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Growth and instability in vegetable production in Himachal Pradesh

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Abstract

The study aims to examine the growth performance of vegetables in Himachal Pradesh. The study is entirely based on secondary data collected from various publications of the state government. The trends in area, production and yield of major vegetables in Himachal Pradesh were worked out through compound growth rate, instability index and decomposition analysis. The analysis was done for the period, triennium ending (TE) 1997-98 to 2021-22. The study revealed that area, production and productivity of vegetable crops increased during the study period, however, the increase in area and production was higher than increase in the productivity. Also, the growth trend of total vegetable crops in the state was significant in area (5.47% p.a), production (6.64% p.a) and productivity (1.12% p.a). Among different vegetables grown in the state, greatest increase in the area, production and productivity was found in cauliflower followed by peas. The peas had dominated the cropping pattern with maximum share in area (27.53%) and tomato had maximum share in the production (27.80%). The instability in area, production and yield of selected vegetables and total vegetables was found very low which indicated that area under vegetables has increased steadily. Decomposition analysis of vegetable production revealed that overall increase in production of vegetable crops was due to area expansion. It was concluded that both agro-ecological as well as economic factors favour the cultivation of vegetable crops in Himachal Pradesh.

Key words: Vegetables, growth, instability and decomposition analysis

India has achieved self-sufficiency and a good degree of stability in food production. This has created an urgent need for providing health security to the population by supplying nutrition through balanced diet. Vegetables form the most important component of a balanced diet. Himachal Pradesh has a potential of becoming vegetable bowl of the country as the State has been endowed with a wide range of agro-climatic conditions due to which a large number of horticulture commodities like fruit crops (from temperate to sub tropical), flowers, vegetables, mushrooms, hops, tea, medicinal & aromatic plants, etc. are successfully grown here. During 2021-22, area under vegetables in Himachal Pradesh was 90.94 thousand hectares and the resultant production was 19.36 lakh tonnes with an average yield of 21.29 tonnes per hectare (Anonymous 2021). The major vegetables (peas, tomato, cauliflower and cabbage) contribute 54.10 per cent and 59.22 per cent of the total area and production of vegetables, respectively in the state. The growth in area and production of crops over a period is different as some areas witness more variability than others, so it is necessary to study the trend pattern of area, production and yield of selected vegetable crops in different districts of the state. Vegetable production is labour intensive, short duration and more profitable which fits well in the marginal and small farm production systems (Bindra *et al*. 2010). It provides regular work throughout the year to the vegetable growers. It is therefore, expected that vegetable production would augment income and employment opportunities for small and marginal farmers of the state and also accelerate the growth of state domestic product. With this background, the study was undertaken to examine the growth performance of major vegetable crops grown in the state. Decomposition analysis has been carried out to examine the causes of production variations during

the period under study.

Methodology

The secondary data in respect of area and production of selected crops were collected from the records and reports of the Directorate of Economics and Statistics and Directorate of Agriculture, Government of Himachal Pradesh, Shimla. The data were taken from 1995-96 onwards because the data for all the twelve districts were available from this year onwards. The analysis was done for the period, triennium ending (TE) 1997-98 to 2021-22 (overall period) which was further divided into two sub-periods, *viz*., period-I from 1997-98 to 2008-09, period-II from 2009-10 to 2021-22. The following statistical tools were employed for data analysis and interpretation of results.

Statistical Analysis

i. Estimation of Growth Rates

To work out the trends in area, production and yield, compound annual growth rates (CAGRs) were computed by using the following formula:

$Y = ab^t$

CGR (%) = (antilog of b – 1) ×100

where,

Y= Area, production and yield of selected crop,

a = Constant term,

b = Regression coefficient,

t = Time variable in years (1, 2, 3, ……, n)

ii. Instability Index: Cuddy-Della Valle Index

Cuddy-Della Valle Instability Index was used to estimate the instability in area, production and yield. This index is a modification of Coefficient of Variation (CV) to accommodate for trend, which is commonly present in time series economic data. It is superior over other scale dependent measures such as Standard Deviation or Root Mean Square Error of the residuals (RMSE) obtained from the fitted trend lines of the raw data and hence suitable for cross comparisons. The Cuddy Della Index (IIN) is calculated as follows.

$$IIN = CV \times \sqrt{1-R^2}$$

Where, R^2 = Coefficient of determination

CV= Coefficient of variation for the time-series calculated as

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

Where, S.D. = Standard deviation

iii. Decomposition analysis

Decomposition model of growth was used to examine the change in area, yield and interaction effect on production (Basitine and Palanisamy 1994):

$$\sum_{t=1}^{n} \Delta Pt = \sum_{t=1}^{n} At-1 \times \Delta Yt + \sum_{t-1}^{n} Yt-1 \times \Delta At + \sum_{t-1}^{n} \Delta At \times \Delta Yt$$

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

P_t = Changes in production of a crop in t^{th} period

Y_t = Changes in yield of the crops in t^{th} period

A_t = Changes in area under crop in t^{th} period

A_{t-1} = Area of crop in (t^{-1}) period

Y_{t-1} = Yield of crop in (t^{-1}) period

"The annual change was obtained by dividing the above equation with n-1 period."

Results and Discussion

i. Trends in the gross value of output of vegetables

Horticulture bears a prime position in the economy of Himachal Pradesh. This can be clearly visualized from the share of horticultural crops in gross value of output. Table1 shows the share of value of output from

Table 1. Gross Value of Output (GVO) of different crop groups at constant prices (2011-12) in Himachal Pradesh

(Rs. in lakh)

Sr. No.	Crop-group	2011-12	2015-16	2018-19	Growth rate (%)
1	Cereals	205409 (28.02)	207993 (20.53)	190588 (23.97)	-0.53 ((0.97))
2	Pulses	14534 (1.98)	20735 (2.05)	23713 (2.98)	6.23* ((2.31))
3	Oilseeds	4713 (0.64)	3597 (0.36)	5712 (0.72)	0.26 ((3.51))
4	Fruits	169533 (23.13)	411309 (40.59)	212203 (26.68)	0.97 ((5.08))
5	Vegetables	239533 (32.68)	263427 (26.00)	270190 (33.98)	2.51* ((0.54))
6	Condiments & Spices	26463 (3.61)	33262 (3.28)	18276 (2.30)	0.46 ((3.67))
7	Others[#]	72887 (9.94)	72932 (7.20)	74547 (9.37)	0.46 ((0.39))
	Total	733072 (100.00)	1013254 (100.00)	795229 (100.00)	1.02 ((1.72))

[#]Others include sugar crops, fibre, drugs, kitchen garden, etc.

* significant at 5 per cent level

Figures in parentheses show percentage to the total

Figures in double parentheses show standard error

Source: MOSPI report on State-wise Value of Output in Agriculture and Allied Activities (2011-12 to 2018-19)

different crops and indicates that the vegetables gross value of output (GVO) from the overall agriculture sector has grown at the rate of 2.51 per cent per year during 2011-12 to 2018-19, to reach an overall value of Rs. 2.70 lakh as in 2018-19. The share of vegetables in gross value of output was found highest i.e. 33.98 per cent followed by fruits crops (26.68%).

ii. Trends in area, production and yield of vegetables

The changes in area and production of vegetable crops in Himachal Pradesh have been presented in Table 2. The contribution of pea crop was found to be highest (27.53 %) in area, followed by tomato (14.93%) in total vegetable area. Whereas, in case of total production, maximum share (27.80 %) was of tomato followed by pea (16.31%) in the state. The relative share of area and production of cabbage has declined from 7.49 to 5.41 per cent and 12.39 to 8.14 per cent during 2009-10 to 2021-22 in the state. The cauliflower accounted for 6.23 per cent of total vegetable area and 6.96 per cent of the production in the state. The other vegetable crops mainly capsicum & chillies, brinjal, cucurbits, etc., contributed sizeable (45.90 %) of the area and 40.78 per cent of the production of total vegetables in the state. The area under all vegetable crops has more than doubled and increased from 26743 ha in 1997-98 to 90942 ha in 2021-22. Similarly, the production of vegetables increased more than four-fold from Rs. 4.50 lakh tonnes in 1997-98 to Rs. 19.30 lakh tonnes in 2021-22. Kumar *et al*. (2017) also revealed that though the area under peas is more than that under tomato, yet the production is more in case of tomato.

Compound annual growth rates (CAGRs.) of area, production and productivity of major vegetables in Himachal Pradesh

Table 3 reveals that in Himachal Pradesh, the area, production and productivity of all the vegetables

Table 2. Relative shares in area and production of major vegetables in Himachal Pradesh, 1997-98 to 2021-22

(Per cent)

Crops		TE 1997-98	TE 2009-10	TE 2021-22
Peas	Area	28.51	32.92	27.53
	Prod	16.62	19.03	16.31
Tomato	Area	13.55	16.36	14.93
	Prod	24.62	31.14	27.80
Cabbage	Area	6.22	7.49	5.41
	Prod	10.02	12.39	8.14
Cauliflower	Area	3.23	4.55	6.23
	Prod	3.64	4.84	6.96
Other vegetables	Area	48.50	38.68	45.90
	Prod	45.10	32.60	40.78
Total vegetables	Area (ha)	26743	59461	90942
	Prod (tonnes)	451126	1112355	1936394

Prod- Production, TE- Triennium ending

Table 3. Growth rates in area, production and yield of vegetables in Himachal Pradesh

Crops	Period-I			Period-II			Overall Period		
	A	P	Y	A	P	Y	A	P	Y
Tomato	9.77*	10.23*	0.42	2.65*	3.69*	1.02*	4.36*	6.14*	1.71*
	(1.04)	(0.76)	(0.51)	(0.26)	(0.18)	(0.37)	(0.46)	(0.38)	(0.19)
Peas	9.13*	10.81*	1.54*	1.64*	2.85*	1.19*	5.66*	6.95*	1.22*
	(0.61)	(0.88)	(0.26)	(0.28)	(0.33)	(0.07)	(0.43)	(0.47)	(0.06)
Cauliflower	9.34*	11.01*	1.53*	6.69*	8.10*	1.32*	8.76*	9.94*	1.08*
	(0.51)	(0.70)	(0.36)	(0.76)	(0.96)	(0.21)	(0.29)	(0.34)	(0.10)
Cabbage	8.75*	10.04*	1.18*	1.41*	1.60*	0.19	5.00*	6.00*	0.95*
	(0.59)	(0.78)	(0.21)	(0.24)	(0.24)	(0.24)	(0.41)	(0.48)	(0.10)
Other vegetables	5.22*	5.22*	0.02	4.72*	6.37*	1.58*	5.46*	6.69*	1.16*
	(0.61)	(0.81)	(0.24)	(0.22)	(0.14)	(0.18)	(0.16)	(0.22)	(0.11)
Total vegetables	7.57*	8.48*	0.84*	3.32*	4.54*	1.17*	5.47*	6.64*	1.12*
	(0.35)	(0.33)	(0.17)	(0.11)	(0.17)	(0.15)	(0.24)	(0.23)	(0.06)

*indicate the significance at 5 per cent level

Figures in parentheses show the standard errors

A-Area, P- Production and Y- Yield

Source: Directorate of Economics and Statistics and Directorate of Agriculture, Government of Himachal Pradesh, Shimla

significantly increased in period I, period II and overall period. The maximum increase in area and production in overall period was found in cauliflower (8.76 & 9.94% p.a) followed by green peas (5.66 and 6.95% p.a). The area under tomato, peas, cauliflower and cabbage increased significantly at the rate of 9.77, 9.13, 9.34 and 8.75 per cent per annum in period I. The area and production increased significantly in period II also but at a lesser rate. The yield of all the vegetable crops significantly increased in overall period whereas, in period I yield significantly increased in peas (1.54% p.a), cabbage (1.18% p.a) and cauliflower (1.53% p.a) and in period II yield significantly increased in green peas (1.19% p.a), tomato (1.02% p.a), cauliflower (1.32% p.a) and other vegetables (1.58% p.a). It is amply clear from the analysis that there has been remarkable increase in area and production of vegetable crops in the state. The yield has also increased but the growth in yield was much lower in magnitude as compared to growth in area. The significant growth in vegetable production can be attributed to the implementation of diversification promotion schemes like micro irrigation, protected cultivation, horticulture technology mission, etc. in the state. Sharma (2007) also reported that the area and production under vegetables showed significant growth in Himachal Pradesh. Kumar *et al*. (2017) and Sood and Kumar (2020) also recorded that area, production and yield under vegetables in Himachal Pradesh increased significantly during the study period. Similarly, Rai (2013) studied the production and growth of horticultural crops in West Bengal and found that the area and production of fruits and vegetables increased where as the productivity growth rate was lower in different districts under study.

iii. Instability in vegetable production in Himachal Pradesh

The instability index was computed to study the variability in area, production and yield of various vegetable crops in Himachal Pradesh. The high instability index indicates the high risk of cultivation of that crop in that particular district. Instability indices for selected vegetable crops in Himachal Pradesh have been shown in Table 4. The instability for area under peas was quite low (3.38 %) in period-II compared to period-I (6.50%). The instability was found to be 12.11 per cent at the state level which implied that area under peas has remained stable in the state. The instability in the production of peas was to the extent of 12.81 per cent in the state level. Instability was more in production when compared to area and yield in case of peas. The instability index for area under tomato was found to be 9.63 per cent in period-I and 3.47 per cent in period-II which also implies that the area under tomato has remained stable in state over the years. The instability in area was higher than production of tomato in overall period. The instability in area, production and yield of selected vegetables and total vegetables was found very low which indicated that area under vegetables has increased steadily for the state as a whole. Similar results were reported in West Bengal by Dhakre and Bhattacharya (2013) where the instability was low which indicated that there was less risk in vegetable cultivation in the state.

iv. Decomposition analysis of vegetable production

The decomposition analysis has been carried out to examine the yield effect, area effect and interaction effects on the production of different vegetables in the state. The analysis enables to comprehend the change in production of a particular crop and whether this change is due to expansion of area or the yield. The

Table 4. Instability indices for major vegetables in Himachal Pradesh, 1997-98 to 2021-22

Crops	Period-I			Period-II			Overall period		
	Area	Prod.	Yield	Area	Prod.	Yield	Area	Prod.	Yield
Peas	6.50	9.26	2.96	3.38	3.98	0.84	12.11	12.81	2.20
Tomato	9.63	7.05	5.68	3.47	2.25	4.63	12.72	10.58	6.55
Cabbage	8.57	2.40	5.28	3.01	3.04	8.27	13.39	3.46	8.41
Cauliflower	5.28	7.40	4.12	8.27	9.93	2.64	8.41	9.54	3.60
Other vegetables*	6.97	9.51	2.79	2.75	1.74	2.21	5.22	7.08	4.01
Total vegetables	3.73	3.56	1.89	1.42	2.00	1.94	7.14	6.71	2.02

*Other vegetables include cucurbits, capsicum & chillies, onion, garlic, etc. Prod.-Production

decomposition analysis was carried out for major vegetable crops for the period 1997-98 to 2021-22 and the results are presented in Table 5.

In case of pea, the production increased at the rate of 9636.81 tonnes per year during this period and this increase was mainly attributed to area effect (76.23 %) followed by yield effect (22.50%). In case of tomato, the production increased substantially by 17089.94 tonnes per year over the period 1997-98 to 2021-22. This tremendous increase in tomato was mainly due to area effect (83.57%) and partly by yield effect (17.47%). However, the interaction effect was found negative (-1.04%) as tomato is a management intensive crop and it becomes difficult to manage larger area under tomato that may compromise the yield. In cauliflower, the production increase was mainly due to area (85.04%) effect and partly due to yield (13.66%) and interaction (1.30%) effect. In case of cabbage, the production increased at the rate of 4495.81 tonnes/year over the period under consideration which was mainly due to 87.18 per cent area and partly due to yield (12.22%) and interaction (0.60%) effect. On overall basis, production of vegetables increased remarkably by 59410.71 tonnes/year which was mainly due to 83.08 and 16.30 per cent of the area and yield effect, respectively. Rai (2013) and Agarawal *et al*. (2016) also revealed that the area effect was stronger than yield effect in case of vegetable crops.

Conclusions

There is great potential for the cultivation of vegetable crops in the state. The cropping pattern has changed in the state in favour of vegetables during the study period. Area, production and productivity of vegetable crops recorded a significant growth in the state over the period 1997-98 to 2021-22. The area under all vegetable crops has more than doubled and increased from 26743 ha in 1997-98 to 90942 ha in 2021-22. Similarly, the production of vegetables increased more than four-fold from Rs. 4.5 lakh tonnes in 1997-98 to Rs. 19.3 lakh tonnes in 2021-22. The study has revealed that the growth performance of total vegetable crops in the State was significant in area (5.47% /annum), production (6.64% /annum) and productivity (1.12% /annum). The decomposition analysis revealed that increase in production of vegetable is mainly because of expansion in area rather than increase in yield. The instability in area (7.14%), production (6.71%) and yield (2.02%) of all vegetable crops was found low which indicated that area, production and yield of vegetables increased

Table 5. Decomposition analysis of vegetable production in Himachal Pradesh, 1997-98 to 2021-22

(Tonnes/year)

Crops	Annual change in production	Yield effect	Area effect	Interaction effect
Peas	9636.48	2168.71	7346.15	121.62
	(100.00)	(22.50)	(76.23)	(1.27)
Tomato	17089.94	2984.87	14283.33	-178.26
	(100.00)	(17.47)	(83.57)	(-1.04)
Cauliflower	4736.41	646.94	4027.97	61.49
	(100.00)	(13.66)	(85.04)	(1.30)
Cabbage	4495.81	549.35	3919.32	27.14
	(100.00)	(12.22)	(87.18)	(0.60)
Other vegetables	23452.06	3578.52	19711.58	161.96
	(100.00)	(15.26)	(84.05)	(0.69)
All vegetables	59410.71	9685.17	49360.06	365.48
	(100.00)	(16.30)	(83.08)	(0.62)

Figures in parentheses indicate per cent to the annual change in production

steadily over the years. Therefore, it is important that the government identifies and fully acknowledges the immense potential of the vegetable production through the infrastructure development, need-based research and development, farmer trainings, and capacity building.

Conflict of interest: The authors declare that there is no conflict of interest in this research article.

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