*Int. J. Agricult. Stat. Sci.* Vol. 14, Supplement 1, pp. 5-13, 2018 *ISSN : 0973-1903*

ORIGINAL ARTICLE

# GROWTH PATTERN OF VEGETABLE CROPS IN HIMACHAL PRADESH

**Nisha Devi* and R.S. Prasher**

Department of Social Sciences, Dr. Y.S Parmar University of Horticulture and Forestry, Nauni Solan - 173230, India
E-mail: nishathakuroachghat@gmail.com

**Abstract :** In Himachal Pradesh, agriculture is a very crucial part of the State's economy as it is the main occupation of people. The farmers in the State have numerous aspirations, out of which prime objective is the maximization of profits. The productive capacity of the region can be raised through accelerating agricultural growth by introduction of latest technologies, infrastructural support, crop diversification etc. High-value crops like vegetables can potentially increase farmers income as demand for high-value food products is increasing more quickly than that of the cereal crops. The present study deals with growth performance of major vegetable crops examined in the State of Himachal Pradesh. Growth was analyzed in terms of compound annual growth rate in area, production and productivity of vegetables, which was carried out at State as well as at the district level for the period 1995-96 to 2015-16. The study has revealed that the growth performance of total vegetable crops in the State was significant in area (6.20% / annum), production (7.30% / annum) and productivity (1.10 % / annum). The growth rates of area and production in almost all the districts have been found positive for different vegetables but the growth rates of productivity was found negative in large number of districts. Among vegetables, tomato and peas which had the largest area-share in the total vegetable crops sector, have paved the way of vegetables in most of the districts in the State.

***Key words:*** Growth rates, exponential production function, area, production, productivity

## 1. Introduction

Growth in area was the major source of production growth until early 1960s [Bhalla and Singha (2001), Vaidyanathan (2010)] but with the growth of technology, modernization and changes in food habits, agricultural cropping pattern of the country has undergone a major shift in the recent past, moving away from the cereal to non-cereal crops cultivation, especially towards the horticulture crops. Horticulture has been one of the fastest growing sectors within the larger agriculture activities and one of the driving forces of overall agricultural development in India. Horticulture sector encompasses a wide range of crops, for example, fruit crops, vegetable crops, potato and tuber crops, ornamental crops, medicinal and aromatic crops, spices and plantation crops. With the growth of urbanization, modernization, and increase in disposable income of the individuals, food consumption pattern gets changed greatly, shifted proportionately more towards the non-cereal crops [Popkin (1998)]. As a result, in the recent past, change in cropping pattern from conventional/ traditional to high-value cash crops has also been experienced in the Indian agriculture [Singh and Chakravorty (2013)] and at the same time, farmers are attracted by the higher market prices of the high-value cash crops. Also, growth of the horticulture sectors is not only enthused by the domestic needs but also by a large quantity of export requirements [Bhattacharyya (2008), Mittal (2007)].

Himachal Pradesh accounts for 1.39 per cent of the total area in the country and about 0.38 per cent of the net cultivated area in 2010-11. This implies that the agricultural growth performance in the State has lagged behind the average for the country as a whole. The agricultural productivity per hectare is less than national average. The analysis of the performance of major crop groups since early 1970's shows that the value productivity of traditional crops in Himachal Pradesh

**Author for correspondence* ***Received*** *August 04, 2018* ***Revised*** *October 18, 2018* ***Accepted*** *November 12, 2018*

has either declined or is stagnated. As a result the agricultural sector has recently failed to meet the requirements of the State. Productivity rates of crops, particularly, food crops, are low and possess little growth potential. On the contrary, the State has made tremendous progress in agriculture through fruits, vegetables and off-season vegetables cultivation. Himachal Pradesh is reported to be the progressive among thirteen hill States and regions in the country and is considered to be a 'model' for development of other hill areas of the Hindu Kush Himalayan region. The reasons for such a diverse record may be varied but the regional heterogeneity; peculiar agro-climatic conditions in the State, low use of non-conventional inputs, subsistence farming and relatively small irrigation potential are the most important factors limiting the growth in output and productivity. However, as noted above, hills have inherent potential for agriculture because they have comparative advantage in production of many location specific commodities of high value and suitable climate.

This paper is devoted to a statistical verification of the pattern, level of the growth in area, production and productivity of major vegetable crops in Himachal Pradesh. The study has been carried out at both the aggregated and disaggregated levels.

## 2. Methodology

In order to examine the trends in area, production and productivity of different crops, the compound growth rates were estimated separately for the districts and the State as a whole for the period 1995-96 to 2015-16 by using exponential production function of the following type.

$$Y = a\, b^{t}$$

where, Y = Area/production/productivity of crop

a = Constant

b = Regression coefficient

t = Time

CGR (%) = (Antilog b-1) × 100

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

## 3. Results and Discussion

### Diversification through vegetables

Till not long ago, Himachal Pradesh was known as an 'apple State' due to the overwhelming contribution as the main fruit crop made to the agrarian economy of this hilly State. However, as the notable revolutions in agriculture and information technology during the past two decades or so combined with the natural bounty of agro-climatic advantages in the State, vegetable cultivation catapulted the State's agriculture to new heights. Decades ago potato was the only traditional cash crop of the State in addition to apple. Of late, a variety of vegetable crops like green pea, tomato, cabbage, cauliflower, french bean, capsicum, garlic, ginger, etc., are being produced in the State. The cultivation of these cash crops however was confined to selected pockets in the mid and high hills. However, the vegetable based agricultural diversification started descending on to mid and low hills of the State towards the early 1990s. Production of the off–season vegetables and quality vegetable seeds besides the seasonal vegetables is one of the fields into which the diversification has been reported during the past decade in all the regions of the State. In those belts of the low hills and also of valleys and plains where irrigation facilities are available, growing off-season vegetable is further picking up. Fresh peas grown in the State are of premium quality and fetch a higher price particularly in the plains where it is an off-season luxury. Vegetable seed production is a dominant feature of vegetable cultivation in the State as the climate of the low hills and valleys and plains is very conducive to seed production. Cultivation of exotic vegetables like broccoli, asparagus, leek, parsley, brussels sprout, and others is catching up fast as these vegetables are specially demanded in hotels and by foreign tourists. The advantage of topography and availability of adequate irrigation water enables cultivators of low hills, valleys and plains to grow out-of-season vegetables.

The area under vegetable crops has witnessed rapid increase in recent years. Table 1 shows that area under vegetable crops increased from 24.98 thousand hectares in the 1995-96 to 75.23 thousand hectares in 2015-16. The production during the same period surged from 424.80 thousand tonnes to around 1608.55 thousand tones. The productivity level, however, increased marginally from around 17.01 tonnes/ha to 21.38 tonnes per hectare during the same period. The productivity of different vegetable crops increased at the same time, but this increase was not very high. Most of the increase in vegetable production in the State has come through an increase in the area under these crops. The

**Table 1:** Share of area, production and productivity of vegetables in Himachal Pradesh from 1995-96 to 2015-16

| | Crops and crop groups | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | Peas (green) | Tomato | Beans | Onion/ Garlic | Cabb-age | Cauli-flower | Radish/ carrot | Bhindi | Cucur-bits | Capsi-cum/ Chillies | Brinjal | Other vege-tables | Total vege-tables |
| Area (000ha.) | 1995-96 | 7.27 | 2.57 | 2.06 | 1.50 | 1.64 | 0.69 | 0.85 | 0.39 | 2.63 | 1.05 | 0.27 | 4.08 | 24.98 |
| | 2000-01 | 9.40 | 6.00 | 2.17 | 2.02 | 2.15 | 1.34 | 1.02 | 0.71 | 2.50 | 1.63 | 0.40 | 2.66 | 32.00 |
| | 2005-06 | 16.35 | 9.21 | 2.67 | 3.74 | 3.68 | 2.26 | 1.57 | 1.73 | 2.08 | 2.08 | 0.77 | 3.72 | 49.86 |
| | 2010-11 | 22.82 | 9.94 | 3.01 | 5.73 | 4.51 | 3.00 | 1.94 | 2.43 | 2.46 | 3.21 | 1.04 | 4.94 | 65.08 |
| | 2015-16 | 23.57 | 11.04 | 3.69 | 6.72 | 4.91 | 5.27 | 2.92 | 2.90 | 2.74 | 3.61 | 1.21 | 6.67 | 75.23 |
| Production (000MT) | 1995-96 | 72.77 | 79.06 | 20.85 | 29.54 | 42.66 | 13.60 | 18.42 | 4.88 | 83.90 | 10.24 | 4.53 | 44.36 | 424.80 |
| | 2000-01 | 90.00 | 207.87 | 21.31 | 37.08 | 61.82 | 24.34 | 17.90 | 5.80 | 62.48 | 15.25 | 7.02 | 29.14 | 580.00 |
| | 2005-06 | 177.04 | 301.18 | 27.97 | 49.62 | 115.92 | 53.10 | 32.68 | 19.66 | 43.85 | 30.88 | 14.27 | 63.82 | 929.98 |
| | 2010-11 | 254.18 | 388.43 | 35.79 | 83.11 | 144.23 | 60.70 | 45.17 | 29.60 | 63.12 | 44.89 | 25.12 | 94.56 | 1268.90 |
| | 2015-16 | 276.36 | 485.54 | 44.69 | 123.04 | 160.74 | 119.01 | 61.65 | 38.77 | 66.35 | 71.93 | 27.71 | 135.44 | 1608.55 |
| Productivity (MT/ha) | 1995-96 | 10.01 | 30.76 | 10.12 | 19.69 | 26.01 | 19.71 | 21.80 | 12.50 | 31.90 | 9.80 | 17.10 | 10.89 | 17.01 |
| | 2000-01 | 9.57 | 34.65 | 9.82 | 18.35 | 28.75 | 18.16 | 17.55 | 8.17 | 24.99 | 9.36 | 17.55 | 10.95 | 18.13 |
| | 2005-06 | 10.83 | 32.70 | 10.46 | 13.29 | 31.53 | 23.47 | 20.80 | 11.38 | 21.06 | 14.84 | 18.48 | 17.17 | 18.65 |
| | 2010-11 | 11.14 | 39.06 | 11.88 | 14.50 | 31.96 | 20.22 | 23.28 | 12.18 | 25.70 | 14.00 | 24.09 | 19.14 | 19.50 |
| | 2015-16 | 11.72 | 43.99 | 12.12 | 18.31 | 32.77 | 22.58 | 21.14 | 13.35 | 24.26 | 19.95 | 22.84 | 20.32 | 21.38 |

**Source**: Directorate of Agriculture, Government of HP, Shimla.

composition of area and production of different vegetable crops (Table 2 and 3) in the State reveals that pea, tomato, cabbage, cauliflower, beans, capsicum, onion and garlic are the main crops grown in the State.

Among these, about one third of total area and one-fifth of total production in the State in 2015-16 were accounted for by green pea only. Second most important crop was tomato whose shares in total area and production were 14.67 and 30.18 per cent, respectively.

**District wise compound annual growth rates of area of different vegetables**

To better understand the trends in cropping pattern of high value crops compound annual growth rates of area under major vegetables in Himachal Pradesh were computed and presented in Table 4. By simply eyeballing the tables for the State, it can be observed that the area under most of the crops increased continuously. It may be attributable to better utilization of the existing infrastructure in addition to growing importance and a wider spread of productivity-raising technology in the recent period. The area under peas expanded at the rate of 7.00 per cent per annum (% p.a.). Following the same trend, area under tomato cultivation increased, registering annual growth rates of 5.80 per cent in that order and area allocated to beans followed the same increasing tendency with growth rate of 3.60 per cent per annum, respectively. Likewise, area allotted to vegetables like onion (8.30% pa), cabbage (6.30% pa), cauliflower (9.70% pa), radish (6.70% pa), bhindi (10.40% pa), capsicum (6.00% pa), brinjal (8.40% pa), other vegetables (4.50% pa) and total vegetables (6.20% pa) increased at varying rates in the selected period.

An analysis of compound annual growth rates of area under vegetables at the district level revealed that among the vegetables producing districts, acreage under peas increased in almost all the districts (eleven) with highest increase was observed in Chamba (12.50% pa), except Bilaspur which registered the non significant change. Five out of twelve districts reported higher growth rates in area than the State average. The assessment of trends in area allocated to tomato during the study period also demonstrated increasing trend in eleven districts except Lahaul-Spiti (-1.60% pa) with highest growth in Chamba district (12.80% pa) and minimum in Kullu (2.80% pa). The results of the present study revealed that, area put to beans grew up

**Table 2:** Crop-wise area share of different vegetables in Himachal Pradesh from 1995-96 to 2015-16 (Percent)

| Crops | Years | | | | |
|---|---|---|---|---|---|
| | 1995-1996 | 2000-2001 | 2005-2006 | 2010-11 | 2015-2016 |
| **Peas(green)** | 29.10 | 29.38 | 32.79 | 35.07 | 31.33 |
| **Tomato** | 10.29 | 18.75 | 18.47 | 15.28 | 14.67 |
| **Beans** | 8.25 | 6.78 | 5.36 | 4.63 | 4.90 |
| **Onion/Garlic** | 6.00 | 6.31 | 7.49 | 8.81 | 8.93 |
| **Cabbage** | 6.57 | 6.72 | 7.37 | 6.94 | 6.52 |
| **Cauliflower** | 2.76 | 4.19 | 4.54 | 4.61 | 7.00 |
| **Radish/Carrot** | 3.38 | 3.19 | 3.15 | 2.98 | 3.88 |
| **Bhindi** | 1.56 | 2.22 | 3.47 | 3.74 | 3.86 |
| **Cucurbits** | 10.53 | 7.81 | 4.18 | 3.77 | 3.64 |
| **Capsicum /Chillies** | 4.18 | 5.09 | 4.17 | 4.93 | 4.79 |
| **Brinjal** | 1.06 | 1.25 | 1.55 | 1.60 | 1.61 |
| **Other vegetables** | 16.31 | 8.31 | 7.45 | 7.59 | 8.86 |
| **Total vegetables** | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

**Table 3:** Crop-wise production share of different vegetables in Himachal Pradesh from 1995-96 to 2015-16 (Percent)

| Crops | Years | | | | |
|---|---|---|---|---|---|
| | 1995-1996 | 2000-2001 | 2005-2006 | 2010-11 | 2015-2016 |
| **Peas(green)** | 17.13 | 15.52 | 19.04 | 20.03 | 17.18 |
| **Tomato** | 18.61 | 35.84 | 32.39 | 30.61 | 30.18 |
| **Beans** | 4.91 | 3.67 | 3.01 | 2.82 | 2.78 |
| **Onion/Garlic** | 6.95 | 6.39 | 5.34 | 6.55 | 7.65 |
| **Cabbage** | 10.04 | 10.66 | 12.46 | 11.37 | 9.99 |
| **Cauliflower** | 3.20 | 4.20 | 5.71 | 4.78 | 7.40 |
| **Radish/Carrot** | 4.34 | 3.09 | 3.51 | 3.56 | 3.83 |
| **Bhindi** | 1.15 | 1.00 | 2.11 | 2.33 | 2.41 |
| **Cucurbits** | 19.75 | 10.77 | 4.71 | 4.97 | 4.12 |
| **Capsicum /Chillies** | 2.41 | 2.63 | 3.32 | 3.54 | 4.47 |
| **Brinjal** | 1.07 | 1.21 | 1.53 | 1.98 | 1.72 |
| **Other vegetables** | 10.44 | 5.02 | 6.86 | 7.45 | 8.42 |
| **Total vegetables** | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

conspicuously in the range from 6.40% pa in Kinnaur to 1.70% pa in Hamirpur. Bilaspur, Chamba and Solan were the districts which registered non-significant change in the acreage under cabbage while rest of the districts had positive growth rate. Trend was more interesting in case of cauliflower for which all (twelve) the districts registered the positive growth rate in acreage ranging from 18.70% pa in Hamirpur to 3.50% pa in Una. Area allocated to capsicum and chillies went up significantly in seven districts with yearly growth rates varying from 3.30 per cent in Shimla to 10.20 per cent in Hamirpur, but it declined in Chamba (5.30% p.a.) only. As far as growth in area under total vegetables was concerned, it increased in all districts with maximum annual growth rates was observed in Kinnaur (10.40% pa) and minimum in Una (3.40% pa).

### District wise compound annual growth rates of production of different vegetables

Table 5 displays compound annual growth rates of production of major vegetables crops. Growth analysis of production of vegetables for the State revealed that the area expansion as well as productivity increase caused the output to grow. A significant change of 8.20% pa was observed in peas production during study period. Tomato and beans, registered a significant growth of 7.70 per cent and 4.90 per cent per annum respectively and total vegetables exhibited growth rates 7.30% pa which was significant. Contrarily, production of cucurbits (-0.80% pa) registered the negative growth.

An analysis of compound annual growth rates of production under vegetables at the district level revealed that the production of peas was observed maximum in Chamba (16.50% pa) and minimum in Solan (2.30% pa) during study period. Tomato is an important crop in the State and is grown throughout the State. Time trends in tomato output were observed to be positive and significant in eleven districts, recording per annum growth rates ranging from 6.00 per cent in Sirmour to 16.40 per cent in Kinnaur. Eight out of twelve districts reported the higher growth rates in output of tomato than the State average. Investigation of beans production for the study period depicted that it grew up in most of the districts (eight) registering growth rates

**Table 4:** District-wise compound annual growth rates of area under different vegetables in Himachal Pradesh from 1995-96 to 2015-16 (Percent per annum)

| Distrcts | Crops and crop groups | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peas (green) | Tomato | Beans | Onion/ Garlic | Cabb-age | Cauli-flower | Radish/ Turnip & carrot | Bhindi | Cucurbits | Capsicum /Chillies | Brinjal | Other vegetables | Total vegetables |
| **Bilaspur** | -0.70 (0.90) | 10.60*** (1.60) | 0.70 (0.60) | 4.90*** (0.70) | -0.90 (0.90) | 5.20*** (0.80) | -1.60* (0.80) | 7.20*** (0.50) | -0.60 (0.50) | -1.10 (1.60) | -1.80 (1.10) | 5.80*** (0.70) | 3.50*** (0.30) |
| **Chamba** | 12.50*** (1.10) | 12.80*** (1.40) | 3.30** (1.30) | 0.90 (1.20) | 1.40 (1.10) | 4.80*** (1.20) | 7.30*** (0.80) | 10.30*** (1.00) | -10.60*** (2.00) | -5.30*** (1.50) | 5.20*** (1.20) | -2.00** (0.80) | 6.20*** (0.40) |
| **Hamirpur** | 6.50*** (0.40) | 7.60*** (1.20) | 1.70** (0.70) | 12.10*** (0.70) | 13.30*** (1.60) | 18.70*** (1.10) | 11.50*** (0.70) | 13.70*** (1.10) | 5.40*** (1.10) | 10.20*** (1.70) | 13.00*** (1.20) | 11.90*** (1.40) | 10.30*** (0.60) |
| **Kangra** | 6.40*** (0.40) | 8.00*** (0.70) | 3.00*** (0.50) | 7.50*** (0.50) | 11.90*** (1.30) | 12.90*** (1.00) | 14.00*** (1.40) | 10.90*** (1.40) | 3.10*** (0.40) | 8.60*** (0.70) | 11.90*** (1.40) | 7.40*** (1.60) | 7.70*** (0.80) |
| **Kinnaur** | 12.40*** (1.20) | 12.30*** (1.20) | 6.40*** (0.50) | -1.40 (1.70) | 8.70*** (1.00) | 9.30*** (1.50) | 9.00*** (1.00) | 6.60*** (1.40) | 7.10*** (1.00) | - | 9.00*** (1.00) | 11.80*** (2.10) | 10.40*** (0.80) |
| **Kullu** | 10.20*** (0.60) | 2.80*** (0.60) | -0.50 (0.60) | 10.80*** (1.90) | 5.60*** (0.60) | 5.90*** (0.60) | 7.70*** (1.40) | 7.70*** (2.20) | -1.60 (0.90) | 0.00 (1.30) | 6.10*** (0.90) | -6.10* (3.00) | 5.20*** (0.20) |
| **L & S** | 8.60*** (1.40) | -1.60 (1.60) | -4.70*** (1.00) | -19.70*** (1.60) | 8.40*** (1.20) | 14.20*** (2.30) | 11.10*** (1.70) | - | -0.50 (2.00) | - | - | 12.10*** (1.50) | 8.50*** (1.10) |
| **Mandi** | 8.30*** (0.60) | 9.60*** (2.10) | 1.50*** (0.50) | 8.10*** (1.20) | 17.30*** (1.30) | 15.70*** (0.80) | 13.70*** (0.90) | 14.70*** (2.60) | 1.60 (2.20) | 6.10*** (0.40) | 10.60*** (0.90) | 4.30*** (1.30) | 7.80*** (0.40) |
| **Shimla** | 6.90*** (0.60) | 6.40*** (1.70) | 6.00*** (0.20) | -1.50 (1.30) | 4.10*** (0.60) | 9.70*** (1.20) | 7.30*** (0.60) | 10.50*** (2.00) | 0.30 (0.30) | 3.30*** (0.70) | 7.50*** (0.90) | 2.60*** (0.80) | 5.90*** (0.30) |
| **Sirmour** | 3.30*** (0.60) | 4.30*** (0.60) | 5.00*** (0.60) | 16.60*** (1.30) | 5.20*** (0.40) | 4.90*** (0.40) | 3.10*** (0.50) | 8.40*** (0.30) | -5.10*** (0.90) | 8.40*** (0.50) | 6.60*** (0.50) | -5.40** (2.40) | 4.90*** (0.10) |
| **Solan** | 1.60*** (0.50) | 5.70*** (0.60) | 3.90*** (1.10) | 2.30*** (0.80) | 0.10 (0.40) | 7.50*** (0.40) | -1.80 (1.10) | 12.20*** (1.80) | -4.70*** (1.50) | 7.90*** (0.80) | 10.50*** (2.40) | 8.00** (3.00) | 4.50*** (0.30) |
| **Una** | 4.70*** (0.80) | 10.80*** (0.80) | 0.80 (0.50) | 6.80*** (0.60) | 3.00*** (0.30) | 3.50*** (0.30) | 3.10*** (0.30) | 3.70*** (0.70) | 3.80*** (0.40) | 6.20*** (0.40) | 5.30*** (0.70) | -4.80** (1.90) | 3.40*** (0.20) |
| **HP** | 7.00*** (0.40) | 5.80*** (0.80) | 3.60*** (0.20) | 8.30*** (0.60) | 6.30*** (0.40) | 9.70*** (0.30) | 6.70*** (0.30) | 10.40*** (0.60) | 0.60* (0.30) | 6.00*** (0.30) | 8.40*** (0.50) | 4.50*** (0.90) | 6.20*** (0.20) |

**Source:** Directorate of Agriculture, Shimla, Himachal Pradesh

**Note:** *** denotes the significance at 1% level of probability, ** at 5% and * at 10%

Figures in the parentheses are standard errors of growth rates

**Table 5:** District-wise compound annual growth rates of production of different vegetables in Himachal Pradesh from 1995-96 to 2015-16 (Percent per annum)

| Distrcts | Crops and crop groups | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peas (green) | Tomato | Beans | Onion/ Garlic | Cabb-age | Cauli-flower | Radish/ Turnip & carrot | Bhindi | Cucurbits | Capsicum /Chillies | Brinjal | Other vegetables | Total vegetables |
| **Bilaspur** | 3.30*** (1.00) | 12.90*** (1.60) | 4.20*** (0.70) | 6.20*** (1.10) | 2.30** (1.00) | 7.30*** (0.80) | 1.30 (0.80) | 11.60*** (0.70) | 2.40 (1.80) | 6.70*** (1.60) | 1.80* (1.10) | 10.30*** (1.00) | 7.20*** (0.30) |
| **Chamba** | 16.50*** (1.80) | 14.10*** (1.40) | 5.00*** (1.20) | 1.20 (1.60) | 0.90 (1.60) | 7.80*** (2.00) | 11.50*** (0.90) | 12.30*** (1.20) | -12.00*** (2.10) | -1.20 (1.40) | 7.10*** (1.10) | 1.40 (1.00) | 7.30*** (0.80) |
| **Hamirpur** | 5.00*** (0.60) | 11.10*** (1.10) | 2.10 (1.30) | 12.50*** (0.70) | 10.20*** (1.90) | 17.80*** (1.20) | 11.50*** (0.90) | 17.00*** (2.00) | 2.20 (1.60) | 13.30*** (3.10) | 13.30*** (1.10) | 13.80*** (1.40) | 9.70*** (0.50) |
| **Kangra** | 8.00*** (0.60) | 13.50*** (2.00) | 5.30*** (0.70) | 7.00*** (0.40) | 14.70*** (1.30) | 14.50*** (0.80) | 15.90*** (1.70) | 13.00*** (1.50) | 3.30*** (0.90) | 10.30*** (0.80) | 14.60*** (1.20) | 11.20*** (1.80) | 9.40*** (0.70) |
| **Kinnaur** | 12.40*** (1.20) | 16.40*** (2.80) | 7.50*** (0.60) | -3.90** (1.80) | 6.90*** (1.30) | 3.00** (2.30) | 8.70*** (1.10) | 7.30*** (1.40) | 6.20*** (1.10) | - | 7.90*** (1.00) | 15.50*** (2.50) | 11.10*** (0.90) |
| **Kullu** | 12.30*** (0.90) | 7.60*** (2.00) | -0.60 (1.20) | 10.30*** (1.00) | 6.10*** (0.90) | 6.30*** (0.90) | 7.50*** (1.40) | 9.70*** (1.90) | -3.20* (1.70) | 1.30 (1.20) | 6.80*** (1.60) | -4.50 (3.10) | 5.80*** (0.60) |
| **L & S** | 8.50*** (1.60) | -4.20** (1.90) | -6.40*** (0.70) | -22.70*** (2.40) | 6.60*** (1.80) | 16.50*** (2.60) | 10.10*** (1.70) | - | 3.00 (3.20) | - | - | 16.40*** (1.80) | 8.70*** (1.20) |
| **Mandi** | 9.70*** (1.10) | 11.40*** (1.50) | 1.20 (0.80) | 7.50*** (2.00) | 17.90*** (2.10) | 17.20*** (1.10) | 14.10*** (1.20) | 15.70*** (2.50) | 0.30 (2.90) | 9.20*** (0.50) | 11.60*** (1.10) | 8.70*** (1.70) | 9.40*** (0.50) |
| **Shimla** | 7.50*** (0.60) | 7.90*** (1.60) | 6.20** (1.90) | -0.20 (2.20) | 6.00*** (0.70) | 11.00*** (1.20) | 5.30*** (0.60) | 12.60*** (1.10) | -1.70*** (0.40) | 6.50*** (1.00) | 8.40*** (1.00) | 4.90*** (0.80) | 6.70*** (0.30) |
| **Sirmour** | 4.10*** (0.60) | 6.00*** (0.70) | 5.90*** (0.60) | 15.70*** (1.10) | 7.60*** (0.30) | 4.20*** (0.30) | 3.20*** (0.40) | 10.50*** (0.50) | -5.00*** (0.80) | 12.10*** (0.70) | 8.40*** (0.60) | -2.50 (2.30) | 5.80*** (0.30) |
| **Solan** | 2.30*** (0.70) | 7.60*** (0.40) | 6.80*** (1.60) | 3.00*** (1.00) | 1.70** (0.80) | 9.90*** (0.80) | -0.50 (1.40) | 15.60*** (2.00) | -6.70** (2.70) | 15.00*** (2.10) | 9.10*** (2.50) | 13.50*** (3.60) | 6.70*** (0.30) |
| **Una** | 5.30*** (0.80) | 12.60*** (1.30) | 2.30*** (0.70) | 5.40*** (0.60) | 2.50*** (0.40) | 3.90*** (0.30) | 4.40*** (0.50) | 6.50*** (0.50) | 1.20*** (0.30) | 8.70*** (0.70) | 6.60*** (0.70) | -3.20 (1.70) | 3.30*** (0.30) |
| **HP** | 8.20*** (0.50) | 7.70*** (0.50) | 4.90*** (0.30) | 11.10*** (1.70) | 7.50*** (0.50) | 10.70*** (0.40) | 7.60*** (0.50) | 12.50*** (0.80) | -0.80 (0.60) | 10.30*** (0.40) | 10.00*** (0.70) | 8.10*** (1.00) | 7.30*** (0.20) |

**Source:** Directorate of Agriculture, Shimla, Himachal Pradesh

**Note:** *** denotes the significance at 1% level of probability, ** at 5% and * at 10%

Figures in the parentheses are standard errors of growth rates

**Table 6:** District-wise compound annual growth rates of productivity of different vegetables in Himachal Pradesh from 1995-96 to 2015-16 (Percent per annum)

| Distrcts | Crops and crop groups | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peas (green) | Tomato | Beans | Onion/ Garlic | Cabb-age | Cauli-flower | Radish/ Turnip & carrot | Bhindi | Cucurbits | Capsicum /Chillies | Brinjal | Other vegetables | Total vegetables |
| **Bilaspur** | 4.00*** (0.90) | 2.30*** (0.40) | 3.50*** (0.30) | 1.30*** (0.40) | 3.10*** (0.40) | 2.20*** (0.50) | 2.80*** (0.30) | 4.40*** (0.60) | 3.00* (1.80) | 7.80*** (0.60) | 3.60*** (0.20) | 4.50*** 0.50) | 3.70*** (0.30) |
| **Chamba** | 3.90*** (1.00) | 1.30*** (0.40) | 1.70*** (0.50) | 0.30 (0.50) | -0.50 (0.80) | 3.10 (2.00) | 4.10*** (0.70) | 2.00*** (0.60) | -1.30** (0.60) | 4.10*** (0.40) | 1.90*** (0.30) | 3.50*** (0.60) | 1.10* (0.60) |
| **Hamirpur** | -1.50*** ( 0.50) | 3.60*** (1.00) | 0.40 (0.70) | 0.40 (0.30) | -3.20*** (0.60) | -0.80*** (0.30) | 0.00 (0.40) | 0.30* (1.90) | -3.20*** (0.70) | 3.00** (1.40) | 0.30 (0.50) | 1.90 (1.30) | -0.60 (0.40) |
| **Kangra** | 1.60*** (0.50) | 5.50*** (1.70) | 0.30*** (0.50) | -0.50 (0.40) | 2.80*** (0.40) | 1.70** (0.70) | 1.90*** (0.70) | 2.10*** (0.50) | 0.20 (0.80) | 1.60** (0.70) | 2.70*** (0.30) | 3.80*** (0.50) | 1.70*** (0.30) |
| **Kinnaur** | 0.00 (0.50) | 4.10* (2.40) | 1.20*** (0.30) | -2.40*** (0.30) | -1.80*** (0.70) | -6.30** (2.70) | -0.20 (0.40) | 3.40** (1.60) | -1.00** (0.40) | 19.00*** (2.90) | -1.00*** (0.30) | 3.70*** (0.50) | 0.60** (0.30) |
| **Kullu** | 2.10*** (0.50) | 4.90*** (1.80) | 0.00 (0.60) | -0.50 (1.40) | 0.60 (0.50) | 0.30 (0.50) | -0.10 (0.40) | 2.00** (0.90) | -1.70 (2.00) | 1.20*** (0.40) | 0.70 (1.00) | 1.60*** (0.50) | 0.70 (0.60) |
| **L & S** | -0.10 (0.30) | -2.60*** (0.90) | -1.70*** (0.60) | -3.10*** (1.10) | -1.80 (1.50) | 2.30** (1.00) | -1.00*** (0.20) | - | -2.20 (2.60) | - | - | 4.30*** (0.90) | 0.30 (0.30) |
| **Mandi** | 1.40** (0.60) | 1.80 (1.10) | -0.30 (0.50) | 0.60 (1.70) | 0.60 (1.50) | 1.50** (0.70) | 0.40 (0.60) | 1.00 (1.10) | -1.30 (0.90) | 3.20*** (0.50) | 1.00* (0.60) | 4.50*** (0.70) | 1.60*** (0.40) |
| **Shimla** | 0.60*** (0.10) | 1.50*** (0.30) | 0.20 (1.90) | 1.30 (1.80) | 1.90*** (0.30) | 1.30*** (0.10) | -2.00*** (0.40) | 2.20* (1.20) | -2.00*** (0.30) | 3.20*** (0.50) | 1.00*** (0.10) | 2.30*** (0.50) | 0.80*** (0.20) |
| **Sirmour** | 0.90*** (0.20) | 1.70*** (0.30) | 0.90*** (0.20) | -0.80 (0.60) | 2.50*** (0.40) | -0.70** (0.30) | 0.00 (0.30) | 2.10*** (0.40) | 0.10 (0.40) | 3.70*** (0.50) | 1.70*** (0.20) | 2.90*** (0.50) | 0.90*** (0.20) |
| **Solan** | 0.70** (0.30) | 1.90*** (0.30) | 2.90*** (0.60) | 0.70 (0.60) | 1.70* (0.90) | 2.40*** (0.80) | 1.30* (0.70) | 3.40*** (0.80) | -2.10 (1.50) | 7.20*** (1.90) | -1.40** (0.70) | 5.50*** (0.70) | 2.20*** (0.20) |
| **Una** | 0.60*** (0.20) | 1.80* (1.00) | 1.50*** (0.40) | -1.40*** (0.50) | -0.50* (0.30) | 0.30 (0.30) | 1.30*** (0.30) | 2.90*** (0.50) | -2.60*** (0.40) | 2.50*** (0.40) | 1.30*** (0.20) | 1.60*** (0.40) | 0.00 (0.20) |
| **HP** | 1.20*** (0.10) | 1.90*** (0.40) | 1.30*** (0.20) | 2.80 (2.00) | 1.20*** (0.20) | 1.10*** (0.20) | 0.90*** (0.30) | 2.20*** (0.40) | -1.30*** (0.40) | 4.30*** (0.40) | 1.50*** (0.50) | 3.60*** (0.40) | 1.10*** (0.10) |

**Source:** Directorate of Agriculture, Shimla, Himachal Pradesh

**Note:** *** denotes the significance at 1% level of probability, ** at 5% and * at 10%

Figures in the parentheses are standard errors of growth rates

varying from 1.20 per cent per annum in Mandi to 7.50 per cent per annum in Kinnaur but, it declined in Lahaul & Spiti (6.40% p.a.). It was not significant, in the remaining districts. Assessment of cabbage production depicted that, it grew up in almost all the districts of State which ranged between 1.70% pa in Solan to 17.90% pa in Mandi, whereas Chamba had non conspicuous change. In relation to the assessment of the growth behaviour of production under cauliflower, it was evident that all the districts sustained increasing trend by securing growth rate between 3.00 per cent per annum in Kinnaur to 17.80% pa in Hamirpur. Cucurbits production declined at varying rate in the districts of Chamba (12.00% pa), Solan (6.70% pa), Sirmour (5.00% pa), Kullu (3.20% pa) and Shimla (1.70% pa) while, it increased in districts of Kinnaur (6.20% pa), Kangra (3.30% pa) and Una (1.20% pa) and no conspicuous ups or downs was observed in rest of the districts during the study period. Time trends in capsicum and chillies output were observed to be positive and significant in eight out of twelve districts. Non significant ups or downs were observed in Chamba, Kinnaur, Lahaul-Spiti and Kullu. Brinjal production exhibited the positive growth in all the districts barring Lahaul-Spiti (no change). The analysis of total vegetables production for the overall period demonstrated that it grew up in all the districts with highest rate of increase was recorded in Kinnaur (11.10% pa) and minimum in Una (3.30% pa).

**District wise compound annual growth rates of productivity of different vegetables**

By simply looking at the Table 6 for the State, It was observed that during the study period all the crops registered the significant increasing growth rate in productivity of all the vegetable crops except cucurbits and onion/garlic. An assessment of the growth of crop productivity at disaggregated level of districts revealed that productivity of peas declined significantly only in Hamirpur (1.50% pa) and increased in nine districts of the State with growth rate ranged from 4.00% pa in Bilaspur to 0.60% pa in Una and Shimla. Increase or decrease was not conspicuous in Kinnaur and Lahaul-Spiti. However, the overall trend in productivity of tomato was fascinating for most of the districts (ten) depicted perceptible growth in the productivity of tomato ranging from 1.30 per cent per annum in Chamba to 5.50 per cent per annum in Kangra. Lahaul-Spiti exhibited decreasing growth rate of 2.60% pa while, Mandi registered the non significant change in the productivity of tomato. The growth path of beans productivity showed that only Lahaul-Spiti registered the declining growth rate of 1.70% pa. Over the whole study period though productivity of onion/garlic increased only in Bilaspur (1.30% pa) and declined in Kinnaur (2.40% pa), Lahaul-Spiti (3.10% pa) and Una (1.40% pa), the growth rates were not significant in rest of the districts. Una (0.50% pa), Hamirpur (3.20% pa) and Kinnaur (1.80% pa) experienced the declining growth rate in productivity of cabbage while it increased in the districts of Bilaspur (3.10% pa), Kangra (2.80% pa), Sirmour (2.50% pa) Shimla (1.90% pa) and Solan (1.70% pa).

By looking at the overall trend of the productivity of cauliflower, it was evident that it increased in half of the districts with the range of 1.30% pa in Shimla to 2.40% pa in Solan and declined in Sirmour (0.70% pa), Hamirpur (0.80% pa) and Kinnaur (6.30% pa). Moreover, productivity trend of radish, turnip & carrot depicted that it declined in Lahaul-Spiti (1.00% pa) and Shimla (2.00% pa) and increased considerably in five districts *viz.* Bilaspur (2.80% pa), Chamba (4.10% pa), Kangra (1.90% pa) Solan (1.30% pa) and Una (1.30% pa). Majority of the districts (ten) experienced significant upward growth in the productivity of bhindi while, Lahaul-Spiti and Mandi registered a non significant change. Likewise, in case of cucurbits, productivity of cucurbits increased only in Bilaspur (3.00% pa) and declined in Chamba (1.30% pa), Hamirpur (3.20% pa), Kinnaur (1.00% pa), Shimla (2.00% pa) and Una (2.60% pa).

The trend was more fascinating when the productivity of capsicum/chillies increased in most of the districts (eleven) with highest growth was observed in Kinnaur (19.00% pa) and minimum in Kullu (1.20% pa) barring Lahaul-Spiti which observed non significant change. Study period depicted that productivity of total vegetables grew up in only eight districts of Himachal Pradesh with the growth rate range from 0.60 per cent per annum in Kinnaur to 3.70 per cent per annum in Bilaspur. The increases or decreases were, however, not significant in the districts of Hamirpur, Kullu, Lahaul-Spiti and Una.

## 4. Conclusion

The present study examined the growth performance of area of cultivation, production and

productivity of major vegetable crops in Himachal Pradesh. Pea, tomato, cabbage, cauliflower, beans, capsicum, onion and garlic were the main crops grown in the State. The growth rate revealed that, fairly large number of districts had positive growth regarding area and production of pea, tomato, cabbage and cauliflower. While in case of productivity tomato, capsicum/chillies and peas were the vegetables for which large number of districts had positive growth rate. Yet, few districts had negative growth. Area under different vegetable crops was increasing at varying rates in almost all the districts except Lahaul-Spiti. Lahaul-Spiti had negative growth rates or statistically non-significant change for most of the vegetables during the study period. Similarly, due to area expansion, production of these vegetables was increasing at different rates in these districts. At the same time an undesirable trend of decline in yield growth for more vegetable crops in large number of districts has emerged. Though, the decrease in yield growth had been marginal and statistically non-significant. Hence, State needs development strategy to boost production and productivity of vegetables. Adoption of modern technology is a pre-condition to boost the production and productivity under the cultivation of vegetable crops in Himachal Pradesh.

## Acknowledgement

Authors are thankful to the Editor and learned Referee for their fruitful and critical comments which have led much improvement on the earlier draft of this manuscript.

## References

Bhalla, G.S. and Gurmail Singh (2001). Economic liberalisation and Indian agriculture: a statewise analysis. *Economic and Political Weekly,* **44**, 34-44.

Bhattacharyya, Ruma (2008). Crop diversification : a search for an alternative income of the farmers in the state of West Bengal in India. *International Conference on Applied Economics*–ICOAE. pp. 83-94.

Mittal, S. (2007). Can horticulture be a success story for India Working Paper No. 197, New Delhi: Indian Council for Research on International Economic Relations.

Popkin, B. (1998). The nutrition transition and its health implications in lower-income countries. *Public Health Nutrition,* **1**, 5-21.

Singha, K. and A. Chakravorty (2013). Crop diversification in India: a study of maize cultivation in Karnataka. *Scientific Journal of Review,* **2**, 1-10.

Vaidyanathan, A. (2010). Agricultural growth in India: role of technology incentives and institutions. New Delhi: Oxford University Press. 38p.