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Research Paper

Growth Performance and Profitability of Rice Production in India: An Assertive Analysis

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ABSTRACT

This study assessed the growth trends and instability in area, production and productivity of rice in major rice growing states during the period 2001-02 to 2018-19. The study revealed that compound growth rate of area under rice was almost constant in the country during last two decades, while it was fluctuating across the states. However, growth rates of production and productivity was found positive and significant. Instability in area under rice was less as compared to production and productivity. Although production of rice has increased due to innovations and adoption of new farm technologies, but a greater instability in production, indicated the influence of irregular monsoon on production during the study period. Many of the States registered negative profitability in rice cultivation and farmers get handful returns only when the farm business income was calculated. To provide better protection to the farmers through restriction on purchasing rice below MSP or government may adopt proper mechanism to stop distress sale of farm produces particularly rice.

Highlights

◉ Area under rice cultivation in India was found to be more or less stagnant over last two decades.

◉ Rice production has increased due to farm innovations but increased instability in production increased distress to the rice growers.

◉ Many of the states registered negative profitability in rice cultivation and only farm business income was positive.

Keywords: Farm business income, Growth, Instability, Loss, Profitability, Rice

The continuum growth of population and changing dietary preferences have raised the food demand and are imposing threat to food security at global level (Dzanku *et al.* 2015; Godfray *et al.* 2010). To maintain the food security, expansion of arable land and intensification of agriculture are two major factors to address the food demand of the growing population (Licker *et al.* 2010). With the limited land resources; it is difficult to meet out the increasing food demand. Net sown area is declining over the years as the agricultural lands
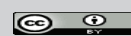
are being utilized in urbanization like constructing residential building and related infrastructures, establishment of industries, etc. (Sinha *et al.* 2016; Singh *et al.* 2015b). Several studies have emphasized extra 75-100 percent increase in food production by 2050 to meet the projected demand of food for ever increasing population with the present diet pattern, income and consumption (Rosegrant *et al.* 2009; UNFPA, 2010 and Van *et al.* 2013). Rice, wheat and maize are major cereal crops and their production is closely related to food security and sustainable development of the society (Singh *et al.* 2015a; Singh *et al.* 2015c).

The spatial variations have been an important dimension of varying growth trends of crops in Indian states because of differences in agro-climatic conditions, infrastructural developments and inherent socio-economic situations across the nation. The instability of economic phenomena is defined as the departure from what may be considered to be a stable passage through time. It quantifies the risk of insecurity arises from production, trade, income and prices etc. Instability measurement with respect to agricultural production is of interest to food issues or to issues resulting due to influence of fluctuations in output on agricultural prices and returns to the producers (FAO, 1998).

The production of rice in India was 116.42 million tonnes, covering an area of 43.79 million hectares, which were approximately 35.33 per cent of area under food crops and 40.86 per cent production of total food-grains of the country during 2018-19. It is an important staple food consumed by 65 per cent population of the country. It contributes around 10 per cent of the agricultural GDP and its production generates 3.5 billion man-days of employment (Ahmad *et al.* 2017; Kumar *et al.* 2018). Consumption of rice as a staple food by a large proportion of people, its contribution in agricultural GDP and generation of employment highlight its role in national food security, income and employment generation in India (Ahmad *et al.* 2019). Rice is the main staple food of India and is cultivated almost in all the states. The major rice producing states with respect to its share in total rice production of the nation were West Bengal (13.79%), Uttar Pradesh (13.34%), Andhra Pradesh including Telangana (12.84%), Punjab (11.01%), Odisha (6.28%), Chhattisgarh (5.61%), Tamil Nadu

(5.54%), Bihar (5.19%), Assam (4.41%), Haryana (3.88%) and Madhya Pradesh (3.86%). As rice is one of the major crops in these states, it is important to find out the present status related to growth and profitability of the crop in these states. Keeping this in consideration, the present study attempted to investigate growth and instability in area, production, productivity, cost of cultivation and profitability of rice in major rice producing states and nation as whole.

MATERIALS AND METHODS

Secondary data pertaining to area, production and productivity of rice for major rice growing states of India covering a period from 2001-02 to 2018-19 were used to assess the growth performance and instability of rice in the states as well as nation as whole. There was continuous fluctuation in all three key variables namely area, production and yield of rice in the states as well as at national level during the period under study. As cost of cultivation data is available only from 2001 onwards, so for comparison purposes the study was limited to these years only. There has not been much increase in area under rice but there has been significant increase in production which reflects India's self sufficiency in rice production and the potential to export rice to other counties. For estimating farm business analysis, data pertaining to cost of cultivation generated by Commission on Agricultural Costs and Prices (CACP) was used covering period from 2000-01 to 2016-17. For detail farm business analysis, the data of triennium ending 2003 and 2017 were used.

Estimation of growth rates

The compound growth rates (CGRs) of area, production and productivity of rice in major rice producing states of India was computed both for states and for India as a whole, using the following formula:

$$CGR = (Antilog\ of\ b\text{-}1)*100$$

Where, *b* is the regression coefficient.

Instability is the deviation from trend and many of the researchers (Hazell, 1982; Larson *et al.* 2004 and Sharma *et al.* 2006) have used the coefficient of variation (CV) as a tool of instability. An index of instability was computed for examining the nature

and degree of instability in area, production and yield of the rice crop at state and nation level. Simple CV does not explain properly the trend component inherent in the time series data so the instability index was calculated using better measure of variability suggested by Cuddy-Della Valle index (Cuddy and Della, 1978).

$$Instability\ \ Index = CV * \sqrt{1 - R^2}$$

$$CV = \frac{\text{Standard deviation of the variable}}{\text{Mean of the variable}} \times 100$$

If the estimated coefficient of regression equation is not significant, then the *CV* itself is taken as instability index.

Where, *CV* is coefficient of variation and R^2 is the coefficient of determination from a time series trend regression adjusted by the degrees of freedom.

Apart from Cuddy Della Valle Index (CDVI), this study also calculated Coppock Instability Index (CII) (Kaur and Singhal, 1988).

$$Coppock's\ Instability\ Index = {}^{Antilog}\left(\sqrt{\log V} - 1\right) * 100$$

$$LogV = \frac{\left[\left(\log \dfrac{X_{t+1}}{X_t}\right) m\right]^2}{N - 1}$$

X_t = area/production/productivity of rice in the year '*t*'; *N* = number of years; *m* = mean of the difference between logs of X_{t+1}, X_t; *Log V* = Logarithmic variance of the series

Farm business analysis

Cost C_2 is used as total cost of cultivation which includes all actual expenses in cash and kind incurred in production as well as interest on value of owned capital assets (excluding land), rental value of owned land and rent paid for leased-in land. Profitability/loss in rice cultivation was estimated using following methods:

Farm business income = Gross income − Cost A_2

Family labour income = Gross income − Cost B_2

Net income = Gross income − Cost C_2

Gross income from paddy cultivation is estimated by adding values of main and by-product which was estimated by the Commission on Agricultural Costs and Prices (CACP). Profitability/loss is calculated as given below:

$$Profit\ or\ loss\ (\%) = \left[\frac{\text{Value of produce}}{\text{Cost of cultivation}} - 1\right] \times 100$$

RESULTS AND DISCUSSION

Growth performance of rice

Compound annual growth rates of area, production and productivity of rice in major rice growing states and the country as a whole was calculated covering data of period from 2001-02 to 2018-19 and the results are presented in Table 1.

Table 1: Growth of area, production and productivity of rice in major rice growing states of India

Sl. No.	States	Area	Production	Productivity
1	Andhra Pradesh including Telangana	0.47***	0.90*	0.43*
2	Assam	0.01	1.22*	1.20*
3	Bihar	-0.22***	1.61*	1.83*
4	Chhattisgarh	-0.02	1.26*	1.28*
5	Haryana	1.05*	1.41*	0.35*
6	Madhya Pradesh	0.83*	3.55*	2.70*
7	Odisha	-0.44*	0.69***	1.13*
8	Punjab	0.50*	0.81*	0.31*
9	Tamil Nadu	-0.09	0.35	0.44
10	Uttar Pradesh	0.11	0.71*	0.60*
11	West Bengal	-0.29*	0.15	0.44*
	India	0.06	0.84*	0.78*

*, *** *indicate significant at 1% and 10% level of significance.*

The compound growth rates of area under rice was estimated to be positive (0.06%) for the nation. The growth rates of area under rice for Andhra Pradesh including Telangana (0.47%), Assam (0.01%), Haryana (1.05%), Madhya Pradesh (0.83%), Punjab (0.50%) and Uttar Pradesh (0.11%) were also estimated to be positive whereas, the states like Bihar (-0.22%), Chhattisgarh (-0.02%), Odisha (-0.44%), Tamil Nadu (-0.09%) and West Bengal (-0.29%) showed negative growth rates. About 85 per cent rice in the country is cultivated under rain-fed conditions and due to erratic behaviour of monsoon over the last two decades, growth rate of area was fluctuating across the major rice growing states and the area under rice increased at

minuscule level (0.06 per cent). The other reasons for fluctuating trends in area under cultivation may be shifting of farmers to other cash crops due to opening up of economy, fetching higher income due to high international prices and expectation of export opportunities.

Growth rates of production and productivity in almost all the states and nation as whole was computed to be positive and significant. The reason for increase in production and productivity could be adoption of new technologies of rice cultivation like use of high yielding varieties, improved package and practices, improved infrastructural facilities for farming.

Instability of area, production and productivity of rice

Instability indices in area, production and productivity of rice from the period of 2001-02 to 2018-19 was computed by using coefficient of variation, Cuddy- Della Valle index (CDVI) and Coppock Instability Index (CII) methods. The results of the analysis are presented in Table 2. The result revealed that instability index of area under rice was comparatively less than that of production and productivity at national level indicating area under rice was more or less stagnant during the period under investigation. No doubt, production and productivity of rice has increased during the period of investigation due to technological changes in production of rice. However, instability indices

of production and productivity was more because production and productivity are influenced by climatic conditions and during study period the monsoon was very erratic, which may have created variation in production and yield. The increased instability in the production also shows the distress in rice production.

State-wise instability indices of area, production and productivity of rice also showed that instability in area was less than that of production and productivity in all the major rice growing states. Instability indices of production and productivity were comparatively high in Madhya Pradesh, Bihar, Tamil Nadu and Chhattisgarh. In Indian states rice is grown in various production ecologies mainly grouped as irrigated and rain-fed systems. Productions in these systems vary widely, while former is considered favourable. States like Andhra Pradesh, Tamil Nadu, Punjab, and Haryana have predominantly irrigated rice while Madhya Pradesh Bihar, Uttar Pradesh, West Bengal, Odisha and Assam represent predominantly rain-fed rice area. During last two decades monsoon remained erratic. Hence, higher instability in production and productivity was observed in rain-fed states (Rani *et al*. 2010). In Tamil Nadu, farmers were not interested in adopting the hybrid rice technology; instead they were interested in the cultivation of HYVs (Sivagnanam, 2014) may be the reason for high instability in production in the state. The poor infrastructural development, socio-economic condition and erratic rainfall in these states

Table 2: Instability in area, production and productivity of rice in major rice growing states of India

Sl. No.	States	Area			Production			Productivity		
		CV (%)	CDVI	CII	CV (%)	CDVI	CII	CV(%)	CDVI	CII
1	Andhra Pradesh including Telangana	13.72	13.72	11.89	17.08	17.08	12.08	7.47	7.47	10.71
2	Assam	3.72	3.72	10.49	17.47	17.47	11.09	16.28	16.28	10.72
3	Bihar	5.91	5.29	10.76	30.54	30.54	14.23	30.30	30.30	13.43
4	Chhattisgarh	1.55	1.54	10.33	22.24	22.24	13.78	21.93	21.93	13.69
5	Haryana	13.24	13.24	10.76	17.20	17.20	10.81	7.21	7.21	10.74
6	Madhya Pradesh	14.48	14.48	11.07	49.23	49.23	13.13	35.55	35.55	12.52
7	Odisha	6.06	6.06	10.38	16.45	16.45	13.56	18.39	18.39	13.27
8	Punjab	6.38	6.38	10.51	10.76	10.76	10.68	5.19	5.19	10.41
9	Tamil Nadu	11.42	11.37	11.83	25.95	25.69	15.97	19.32	18.68	13.88
10	Uttar Pradesh	4.72	4.52	10.85	13.34	13.34	11.81	10.70	10.70	11.12
11	West Bengal	5.03	5.03	10.59	4.57	4.21	10.60	5.81	5.81	10.27
	India	2.52	2.40	10.49	11.41	11.41	11.06	10.16	10.16	10.70

have also adversely affected the production and productivity of rice.

Profitability/loss trend in cultivation of rice

Cost of cultivation data collected and compiled by Commission on Agricultural Costs and Prices (CACP) was used covering period from 2000-01 to 2016-17. For detail farm business analysis the data of triennium ending 2003 and 2017 were used and the results are presented in Table 3. The results revealed that gross income from rice cultivation was comparatively high in Punjab followed by Tamil Nadu, Haryana and Andhra Pradesh. Total cost (Cost C_2) was more in Tamil Nadu followed by Andhra Pradesh, Punjab and Haryana. Net income was comparatively high in case of Punjab followed by Haryana, Tamil Nadu and Andhra Pradesh and in rest of the state net income was negative. The reason may be that the productivity of Punjab, Haryana, Tamil Nadu and Andhra Pradesh was comparatively high as compared to Assam, Bihar, Chhattisgarh, Odisha, Madhya Pradesh and West Bengal. The other reason may be that Punjab, Haryana, Tamil Nadu and Andhra Pradesh have regulated markets and farmers might have sold their produce on minimum support price (MSP). Punjab and Haryana have well developed procurement policy for paddy and during 2018-19 these two states contributed 113.3 lakh metric tonne and 39.4 lakh metric tonne of rice to the total central pool, respectively of total 443.3 lakh million tonne. In open market the prices often remain less than that of MSP. The other reason could be the highest productivity for rice (4 tonnes/ha).Results for the States like Assam, Bihar, Chhattisgarh, Madhya Pradesh, Odisha, Uttar Pradesh and West Bengal have indicated losses in cultivation of paddy because the productivity of these states are comparatively less as compared to Punjab, Haryana, Tamil Nadu and Andhra Pradesh. The underdeveloped procurement policy for paddy along with less electric power supply to agricultural sector in these states lowers the profitability from rice cultivation. Farmers have to depend on diesel to pump groundwater which makes the irrigation costly and raise the cost of cultivation. The other reason for losses in rice cultivation may be less adoption of technologies due to poor economic condition and infrastructures for agricultural operations. Only the farm business income was found to be positive that is why the farmers are continuing rice farming. Otherwise rice farming in most of the Indian states is not profitable.

From the above analysis and ongoing discussion, it may be inferred that compound growth rate of area under rice was almost constant in the country during the period of investigation. It was fluctuating across the states but growth rates of production

Table 3: Cost of paddy cultivation and gross income in major paddy growing states of India

State	TE-2003						TE-2017					
	Gross income (000' ₹/ha)	Total cost (000' ₹/ha)	Net income ((000' ₹/ha)	Family labour income (000' ₹/ha)	Farm business income (000' ₹/ha)	Per cent profit loss	Gross income (000' ₹/ha)	Total cost (000' ₹/ha)	Net income (000' ₹/ha)	Family labour income (000' ₹/ha)	Farm business income (000' ₹/ha)	Per cent profit/ loss
Andhra Pradesh	28.90	27.51	1.39	4.40	13.74	5.04	89.07	80.36	8.71	17.85	46.59	10.83
Assam	12.61	13.17	-0.56	3.51	6.95	-4.25	37.98	51.96	-13.98	2.60	15.20	-26.90
Bihar	11.39	12.37	-0.98	0.83	4.70	-7.88	42.25	42.09	0.16	6.92	20.15	0.39
Chhattisgarh	9.17	11.68	-2.51	-0.62	3.40	-21.47	46.56	48.11	-1.55	6.39	20.55	-3.21
Haryana	29.29	24.98	4.31	7.88	16.29	17.27	104.70	81.26	23.43	35.13	69.68	28.83
Madhya Pradesh	9.17	11.68	-2.51	-0.42	2.86	-21.47	41.16	43.02	-1.86	7.25	18.95	-4.32
Odisha	14.84	16.11	-1.27	2.01	6.40	-7.89	46.60	58.62	-12.02	5.62	19.14	-20.50
Punjab	32.61	25.08	7.53	9.37	18.59	30.02	106.89	74.65	32.24	38.60	72.25	43.19
Tamil Nadu	31.37	29.42	1.94	4.67	12.86	6.60	77.93	74.75	3.18	11.45	30.86	4.26
Uttar Pradesh	15.74	16.03	-0.29	2.61	7.44	-1.84	49.59	58.94	-9.35	2.01	19.90	-15.87
West Bengal	17.84	21.51	-3.67	1.19	6.52	-17.06	61.71	73.90	-12.19	6.10	22.94	-16.49

and productivity was positive and significant indicating the production of rice increased during the period under study. Instability indices were found to be less as compared to production and productivity due to technological changes in cultivation practices. Increased instability in production indicated the influence of irregular monsoon on production during the study period. Most of the states registered negative profitability in rice cultivation. Only the farm business income was found to be positive. Hence, policies should be framed to sustain the rice farming in the country for ensuring food security of the nation. To provide better remuneration, policies should be framed to restrict sale of rice below MSP and purchase of rice below MSP may be made punishable, so that farmers may not shift to other crops or quit rice farming in order to ensure national food security.

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