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To develop predictive models for the area, production and productivity of potato in different districts of Chhattisgarh plains

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Abstract
The present study had an attempt to the Development of relational database and predicted models of area, production and productivity of potato crop in different agro climatic zones of Chhattisgarh. The state has 33 districts out of which only 17 districts are undertaken for study on the basis of availability of secondary data during 2004-05 to 2021-22. The analysis was done according to district wise area, production and productivity of potato crop using database. Estimation of prediction model for potato crop for districts of Chhattisgarh have been made and fitted for area, production and productivity by crop wise separately. The productivity of potato crop are expected to increase in future as prediction model has been predicted. For the Potato crop only in Kabirdham district the production function satisfactorily fits to the data as indicated by more than 70 percent. The model showed highest R^2 up to 98.39 percent for Kabirdham district in Rajnandgaon district the area influences the production by more than 90 percent. For Dhamtari the production was influenced by the productivity and only a little contribution is made by the area. It was observed that the compound annual growth rate of vegetables in terms of productivity is negative during the 2004-05 to 2021-22 periods, even though the area under the cultivation of vegetables crop and its production was positive.
For the Potato crop only in Kabirdham district the production function satisfactorily fits to the data as indicated by more than 70 percent. The model showed highest R^2 up to 98.39 percent for Kabirdham district in Rajnandgaon district the area influences the production by more than 90 percent. For Dhamtari the production was influenced by the productivity and only a little contribution is made by the area.

Keywords: India's agricultural landscape, develop predictive, ecological diversity, economic prosperity

Introduction

India's agricultural landscape is a tapestry of ecological diversity, with its expansive and varied climate zones ensuring the availability of a vast array of vegetable varieties. This bounty of vegetables holds a paramount significance within the broader agricultural and horticulture sectors of India, underpinning the nation's food security and economic prosperity (Emerick, 2018) [2].

The robust growth of the vegetable sector in India represents a remarkable success story driven by a confluence of diverse and interrelated factors. These factors, taken together, have propelled vegetable cultivation to new heights and underscore the central role that vegetables play in India's agricultural landscape and economy. One key driver of this growth is the rising per capita income among India's populace. (Mariyono, 2018) [3].

Potato (*Solanum tuberosum* L.) belongs to family Solanaceae and is one of the most important vegetable cum starch supplying crop having high production per unit area per unit time. Potato, an underground tuber occupies prime position among the cash crops in India
India is the second largest producer of potato in the world after China, with cultivation in an area of about 2.02 m ha and production of 46 million metric tons [2]. Potato is grown almost in all the states of India except Kerala. In Chhattisgarh, it is cultivated in an area of about 37,888 ha with a production of 5.5 lakh metric tons [3]. Due to its suitability and high returns, the area of potato is increasing every year in this state.

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In Chhattisgarh, potato is mainly cultivated in Sarguja, Raigarh, Jashpur, Bilaspur and Raipur districts in Rabi season except in Mainpat and Samaryapat hills of Chhattisgarh, where this crop is grown during kharif and Rabi season both. Chhattisgarh plains (68.49 lakh hectares, 50% of sown area), Bastar plateau (39.06 lakh hectares, 29% of sown area), and Northern hills (28.47 lakh hectares, 21% of sown area. With capital at Raipur district, the State of Chhattisgarh has thirty three district.

- the Chhattisgarh plains area of Raipur, Durg, Rajnandgaon, Bilaspur, Dhamtari, Mahasmund, Korba, Kawardha, Janjgeer, Kanker, Blaudabazar, Gariyaband, Bemetera, Mungeli, Balod, Raigarh,gaurela-pendra-marwahi, sakti, sarangarh-bilaigarh, khairagarh-chhuhikhadan-gandai, mohla-manpur-ambagarhchauki
- Northern hills of Chhattisgarh Sarguja, Jashpur, Koriya, Balrampur, Surajpur, manendragarh-chirmiri-bharatpur
- The Bastar plateau comprises of Bastar, Dantewara, Narayanpur, Bijapur, Kondagaon and Sukma.

Materials and Methods

During analyses it was realized that the response variable in most of the districts/region. Therefore, this periodic effect was considered as a structural effect changing every three years the area, production and productivity scenario of all potato crop probably due to some research or technical break- through, etc. The periodic effect variable 'P' was introduced to measure the periodic trend along with the annual effect variable 'T' to measure annual trend with in each period. So, the following multiple regression models was finalized and fitted in all cases using stepwise regression technique as described

$$\text{Ln } Y = \ln t + bp\,P + bt + \epsilon \quad \dots\dots\dots\dots\dots \text{ (1a)}$$
$$\text{Or} \quad \text{Ln } Y\,{}^{\wedge} = \ln t + bp\,P + bt\,T \quad \dots\dots\dots\dots\dots \text{ (1b)}$$

Results and Discussion

Performance of Potato: It was observed from the Table 4.2.3 that partial compound growth rate in area in Mahasamund (-65.63), Dhamtari (-91.48), Kabirdham (-67.45), Korba (-85.83), Bilaspur (-58.11), Dantewada (-41.58), Janjgir (-95.62), koriya (-86.62), Sarguja (-93.30), Baster (-31.86) was significant at 1% level. Raipur (-71.29), Durg (-71.93), Rajnandgaon (-67.40), Raigarh (-95.01), Jashpur (-77.54), Baster (-31.86) were found 5% level Significant whereas Jagdalpur (-101.66) was found Non-significant. The annual partial compound growth rate observed for Sarguja (92.71), Koriya (91.91), Baster (56.52) area in were found statistically significant at 10% level and remaining Districts were found non-significant.

In case of Potato the partial compound growth rate in production Mahasamund (-48.10), Durg (-54.47), Rajnandgaon (-66.10), Kabirdham (-61.13), Dantewada (-47.15), Bilaspur (-59.62), Korba (-87.53), Jashpur (-68.17), Janjgir (-80.00), Koriya (-78.78), Bastar (-14.15) were found respectively and statistically significant at 1% level and Raipur was significant at 5% level and Kanker (-54.82), Jagdalpur (-102.1), Dhamtari (-100.03), Raigarh (-93.42), Sarguja (-99.24) were Non-significant. The annual partial compound growth rate observed for production in Kanker (133.229) were found statistically significant at 5% level and Janjgir (74.21) statistically significant at 10 percent level and remaining Districts were found non-significant.

In case of Potato the partial compound growth rate in productivity Raipur (-88.96), Durg (-82.54), Rajnandgaon (-97.21), Kabirdham (-93.68), Koriya (-92.16) were found respectively and statistically significant at 1% level and Mahasamund (-82.46), Kanker (-78.08), Janjgir (-84.37) was significant at 5% level and Jagdalpur (-100.43), Dhamtari (-108.55), Dantewada (-102.01), Bilaspur (-101.51), Raigarh (-98.40), Jashpur (-90.62), Bastar (-102.24), Sauguja (-99.35), Korba (-101.70) is Non-significant. The annual partial compound growth rate observed for productivity in Janjgir (-76.28), Jashpur (-131.29) were found statistically significant at 10% level statistically significant and remaining Districts were found non-significant.

Table 1: Prediction models of area, productivity and production under potato for different agro climatic zones of Chhattisgarh and its constituent districts for period

District		INT	BP	% R1	BT	% r2	% R square
Raipur	Area	-0.50243	0.287086*	-71.29*	0.164433	-83.55	19.96*
	Production	1.85628	0.397434**	-60.25**	0.104574	-89.54	27.67**
	Productivity	9.266468	0.110349***	-88.96***	-0.05986	-105.98	56.58***
Mahasamund	Area	-2.07915	0.343605***	-65.63***	0.071822	-92.81	61.16***
	Production	0.110328	0.518974***	-48.10***	-0.1522	-115.22	72.84***
	Productivity	9.097236	0.175369**	-82.46**	-0.22402	-122.40	29.09**
Dhamtari	Area	-1.01521	0.085169***	-91.48***	-0.0067	-100.67	40.30***
	Production	1.498223	-0.00037	-100.03	0.001121	-99.88	0.0006
	Productivity	9.421185	-0.08554	-108.55	0.007818	-99.21	11.98
Durg	Area	-0.96826	0.280683**	-71.93**	0.229042	-77.09	36.12**
	Production	1.410801	0.455236***	-54.47***	0.212875	-78.71	46.87***
	Productivity	9.286815	0.174553***	-82.54***	-0.01617	-101.61	35.27***
Rajnandgaon	Area	-1.54287	0.32594**	-67.40**	0.338813	-66.11	38.97**
	Production	0.825826	0.33898***	-66.10***	0.3565	-64.35	42.01***
	Productivity	9.236662	0.027893***	-97.21***	0.002925	-99.70	57.55***
Kabirdham	Area	-3.38153	0.325484***	-67.45***	0.185473	-81.45	62.16***
	Production	-0.76314	0.38864***	-61.13***	0.212878	-78.71	66.86***
	Productivity	9.526144	0.063155***	-93.68***	0.027405	-97.25	26.04***
Jagdalpur	Area	-1.35416	-0.01669	-101.66	0.031517	-96.84	0.66
	Production	1.67763	-0.021	-102.1	-0.04941	-104.94	2.68
	Productivity	9.939546	-0.00431	-100.43	-0.08092	-108.09	5.06
Kanker	Area	-1.64801	0.232618***	-76.73	0.061457***	-93.85	84.47***

	Production	0.168615	0.451757***	-54.82	-0.13229***	-113.22	58.01***
	Productivity	8.724383	0.219139**	-78.08**	-0.19374**	-119.37**	28.90**
Dantewada	Area	-5.14982	0.584161***	-41.58***	0.399916	-60.00	58.94***
	Production	-2.02383	0.528417***	-47.15***	0.347889	-65.21	38.77***
	Productivity	9.755287	-0.02015	-102.01	0.000137	-99.98	0.31
Bilaspur	Area	-0.56243	0.41887***	-58.11***	0.2671	-73.29	50.42***
	Production	1.86732	0.403726***	-59.62***	0.238198	-76.180	59.28***
	Productivity	9.337499	-0.01514	-101.51	-0.0289	-102.89	0.30
Janjgir	Area	-0.35583	0.043722***	-95.62***	0.020621	-97.93	50.74***
	Production	1.260437	0.199968***	-80.00***	0.257811*	-74.21*	49.13***
	Productivity	8.524021	0.156246**	-84.37**	0.23719*	-76.28*	38.65**
Korba	Area	-0.33229	0.141681***	-85.83***	0.055773	-94.42	68.98***
	Production	2.134966	0.124658***	-87.53***	0.098137	-90.18	59.58***
	Productivity	9.375015	-0.01702	-101.70	0.042364	-95.76	17.71
Raigarh	Area	0.862158	0.049849**	-95.01**	0.050755	-94.92	29.82**
	Production	3.452859	0.065786	-93.42	0.085978	-91.40	19.84
	Productivity	9.498456	0.015937	-98.40	0.035223	-96.47	4.12
Jashpur	Area	-0.5092	0.224552**	-77.54**	0.230638	-76.93	33.41**
	Production	2.496021	0.318258***	-68.17***	-0.08235	-108.23	54.88***
	Productivity	9.912974	0.093706	-90.62	-0.31299*	-131.29*	22.24
Sarguja	Area	2.079769	0.066987***	-93.30***	0.072879*	-92.71*	53.79***
	Production	4.815264	0.007523	-99.24	0.132254	-86.77	2.93
	Productivity	9.284229	0.006478	-99.35	0.059376	-94.06	0.29
Koriya	Area	0.08033	0.133786***	-86.62***	0.080835*	-91.91*	74.28***
	Production	2.45579	0.212108***	-78.78***	0.074491	-92.55	77.82***
	Productivity	9.283225	0.078321***	-92.16***	-0.00635	-100.63	67.72***
Bastar	Area	-3.99399	0.68139***	-31.861***	0.434702*	-56.52*	69.66***
	Production	-1.85808	0.858419***	-14.1581***	0.191502	-80.84	88.03***
	Productivity	9.688769	-0.0224	-102.24	0.001256	-99.87	0.13

**, **, *significant at 1%, 5% and 10% level of significant respectively @ % r1 & r2 indicate the partial compound growth rates (In percentage) corresponding to bp (partial linear regression coefficient corresponding to periodic effect variable 'P') and BT (Partial Linear regression coefficient corresponding to time variable 'T') respectively.
A: Area in 000' ha, Y: Yield in Kg/ha, P: Production in 000' tones

Conclusion
Area under Potato crop the partial compound growth rate Mahasamund, Dhamtari, Kabirdham, Korba, Bilaspur, Dantewada, Janjgir, koriya, Sarguja, Baster was significant at 1% level. Raipur, Durg, Rajnandgaon, Jashpur, Baster were found 5% level Significant. Aannual partial compound growth rate observed for koriya, Baster area in were found statistically significant at 10% level and remaining Districts were found non-significant.

In case of production under Potato the partial compound growth rate in Mahasamund, Durg, Rajnandgaon, Kabirdham, Dantewada, Bilaspur, Korba, Jashpur, Bastar were found significant at 1% level and Raipur was significant at 5% level. The annual partial compound growth rate in Kanker were found significant at 5% level and statistically significant at 10 percent level.

For the Potato crop only in Kabirdham district the production function satisfactorily fits to the data as indicated by more than 70 percent. The model showed highest R^2 up to 98.39 percent for Kabirdham district in Rajnandgaon district the area influences the production by more than 90 percent. For Dhamtari the production was influenced by the productivity and only a little contribution is made by the area.

References
1. Chawla K, Singh AK. Prediction of area and production along with production function for area, production and productivity of linseed crop in undivided bastar region of Chhattisgarh. J Pharmacogn Phytochem. 2019;8(4):498-504.
2. Emerick K. Agricultural productivity and the sectorial reallocation of labour in rural India. J Dev Econ. 2018;135:488-503.
3. Mariyono J. Profitability and determinants of smallholder commercial vegetable production. Int J Veg Sci. 2018;24(3):274-288.
4. National Horticulture Board. Area and production statistics [Internet]. 2014 [Cited 2014 July 12]. Available from: http://nhb.gov.in/area%20_production.html
5. Chhattisgarh Horticulture. Statistics: At a glance [Internet]. 2014 [cited 2014 July 12]. Available from: http://www.cghorticulture.gov.in/statistics.htm
6. Tegar A. An analysis of growth in area, production and productivity of major vegetables in Bilaspur district of Chhattisgarh State, India. Plant Arch. 2016;16(2):797-800.
7. Weis T. The ecological hoof print: The global burden of industrial livestock. Bloomsbury Publishing; c2013.