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

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ABSTRACT

Rice is the most important staple food of the country consumed by about 65 per cent of the population (Singh and Singh, 2020). It is grown in almost all the states, however, the major rice producing states with respect to its share in total rice production of the country during 2018-19 are 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%). In the present study, an attempt has been made to assess 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 results of the investigation revealed that compound growth rate of area under rice was almost constant in the country during the period under investigation while it was fluctuating across the states but growth rates of production and productivity was found positive and significant. Instability indices of area under rice were found to be less as compared to production and productivity. Although production of rice has increased due to technological changes in cultivation practices but increased instability in production also indicated distress in rice production across the states. Most of the States registered negative profitability in rice cultivation and only the farm business income was found to be positive. Hence, policy makers, planners and stakeholders should formulate policies to sustain the rice farming in the country for food security of the nation. Restriction may be imposed on purchase of rice below MSP or government may adopt proper mechanism to stop distress sale of farm produces particularly rice. As paddy is water consuming crop and sustainability of ground water and other natural resources is threatened from paddy cultivation in areas with scarce groundwater specifically in states like Punjab and Haryana. It would adversely affect food security in the long run. Hence, farmers should be encouraged to shift out from paddy cultivation in the states where groundwater is depleting and should only grow paddy in water surplus areas keeping the sustainability of groundwater in mind.

Highlights

- Area under rice cultivation in India was found to be more or less stagnant.
- Production of rice has increased during the period of investigation on account of technological changes in cultivation practices but increased instability in production indicated distress in rice production
- Most of the states registered negative profitability in rice cultivation and only farm business income was found to be positive.

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 landresources; 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.*2015).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.* 2015, Singh *et al.* 2015)

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 measurementwith respect to agricultural production is of interest to food issues or to issues resultingdue 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,coveringan area of 43.79 million hectares, which was approximately35.33 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 billionmandays 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 highlights its role in national food security, income and employment generationin 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%). Keeping these facts in consideration,

the present study was 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. 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 dataof triennium ending 2003 and 2017 were used.

Estimation of growth rates

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

$$CGR = (Anti \log of \ b - 1)x \ 100$$

Where, b is the regression coefficient.

Instability is the deviation from trend and many of theresearchers have used the coefficient of variation (CV) as atool of instability. An index of instability was computed forexamining 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 trendcomponent inherent in the time series data so the instabilityindex was calculated using better measure of variabilitysuggested by Cuddy-Della Valle index (Cuddy and Della, 1978).

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

$$CV = \frac{\text{Standard deviation of the variable}}{\text{Mean of the variable}} X100$$

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 coefficientof determination from a time series trend regression adjustedby the number of degrees of freedom.

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

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

$$\text{Where} LogV = \frac{\sum(log\frac{X_{t+1}}{X_t} - m)^2}{n}$$

X_t = area/production/productivity of rice

t = 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:

$$Profit\ or\ loss(\%) = \left[\frac{Value\ of\ produce}{Cost\ of\ cultivation} - 1\right] X100$$

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. 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 decade growth rate of area was found positive fluctuating across the major rice growing states and marginal increase in area under rice was only 0.06 per cent for

the nation. 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 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. Another reason may be the rice intensification programme of government.

Table 1: Growth performance 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.

Instability analysis 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 as these states have not benefited from technological changes during Green revolution. The poor infrastructural development, socio-economic condition and erratic rainfall in these states have also adversely affected the production and productivity of rice.

Table 2: Instability indices 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

Profitability/loss trend in cultivation of rice

Augmenting farmer's income is prime concern of the Central government and respective state governments. Central government has decided to double the income of the farmers by 2022. An attempt has been made to assess the profitability/ loss in cultivation of rice in major rice growing states of India. 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. The results of the farm business analysis 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). In open market the prices often remains less than that of MSP. States like Assam, Bihar, Chhattisgarh, Madhya Pradesh, Odisha, Uttar Pradesh and West Bengal have shown 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 other reason for losses in rice cultivation may be less adoption of technologies due to poor economic condition and infrastructures for agricultural works. 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.

CONCLUSION

From the above 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 and it was fluctuating across the states but growth rates of production and productivity was positive and significant indicating the production of rice has increased during the period under study. Instability indices of found to be less as compared to production and productivity due to technological changes in cultivation practices. Increased instability in production also indicated distress in rice production across the states. Most of the states registered negative profitability in rice cultivation. Only the farm business income was found to be positive. Though rice is an important staple food of about 65 per cent population of the country, it still is a water consuming crop and its cultivation in water scarce areas adversely affects the sustainability of groundwater and other natural resources, specifically in states like Punjab and Haryana. This could adversely affect food security in the long run; hence, the farmers should be encouraged to shift out of paddy cultivation in the states where groundwater is depleting keeping in mind its sustainability. From food security point of views, policy makers, planners and stakeholders should advocate to cultivate paddy in water surplus states, as per requirement of the nation and frame policies to restrict sale and purchase of paddy below MSP and doing so by any agency may be made punishable offence so that farmers do not quit rice farming.

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Table 3: Per hectare cost of paddy cultivation and gross income in major paddy growing states of India

State	TE-2003						TE-2017					
	Gross income (Rs/ha)	Total cost (Rs/ha)	Net income (Rs/ha)	Family labour income (Rs/ha)	Farm business income (Rs/ha)	Percent profit/loss	Gross income (Rs/ha)	Total cost (Rs/ha)	Net income (Rs/ha)	Family labour income (Rs/ha)	Farm business income (Rs/ha)	Percent profit/loss
Andhra Pradesh	28896.58	27510.36	1386.23	4398.11	13736.04	5.04	89068.27	80361.15	8707.12	17854.84	46591.63	10.83
Assam	12609.42	13168.62	-559.20	3514.35	6951.24	-4.25	37981.64	51958.54	-13976.90	2596.18	15201.92	-26.90
Bihar	11393.40	12368.63	-975.23	828.63	4695.01	-7.88	42253.61	42091.29	162.33	6921.45	20152.49	0.39
Chhattisgarh	9172.77	11680.96	-2508.19	-620.05	3401.88	-21.47	46558.87	48105.26	-1546.39	6391.46	20550.97	-3.21
Haryana	29292.90	24980.00	4312.90	7878.95	16289.41	17.27	104695.03	81264.43	23430.60	35131.00	69681.53	28.83
Madhya Pradesh	9172.77	11680.96	-2508.19	-418.03	2864.10	-21.47	41163.27	43024.00	-1860.73	7253.13	18948.24	-4.32
Odisha	14843.54	16114.75	-1271.21	2011.58	6400.01	-7.89	46603.64	58621.13	-12017.49	5618.63	19137.73	-20.50
Punjab	32606.03	25077.29	7528.73	9371.58	18593.40	30.02	106891.57	74651.91	32239.66	38604.33	72250.91	43.19
Tamil Nadu	31365.21	29422.10	1943.11	4665.83	12864.61	6.60	77930.72	74747.18	3183.54	11452.20	30859.94	4.26
Uttar Pradesh	15737.18	16031.71	-294.53	2606.52	7443.49	-1.84	49589.11	58942.69	-9353.58	2006.47	19896.74	-15.87
West Bengal	17840.41	21509.20	-3668.78	1187.82	6515.67	-17.06	61712.30	73901.22	-12188.92	6097.88	22935.37	-16.49