

GROWTH PERFORMANCE AND ECONOMICS OF POTATO CULTIVATION IN HIMACHAL PRADESH

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ABSTRACT: This research paper studied the growth and economic performance of potato cultivation in Himachal Pradesh over a period of 21 years (2001-02 to 2021-22). The study was entirely based on secondary data, employing growth rate analysis, instability indices, decomposition analysis, and cost concept to fulfill the objective. The findings of the study revealed a significant increase in area, production, and productivity of potatoes, with the decomposition analysis highlighting the major role of expanded cultivation area in production growth. Instability indices reveal fluctuations in production, mainly attributed to variability in cultivation area. Input-use patterns show a decrease in input quantity but an increase in their value. The cost structure analysis emphasizes the capital-intensive nature of potato cultivation, with operational costs, particularly seed and human labor, contributing significantly. The study underscores the need for measures to stabilize potato production and mitigate the impact of rising input prices.

KEYWORDS: Growth rate, instability indices, decomposition analysis, cost of cultivation and potato

INTRODUCTION

Potato (*Solanum tuberosum* L.) is the most important food crop in India and ranks fourth after rice, wheat and maize. In comparison to other main food crops, it has significantly greater levels of carbohydrates, fibre, vitamin C, and vitamin B, making it the most affordable and abundant source of nutrients and calories (Bisht and Sharma, 1997). Potato is one of the important commercial cash crops grown in Himachal Pradesh. It occupies an area of 15165 ha with the production and productivity of 195350 tonnes and 12.89t/ha, respectively in the year 2021-22 (Statistical Yearbook of Himachal Pradesh 2021-22). Most of the farmers in Himachal Pradesh are small and marginal who diversified their cropping pattern by shifting from cereal based farming system to high value cash crops like potato and other vegetables (Sharma, 2011). In Himachal Pradesh, potato farming is an

important part of the state's agricultural terrain (Singh *et al.* 2015).

The unique agro-climatic conditions of the region, characterized by varying altitudes, diverse topography, and distinct seasons, create an ideal environment for potato cultivation (Sati and Wei, 2018). In the backward areas of the state, seed potato has been identified as one of the major remunerative crop. It boosts the state's economy and improves its residents' income as well as their standard of living. Moreover, the harvesting time of potato in higher hills of the state coincide with the sowing period in the plains area which ensure the year around production of potato in the state (Thakur and Moorti, 1991). Then it is sold in various parts of the country as *Pahari Aloo* which gets premium price as it is fresh and does not have sweet taste like the cold stored potatoes (Pandit *et al.* 2010). This *khariif* potato from

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hills has been fetching 1.5 to 2 times higher price in the market as compared to cold stored potato produced under *rabi* season in the plains (Singh *et al.* 2018). That is why the state government is laying emphasis on production of off-season vegetables, through timely and adequate supply of inputs, demonstration and effective dissemination of improved farm technology, replacement of old variety seed, promotion of integrated pest management, bringing more area under efficient use of water resources and implementation of Wasteland Development Projects (Economic survey 2021). However, during the last few years state's potato growers have faced new challenges on production fronts. The cost of inputs has increased affecting the profitability matrix of different commercial crops (Lal and Sharma, 2006). Keeping in view the significance of potato in the state, the present study was carried out to examine the growth performance and economics of potato cultivation in Himachal Pradesh. By unraveling the intricacies of potato cultivation in Himachal Pradesh, this research seeks to provide a foundation for informed decision-making, and the enhancement of the potato value chain in the region.

MATERIAL AND METHODS

The study relied mainly on the secondary data i.e. time series data on area, production and productivity of potato in Himachal Pradesh. The data for a period of 21 years from the year 2001-02 to 2021-22 were collected from various published sources or official websites. The entire study was split into two sub periods. The sub period was framed as period I (2001-02 to 2010-11), period II (2011-12 to 2021-22) and Overall period (2001-02 to 2021-22).

Growth Rate

The compound annual growth rates were worked out to examine the growth in

area, production and productivity of potato in Himachal Pradesh using exponential production function:

$$Y = ab^t$$

$$\text{Log} Y = \text{Log} a + t \text{Log} b$$

where,

Y = Area, Production and Productivity,

a = Constant term,

b = Regression coefficient,

t = Time variable in year

Instability Index

An index of instability was computed to examine the nature and degree of instability in area, production and productivity of potato in Himachal Pradesh. The co-efficient of variation (CV) was worked out for area, production, and yield to measure variability which is given by

$$\text{Coefficient of Variation (CV)} = \frac{\text{SD}}{\text{Mean}} \times 100$$

where,

SD = Standard deviation of area/production/productivity

Decomposition Analysis

To measure the relative contribution of area and productivity towards the total output, a decomposition model was used (More *et al.* 2015). In the decomposition analysis the change in production was taken as the effect of three factors such as yield effect, area effect and interaction effect.

$$\Delta P = A_0 \Delta Y + Y_0 \Delta A + \Delta A \Delta Y$$

where;

ΔP = Change in production

A_0 = Area in base year

Y_0 = Yield in the base year

Y_t = Yield in the current year

A_t = Area in the current year

ΔA = Change in area ($A_t - A_0$)

ΔY = Change in the yield ($Y_t - Y_0$)

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

Thus, the total change in production was decomposed into three effects *viz.* yield effect, area effect and interaction effect due to change in yield and area.

To examine the economic performance of potato, the published data on cost of cultivation from cost of cultivation scheme, of past years were used. The structural changes in cost of cultivation were analyzed by working out the difference in cost at two points of time (i.e. 2001-02 to 2021-22), along with relative share to total cost. The cost structure of potato was analyzed by working out the share of each item of cost in total cost of cultivation. The changes in structure of cost of cultivation of crops were assessed by comparing the cost structure of potato during 2021-22 compared to 2001-02.

RESULTS AND DISCUSSION

Growth in area, production and productivity of potato

It is evident from the Table 1 that in period I the area has increased significantly at the rate of 4.09 per cent per annum but production and yield could not record growth. In period II the area has increased but not significantly whereas production and yield increased significantly at the rate of 7.80 and 3.67 per cent per annum, respectively. During the overall period, area, production and yield of potato crop have significantly increased at the rate of 3.60, 4.88 and 1.24 per cent per annum, respectively. The results are in collaboration with the studies conducted by Rana and Anwer (2018) and Pant *et al.* (2020).

In overall period, the coefficient of determination for potato indicates that 67.47 per cent of variation in model was explained together with variables area and time. Similarly, the value of the coefficient of determination indicates that 66.56 per cent of variation in model was explained together with variables production and time and about 33.44 per cent of variation remains unexplained. In yield 23.68 per cent variation was explained and about 76.32 per cent of variation remains unexplained. This explained variation may increase if we have taken more variables into account like price of crop, rainfall etc.

Instability analysis in area, production and productivity of potato

The index of instability was computed to study the variability in area, production and productivity of potato in different periods. The instability index indicates the risk of crop cultivation. Instability indices have been shown in Table 2. The instability in area was quite low in period-I (16.42%) compared to period-II (22.42%). The instability was found to be 27.70 per cent in the overall period which implies that area has remained almost stable in the state. The instability in the production was to the extent of 34.90 per cent in the overall period, while it was low in the period-I (22.30%). The yield instability remained consistently low at around 14 per cent throughout period I, period II, and the

Table 1. Annual compound growth rates (per cent) in area, production and productivity of Potato in Himachal.

Items	Period I			Period II			Overall		
	A	P	Y	A	P	Y	A	P	Y
GR	4.09*	3.81	-0.26	3.99	7.80*	3.67*	3.60*	4.88*	1.24*
Std error	1.23	2.54	1.79	2.00	2.12	0.91	0.58	0.81	0.51
r	0.5893	0.2262	0.0026	0.3145	0.6189	0.6474	0.6747	0.6656	0.2368

Note: A= Area, P =Production, Y=Productivity, GR = Growth rate, Std error = Standard error, r = coefficient of determination

*Significant at 5 per cent level of significance

Period I = 2001-02 to 2010-11, Period II = 2011-12 to 2021-22, Overall period = 2001-02 to 2021-22

Table 2. Instability in area, production and productivity of Potato in Himachal (Per cent).

	Area			Production			Productivity		
	Mean	SD	CV	Mean	SD	CV	Mean	SD	CV
Period I	10186.00	1672.71	16.42	1041990.20	232364.15	22.30	102.02	14.43	14.14
Period II	14730.36	3301.96	22.42	1679200.18	447044.99	26.62	113.18	16.44	14.53
Overall	12566.38	3481.26	27.70	1375766.86	480171.23	34.90	107.87	16.17	14.99

Note: Period I = 2001-02 to 2010-11, Period II = 2011-12 to 2021-22, Overall period = 2001-02 to 2021-2

overall period. Thus, it can be clearly seen from the table that the instability in production is mainly attributed to variability in area at the state level. Pant *et al.* (2020) in their study also found that instability was highest in production followed by area than productivity.

Decomposition analysis of growth in potato production

The decomposition analysis has been carried out to examine the yield effect, area effect and interaction effect on the production of potato crop. The analysis enables to comprehend the change in the production of a crop and whether this change is attributed more to the expansion of area or to the improvement in the yield. The results presented in Table 3 shows that in period 1, the production of potato increased by 31319 tonnes per year in which area contributed to 93.02 per cent while yield effect was 7.15 per cent and interaction effect was negative. This clearly indicates that the yield has not increased to that extent and increase in production was mainly due to area effect. In period 2, production increased approximately by 81442 tonnes per annum which was mainly due to area (57.13%) and yield effect (54.06%) while the interaction effect was negative. In overall

period, production increased by 57017 tonnes per year. This increase was mainly due to area effect (63.54%) and yield (44.98%) while the interaction effect was negative. It was clearly seen that, increase in area was the major reason behind increase in the production in overall study period followed by improvement in yield while the interaction effect was negative. The findings align with the research carried out by Sagolsem *et al.* (2017).

Input use pattern in potato

The input-use pattern of potato crop is presented in Table 4. The results showed that the quantity of input decreased over the years but the value has increased by a high percentage. The quantity of fertilizers decreased by 69.48 per cent from 181.97 to 55.54 kg/ha. The quantity of manures increased from 107.59 qtl to 169.87 qtl/ha. The value of input increased at a rate of 3442.76 per cent in animal labour followed by human labour (528.16%) and seed (278.70%), respectively.

Break-up of total cost, cost concept wise and income over different cost in potato

The cost and income on the basis of the cost concept in the production of potato have been presented in Table 5 at two different time

Table 3. Decomposition analysis of potato in Himachal Production (Qtl/year)

	Annual Change in Production	Yield Effect	Area Effect	Interaction Effect
Period I	31319.00 (100.00)	2239.61 (7.15)	29134.02 (93.02)	-54.64 (-0.17)
Period II	81442.55 (100.00)	44031.70 (54.06)	46524.42 (57.13)	-9113.57 (-11.19)
Overall	57017.14 (100.00)	25645.90 (44.98)	36230.92 (63.54)	-4859.67 (-8.52)

Note: Period I = 2001-02 to 2010-11, Period II = 2011-12 to 2021-22, Overall period = 2001-02 to 2021-22

Table 4. Input use pattern of Potato in Himachal

Items	2021-22		2001-02		% Change in 2021-22 over 2001-02	
	Quantity	Value (Rs./ha)	Quantity	Value (Rs./ha)	Quantity	Value (Rs./ha)
Seed (Kg.)	1899.74	7.09	1745.30	26.85	-8.13	278.70
Fertilizer (Kg.)	181.97	13.22	55.54	26.89	-69.48	103.40
Manure (qtl.)	107.59	25.98	169.87	98.06	57.89	277.46
Human Labour (Man Hrs.)	707.98	9.48	612.10	59.55	-13.54	528.16
Animal Labour (Pair Hrs.)	137.12	4.21	49.66	149.15	-63.78	3442.76

Table 5. Break-up of total cost, cost concept wise and income over different costs in Potato.

S. No.	Different Costs	Break up of total cost (Rs./ha)			Income over different cost (Rs./ha)		
		2001-02	2021-22	% Change	2001-02	2021-22	% Change
1	A ₁	21059.34	78849.15	274.41	54316.18	75551.22	39.09
2	A ₂	21059.34	78849.15	274.41	54316.18	75551.22	39.09
3	B ₁	22425.63	80903.08	260.76	52949.89	73497.29	38.80
4	B ₂	30993.03	101710	228.17	44382.49	52690.38	18.71
5	C ₁	28536.32	115182.6	303.63	46839.2	39217.74	-16.27
6	C ₂	37103.72	135989.5	266.51	38271.8	18410.83	-51.89

periods. It is clear from table that per hectare Cost A₁, Cost B₁, Cost B₂, and Cost-C₂ have increased over the years. The highest change was observed in Cost C₁ (303.63%) followed by Cost A₁ (274.41%), Cost C₂ (266.51%), and Cost B₁ (260.76%). The average income per hectare over Cost A₁ increased from Rs. 54316.18 in 2001-02 to Rs. 75551.22 in 2021-22 with per cent change of 39.09. Income over Cost B₁ and Cost B₂ also increased from Rs. 52949.89/ha and Rs. 44382.49/ha during 2001-02 to Rs. 73497.29/ha and Rs. 52690.38/ha in 2021-22, showing an increase of 38.80 and 18.71 per cent, respectively. Income over Cost C₁ and C₂ decreased by 16.27 and 51.89 per cent, respectively as the cost of cultivation increased in the year 2021-22 compared to 2001-02. It is revealed from the table that income over cost A₁, A₂, B₁ and B₂ has increased over the years, but showed a gradual decrease over cost C₁ and C₂. This may be because farmers received very low prices due to market gluts in that year. Similar finding was reported by Pandey *et al.* (2004).

Measure of farm profit

The details of measures of profit of potato for the state are given in Table 6. The gross income of potato has increased from Rs. 75375.52/ha in 2001-02 to Rs. 154400.37/ha in 2021-22 with per cent change of 104.84. During this period, farm business income has also increased by 39.09 per cent from Rs. 54316.18/ha in 2001-02 to Rs. 75551.22/ha in 2021.22. The net income which is the residual of gross return over total cost has recorded a decrease of 51.89 per cent. As far as the farm investment income is concerned, it decreased by 14.38 per cent. It is clear from the table that the farm investment income and net income decreased in 2021-22 compared to 2001-02, which may be due to a disproportionate increase in input cost as compared to the revenue generated.

Cost structure and change in cost structure

The cost of cultivation of potato in the state for the years 2001-02 to 2021-22 has been given in Table 7 and revealed that

Table 6. Measures of farm profits in Potato.

S. No.	Items (Rs./ha)	2001-02	2021-22	% Change
1	Value of Main Product	75375.5	154400.37	104.84
2	Value of By- Product	-	-	-
3	Gross Income	75375.52	154400.37	104.84
4	Farm Business Income (GI- Cost A2)	54316.18	75551.22	39.09
5	Family Labour Income (GI-CostB2)	44382.49	52690.38	18.71
6	Farm Investment Income (GI- (Cost A2+IFL)	48205.48	41271.67	-14.38
7	Net Income (GI- Cost C2)	38271.80	18410.83	-51.89

Table 7. Cost structure and change in cost of cultivation.

S. No.	Items	Cost of cultivation				Change in 2021-22 over 2001-02	
		2001-02 (Rs./ha)	%	2021-22 (Rs./ha)	%	(Rs./ha)	%
(A)	Operational Cost						
1	Human Labour						
	Family	6110.70	16.47	34279.55	25.21	28168.85	28.49
	Attached	73.09	0.20	0.00	0.00	-73.09	-0.07
2	Casual						
	Animal Labour	530.22	1.43	2169.57	1.60	1639.35	1.66
	Hired	155.03	0.42	0.00	0.00	-155.03	-0.16
	Owned	421.65	1.14	7407.29	5.45	6985.64	7.06
3	Machine Labour						
	Hired	44.43	0.12	342.17	0.25	297.74	0.30
	Owned	0.00	0.00	651.89	0.48	651.89	0.66
4	Seed	13474.90	36.32	46862.12	34.46	33387.22	33.76
5	Fertilizer	2405.45	6.48	1493.33	1.10	-912.12	-0.92
6	Manure	2795.45	7.53	16658.15	12.25	13862.70	14.02
7	Insecticides	184.70	0.50	414.38	0.30	229.68	0.23
8	Irrigation Charges	-	-	87.42	0.06	87.42	0.09
9	Miscellaneous	-	-	48.03	0.04	48.03	0.05
10	Interest on Working Capital	627.65	1.69	2379.19	1.75	1751.54	1.77
	Total Operational Cost	26823.27	72.29	112793.09	82.94	85969.82	86.94
(B)	Fixed Costs						
1	Rental Value of Owned Land	8567.40	23.09	20806.91	15.30	12239.51	12.38
2	Rent Paid For Leased-in-Land	-	-	-	-	-	-
3	Land Revenue, Taxes, Cesses	15.18	0.04	7.27	0.01	-7.91	-0.01
4	Depreciation on Implements & Farm Building	331.59	0.89	328.34	0.24	-3.25	0.00
5	Interest on Fixed Capital	1366.28	3.68	2053.93	1.51	687.65	0.70
	Total Fixed Cost	10280.45	27.71	23196.45	17.06	12916.00	13.06
(C)	Total Cost (A+B)	37103.72	100.00	135989.54	100.00	98885.82	100.00

the total cost of cultivation per hectare has increased from Rs. 37103.72/ha in 2001-02 to Rs. 135989.54/ha in 2021-22 over the years. During 2001-02, the operational cost and fixed cost were in the ratio of 72:28 and during 2013-14, the ratio was 83:17. It indicates that the proportion of operational cost and fixed cost has changed only marginally. The increase in cost of cultivation has occurred in all major items of cost such as human labour, animal labour, machine labour, seed, rental value of owned land and interest on fixed capital whereas, fertilizer cost has decreased over the years. Out of total increase of Rs. 98885.82/ha in cost of cultivation over the years, 86.94 per cent was attributable to operational cost and 13.06 per cent to fixed cost items. The major items of operational cost which caused for the increase in cost of cultivation were seed (33.76%), family labour (28.49%) and manure (14.02%). Out of total fixed cost items, rental value of owned land contributed maximum i.e. 12.38 per cent increase in fixed cost. The findings are in collaboration with the study conducted by Pandey *et al.* (2004) in Shimla district of Himachal Pradesh.

CONCLUSION

The foregoing results revealed that the area, production and productivity of potato crop significantly increased over the period. The instability was found to be highest in production in the overall period compared to area and productivity. The decomposition analysis showed that an increase in area was the major reason behind the increase in the production in overall period, followed by an improvement in yield, while the interaction effect was negative. The quantity of input decreased but the value of inputs has increased which indicates higher prices of agricultural inputs over the years. The cost of cultivation analysis revealed that operational

cost contributed more towards the total cost as compared to fixed cost. The potato crop is capital intensive thus major items attributed to operational cost were value of seed followed by human labour. It is necessary to implement measures to stabilize potato production by focusing on sustainable farming practices, providing support for improved yield, and addressing negative interaction effects. Also, it is advisable to develop such policies which mitigate the impact of rising agricultural input prices by promoting cost-effective technologies, subsidizing essential inputs, and fostering initiatives to enhance input efficiency in potato cultivation.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest

ETHICAL STATEMENT

This article does not contain any studies with human participants or animals performed by any of the author

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