also affected the economy of the state.

**Table 2: Compound Growth Rate of Apple Productivity**

Sr. No.	District	P I	P II	Total Period
1	Bilaspur	#	#	#
2	Chamba	- 6.32	4.21	- 1.65
3	Hamirpur	#	#	#
4	Kangra	2.01	2.14	4.65
5	Kinnaur	2.26	4.15	2.60
6	Kullu	- 1.87	5.42	- 0.30
7	Lahaul & Spiti	#	#	#
8	Mandi	- 6.16	4.33	0.91
9	Shimla	- 2.02	6.55	1.01
10	Sirmaur	- 7.97	14.51	- 0.49
11	Solan	- 7.11	2.44	0.06
12	Una	#	#	#
<b>Total HP</b>		<b>- 2.24</b>	<b>5.73</b>	<b>0.48</b>

**Note:** i) # value cannot be calculated.

ii) P I period from 1981-82 to 1998-99; P II period from 1999-00 to 2016-17; Total Period from 1981-82 to 2016-17.

*Source: Same as mentioned in Table 1.*

The highest growth rate was registered in Sirmaur districts which improved the productivity of apple and reached 14.52 per cent growth in the State. Whereas, Shimla and Kullu district have also improved their situation during Period-II. The productivity of apple in these districts increased at the rate of 6.55 per cent and 5.42 per cent during Period-II. Overall, the yield of apple increased at the rate of 5.73 per cent during Period-II in Himachal Pradesh, which was negative during the Period-I. Hence, it can be said that the period from 1981-82 to 1998-99 was the worst period for the apple in Himachal Pradesh.

#### **4.3 Volatility of Apple Production in Himachal Pradesh**

District-wise and period wise volatility index in Apple production of apple has been analyzed in Table 3. Data show that the volatility in apple production has increased to 4.33 per cent during Period-II from 2.81 during Period-I. The volatility for the whole period was 3.82 per cent in Himachal Pradesh. District-wise volatility reveals that Kangra and Solan district had

the highest volatility index, that is, 19.44 per cent and 13.21 per cent respectively, during the Period-I. These districts were followed by Sirmaur (8.55 per cent) and Chamba (7.39 per cent).

**Table 3: Volatility Index in the Production of Apple**

Sr. No.	District	P I	P II	Total Period
1	Bilaspur	#	#	#
2	Chamba	7.39	7.36	7.28
3	Hamirpur	#	#	#
4	Kangra	19.44	7.39	13.75
5	Kinnaur	2.60	1.80	2.17
6	Kullu	4.21	6.16	5.45
7	Lahaul & Spiti	#	#	#
8	Mandi	4.50	7.06	6.34
9	Shimla	3.25	5.22	4.56
10	Sirmaur	8.55	9.61	11.81
11	Solan	13.21	9.13	11.95
12	Una	#	#	#
<b>Total HP</b>		<b>2.81</b>	<b>4.33</b>	<b>3.82</b>

**Note:** i) # value cannot be calculated.

ii) P I period from 1981-82 to 1998-99; P II period from 1999-00 to 2016-17; Total Period from 1981-82 to 2016-17.

*Source: Same as mentioned in Table 1.*

While during Period-II the volatility in apple production was found more in Sirmaur (9.61 per cent), Solan (9.13 per cent), Kangra (7.39 per cent), Chamba (7.36 per cent) and Mandi (7.06 per cent). The table clearly reveals that volatility has increased during Period-II over Period -I in almost all the districts, except Kinnaur, Kangra and Solan district. Overall, the volatility for the whole period shows that the volatility index of all the districts, except Kinnaur, was higher than the state volatility index. Hence it can be concluded that there exists volatility in apple production. The district with high volatility needs to look towards diversification, as these districts are not performing good in apple production in the state

#### 4.4 Volatility in the Productivity of Apple in Himachal Pradesh

District-wise and period wise volatility index in yield of apple has been analyzed in Table 4 which shows that in Himachal Pradesh the volatility in yield of apple during Period-I was 4.27 per cent, which increased to 6.79 per cent during Period-II, whereas as a whole the volatility in yield of apple in Himachal Pradesh was 6.21 per cent. District-wise data reveal that Kangra has the highest volatility during Period-I. Sirmaur and Solan district registered high volatility during both the periods. Kinnaur district is the only district which registered very low volatility during both the periods.

**Table 4: Volatility Index in the Productivity of Apple**

Sr. No.	District	P I	P II	Total Period
1	Bilaspur	#	#	#
2	Chamba	8.96	10.36	10.33
3	Hamirpur	#	#	#
4	Kangra	17.59	7.61	12.7
5	Kinnaur	3.14	1.97	2.62
6	Kullu	5.60	8.61	7.54
7	Lahaul & Spiti	#	#	#
8	Mandi	6.16	9.79	9.17
9	Shimla	4.52	7.83	6.77
10	Sirmaur	10.60	12.25	16.05
11	Solan	11.72	11.06	12.30
12	Una	#	#	#
<b>Total HP</b>		<b>4.27</b>	<b>6.79</b>	<b>6.21</b>

**Note:** i) # value cannot be calculated.

ii) P I period from 1981-82 to 1998-99; P II period from 1999-00 to 2016-17; Total Period from 1981-82 to 2016-17.

Source: Same as mentioned in Table 1.

*The remaining districts show an increasing trend during Period-II over Period-I. Overall, the volatility in yield of apple in Sirmaur was 12.30 per cent, 12.70 per cent in Kangra, 12.30 per cent in Solan, 9.17 per cent in Mandi, 7.54 per cent in Kullu and 6.77 per cent in Shimla district. The high*



*volatility in yield of apple indicates that the potential of area under Apple has not been harnessed fully.*

### **Conclusion**

*It can be concluded from the above analysis that the growth of apple production has increased over the last four decades taken in the study. Himachal Pradesh has explored the potential for apple farming which is not only strengthening the state economy but contributing towards the growth of the Indian economy as a whole. Apple farming in Himachal economy plays a very crucial role as eight districts are involved in apple cultivation out of which five districts, namely, Chamba, Kinnaur, Kullu, Mandi, and Shimla, have made a significant contribution in apple farming. but the volatility in the apple production resulted in a fluctuation in growth and development of these districts as well as the state. The volatility index shows that out of five major apple-producing districts Chamba and Mandi are having high volatility in apple production. Hence, there is to tackle volatility of apple by preparing need-based model for every apple producing district of Himachal Pradesh.*

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