



AN ANALYSIS OF TREND AND STRUCTURAL STABILITY RICE CULTIVATION IN THE PRE AND THE POST- LIBERALIZATION PERIODS

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ABSTRACT

India is a major rice grower on a global scale. It is a typical plant and a common crop. In terms of rice production, India is second only to China, accounting for more than 20% of global output. In order to reach the goal, secondary data was obtained from the Directorate of Economics and Statistics, Government of India's Agricultural Statistics at a Glance - 2020. According to the study, during the pre-liberalization period, the five-year moving average for the area in million hectares was 38.092 to 67.154 million tonnes, and the yield ranged from 1033.4 to 1622. From 1991-92 to 2019-20, the area was 42.68 to 43.84 million hectares, and the population was 78.736 to 112.356. Between the two periods, 11.49 percent of area, 90.06 percent of output, and 71.68 percent of rice yield happened. Rice underwent structural changes during the pre-liberalization and post-liberalization periods.

KEYWORD: Liberalization, Growth, Structural stability, Regression, Moving average

INTRODUCTION

Agricultural production – Rice production is a significant part of India's economy. India is responsible for more than 20% of global rice production. Rice cultivation covers almost a quarter of India's total planted area. India's rice production volume reached 122 million metric tonnes in the fiscal year 2021. Rice is the most important crop in coastal India and a few parts of eastern India. West Bengal, Uttar Pradesh, Andhra Pradesh, Punjab, and Tamil Nadu are the top five rice-producing states. West



Bengal generates 15% of the country's total rice production. Rice is an important food crop in India. India is the world's second-largest rice producer. Rice farming can be divided into four distinct methods. There are four methods: transplantation, drilling, broadcasting, and Japanese approaches. The most frequent approach is transplantation, in which seeds are placed in a nursery and seedlings are moved to the main field once they exhibit certain leaves. India is the world's largest producer of rice as well as its greatest exporter. It's one of the most important crops.

SCOPE OF THE STUDY

Rice is one of India's most important crops and an important part of its economy. Rice is consumed by a large portion of India's population; therefore, rice trading is important in international trade. Rice's origins and development are well-known. In India, a wide variety of rice cultivars are farmed. Rice commerce in India has developed tremendously as a result of increased demand for various varieties of rice. Rice's importance has been emphasized several times throughout the food scarcity. Rice contributes a considerable amount to India's total food grain production. As a result, the study proposed to the area under rice cultivation, rice output, and rice yield per hectare.

OBJECTIVE

1. To analyze the growth trend of Rice production, area and Yield in the Pre and the Post-Liberalization Period.
2. To examine the structural stability of regression model for Rice production and the area.

HYPOTHESIS

There is no structural change in the rice production and area under cultivation pre and postliberalization period.

METHODOLOGY

Secondary data was used in India's rice output to achieve structural stability, trend, and the moving average. The Directorate of Economics and Statistics-Government of India ministry of agriculture



and farmers welfare, Department of agriculture, cooperation, and farmers welfare published data on the area, yield, and output of rice in the agricultural statistics at a glance-2022. Pre-liberalization (Period I – 1965-66 to 1990-91) and post-liberalization (Period II – 1991-92 to 2019-2020) periods in India were studied. For the regression model's structural stability, both periods were aggregated (pooled) and then estimated separately for periods I and II. Compound annual growth rate (CAGR), trend analysis, and the five-year moving average were also used to evaluate the data. (Area in Million Hectares, Production in Million Tonnes, Yield per Kg. / Hectare)

STRUCTURAL STABILITY REGRESSION MODEL:

$$Y_t = Z_1 + Z_2 X_t + E_t$$

Y represents the amount of rice produced (in million tonnes), t represents the time period, $Z_1 / V_1 / U_1$ represents the intercept, $Z_2 / V_2 / U_2$ represents the growth parameter to be estimated, X represents the area under rice cultivation, and E represents the stochastic term in the pooled sample, Period I and Period II. S_1 is the residual sum of squares (RSS_1) of the pooled sample, S_2 is the residual sum of squares (RSS_2) of the I period, S_3 is the residual sum of squares (RSS_3) of the II period, and S_4 is the sum of S_2 and S_3 . The number of parameters is k, and the difference between S_1 and S_4 is S_5 . $F = S_5 / k / S_4 / (n_1 + n_2 - 2k)$

REVIEW OF LITERATURE

Singha K, Mishra S (2015) Sustainability of Rice Cultivation: A Study of Manipur; this research uses primary data to examine the sustainability of the rice crop in Manipur. According to the survey, 20% of farmers are sustainable, 64% are moderate, and 16 are vulnerable. Manipur's agricultural industry, particularly the rice production, remains vital. Although the crop's yield is substantially higher than the national average, the demand in the state is much higher than the supply, owing to its importance. This study also suggests that, despite its good agro-climatic conditions, rice agriculture in Manipur has not been particularly outstanding. Of the five aspects used to measure sustainability, the social element came out on top, followed by the economic factor. Lakshmi Prasanna and her colleagues (2009) The relationship between farm productivity and farm structure has been examined in Rice Production in India — Implications of Land Inequity and Market Imperfections, focusing primarily on one channel of transmission of this relationship, namely the input-use pattern in rice production. The hypothesis



addressed in this study is that land inequality effects rice crop productivity through influencing access to and utilization of resources. Land disparity has a detrimental impact on production, which is exacerbated by market defects. Although smallholders' share of inputs like as fertilizers and irrigation has risen over time, a huge percentage of smallholders still lack access to these resources. According to research, interventions such as fertilizer subsidies, agricultural finance, and minimum support prices can alleviate market flaws. Rice production constraints and 'new' challenges for South Asian smallholders: insights into de facto research priorities, John and Fielding (2014) According to estimated congruency ratios, peer-reviewed research exhibits a strong bias toward abiotic production restrictions. Meanwhile, while accounting for more than 22% of rice yield losses in the South Asian farming systems studied, socio-economic production restrictions have gotten very little attention from the academic community. Furthermore, while most study articles have focused on the most major rice production restrictions and linked those constraints to environmental concerns, there are many medium and minor production constraints that have gotten little research attention. Despite the fact that the combination of these less severe limitations accounts for the majority of total rice production losses, this is the case. Paudel et al., Economics of rice production in a rice zone in Nepal's Gorkha District, 2021. The Gorkha district undertook studies to learn more about the economics of rice farming. In the spring and summer, the average rice cultivation area was 0.47 hectare. Farmers were divided into smallholding (67 in number), medium, and large holding farmers based on the average rice growing area (53 in number). Rice grains and straw contributed 79.5 percent and 20.5 percent, respectively, to the return on rice. Rice production is a top priority among farmers since it contributes to food security. According to the study, timely use of agricultural inputs and optimal use of input resources serve to stimulate rice production in those places, making it an even more profitable occupation. This study, Singh et al. (2021), Growth Performance and Profitability of Rice Production in India: A Proactive Evaluation, examined the growth trends and instabilities in rice acreage, production, and productivity in major rice-growing states from 2001 to 2018. The study found that the country's compound growth rate of area under rice was nearly consistent over the last two decades, however it varied across states. Production and productivity growth rates were both positive and considerable. In comparison to production and productivity, instability in rice area was lower. Rice output has increased as a result of innovations and the implementation of new agricultural equipment, but there has been an increase in production volatility, indicating the impact of the



unpredictable monsoon. Chanda and et al. (2020) This study, titled An Overview of Rice Productive Cultivation and Variety in India, focuses on global rice production possibilities, trade, and other economic implications. Rice output has expanded dramatically in India and throughout Asia. The rapid expansion of India's rice sector, agriculture, trade, and production across the country. This report details the current worldwide food crisis as well as the rice trade's economic prospects. Rice production and supply are affected by trade policies and agreements established between countries that give mutual benefits. From a farming and economic standpoint, it is difficult to compare a large volume of production and trade data. Rice in India: Present Status and Strategies for Increased Production, Wanjari et al., 2006. Hybrids seeks to explain the current situation in India, including strategies and agro-techniques for seed and grain production, quality measures, and economic elements of hybrid rice. Because hybrid rice seed production requires a lot of knowledge and labour, multiple agro-techniques must be used to make it more successful. The different parent lines should indeed be sowed and transplant at the appropriate times, with a 50-100 m separation interval. Differential sowing of parental lines for synchronized flowering can be based on their effective accumulated temperature (12-27°C) from seeding to blooming. For seed to pollen parent plants, the ideal ratio is 3.5 seed parent spikelets per pollen parent spikelet. Long slender (LS) grain, 60-70 percent milling, and 24-31 percent amylose concentration are among the grain quality features. Seed quality control is another important need that must be met throughout the seed production process.

RESULTS AND DISCUSSION

According to the report, the area under rice cultivation increased slightly from 35.47 in 1965-66 to 43.78 in 2019-20. Rice production and yield per hectare have also increased, from 30.59 and 862 in 1965-66 to 118.43 and 2705 in 2019-20. From period I to period II, the CAGR in area, production, and rice yield per hectare was 11.49 percent, 90.06 percent, and 71.68 percent, respectively. From 1965-66 to 2019-20, the five-year moving average for area, production, and yield was 36.786, 38.092, and 1033.4, respectively. Area, output, and yield of rice have coefficient increase of 0.2407, 1.4827, and 28.91 for period I, and 0.0335, 1.4439, and 31.61 for period II.



Table 1

Average Area, Production and Yield of Rice: Period I, Period II, and Pooled

Average Production, Area and Yield of Rice			
Measure	Average Area of Rice Cultivation	Average Production of Rice	Average Yield per Hectare
Average (Period I)	38.99	48.97	1245.64
Average (Period II)	43.47	93.07	2138.55
Grand Average	41.40	72.65	1725.17
CAGR of Area, Production and Yield of Rice			
CAGR (Period I)	0.724	3.724	2.902
CAGR (Period II)	0.09	1.66	1.57
Overall CAGR	0.40	2.54	2.14

Source: Author calculation – 2020

Table 1 shows average area, production and yield per hectare of rice, suggesting that 11.49 percent of area, 90.06 percent of production and 71.68 percent of yield of rice occurred between the two periods. The grand average area of rice cultivation is 41.40, the average production of rice is 72.65 and the average yield per hectares of rice were 1725.17. compared to period I, the CAGR of the area under the cultivation, the production and the yield per hectares of rice is decreased during the period II.

Table 2

Rice Production, area and the yield in the Pre liberalization Period

Year	Area	5 yearly	Production	5 yearly	Yield	5 yearly
1965-66	35.47	-	30.59	-	862	-
1966-67	35.25	-	30.44	-	864	-
1967-68	36.44	36.786	37.61	38.092	1032	1033.4
1968-69	36.97	37.288	39.76	40.618	1075	1088.8
1969-70	37.68	37.338	40.43	40.944	1073	1096.4
1970-71	37.59	37.602	42.22	41.802	1123	1111.4
1971-72	37.76	37.644	43.07	41.632	1141	1105.8
1972-73	36.69	38.022	39.24	42.936	1070	1128.2



1973-74	38.29	38.172	44.05	42.706	1150	1117.8
1974-75	37.89	38.89	39.58	45.392	1045	1165.4
1975-76	39.48	39.328	48.74	47.336	1235	1201
1976-77	38.51	39.634	41.92	47.886	1089	1206.8
1977-78	40.28	39.768	52.67	48.864	1308	1227
1978-79	40.48	40.208	53.77	51.13	1328	1270.8
1979-80	39.42	39.804	42.33	50.02	1074	1255.6
1980-81	40.15	39.956	53.63	51.286	1336	1281.4
1981-82	40.71	40.304	53.25	54.488	1308	1350
1982-83	38.26	40.502	47.12	56.528	1232	1393.2
1983-84	41.24	40.594	60.1	57.99	1457	1425.8
1984-85	41.16	40.704	58.34	59.938	1417	1472.4
1985-86	41.14	40.802	63.83	62.016	1552	1518.8
1986-87	41.17	41.004	60.56	65.062	1471	1584.4
1987-88	38.81	41.314	56.86	67.154	1465	1622.0
1988-89	41.73	-	70.49	-	1689	-
1989-90	42.17	-	73.57	-	1745	-
1990-91	42.69	-	74.29	-	1740	-

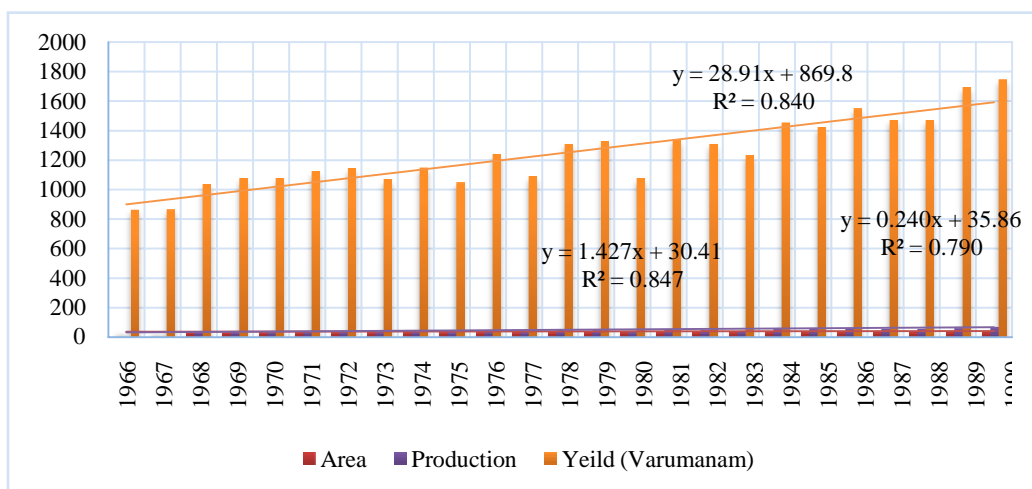
*Source: Agricultural statistics at Glance – 2021, Directorate of Economics and Statistics,
Authors Calculation*

Table 2 shows the rice production, area, and yield in the pre-liberalization period by the five-yearly moving average, showing that the moving average for the area in million hectares, 38.092 to 67.154 million tonnes, and yield from 1033.4 to 1622 were 36.786 to 41.314 for the area in million hectares, 38.092 to 67.154 million tonnes, and yield from 1033.4 to 1622 for the yield, respectively, from 1965-66 to 1990-91. From 1965-66 to 1990-91, the area of rice production, total rice production, and yield per hectare were 35.47 to 42.69 million hectares, 30.59 to 74.29 million tonnes, and 862 to 1740 kg/hectares, respectively.



Figure 1

Trends in the Area, Production and Yield of Rice in Pre-Liberalization Period



Source: Agricultural statistics at Glance – 2021-Directorate of Economics and Statistics,

Authors Calculation

Figure 1 depicts the pre-liberalization growth trend of rice production, area, and yield; the production, area, and yield coefficients were 0.2407, 1.4827, and 28.91, respectively, while the intercepts were -437.08, -2774.4, and -55938 respectively.

Table 3

Rice Production, area and the yield in the Post liberalization Period

Year	Area	5 yearly	Production	5 yearly	Yield	5 yearly
1991-92	42.65	-	74.68	-	1751	-
1992-93	41.78	-	72.86	-	1744	-
1993-94	42.54	42.68	80.3	78.736	1888	1844.4
1994-95	42.81	43.014	81.81	80.672	1911	1875.6
1995-96	42.84	43.466	76.98	81.828	1797	1882.2
1996-97	43.43	43.936	81.73	83.402	1882	1897.2
1997-98	43.45	44.31	82.54	85.002	1900	1918
1998-99	44.8	44.604	86.08	87.324	1921	1957.4



1999-00	45.16	44.15	89.68	85.18	1986	1926.2
2000-01	44.71	43.708	84.98	85.67	1901	1957.8
2001-02	44.9	43.058	93.34	84.36	2079	1957.4
2002-03	41.18	42.848	71.82	85.722	1744	1997.6
2003-04	42.59	42.63	88.53	85.726	2079	2008
2004-05	41.91	43.176	83.13	90.7	1984	2099.6
2005-06	43.66	43.766	91.79	92.83	2102	2119.4
2006-07	43.81	43.768	93.36	94.022	2131	2147.6
2007-08	43.91	43.608	96.69	94.86	2202	2175
2008-09	45.54	43.648	99.18	97.248	2178	2227.4
2009-10	41.92	43.416	89.09	98.956	2125	2279.2
2010-11	42.86	43.136	95.98	100.45	2239	2326.8
2011-12	44.01	43.574	105.3	103.728	2393	2380
2012-13	42.75	43.702	105.23	105.414	2461	2412.2
2013-14	44.14	43.698	106.65	106.294	2416	2432.4
2014-15	44.11	43.902	105.48	107.8	2391	2455.4
2015-16	43.5	43.906	104.41	109.766	2400	2499.8
2016-17	43.99	43.84	109.7	112.356	2494	2562.6
2017-18	43.77	-	112.76	-	2576	-
2018-19	44.16	-	116.48	-	2638	-
2019-20	43.78	-	118.43	-	2705	-

Source: Agricultural statistics at Glance – 2021 -Directorate of Economics and Statistics,

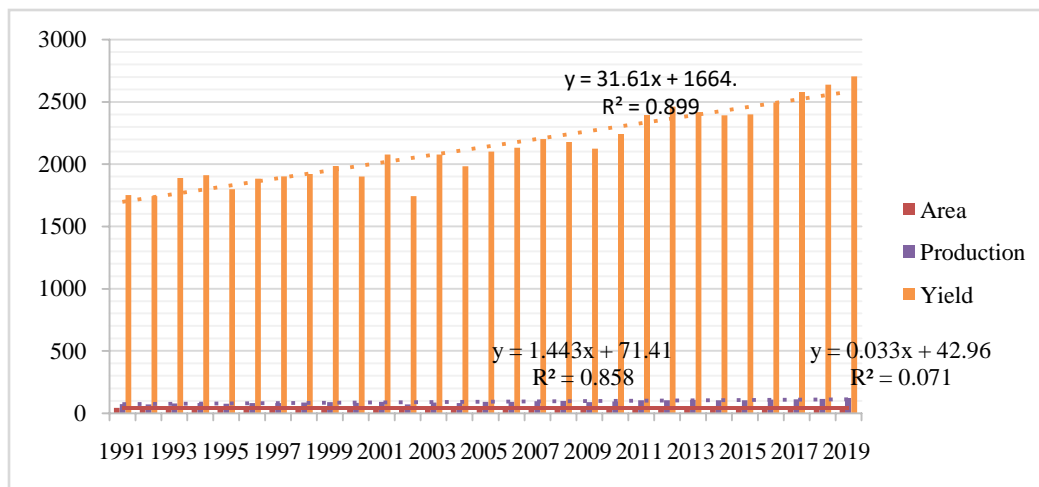
Authors Calculation

Table 3 shows the rice production, area, and yield in the post-liberalization period by five-yearly moving average, showing that the moving average for the area in million hectares, 78.736 to 112.356 million tonnes, and yield from 1844.4 to 2562.6 were 42.68 to 43.84 for the area in million hectares, 78.736 to 112.356 million tonnes, and yield from 1844.4 to 2562.6 for the yield, respectively, from 1991-92 to 2019. From 1991-92 to 2019-20, the area of rice production, total rice output, and yield per hectare were 42.65 to 43.78 million hectares, 74.68 to 118.43 million tonnes, and 1751 to 2705 kg/hectares, respectively.



Figure 2

Trends in the Area, Production and Yield of Rice in Post-Liberalization Period



Source: Agricultural statistics at Glance – 2021 - Directorate of Economics and Statistics,
Authors Calculation.

Figure 2 depicts the post-liberalization growth trend of rice production, area, and yield; the production, area, and yield coefficients were 0.0335, 1.4439, and 31.614, respectively, while the intercepts were -23.632, -2802, and -61248 respectively.

Structural Stability of Regression Model for the Rice production, area was examined in the Pre-Liberalization and Post Liberalization Periods by table4.

Table 4

Structural Stability of Regression Model – Food grains - Rice

	Pooled sample	Period I	Period II
Rice	$\hat{Y}_t = 8.4643 - 277.743X_t$ $S_1 = 5735.483$ D f = 52	$\hat{Y}_t = -166.69 + 5.535X_t$ $S_2 = 418.484$ D f = 24	$\hat{Y}_t = -172.882 + 6.1178X_t$ $S_3 = 3734.297$ D f = 27
	$S_4 = 4152.781$	$S_5 = 1582.702$	F = 9.909
			Table value = 3.23

Source: Author calculation



The structural stability of the regression equation for foodgrains - Rice is shown in Table 4. The critical $F_{2,52}$ is expected to be 3.23, therefore reject the null hypothesis because the observed test values for Rice structural stability equation were 9.909, which is more than the critical value. Rice's structural stability and production area are both impacted.

CONCLUSION

India is a major rice-growing country with the greatest rice-growing area in the world. India produces more than 20% of the world's rice and is the second largest producer after China. Rice production occupies the broadest area among the foodgrains in India, and West Bengal is the major producer of rice in India. Rice output, area, and yield increased from 35.47 million hectares, 30.59 million tonnes, and 862 kg/hectares in 1965-66 to 43.78 million hectares, 118.43 million tonnes, and 2705 kg/hectares in 2019-20. The CAGR in the area, production and yield of rice were 0.40, 2.54 and 2.14 from 1965-66 to 2019-20 periods. The coefficient growth of the area, production and yield of rice are 0.2407, 1.4827 and 28.91 for the period I and 0.0335, 1.4439 and 31.61 in the period II. According to the study's findings, structural changes happened in Rice during the pre-liberalization and post-liberalization periods.

DECLARATION COMPETING OF INTEREST

The authors declare no conflict of interest.

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