GROWTH, INSTABILITY AND PROFITABILITY OF POTATO PRODUCTION IN EASTERN INDIA

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ABSTRACT: This study has examined the historical performance of potato production in eastern India, a key producing region. It has utilized the state-level time-series data collated from secondary sources for the period 2000-01 to 2018-19. Growth in potato is analyzed employing ACGR, while instability is measured applying index method. Positive and significant growth in area, production and productivity of potato has been noticed during study periods (I, II and overall) in states, regional and all-India levels. Further, growth during 2010s has weakened over the previous decade at all level. Analysis of instability revealed decline in variability in period II over period I, and this infers spread and adoption of improved technologies in potato growing states. Economics of potato has shown that net returns per ha increased with varying degrees across states during 2008-18. However, a strict vigil is needed on prices and required steps need to be taken to save interest of the farmers. Also, attention is drawn to develop and promote site-s pecific improved technologies to improve growth and reduce instability.

KEYWORDS: Potato, growth rate, instability, profitability, Eastern India

INTRODUCTION

Potato (*Solonum tuberosum*) is one of the main food crops worldwide. Its production at global level reached at 366.2 million tonne (Mt), covering 17.6 million ha (Mha) with a yield of 20.8 t/ha during triennium ending (TE) 2018. India is the second largest contributor after China, both in area and production of potato. It contributed over 12 % share in both area and production of potato with a yield of 21.8 t/ha during TE 2018. About a third of global production of potato comes from China and India (FAO, 2017).

The value of potato output in India was ₹ 29,062 crore (at 2011-12 prices) during TE 2018-19 (GoI, 2021). Potato production in India reached at 53.03 Mt from harvested area of 2.2 Mha in 2019-20. The eastern region of India is the key potato producing tract and accounts for about 72 % of total output in 2019. In this region, Uttar Pradesh (eastern part), West Bengal, Bihar, Assam, and Jharkhand are the key producers and share over 95 % of total output of the region. Since, eastern India is the key producing region and substantial area falls in this region, the updated knowledge of growth and instability is a necessary condition for moving the potato sector forward.

Measurement of growth and instability in agricultural production has been a topical subject in agricultural economics literature in India. While the increase in agricultural output or growth is taken as obvious, the rise in instability is viewed adverse due to several reasons. It raises the risk involved in farm production, affects farmers' income and decisions to adopt capital-intensive technologies and make investments in farming (Chand and Raju, 2009). Instability in output affects price stability, consumers' demand, and increases vulnerability of low income households. A large number of studies have been made in assessing the performance using physical output and value of production for major foodgrains, oilseeds, pulses, sugarcane, and commercial crops (Hazell, 1982; Mahendra

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Dev, 1987; Saha and Swaminathan, 1994; Larson *et al.,* 2004; Sharma *et al.,* 2006; Chand and Raju, 2009; Kumar and Jain, 2013; Tewari *et al.,* 2017). However, studies dealing with potato in major states of eastern India are limited. The present study analyzes the growth performance, instability and profitability of potato production in eastern India. The paper is organized in four sections. Background of the paper is provided in section I, and the methodology is dealt in section II. The results and discussion is described in section III and the last section summarized conclusions and suggestions emerged from the study.

MATERIALS AND METHODS

The present study is based on the state-level time-series data collated from secondary sources (DES, 2020; GoI, 2021; and ICAR-CPRI Annual Reports, various years). The historical growth performance of potato has been analyzed for key states of eastern India. This key producing region cover states of Assam, Bihar, Chhattisgarh, Jharkhand, Odisha, West Bengal and Uttar Pradesh (eastern parts). It contributed to about 72 % of total potato output during TE 2019. The study covered last two decades from the period 2000-01 to 2018-19. This long time period was divided into two sub-periods, period I (2000-2010) and period II (2011-2019). The basis for dividing into sub-periods was to understand the decadal performance. The analysis for Chhattisgarh and Odisha states could not be done due to paucity of required data, while whole Uttar Pradesh was taken due to absence of district level data to arrive at figures for eastern parts.

The annual compound growth rates (CAGR) of area, production and productivity of potato were computed to examine growth performance. The exponential model is used to estimate growth rate.

$$Y_t = ab^i$$

where, Y is Area/ production/ yield; a refers intercept, b denotes Regression co-efficient, i is Time trend and e_t is residual of regression. The above equation can also be expressed as follows after taking natural log transformation of both side and estimating the regression equation:

$$Ln\ Y_t = Ln\ a + i\ Ln\ b + e_t$$

The compound growth rate was worked out by:

$$CAGR\ (r) = [e(ln\ b) - 1] * 100$$

where, r is compound growth rate, e is exponential function.

Measurement of instability in potato performance is another dimension and has been analyzed using index method suggested by Ray (1983) and widely used to estimate instability in agricultural production (Mahendra Dev, 1987; Rao *et al.,* 1988; Chand and Raju, 2009). This method of instability is measured by:

$$Instability\ index = std.dev\ (ln\ (Y_{t+1} / Y_t))$$

where, Y_t is the Area/production/yield in the current year and, Y_{t+1} refers for the next year. This index is unit free and very robust, and it measures deviations from the underlying trend (log linear in this case). When there are no deviations from trend, the ratio of Y_{t+1}/Y_t is constant and thus standard deviation is zero. As the series fluctuates more, the ratio of Y_{t+1} and Y_t also fluctuates more, and standard deviation increases.

Another data set used in this study was costs and returns associated with potato production and derived from Cost of Cultivation series presented by Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India.

RESULTS AND DISCUSSION

Production Profile and Growth

Total production of potato increased substantially at all-India level during past

forty years, from 9.7 Mt in 1981 to 53.0 Mt in 2019 (Figure 1). During the above period, area increased by 3-times, productivity by 2-times, and output by 5-times. The increase in productivity was due to release of stress tolerant (drought and disease) and input responsive potato varieties, particularly of improved genetic potential, use of certified quality seeds and its frequent replacement (CPRI, 2019), and micro irrigation replacing furrow method (Kumar *et al.*, 2009; Singh, 2013). Evidence revealed that on an average, seed replacement rate (SRR) for improved varieties was 100 % and 91.2 % in West Bengal and Uttar Pradesh, respectively, and the SRR for certified seeds was 40.3 % and 30 % in West Bengal and Uttar Pradesh, correspondingly (CPRI, 2019), while it was very poor (14.2 %) in Bihar (CPRI, 2018).

Historical Performance

This section briefly presents the historical performance and growth of potato production in key states of eastern region of India.

(i) Changes in Production

The eastern India is a major producing region of potato in the country. In the region, potato output increased nearly 88 %, from 19,424 thousand tonne to 36,484 thousand tonne during 2001-19 (Table 1). The region
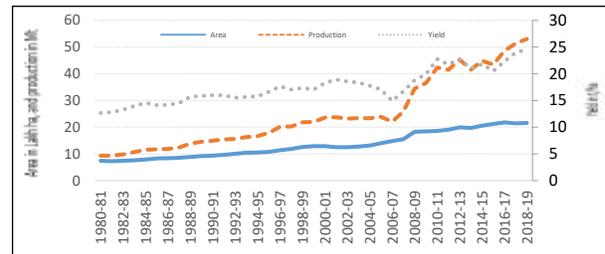

Figure 1. Trend in area, production and yield of potato in India, 1981-2019

contributed 69 % of total output at all-India and 96 % at region level in TE 2019. Further, 62 % of additional potato production in past two decades (2001-2019) came from eastern region (Uttar Pradesh, West Bengal and Bihar). In view of poor progress, special attention is needed for states of Assam and Jharkhand to stabilize production in the region.

(ii) Growth Performance

Growth performance of potato was analyzed for sub-periods viz. 2000s, 2010s and overall period (2001-2019) and presented (Table 2). Analysis shows that during the overall period, growth in area, production and yield was positive and significant at all-levels. Also, growth in production was contributed by both area and yield. It is noted that growth in output was highest in Bihar (15.8 %), followed by Jharkhand (4.3 %), Uttar Pradesh

Table 1. Change in production of potato in eastern India

State/ region	Production during TE (thousand tonne)			Change in production (thousand tonne)			Share in changed production (%)
	2001	2011	2019	2001-11	2011-19	2001-19	2001-2019
Assam	658.4	647.1	742.6	-11.3	95.5	84.2	0.30
Bihar	1,605.4	5,632.6	7,289.7	4,027.2	1,657.1	5,684.3	20.76
Jharkhand	3,76.2	529.2	683.4	153.0	154.2	307.2	1.12
West Bengal	7,282.7	8,787.1	12,210.1	1,504.4	3,423.0	4,927.4	18.00
Uttar Pradesh	9,502.3	12,611.2	15,558.1	3,108.9	2,946.9	6,055.8	22.12
Eastern India	19,423.9	28,207.2	36,483.8	8,783.3	8,276.6	17,059.9	62.33
All-India	23,604.0	37,769.2	50,980.3	14,165.2	13,211.1	27,376.3	100.00

Source: Authors' estimate

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Table 2. Annual compound growth rates in area, production and yield of potato in eastern states during

State/ region	Period I (2001-10)			Period II (2011-2019)			Overall period (2001-2019)		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
Assam	0.33	-1.14	-1.46	2.09 [b]	-0.10	-2.15	2.20 [a]	2.53 [a]	0.32
Bihar	7.85[a]	13.34 [a]	5.09 [a]	-0.26	3.00	3.27	6.06 [a]	15.82 [a]	9.20 [a]
Jharkhand	0.40	1.20 [c]	1.16	1.23	0.61	-0.61	1.79 [a]	4.26 [a]	2.43 [a]
West Bengal	3.24 [a]	-1.56	-4.65	1.35	0.81	-0.53	2.07 [a]	3.33 [a]	1.23
Uttar Pradesh	3.04 [a]	3.24 [a]	0.20	1.26 [a]	1.66 [b]	0.40 [b]	2.47	3.41 [a]	0.92 [a]
Eastern India	3.73 [a]	2.99 [a]	-0.71	1.01 [b]	1.53	0.52	2.92 [a]	5.50 [a]	2.51[b]
All-India	4.90 [a]	4.55 [a]	-0.34	2.01 [a]	2.91 [a]	0.89	3.78 [a]	5.68 [a]	1.84 [a]

Note: a, b and c indicate significance at 1, 5 and 10 per cent, respectively.
Source: Authors' estimate

(3.4 %), West Bengal (3.3 %), and lowest in Assam (2.5 %). Further, during 2000s and 2010s, area and output growth was positive and significant, except in Assam and West Bengal. This suggests for a yield enhancing technologies and suitable policies for Assam and West Bengal. Also, during 2010s, growth in output and yield weakened and area growth was mainly responsive for increase in output.

Instability in Production

Instability in potato output is caused by variability in area and yield. If the instability in both components decline, the instability in output declines. The instability index (derived from standard deviation of natural logarithms of area, production and yield) of potato production is presented here. It is interesting to note that instability in area and yield of potato has declined in states of eastern region and at all-India during the Period II over the period I (Table 3). The effect of decline is reflected as declining instability in output at all levels. This infers large scale spread and adoption of improved technologies and use of quality inputs across potato growing regions. However, rise in instability in area and almost stagnating in output and yield has been reported for periods between 1950-51 and 2006-07 (Chand and Raju, 2009). The instability in output could be further reduced by adopting area-specific recommended cultivars resistance to key diseases, insect-pests and climate resilient.

Table 3. Instability in area, area production and yield of potato in eastern states during

State/ region	Period I (2001-10)			Period II (2011-2019)			Overall period (2001-2019)		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
Assam	0.064	0.233	0.240	0.042	0.232	0.207	0.054	0.227	0.210
Bihar	0.248	0.488	0.255	0.022	0.075	0.086	0.179	0.352	0.255
Jharkhand	0.033	0.162	0.154	0.085	0.053	0.064	0.063	0.120	0.154
West Bengal	0.092	0.473	0.502	0.074	0.250	0.219	0.082	0.374	0.502
Uttar Pradesh	0.062	0.110	0.094	0.041	0.046	0.058	0.052	0.084	0.094
Eastern India	0.066	0.156	0.180	0.023	0.352	0.255	0.050	0.127	0.180
All-India	0.074	0.113	0.091	0.021	0.076	0.071	0.055	0.094	0.091

Source: Authors' estimate

Economics of Production

(i) Profitability

The profitability in potato production is studied using the cost of cultivation data. Quinquennial average for operating cost, gross returns and net returns were worked out to understand changes occurred between 2004-08 and 2014-18. In the cost concept terminology, the operational cost also called as Cost A1 included those items of cost for which farmers pay from their pocket plus land revenue. Analysis shows that operational cost increased proportionately higher than that of gross returns during above period (Table 4).

In West Bengal, farmers incurred higher cost in potato cultivation (₹ 115,169/ ha), followed by Uttar Pradesh (₹ 74,439/ha) and Bihar (₹ 59,906/ha). Regarding net returns, Uttar Pradesh was at top (₹ 60,354/ ha), followed by Bihar (₹ 41,186/ha), and it was lowest in West Bengal (₹ 27,722/ha) during 2014-18. Almost similar trend is seen during previous period (2004-08) as well. The higher operational cost was associated with higher input cost, especially on family labour, fertilizers, insecticides, and manures. In depth scrutiny has revealed that family labour cost was 2-times higher than that in other states of eastern region. Data show that benefit-cost (B-C) ratio was positive and declined marginally in recent over previous period.

(ii) Yield and Price

To further probe the reasons for lower returns in West Bengal, the yield, production cost and price received per quintal was correlated. Data show that potato yield was higher in West Bengal, followed by Uttar Pradesh and Bihar during 2014-18 (Table 5). About price, potato farmers in Bihar and Uttar Pradesh received ₹ 600/q, and ₹ 664.7/q, respectively, while farmers in West Bengal received ₹ 551/q during 2014-18. In addition, wide fluctuations in prices of potato per quintal noted as ₹ 835, ₹ 351, ₹ 717 and ₹ 419 during the year 2015, 2016, 2017, and 2018, respectively, in West Bengal (https://eands.dacnet.nic.in). These evidences suggest that low average prices are mainly causing lower returns. Findings suggest to keep a strict vigil on prices to save interest of producers. However, a study of 100 sample farms in West Bengal (50 each in Bardhaman and Hooghly districts) reported average price of potato received ₹ 696/q during

Table 4. Economics of potato production i n major states of eastern India

(₹/ha)

State	Operational cost		Gross returns		Net returns		B:C ratio	
	2004-08	2014-18	2004-08	2014-18	2004-08	2014-18	2004-08	2014-18
Bihar	31,972.4	59,906.0	65,014.0	1,01,092.6	33,041.6	41,186.6	2.03	1.69
Uttar Pradesh	38,591.6	74,439.1	80,029.9	1,34,793.2	41,438.1	60,354.1	2.07	1.81
West Bengal	53,533.6	1,15,169.4	67,963.9	1,42,892.3	14,430.3	27,722.9	1.27	1.24

Source: Authors' estimate

Table 5. Average yield and farm gate price received by potato farmers in major states of eastern India

State	Yield (q/ha)		Production cost (₹/q)		Farm gate price (₹/q)	
	2004-08	2014-18	2004-08	2014-18	2004-08	2014-18
Bihar	165.8	168.3	192.8	355.9	392.1	600.7
Uttar Pradesh	204.3	202.8	188.9	367.1	391.7	664.7
West Bengal	196.4	259.3	272.6	444.2	346.0	551.0

Source: Authors' estimate

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2018 (CPRI, 2019). Thus, potato cultivation in West Bengal is remunerative like other states of eastern region of India.

CONCLUSION

The findings of study indicate that states of eastern India are important producer of potato and shared about 72 % of total output in the country during TE 2018-19. The growth in output was contributed by growth in area and yield during 2001-2019, while growth weakened during 2010s over the previous decade (2000s), and negative growth in yield noticed for West Bengal in both periods. The negative yield growth in West Bengal and weakening growth in other states needs special attention of potato researchers and policy makers to improve the situation. Because, the eastern region of the country will remain the key producing region in years to come owing to crop suitability and quick income generating crop. Decline in instability in potato is noticed and this shows wide-scale spread and adoption of improved technology. This also infers that potato production has become less-riskier than was two-decades ago. Economics of potato shows that this crop is profitable. Wide fluctuations in prices in alternate years, particularly in West Bengal, needs a strict vigil and steps required to save the interest of farmers.

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