

Trends in area, production and productivity of apple orchards in Himachal Pradesh

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ABSTRACT

The present study was undertaken with a vision to study the status of apple productivity. The objective was aimed at analyzing the trends in apple production and productivity. General mathematical and statistical methods were utilized to perform the present study. It was observed that India has registered a compound growth rate of 1.1 MT/ha which is at par with the world average of 1.2 MT/ha in the context of apple productivity whereas in Himachal Pradesh it was 0.03 MT/ha during the time period 1973-74 to 2011-12. The maximum mean productivity was noticed in France with apple yield of 33.60 MT/ha over the 39 years. Shimla and Kinnaur districts of Himachal Pradesh showed a positive trend in all aspects of apple cultivation.

Keywords: Apple production; cultivation; productivity; area

INTRODUCTION

Apples constitute a major part of the economy of Himachal Pradesh with a turnover of over Rs 3000 crores and accounting for almost 10 per cent of the gross domestic product. In the post-independence period especially after the statehood in 1971 there has been a strong backing from the state for apple plantation. Consequently the area under apple cultivation has increased substantially from a mere 400 hectares in 1950s to 114939 hectares in 2011-12. Of the total area under fruit production apples make up for more

than 48 per cent and of the total fruit production apple alone accounts for more than 74 per cent. Despite the meteoric rise in area and production the productivity of apple in India remains stagnated around 10 MT/ha far behind from that of the leading countries like Italy (42.41 MT/ha), Chile (33.37 MT/ha), France (44.36 MT/ha) and the world average being 15.87 MT/ha in the year 2011 (Anon 2013). Considering the vital role that apple has in the economy of Himachal Pradesh there is a need to analyse the trends in area, yield, production and economics of apple and problems encountered by the orchardists in the state.

An orchard is a long term investment and careful planning is essential to ensure economic success. Apple orchard is no exception in this regard (Marini 1997). The gains in production have come essentially from increase in the acreage rather than through intensive cultivation practices. Braun and Muller (2012) stated that in fruit trees one can consider a number of possible threats to production associated with climate change. Lewis (1978) pointed out that in the long run productivity is the only 'engine of growth' to the farm economy. The author suggested that an improvement in agricultural productivity enables farmers to grow more food which translates into better diets and higher farm incomes.

In Himachal Pradesh district Shimla has the largest production of apples followed by Kullu, Kinnaur, Mandi, Chamba and Solan. Majority of apple orchardists according to 1989 horticulture census are marginal (86%), small (10%), semi-medium (3%), medium (0.5%) farmers and just 0.03 per cent are the large farmers. The low productivity of apple orchards in Himachal Pradesh is due to the factors like preponderance of the small land holdings (85%) and further relative sub-division of the same holdings (Sharma 2011). Hence predominance of small holding, deteriorating quality of land, changes in climatic conditions, inadequate chilling hours during winters, hailstorms during springs, untimely and insufficient

winter precipitation, low temperature during blooming times and prolonged droughts are some of the major constraints observed at different time periods of the year invariably affecting adversely the productivity of the crop. The vast technological gaps existing in apple crop indicate the scope of increasing productivity rates by plugging these gaps through balanced use of modern inputs.

The present study intends to assess the inter-temporal, inter-country comparison in the productivity of apple crop; to know where we stand and what ought to be done to achieve the international standards in the productivity. Quantification of productivity level across regions will seriously bring this crucial aspect to limelight. The proposed study would be useful in filling up the lacunae and in formulating horticultural policies aimed at improving the apple productivity.

METHODOLOGY

Secondary data

Secondary data pertaining to the list of village households, cropped area, production and productivity of apple in Himachal Pradesh, India and World were recorded from the Directorate of Horticulture, Shimla, Himachal Pradesh, National Horticulture Board, block development offices of respective blocks, respective revenue offices, directorate of land records and FAO.

Effect of area and yield on production

In order to study the effect of area and yield in increasing production during the

period under study the following model of Narula and Vidyasagar (1973) was employed.

$$Q_n - Q_o = \frac{(Y_n - Y_o) A_n + A_o}{2} + \frac{(A_n + A_o) Y_n + Y_o}{2}$$

where

Q_n and Q_o = Production of a crop during the end period (2011-12) and base period (1973-74) respectively

Y_n and Y_o = Yield of a crop during the end and base period respectively

A_n and A_o = Area under a crop during the end and base period respectively

Comparative analysis of apple productivity

One way classification method was applied to find out the comparative analysis of apple productivity.

$$CD = \text{'t' table value at error df} \times \sqrt{\frac{2 \times MSE}{r}}$$

$$CV = \frac{SD}{Mean} \times 100$$

where

r = Number of observations in each category

CD = Critical difference

MSE = Mean sum of errors

CV = Coefficient of variation

SD = Standard deviation

the power function to the figures of area, production and productivity of apple for the period of 1973-1974 to 2011-2012 to world, Asia, India and different districts of Himachal Pradesh. The ordinary least square method was used to fit the power function of the following form $Y = ab^t$. It was converted into log linear function with the help of logarithmic transformation as under:

Compound growth rate (CGR)

The compound growth rates for different variables were computed by fitting

$$\log Y = \log a + t \log b$$

where

Y = Dependent variable (area, production and productivity etc)

t = Independent variable (time in a year)

Compound growth rates (CGRs) were calculated by using the following formula:

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

Standard error (SE) of CGR was calculated by using the following formula:

$$\text{SE of CGR} = \frac{100 \cdot b}{\log_e 10} \times \text{SE Log } b$$

Student's t test was used to test the significance of growth rates.

RESULTS and DISCUSSION

World Scenario

India ranks second in the production of fruits next to China. Apple is widely grown in the temperate regions of the world and in the year 2011-12 the world apple production was 7.56 crore tons. The world apple production has grown at compound growth rate of 2.4 per cent per annum from 1973-74 to 2011-12. Asian continent has witnessed an impressive growth in area, production and productivity of apple as noticed from the Table 1. China

happens to be the major growth engine in apple farming in Asia. China ranks first in the subject of apple production accounting for nearly 40 per cent of global production followed by United States of America (6.65%), Turkey (4.25%), Poland (4.13%), Iran (4.01%), France (3.64%) and Italy (3.31%).

The average share of Indian apple production based on 2011-12 data was 3.82 per cent and the country ranked 8th among the apple producing countries of the world. At present India has achieved a production potential of 28.91 lakh tons annually. During the period 1973-74 to 2011-12 apple production in India recorded a significant growth of 3.5 per cent per annum. In apple production India's growth rate was found more than world's growth rate but less than Asian growth in production. Presently apple occupies 4.5 per cent of area under total fruits and contributes 3.9 per cent towards total fruit production in India.

In India the production of apple is majorly confined to Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Arunachal Pradesh, Nagaland and Sikkim. However Jammu and Kashmir and Himachal Pradesh are the most important states together accounting for 81 per cent of the total area and 95 per cent of the production in the country. The fruit plays an important role in the economy of these hilly states and well being of farming community.

Table 1. Compound growth of area, production and productivity of apple in various regions of the world during 1973-74 to 2011-12 (Anon 2013)

Region	Area	Production	Productivity
India	2.4** (0.044)	3.5* (0.090)	1.1 (0.088)
Asia	3.9* (0.181)	6.3* (0.093)	2.4* (0.133)
World	1.2 (0.088)	2.4** (0.044)	1.2 (0.088)

*Significant at 1% level of significance

**Significant at 5% level of significance

International comparison of productivity in apple

The study on productivity per unit of land is important to study the comparative advantages/disadvantages in various pockets of apple production. Competitiveness between states, regions and nations in the long run is influenced by comparative advantage and ability to develop the comparative advantages. Therefore estimates of productivities of major apple producing countries were used to study the comparative advantages in the apple production. The disparity in apple yields between the countries may depend upon level of adoption and degree of adjustments of production system to the new technological advances and the climatic factors.

The productivity was found relatively more stable in countries like, USA, Italy, Turkey, France and India. The degree of instability in the productivity was found highest in China followed by Brazil, Chile and Iran.

The average annual yield per hectare for 1973-74 through 2011-12 was found highest for France (33.60 MT/ha) followed by Italy (31.38 MT/ha), Chile (25.50 MT/ha) and USA (24.65 MT/ha) (Fig 1). Next to the above mentioned countries were Brazil (20.85 MT/ha) followed by Turkey (18.08 MT/ha), Iran (10.65 MT/ha) and China (6.81 MT/ha). It is fascinating to note that though China is the leader in apple production it stood eighth in terms of productivity. In comparison with all other major countries it is depressing to note that India was falling behind all of them with a meager productivity of 5.92 MT/ha placing itself in a critical position amidst the apple industry. The related details are given in Table 2.

The Table reveals that statistically there was no difference in the average annual mean productivity of China and India and between USA and Chile because productivity differences are less than that of critical difference value that is 1.89. In case of other countries there existed major

differences between the productivities. The countries like France, Italy, USA and Turkey with higher levels of productivity experienced higher levels of stability in productivity except the cases of Chile and India.

These international differences in apple productivity may be endorsed to different factors like land area, type of land, cultivars, technology adopted, geographical conditions like slope, elevation and aspect, the irrigation facilities, managerial skills and risk bearing abilities of the farmers. Above all factors like micro and macroclimate play a very crucial role.

Trends in area, production and productivity of Himachal Pradesh

The level of growth in output is jointly determined by the growth rate in area and in yield. The purpose of this analysis was to examine the performance of apple cultivation in the study state and see if there have been any noticeable changes during the last four decades. This would help in finding out the underlying factors responsible for such performance and thereby permitting a broad judgment about the overall production possibilities in times to come.

Himachal Pradesh has undergone a revolution in the apple production during last few decades. The area under apple has increased by more than six-folds since 1966-67. It increased at a compound

growth rate of 3.27 per cent per annum between 1973-74 and 2011-12. During 1966-67 the area under apples constituted nearly 58 per cent of the total fruit area in the state. In the later years there has been relatively more emphasis on planting of other fruit trees in the state as a consequence of which the proportionate share of apple area has come down to nearly 48.30 per cent in the year 2011-12. More than 2 lakhs farm families are engaged in apple cultivation out of which nearly 90 per cent are small and marginal with an average holding of less than 0.6 hectares. Apple farming is the fastest growing economic activity of the state and is being grown in 9 out of 12 districts. Due to varied agro-climatic conditions across the districts there exists large variation in the area and output growth of this crop.

Changes in acreage

The district-wise broad picture of change in the apple acreage has been presented in Table 3 which reveals that the area under apple has been showing a steady growth in Himachal Pradesh. Fig 2 gives the trends in area under apple in Himachal Pradesh (1973-74 to 2011-12).

For the state as a whole the area increased by nearly 224.37 per cent during triennium ending 2011-12 over the base triennium 1975-76. In terms of compound growth rates it grew at the rate of 3.27 per cent per annum during the study period.

Area, production, productivity of apple

Table 2. Comparative analysis of apple productivity of major apple producing countries (Anon 2013)

Country	Range	Annual average for the period 1973-74 - 2011-12 (MT/ha)	Coefficient of variation (%)
China	2.62 - 17.54	06.81	68.28
USA	17.59 - 31.95	24.65	15.90
Turkey	10.92 - 23.81	18.08	18.97
Italy	23.60 - 42.41	31.38	16.73
India	4.14 - 10.00	05.92	20.10
France	18.69 - 44.36	33.60	19.67
Iran	3.95 - 16.00	10.65	34.27
Brazil	5.89 - 38.39	20.85	46.52
Chile	10.34 - 40.00	25.50	34.51

CD = 1.89

Table 3. District-wise changes in area of apple in Himachal Pradesh (1973-74 to 2011-12)

District	Base triennium ending 1975-76 ('000 ha)	Triennium ending 2011-12 ('000 ha)	Percentage change over base triennium ending 1975-76	Compound growth rate (%/annum)
Chamba	0.87	12.23	1305.75	7.50* (0.094)
Kangra	0.34	0.44	29.41	0.50** (0.131)
Kinnaur	0.95	9.98	950.53	6.10* (0.092)
Kullu	8.07	24.13	199.00	3.00* (0.045)
Lahaul & Spiti	0.06 ^a	8.66	14333.33	9.40* (0.239)
Mandi	4.97	15.69	215.69	3.30* (0.045)
Shimla	15.87	34.66	118.40	2.20* (0.044)
Solan	0.18	0.09	- 50.00	- 3.00* (0.379)
Sirmaur	2.34	3.12	33.33	0.80* (0.088)
HP	33.60	108.99	224.37	3.27* (0.045)

Source: Directorate of Horticulture, Govt of Himachal Pradesh

^aBase triennium ending 1984-85

*Significant at 1% level of significance

**Significant at 5% level of significance

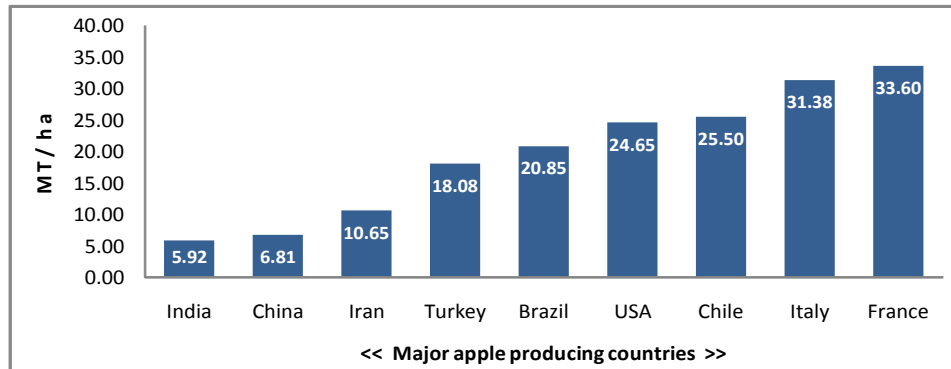


Fig 1. Annual average apple productivity of the major apple producing countries during 1973-74 to 2011-12

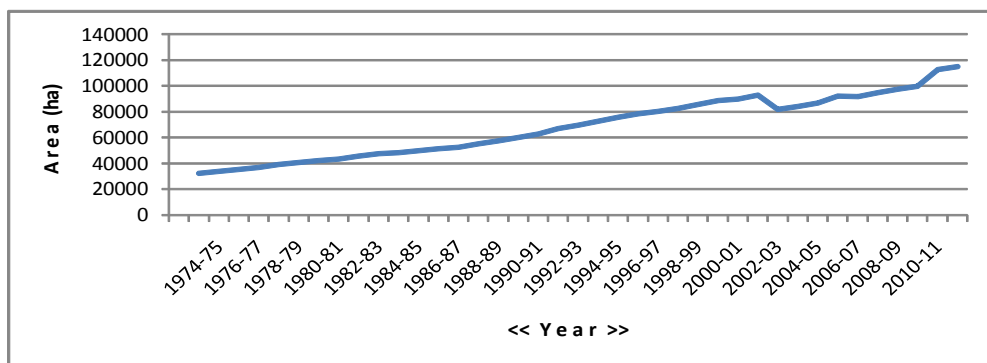


Fig 2. Trends in area under apple in Himachal Pradesh (1973-74 to 2011-12)

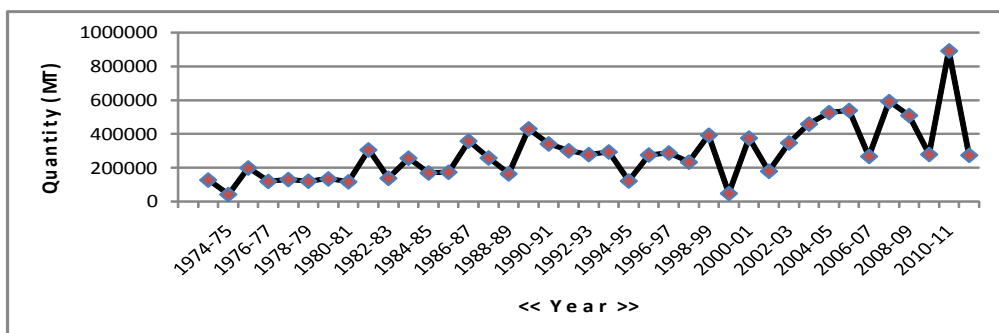


Fig 3. Trends in production of apple in Himachal Pradesh (1973-74 to 2011-12)

The area growth was quite impressive and significant in Lahaul & Spiti, Chamba, and Kinnaur districts. These districts constituted backward tribal districts which received added attention in the recent past by the state government for augmenting growth promotion in these untapped non-traditional areas. Moreover climatic conditions are more favourable in these districts for the successful cultivation of apples. Shimla, Mandi and Kullu districts comprise of the traditional areas for apple that recorded an increase of 118.40, 215.69 and 199.00 per cent respectively in the study area during triennium ending 2011-12 over base triennium 1975-76. The corresponding figures of growth rates in area were worked out to be 2.20, 3.30 and 3.00 per cent per annum.

District Kangra and Sirmaur which have lesser comparative advantage of growing apple also experienced positive and significant growth of 0.50 and 0.80 per cent per annum respectively. It is interesting to note that district Solan exhibited a declining trend in the area expansion during the study period of 39 years.

Changes in production

Amongst all the fruits grown in the state apple occupies the premier position in terms of production also accounting for nearly 74 per cent of total fruit production. The results of the district-wise analysis of change in the production of apple have been presented in Table 4. The data show that

apple production has taken new stride and has increased by about 289 per cent during triennium 1975-76. Production has increased at the compound growth rate of 3.50 per cent per annum during the study period in the state. The three tribal districts viz Lahaul & Spiti, Kinnaur and Chamba (high growth districts) have recorded a significant increase in the production at a compound growth rate of 9.90, 8.20 and 4.50 per cent per annum respectively during the span of 39 years. However the low altitude districts of Kangra, Solan and Sirmaur recorded negative growth in the production of apples during study period. This may be attributed to change in climatic conditions adversely affecting the productivity of the crop. The incremental production of apples has come mainly because of area expansion and the productivity of this fruit is quite low as compared to advanced countries. Trends in production of apple in Himachal Pradesh (1973-74 to 2011-12) are given in Fig 3.

Changes in productivity

Productivity in fruit farming is most often assessed by measures of crop yield. The growth rate in productivity is an important determinant of agricultural transformation and is considered as the engine of growth to the farm economy. Thus it is important to assess the fruit productivity; its growth to know our stand and what ought to be done to achieve the international standards in the productivity. The crop productivity growth is an indicator of use

Table 3. District-wise changes in area of apple in Himachal Pradesh (1973-74 to 2011-12)

District	Base triennium ending 1975-76 (‘000 ha)	Triennium ending 2011-12 (‘000 ha)	Percentage change over base triennium ending 1975-76	Compound growth rate (%/annum)
Chamba	0.87	12.23	1305.75	7.50* (0.094)
Kangra	0.34	0.44	29.41	0.50** (0.131)
Kinnaur	0.95	9.98	950.53	6.10* (0.092)
Kullu	8.07	24.13	199.00	3.00* (0.045)
Lahaul & Spiti	0.06 ^a	8.66	14333.33	9.40* (0.239)
Mandi	4.97	15.69	215.69	3.30* (0.045)
Shimla	15.87	34.66	118.40	2.20* (0.044)
Solan	0.18	0.09	- 50.00	- 3.00* (0.379)
Sirmaur	2.34	3.12	33.33	0.80* (0.088)
HP	33.60	108.99	224.37	3.27* (0.045)

Source: Directorate of Horticulture, Govt of Himachal Pradesh

^aBase triennium ending 1984-85

*Significant at 1% level of significance

**Significant at 5% level of significance

Table 4. District-wise changes in production of apple in Himachal Pradesh (1973-74 to 2011-12)

District	Base triennium ending 1975-76 (‘000 MT)	Triennium ending 2011-12 (‘000 MT)	Percentage change over base triennium ending 1975-76	Compound growth rate (%/annum)
Chamba	1.63	5.94	264.42	4.50* (0.454)
Kangra	1.25	0.41	- 67.20	- 1.10 (0.601)
Kinnaur	3.35	52.45	1465.67	8.20* (0.283)
Kullu	34.55	96.74	180.44	2.80* (0.402)
Lahaul & Spiti	0.02 ^a	0.17	844.44	9.90* (0.527)
Mandi	17.41	11.80	- 32.22	2.80* (0.402)
Shimla	56.98	314.42	451.81	3.60* (0.360)
Solan	0.60	0.08	- 86.67	- 6.60* (0.366)
Sirmaur	8.21	0.46	- 94.40	- 4.60* (0.498)
HP	124	482.42	289.05	3.50* (0.315)

Source: Directorate of Horticulture, Govt of Himachal Pradesh

^aBase triennium ending 1984-85

*Significant at 1% level of significance

of farming knowledge, technology, infrastructural development, farm investments, and development of suitable price policy. The productivity growth allows farmers to break out of poverty and low income equilibrium trap and contribute to overall economic growth. To achieve this there is a need for strengthening the efforts at increasing production by maintaining or increasing productivity.

In Himachal Pradesh the overall productivity of apple hovers around 4 tons per hectare as compared to 7 tons of all India level which is much below the international level of 40 tons per hectare. The district-wise growth in the productivity of bearing plants in Himachal Pradesh is given in Table 5. Trends in productivity of apple in Himachal Pradesh (1973-74 to 2011-12) are given in Fig 4.

It is evident that except Kinnaur and Shimla all the districts exhibited the waning trends in growth in productivity. The declining growth in productivity was significant for the districts of Solan, Sirmaur, Chamba and Lahaul & Spiti. Growth in productivity was observed in only two districts namely Shimla and Kinnaur. The scenario of continued deceleration in apple productivity is a cause of concern. This dismal growth in yield may be attributed to predominance of old and senile orchards, development of apple industry in rainfed conditions, global warming, low density of

plantation, lack of efficient use of irrigation water, quality seeds and planting material, pollination problems, site selection, imbalanced use of resources etc.

Inter-district comparison of apple productivity

The productivities of various districts of Himachal Pradesh were compared and are given in Table 6 (Fig 5). Average annual productivity was highest in Shimla followed by Kullu and Kinnaur districts. This may be due to existence of niche advantages for the cultivation of apple in these districts. These high productivity districts also exhibited high degrees of stability and productivity levels. In general the low productivity districts were found facing higher instability in the yield levels. Therefore apple farming was getting low prominence here. The data show that there existed statistically no differences in the productivity between the districts Solan, Sirmaur, Lahul & Spiti and Kangra. Similarly productivity differences in apple in Mandi, Chamba and Kangra were non-significant. However statistically wide differences were observed in apple productivity between Kinnaur, Kullu and Shimla.

Effect of area and yield on production

Yield and area are considered important contributors in the production of apple. In order to visualize the contribution of each of them in the production, Narula

Table 5. District-wise changes in productivity of apple in Himachal Pradesh (1973-74 to 2011-12)

District	Base triennium ending 1975-76 (MT/ha)	Triennium ending 2011-12 (MT/ha)	Percentage change over base triennium ending 1975-76	Compound growth rate (%/annum)
Chamba	1.85	0.49	-73.51	- 3.00* (0.421)
Kangra	3.66	0.94	-74.31	- 1.60 (0.684)
Kinnaur	3.43	5.25	53.06	2.10* (0.222)
Kullu	4.22	4.02	- 4.74	- 0.20 (0.391)
Lahaul & Spiti	0.3 ^a	0.08	-73.33	- 3.70* (0.795)
Mandi	3.57	0.76	-78.71	- 0.40 (4.325)
Shimla	3.58	9.08	153.63	1.40* (0.396)
Solan	3.43	0.32	- 90.67	- 3.60* (0.545)
Sirmaur	3.51	0.15	- 95.73	- 5.40* (0.494)
HP	3.67	4.38	19.33	0.30 (0.305)

^aBase triennium ending 1984-85

*Significant at 1% level of significance

**Significant at 5% level of significance

Table 6. Inter-district comparative analysis of apple productivity in Himachal Pradesh

District	Range	Annual average for 1973-74 to 2011-12 (MT/ha)	Coefficient of variation (%)
Chamba	0.18-11.64	1.24	145.97
Kangra	0.05-4.47	1.13	97.34
Kinnaur	0.46-6.38	3.46	36.42
Kullu	0.38-8.68	4.24	46.7
Lahaul&Spiti	0.00-0.71	0.22	90.91
Mandi	0.27-6.78	1.26	92.06
Shimla	0.6-17.41	6.67	51.27
Solan	0.06-5.14	0.65	163.07
Sirmaur	0.02-4.63	0.48	197.92

CD= 0.67

Area, production, productivity of apple

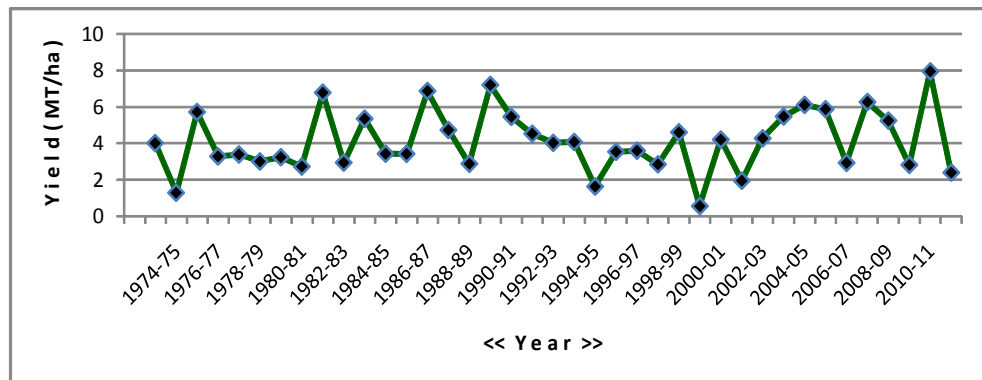


Fig 4. Trends in productivity of apple in Himachal Pradesh (1973-74 to 2011-12)

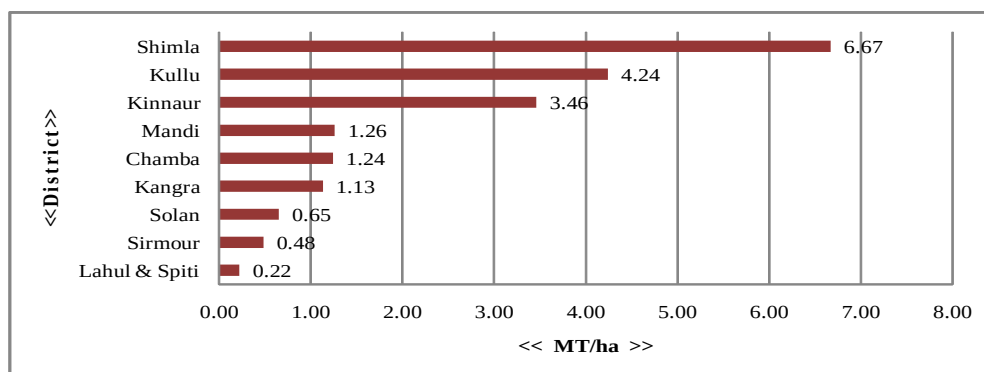


Fig 5. Annual average apple productivities of the districts in Himachal Pradesh (1973-74 to 2011-12)

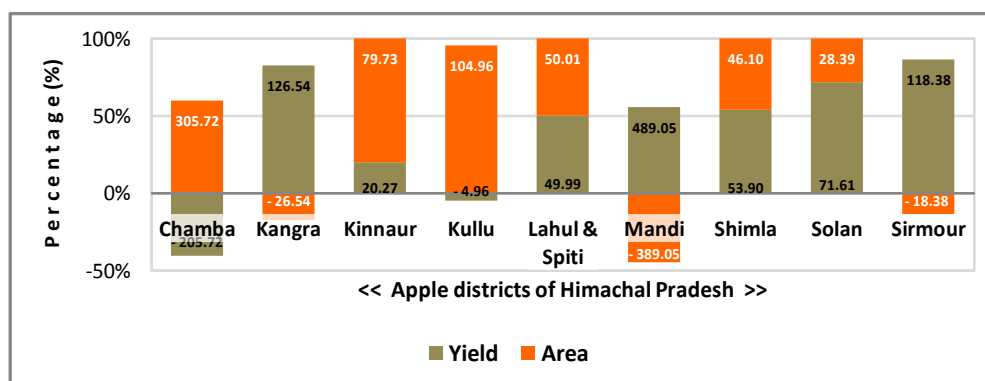


Fig 6. Percentage contribution due to yield and area in production

Table 7. Contribution of yield and area in the production of apples in different districts of Himachal Pradesh (1973-74 to 2011-12)

District	Percentage contribution due to	
	Yield	Area
Chamba	-205.72	305.72
Kangra	126.54	-26.54
Kinnaur	20.27	79.73
Kullu	-4.96	104.96
Lahaul & Spiti	49.99	50.01
Mandi	489.05	-389.05
Shimla	53.90	46.10
Solan	71.61	28.39
Sirmaur	118.38	-18.38
HP	14.33	85.67

Source: Directorate of Horticulture, Govt of Himachal Pradesh

Table 8. Contribution of yield and area in the production of apples in different regions (1973-74 to 2011-12) (Anon 2013)

Region	Percentage contribution due to	
	Yield	Area
India	52.00	48.00
Asia	40.51	59.49
World	53.84	46.16

and Vidyasagar (1973) model was used. The results of the analysis have been presented in the Table 7 (Fig 6) for different apple producing districts of the state. The data clearly show that for the state as a whole increase in apple production during the period of 39 years was mainly due to area expansion (85.67%). The yield factor

contributed only 14.33 per cent towards the total increase in apple output. This may be due to the better management and adoption of new farm technology. Yield effect was more pronounced in Kangra, Mandi, Solan and Sirmaur districts. In Lahaul & Spiti and Shimla districts increase in apple production was almost equally

shared by yield and area. Production of apple increased by 305.72 and 104.96 per cent due to increase in acreage in Chamba and Kullu respectively and the corresponding effects of yield in these districts decreased the production by 205.72 and 4.96 per cent.

As expositied in Table 8 the contribution of yield towards the growth of production was estimated at 52 per cent at all India level while area shared 48 per cent towards increased production. For the Asia as a whole increase in apple area contributed more than the productivity. In the total world production of apples the contribution of yield was 53.84 per cent and that of area it was 46.16 per cent.

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