RESEARCH ARTICLE

A Temporal Analysis of Growth in Fertilizer Consumption vis-à-vis Food Grain Production in Rajasthan, India

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Abstract

The present investigation pertaining to the growth of fertilizer consumption and food grains production in Rajasthan was conducted during 2017–18. This study was based on time series data, which was collected from 1967-68 to 2014-15. The results of the present investigation revealed an increasing trend in fertilizer consumption and food grains production from 1967–68 to 2014–15 in Rajasthan. Total fertilizer consumption in Rajasthan significantly increased at the rate of 13.82 percent per annum during the post-green revolution phase-I. The consumption of N significantly grew by 14.26 percent per annum, that of P and K increased by 12.24 percent and 12.71 percent, respectively. Food grains production also increased by 2.41 percent per annum. In the post-green revolution phase-II, a growth rate of total fertilizer consumption increased at the rate of 9.96 percent, N significantly grew by 7.88 percent, P increased by 17.09 percent; whereas, K decreased by 0.94 percent per annum. However, food grains production was increased by 1.57 percent per annum. The analysis of post-reform period pointed out that the total consumption of composite fertilizers, N, P, and K significantly increased at the rate of 4.49 percent, 4.32 percent, 4.79 percent, and 7.21 percent, respectively. Food grains production also registered a significant growth rate of 3.71 percent per annum. In the entire period of study (1967-68 to 2014-15), total consumption of fertilizers had increased at the rate of 8.35 percent per annum. While the consumption of N grew by 8.08 percent per annum, that of P and K increased by 9.60 percent and 4.95 percent, respectively. Food grains production was increased by 2.78 percent per annum.

Keywords: Fertilizer consumption, Food grains production, Post-green revolution, Post-reform period.

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Introduction

Fertilizer consumption in India has been increasing since independence. Increase in fertilizer consumption is one of the key components in the growth of the agricultural sector in India. The annual consumption of fertilizers in term of N, P, and K nutrients has increased from 1.1 million tonnes (mt) in 1966–67 to 25.95 mt during 2016–17. Rajasthan is the largest state in terms of geographical area (3,42,239 km^2) and occupied 10.41 percent of the land area of the country.

The state of Rajasthan shared about 12.06 percent of total gross cropped area of the country. However, fertilizer consumption in the state is only 61.56 kg per hectare, which is much lower than that of the national average (130.80 kg per hectare) during 2016–17. The total consumption of N+P+K in Rajasthan was 1.3 million tonnes, which accounted for only 5.08 percent of the total consumption of India during 2016–17. Many researchers reported that most of the increase in food grains production during the first two decades of the green revolution is attributable to chemical fertilizers (Desai and Vaidyanathan, 1995). The growing population, increasing urbanization, rising domestic incomes, and changing lifestyles have led to an increasing demand for agricultural products. The temporal growth of fertilizer and agricultural output assume great significance while formulating any strategy for the development of fertilizers and food grains. Therefore, growth in fertilizer consumption in the Rajasthan is of paramount importance to raise agricultural production as well as productivity and to meet future requirements of the state.

Many studies have been before now carried out to examine the growth of fertilizer consumption and food grains production at all India level (Philip, 2004; Chanda and Sati, 2005; Sharma and Thaker, 2011; Singh, 2013; Desai *et al*., 2017 and Kumar and Indira, 2017) and also in different states like Tamil Nadu (Mohanam, 1990), Orissa (Pradhan *et al.*,1993), Madhya Pradesh (Singh and Chandra, 2001) and Rajasthan (Meena, 2002). However, no such recent detailed studies are available in the context of Rajasthan. Thus, keeping the significant role of fertilizers in boosting the food grains production, the present study was undertaken to examine the growth rate of fertilizer consumption and food grains production in Rajasthan.

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Materials and Methods

The present study was based on secondary data. The time series data on various aspects like fertilizer consumption and

food grains production was obtained from various sources like Fertilizer Statistics of India (Fertilizer Association of India, New Delhi), Statistical Abstract of Rajasthan (Directorate of Economics and Statistics, Rajasthan, Jaipur) and Rajasthan Agricultural Statistics at a Glance. For determining the growth of fertilizer consumption and food grains production, year wise data of whole Rajasthan was collected from the period 1967–68 to 2014–15. For analysis, the study was divided into two periods *viz.,* post-green revolution period (1967–68 to 1990-91) and Post-reform period (1991–92 to 2014–15). The Post-green revolution period (1967–68 to 1990–91) has been further divided into two sub-phases: Post-green revolution-Phase I (1967–68 to 1980–81) and Post-green revolution- Phase II (1991–92 to 2014–15).

The compound growth rate assessed the growth rate of fertilizer consumption and food grains production in Rajasthan. The compound growth rate was computed by fitting the following exponential function of the form:

$$Y_t = Y_0 (1 + r)^t$$

Where,

Y_t = Consumption of fertilizer in the year

Y_0 = Consumption of fertilizer in the base year

r = Compound growth rate

t = 1, 2, 3……..years.

The log transformation of the above equation becomes

$$\text{Log } Y_t = \text{Log } Y_0 + t \text{ Log } (1+r)$$

$$r = (\text{Antilog } (1 + r) - 1) \times 100$$

The (1 + r) values were tested for statistical significance using the formula:

$$t = \frac{\hat{a}}{SE\ (\hat{a})}$$

Where,

a = (1 + r)

Similarly, the growth rate of food grains production in the state had been computed.

Results and discussion

Post-green Revolution Phase I (1967–68 to 1980–81)

The growth rate of fertilizer consumption and food grains production during the post-green revolution phase-I are presented in Table 1. In the post-green revolution phase-I and just after onset of the green revolution in 1967–68, the total consumption of fertilizers was about 23.99 thousand tonnes. In 1970–71, total fertilizer consumption increased to 53.72 thousand tonnes, which further increased to 135.10 thousand tonnes in 1980-81. The analysis of post-green revolution phase-I shows that the total consumption of fertilizers in Rajasthan significantly increased at the rate of 13.82 percent per annum. While the consumption of N significantly grew by 14.26 percent per annum, that of P and K increased by 12.24 percent and 12.71 percent, respectively. Food grains production has also increased from 6.60 lakh MT in 1967-68 to 6.49 lakh MT in 1980-81, having a compound annual growth rate of 2.41 percent per annum.

Post-green Revolution Phase-II (1981–82 to 1990-91)

The growth of fertilizer consumption and food grains production during post green revolution phase-II are

Table 1: Growth of fertilizer consumption and foodgrains production in rajasthan during post-green revolution phase-i (1967–68 to 1980–81)

Year	*N (tonnes)*	*P (tonnes)*	*K (tonnes)*	*Total (tonnes)*	*Food grains production (metric tonnes)*
1967–68	18120	4802	1069	23991	6600000
1968–69	23045	5846	1300	30191	3549000
1969–70	31431	8210	1500	41141	4698000
1970–71	40610	11261	1850	53721	8841000
1971–72	46018	9403	3135	58556	6335000
1972–73	46822	9460	3694	59976	5155000
1973–74	55074	13628	4555	73257	6719484
1974–75	47639	8780	2041	58460	4977506
1975–76	62353	12769	2132	77254	7735301
1976–77	79085	15827	3640	98552	7490257
1977–78	90165	18862	4879	113906	7158429
1978–79	105455	22498	5631	133584	7782099
1979–80	115473	26105	5667	147245	6245016
1980–81	106623	22982	5499	135104	6496586
CGR (%)	14.26**	12.24**	12.71**	13.82**	2.41

**Significant at 1 percent level of significance, CGR = Compound growth rate

Table 2: Growth of fertilizer consumption and food grains production in Rajasthan during post-green revolution phase-II (1981–82 to 1990–91)

Year	*N (tonnes)*	*P (tonnes)*	*K (tonnes)*	*Total (tonnes)*	*Food grains production (metric tonnes)*
1981–82	106707	25747	5590	138214	7163085
1982–83	125864	33734	5929	165527	8323409
1983–84	157998	46202	5470	209670	10075718
1984–85	150409	51371	4790	206570	7914402
1985–86	160849	55510	4564	220923	8129882
1986–87	237067	83923	5319	326309	6791005
1987–88	149692	62010	3113	214815	4781815
1988–89	211931	89748	3696	305375	10656673
1989–90	200914	103425	5498	309837	8532913
1990–91	242985	120657	7031	370673	10934527
CGR (%)	7.88**	17.09**	-0.94	9.96**	1.57

**Significant at 1 percent level of significance, CGR = Compound growth rate

presented in Table 2. In the post-green revolution phase-II, total fertilizer consumption had remarkably increased from 138.04 thousand tonnes in 1981-82 to 370.67 thousand tonnes in 1990-91, except dips during 1984-85 and 1987-88. The growth analysis of post-green revolution phase-II indicated that total consumption of fertilizers in Rajasthan significantly increased at the rate of 9.96 percent per annum. The consumption of N also significantly grew by 7.88 percent per annum, P increased by 17.09, and K decreased non-significantly by 0.94. The negative growth in case of K can be attributed to the fact that there had been large fluctuations in fertilizer consumption in the state from the period 1983-84 to 1988–89. Food grains production was increased by 1.57 percent per annum, and it has increased from 7.16 lakh MT in 1981–82 to 10.93 lakh MT in 1990-91. Further, it was observed that the growth of fertilizer consumption and food grains production during the post-green revolution phase-II was lower than that of post-green revolution phase-I.

Post-reform Period (1991–92 to 2014–15)

The growth of fertilizer consumption and food grains production during the post reform period are presented in Table 3. In the post reform period, the total fertilizer consumption was observed to increase continuously from 431.12 thousand tonnes in the year 1991–92 to 1298.97 thousand tonnes in the year 2014-15, except dips for the years 2000–01, 2002–03, 2012–13 and 2013–14, where it was observed to decrease. An analysis of the post-reform period pointed out that the total consumption of fertilizers in Rajasthan significantly increased at a rate of 4.49 percent per annum. The consumption of N also significantly grew by 4.32 percent per annum, that of P and K increased by 4.79 percent and 7.21 percent, respectively. Food grains production also registered a significant growth rate of 3.71 percent per annum, and it has increased from 79.81 lakh metric tonnes in 1991–92 to 196.22 lakh metric tonnes in 2014-15. Further, it was found that the growth of total fertilizer consumption, nitrogen, and phosphorous was lower than the post-green revolution phase-II while it was higher for potassium. The growth rate of food grains production was also found higher during the post-reform period as compared to the post-green revolution period-II.

Growth Rate during Post-green Revolution Period (1967–68 to 1990–91), Post-reform Period (1991–92 to 2014–15) and overall period (1967–68 to 2014–15)

The analysis of growth of fertilizer consumption and food grains production during post-green revolution period, post-reform period, and overall period in Rajasthan state has been done and depicted in Table 4. In the post-green revolution period, total consumption of fertilizers in Rajasthansignificantly increased at the rate of 11.32 percent per annum. While the consumption of N grew by 10.66 percent per annum, that of P and K increased by 14.14 percent and 5.78 percent, respectively. Food grains production was increased by 2.20 percent per annum. In the post-reform period, total consumption of fertilizers in Rajasthan increased at the rate of 4.49 percent per annum. While the consumption of N grew by 4.32 percent per annum, that of P and K increased by 4.79 percent and 7.21 percent, respectively. Food grains production was increased by 3.71 percent per annum. In the entire period of study, the total consumption of fertilizers in Rajasthan increased at a rate of 8.35 percent per annum. While the consumption of N grew by 8.08 percent per annum, that of P and K increased by 9.60 percent and 4.95 percent, respectively. Food grains production was increased by 2.78 percent per annum.

The foregoing analysis indicated that the growth rate in consumption of total fertilizer use as well as for the three nutrients individually were much higher in the post-green

Table 3: Growth of fertilizer consumption and food grains production in Rajasthan during the post-reform period (1991–92 to 2014–15)

Year	*N (tonnes)*	*P (tonnes)*	*K (tonnes)*	*Total (tonnes)*	*Food grains production (metric tonnes)*
1991–92	291943	140789	8197	431121	7981166
1992–93	349402	136046	5074	490522	11479171
1993–94	365986	133752	2627	502365	7054971
1994–95	451139	142811	8040	601990	11710400
1995–96	486346	150489	5716	642551	9567110
1996–97	546169	146965	7344	700478	12821456
1997–98	591847	190072	5518	787437	14036196
1998–99	532520	188480	6128	727128	12934574
1999–20	564050	246884	6325	817259	10685861
2000–01	495186	164246	5375	664807	10040053
2001–02	583322	199693	6840	789855	14001881
2002–03	401641	141855	7013	550509	7535213
2003–04	563213	204793	10621	778627	18009181
2004–05	541858	203142	16328	761328	12163209
2005–06	619825	242394	19864	882083	10823629
2006–07	664890	258245	12994	936129	14928317
2007–08	705335	260464	20912	986711	16084435
2008–09	709533	319022	23470	1052025	16693851
2009–10	721962	316184	34748	1072894	12359839
2010–11	870392	413303	34951	1318646	23574113
2011–12	913494	416112	26175	1355781	21925164
2012–13	962146	351264	18220	1331630	20060126
2013–14	929504	279370	5159	1214033	20719492
2014–15	952350	331444	15178	1298972	19622159
CGR (%)	4.32**	4.79**	7.21**	4.49**	3.71**

**Significant at 1 percent level of significance, CGR = Compound growth rate

Table 4: Growth rate during post-green revolution period, post-reform period and overall period

Year	*Post-green revolution period (1967–68 to 1990–91)*	*Post-reforms period (1991–92 to 2014–15)*	*Overall period (1967–68 to 2014–15)*
N	10.66**	4.32**	8.08**
P	14.14**	4.79**	9.60**
K	5.78**	7.21**	4.95**
Total NPK	11.32**	4.49**	8.35**
Food grains production	2.20**	3.71**	2.78**

**Significant at 1 percent level of significance, CGR = Compound growth rate

revolution period (1967–68 to 1990–91) as compared to a post-reform period (1991–92 to 2014–15). In the post-reform period, growth rate of fertilizer consumption turned out to be 7.21 percent per annum which was less than that achieved during the post-green revolution period (11.32 percent per annum). Similar results were also reported by Sharma and Thaker (2011) and Pandey and Tripathi (2013) at all India level.

The major reasons for higher growth in fertilizer consumption during post-green revolution period might be spread of HYV seeds, the rapid expansion of irrigation facilities, the introduction of Retention Price Scheme,

distribution of fertilizers to farmers at reasonable prices, expansion of dealer's network and improvement in fertilizer availability. Moreover, for the post-green revolution period, the base period for calculating the growth rate was 1967–68, during which the fertilizer consumption was almost at very low level but for the post-reform period, the base period was 1991–92, during which the consumption was quite high. In 1991–92, certain policy reforms were also initiated in the fertilizer sector as a part of macro-economic reforms. The potassic and phosphatic fertilizers were decontrolled w.e.f. August 25, 1992. This caused a reduction in the consumption of phosphatic and potassic fertilizers in the few initial years. Total consumption of phosphatic fertilizers fell by about 4.99 percent (from 140.78 thousand tonnes in 1991–92 to 133.75 thousand tonnes in 1993–94) and for potassic fertilizers by 67.95 percent (8.19 thousand tonnes in 1991–92 to 2.62 thousand tonnes in 1993–94). These policy interventions led to a slowdown in fertilizer consumption in the initial years of the post-reform period. Due to the introduction of concession scheme on decontrolled phosphatic and potassic fertilizers in 1992–93, fertilizer consumption started picking up from 1994–95 onwards.

Further, the government introduced the Nutrient Based Subsidy (NBS) Policy from 1 April 2010 where a fixed rate of subsidy was announced on the nutrients. Urea was covered under statutory price control, whereas P and K fertilizers were covered under the NBS Policy, in which the maximum retail price (MRP) of fertilizers were fixed by fertilizer companies based on the prices prevailing in the international market. After the introduction of the NBS Policy, there had been a significant increase in the prices of P and K fertilizers due to an increase in the international prices of these products and raw materials. This disparity in the prices of urea and P and K fertilizers again led to a distortion in the consumption pattern of NPK fertilizers. After the NBS Policy came into effect, between 2010–11 and 2014–15, consumption of N increased by just 9.42 per cent (from 8.70 lakh MT in 2010–11 to 9.52 lakh MT in 2014–15), whereas, consumption of P and K fell by 19.81 percent (from 4.13 lakh MT in 2010–11 to 3.31 lakh MT in 2014–15) and 56.57 percent (from 34.95 thousand MT in 2010–11 to 15.17 thousand MT in 2014–15), respectively. All these factors led to a decrease in fertilizer growth during the post-reform period. Whereas the opposite results were observed in the case of foodgrains production. The growth rate of food grains increased from 2.20 percent during post-green revolution period to 3.71 percent during the post-reforms period. Similar results were found in the study of Sarkar and Chakraborty (2002) conducted in the state of West Bengal, where the growth of food grains' area, production and yield had decreased significantly during the post-reform period, whereas, Sharma and Thaker (2011) and Pandey and Tripathi (2013) reported contradictory observations.

In this study, the high growth of food grains production and crop output in the post-reform period might be due to a substantial increase in the gross irrigated area, gross cropped area and state of technology in the state. However, from 1967–68 to 2014-15, total fertilizer consumption recorded a growth rate of 8.35 percent per annum and food grains production increased by 2.78 percent per annum.

Conclusion

It can be concluded from the above discussion that an increasing trend had been observed in fertilizer consumption and food grains production from 1967–68 to 2014–15. Total fertilizer consumption, N, P, and K in Rajasthan significantly increased during the post-green revolution phase-I (1967–68 to 1980–81). Food grains production also increased but non-significantly. In the post-green revolution phase-II (1981–82 to 1990-91), growth rate of total fertilizer, N and P consumption significantly increased but K found decreased. Food grains production was also increased during phase-II. The total consumption of fertilizers, N, P, K and food grains production in Rajasthan registered significant growth during the post-reform period. In the entire period of study (1967–68 to 2014–15), total consumption of fertilizers, N, P, K and foodgrains production in Rajasthan had increased at the rate of 8.35, 8.08, 9.60,4.95 and 2.78 percent per annum, respectively. Thus, it is clearly revealed from the results of the study that growth rate in consumption of total fertilizer use as well as for the three nutrients individually was much higher in the post-green revolution period as compared to post-reform period. Whereas, food grains production was found to be higher in the post-reform period in comparison to the post-green revolution period.

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