

**GROWTH PATTERS OF FERTILIZER USE IN RAJASTHAN FROM 1978-79 TO  
2010-11**

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**ABSTRACT**

*The Study was carried out to find out trends, growth and instability in consumption of chemical fertilizer in Rajasthan from 1978-79 to 2010-11 with the help of secondary data and it was found that In Kharif season it was found that in TE 1980-81 Nitrogenius (N) was 35003 tonnes and it was widely used then other two segments of fertilizers in the absolute terms consumption of fertilizer was heavily increased and became in TE 2010-11 is 307452 tonnes. Consumption of other fertilizers was relatively less in absolute terms in TE 1980-81 as Phosphetic (P) was 7222 tonnes and Potasic (K) was 1613 tonnes. Use of Potasic fertilizers was with at stagnant till TE 2000-01 as it was 3144 tonnes and it was seen sudden rapid rise upto 16978 tonnes in TE 2010-11. Similar pattern was observed in Rabi season use of Nitrogenius fertilizer was seen increased continuously from 74181 tonns in TE 80-81 to 459844 tonnes in TE 2010- 11. Consuption of Potasic fertilizers was increased after TE 2000-01. Consumption of Nitrogenius fertilizers was always higher than Phosphetic and Potasic fertlisers. Potasic fertilizers were not poplar till TE 2000-01 after it consumption of potasic fertilizer increased dramatically. Growth of consumption was found highest in Phosphetic fertilizers and lowest potasic fertilizers and instability was lowest in Nitrogenius fertilizers. AGR was recorded high in Kharif crops in all kind of fertilizers. Instability was lower in Kharif crops in N and K. Per Hectare Consumption of Total Fertilizer in Kg was found always higher in Rabi crops but growth and instability was recorded higher in Kharif crops.*

**1. INTRODUCTION**

Agriculture in Rajasthan is also having important place in every aspect as shouted by agricultural economist as well as several researchers terms of contribution in income, food, employment and raw material to industries etc. Agriculture in Rajasthan is always a challenging task because large part of state belongs to thar desert and rain fall is very uncertain. Several efforts have been made to increase irrigation facility through canal system. Agricultural production also increasing in Rajasthan even having several limitation which can be argued with these compiled data given in table 1 Trienum Ending 1970-71 having Gross irrigated area 2472.33 thousand hectare which shown increasing at every decade it was 3761.17 in TE 1980-81 and reached in TE 2010- 11 to 7846.84 thousand hectare and in this period gross irrigated area increased to 217.39 percent from TE 1970-71 level. Rise in irrigation facility provide a chance to enhance area under the crop which seems true for the state also but during the same period total cropped area was 15881 thousand hectare in TE 1970-71 and increased to 23506 thousand hectare in TE 2010-11 and only 48.01 percent gross area can be increased. Production of overall food grain which includes Cereals and

Pulses was increased but in this segment only cereals were found contributory then pulses. Production of pulses was with having more uncertainty and stagnant in nature on other hand production of oilseed category increased so sharply and in the same period production of oilseed crops increased 919.97 percent. These facts clearly indicating farmers shifting towards high value crops then low value after spread of green revolution.

**Table 1: GROSS IRRIGATED AND TOTAL CROPPED AREA, PRODUCTION OF FOODGRAIN CROPS AND OILSEEDS**

Year	Area in thousand Hectares		Production in thousand Tonnes			
	Gross irrigated area	Total cropped area	Foodgrain crops	Cereals	Pulses	Oilseeds
TE 1970-71	2472.33	15881.00	8841.00	7064.00	1777.00	532.00
TE 1980-81	3761.17	17072.00	6507.90	5206.77	1301.13	395.80
TE 1990-91	4492.83	18707.00	10934.53	9215.70	1718.82	2355.62
TE 2000-01	6625.73	19972.00	11220.16	9864.05	1356.11	3084.59
TE 2010-11	7846.84	23506.00	17542.60	15615.84	1926.77	5426.25
Percentage change from TE 70-71 to TE 2010-11	217.39	48.01	98.42	121.06	8.43	919.97

Source: Compiled with the data collected from “50 Years of Agricultural Statistics of Rajasthan(1956-57 - 2005-06)” and Agricultural Statistics Rajasthan various issues

Experience of green revolution with increasing irrigation facility use of fertilizer became very popular and attractive to farmer in order to earn profit. Fertilizer is any material which having the essential nutrients required by the plants are one of the key elements which were being used to maintain high land productivity for agricultural use. The use of fertilizer coupled with fertilizer responsive hybrid and high yielding varieties and irrigation resulted in a quantum jump in food production. Normally fertilizer used in agriculture were mainly of two categories first natural or organic and second were inorganic material or synthetic origin. (other than liming materials). This study is only about man-made fertilizers which were mainly categorized in nitrogen, phosphorus and potassium on the basis nutrients availability in it. Season wise in Rajasthan there are two main crop growing seasons first Kharif are start with the arrival of monsoon and harvested between September to October second is Rabi start generally from October -November and harvested in February- March.

**ORGANIZATION OF STUDY:**

The paper is divided in five part first one is introductory in second part comprising with literature review, research gap, objectives and hypothesis of the study, in the third part data

source and methodology will be discussed, forth part having results and discussion and finally infifth part summary and conclusion will be analyzed.

## **2. LITERATURE REVIEW**

Ramasamy et al. (1986) Pointed out about the importance of fertilizer as it was one of the variable among the different variables which contributing significantly to the improvement of crop yields in India. It was arguedthat with introduction of the high yielding varieties in late of sixties fertilizer got crucial determining place.

Nkonya et al. (1997) studied via primary survey of 246 farmers to find out the factors affecting the adoption of improved variety of maize seed and effect of fertilizer in Northern Tanzania. The result of the study revealed that influence of fertilizer use on the improved variety of maize seed was found significant.

Dev.G (1998) Argued that use of balanced and adequate fertilizer is necessary for ensuring sustainable growth of agriculture and for increasing crop yields. Soil test based fertiliser use anduse of secondary and micronutrients are very important part of balanced fertilizer and for that it was recommended to strengthen existing laboratories for it.

Sengupta (2009) studied role of fertilizer on agricultural production using secondary data at Indialevel and observed that in role of chemical fertilizers is important in raising agricultural productivity in given four decades period as a result of which India can achieved self-dependent which is required in food grain specially cereals production. The imports of chemical fertilizer like phosphatic and potassic fertilizers have inceased substantially during past few years.

Mohanam (1989) analyzed the growth patterns of fertilizer use in Tamil Nadu. The study found that the growth rate of fertilizer consumption in Tamil Nadu is less than the all-India growth rate,andit was observed that high growth showing districts were showing the growth rates in a narrow range so look like that 18 the districts in Tamil Nadu were made almost cluster around the state level growth rate, there is inter-district variation, in the growth of fertilizer use. There was found variation in difference in the growth rates of fertilizer use before 1967-68 and after 1967-68.

Pradhan et al. (1993) used secondary data to find the trend and pattern of consumption of fertilizer in Orissa in 1968-1992. Growth rate of fertilizer use was found in Orissa was almost equal to the all India level. The growth rate for per hectare fertilizer consumption was less than all India level as growth rate of the state was 7.47 percent and same for all India was 8.67 percent. Total share in fertilizer consumption was highest irrigated area as only five districts have in 87.79 percent share in 1970-71 and remains highest in these five to 73.88 percent in 1991-92.

Chandrasekaran and Krishnamurthy (1999) studied about growth of fertilizer use in Tamil Nadu using secondary time series data. Two dimensions used in the study as per hectare fertilize and total fertilizers found that during the study period growth in both dimensions both was positive. The use of N became slower than of P and K fertilizers for crops. Among all the districts of in Tamil Nadu it was found that the proportionate use of fertilizer consumption was almost same and did not changed considerably in per hectare consumption of fertilizer.

A study by Xavier (2004) studied on the basis of primary survey of 200 farmers of Sivagangai district of Tamil Nadu and it was found that in all categories of farmers application of N was more than the recommended level while opposite in case of P fertilizers and use was less than therecommended level.

Sheoran and Nandal (1997) undertaken study in Haryana to examine about the factors affecting the consumption of Nitrogenous fertilizer. Irrigation and nitrogen responsiveness were the most important determinants for use of Nitrogen fertilizer. Cropping pattern was found shifted in the study towards nitrogen consuming fertilizers in the state main reasons were the improved farming methods and management practices, easy availability of Nitrogenous fertilizers especially availability on credit through government/ Cooperative outlets at subsidized rates.

Malik R.P.S. and Sekhar C.S.C (2007) studied with the objectives to find out trends in fertilizer use, determinants of consumption of fertilizer and impact of fertilizer use using both primary and secondary data. It was found that even with regional variations in fertilizer use yet consumption of fertilizer was quite high than most of other regions of country and consumption was further more than recommend use. On the basis of marginal product and marginal cost it was argued that Haryana was not at the exhausted level. Major determinant for for fertilizer consumption were crop-fertilizer prices and percentage area irrigated.

Sharma Vijay Paul and Thaker Hrima (2011) used secondary data to find out fertilizer consumption and determinants of it. It was found in the study that northern region of country consumed highest 34.1 percent, west and south having around 25 per cent each and the eastern region has lowest 15.5 per cent. Study period was divided in three phases and growth Rates was higher in pre green revolution period in both terms total as well as per hectare. As a determinant price of fertilizer and output and credit were not as effective as area under HAV to Gross Cropped area and Percentage of gross irrigated area to gross cropped area. Price of fertilizer was found negative in total fertilizer and all components of N,P and K type of fertilizer.

## **RESEARCH GAP**

It was observed that there were too much work in the field fertilizer used in agriculture in different states India when it comes for Rajasthan then only few and very limited study were found. It well known fact that Rajasthan is a rainfed state so mostly researchers have overlooked effect of fast improving irrigation facilities in the state. In this way this study with larger range of data will be a significant addition in this field.

### **OBJECTIVES OF THE STUDY**

The objectives of the study are as follows.

- 1 To find the trends in consumption of chemical fertilizer in Rajasthan from 1978-79 to 2010-11
2. To estimate the growth of chemical fertilizer consumption.
3. To estimate the instability of chemical fertilizer consumption.

### **3. DATA SOURCE AND METHODOLOGY**

#### **Data and data Source:**

Data in the study were secondary mainly published sources as “50 Years of Agricultural Statistics of Rajasthan (1956-57 - 2005-06)”, Agricultural Statistics Rajasthan various issues, Statistical Abstract, Rajasthan, 2012, ‘Some Facts about Rajasthan 2013’ all are from Directorate of Economics and Statistics, Department of Planning, Rajasthan, Yojana Bhawan, Jaipur, Government of Rajasthan.

#### **Period and Coverage of study:**

Period of study was from 1978-79 to 2010-11 using time series data of agricultural production. Coverage of the study was the consumption of nitrogen, phosphorus and potassium fertilizers in both kharf and rabi seasons. Per Hectare Consumption Of total fertilizer used in Kg was also used in the study.

#### **Tools and Techniques**

In order to meet objectives of the study following tools and techniques were used

#### **Three year moving average**

Agriculture production in Rajasthan is highly unstable and uncertain, and it is frequently faced by famines and scarcity. To examine cropping pattern three years moving average was taken for area under the crop and production of the crop and term which was used by several researcher Triennium Ending [TE] as recently used by several researchers, it was indicating end period of three years average of the desired variable. Individual variable related to agriculture of any year may be positive or negative abnormal then conclusion based on these can be misleading.

### **Percentage change**

Percentage Change in

$$Y(Y_{t+1} - Y_t)/Y_t$$

x100

$Y_{t+1}$  = Value of variable at next

level  $Y_t$  = Value of variable at

present level

### **Proportion**

Share of variable out of total has been used to demonstrate relative

$$\text{changeProportion} = (\text{Value of Variable} / \text{Total Value}) \times 100$$

### **Cropping Intensity**

Cropping Intensity is simply a the ratio of gross cropped area to net cropped area and it denotes the intensification of use of land under cultivation. It is one of the measure to increase output using same land more than once.

$$\text{Cropping Intensity} = (\text{Total Cropped Area} / \text{Net Area Sown}) \times 100$$

### **Percent Irrigation**

Irrigation Intensity is simply ratio of gross irrigated to net sown area in per cent which indicates the intense use of irrigation facility

$$\text{Percent Irrigation} = (\text{Gross Irrigated Area} / \text{Net Area Soan}) \times 100$$

### **Compound Annual Growth rate**

To compute annual growth rate with the date with a particular gap formula of compound growth rate was used

$$\text{Compound Annual growth rate} = [ ( Y_{\text{present}} / Y_{\text{initial}} )^{1/n} - 1 ]$$

x100  $Y_{\text{present}}$  = Value of variable at present level

$Y_{\text{initial}}$  = Value of variable at

beginning  $n$  = Number of years

### **Semi log models for Compound Growth rate**

To obtained compound growth rate several researchers used semi log function as Kaushik K.K.(1993). In the study for computation of compound growth rates in Agriculture, K.P. Chandran (2005) suggested using natural log as good model

$$\ln Y_t = \alpha + \beta t + \varepsilon$$

where

$$\alpha = \ln Y_0$$

$$\beta = \ln(1 + r)$$

$\varepsilon$  = Error term

r = Compound rate of growth of Y

$Y_t$  = Value of variable at present

level  $Y_0$  = Value of variable at

beginning

t = time

**Instability Index:**

Instability Index has been used by several researchers which was also used by Chand R and Raju S.S. (2009). Same tool was used to find out instability in production of various crops.

Instability index = Standard deviation of Natural Logarithm (  $Y_{t+1} / Y_t$  )

$\times 100 Y_{t+1}$  = Value of variable at next level

$Y_t$  = Value of variable at present level

**4. RESULTS AND DISCUSSION**

**CONSUMPTION PATTERN OF FERTILIZERS**

As discussed above fertilizers were being used in both Kharif and Rabi seasons and there are three type of chemical fertilizers were prominently used by farmers. Season wise consumption of pattern of chemical fertilizers depicted as for Kharif season given in table 2 along with percentage change. In the Kharif season total consumption of fertilizer was 43838 Tonnes in TE 80-81 out of it 35003 tonnes was nitrogen, 7222 tonnes was phosphorus and 1613 tonnes was potassium used. From TE 80-81 to TE 90-91 total consumption of fertilizer increased nearly three times and became 125109 tonnes in this rise majority contribution was because of phosphorus fertilizer which became 41123 tonnes increased more than four times potassium fertilizer were also increased rate of change was slowest than other two.

Table 2: Use of Fertilizer in Kharif season

Years	Quantity in Tonnes				Percentage change from own level			Annual Growth Rate		
	TE 80-81	TE 90-91	TE2k-01	TE 2010-11	TE 80-81 to TE90-91	TE 90-91 to TE2k-01	TE2k-01 to TE10-11	TE 80-81 to TE90-91	TE 90-91 to TE2k-01	TE2000-01 to TE2010-11
Nitrogen (N)	35003	81369	241584	307452	132.46	196.90	27.27	8.80	11.50	2.44
Phosphatic (P)	7222	41123	106465	195221	469.41	158.89	83.37	19.00	9.98	6.25
Potassic (K)	1613	2617	3144	16978	62.24	20.14	440.01	4.96	1.85	18.37

Total	43838	125109	351194	519650	185.39	180.71	47.97	11.06	10.87	4.00
Source: Compiled with the data collected from 50 Years of Agricultural Statistics of Rajasthan(1956-57 - 2005-06) and Agricultural Statistics Rajasthan various issues										

In the TE2000-01 change in total consumption of fertilizer increased almost around 185 percent and became 351194 tonnes from 125109 tonnes in this period major contributor was nitrogen fertilizer which rise upto three fold and became 241584 tonnes from 81369 tonnes, change in phosphorus was also following and increased upto more than two and half times became 106465tonnes and consumption of potassium was also increased to around 20 percent and 3144 tonnes from 2617 tonnes in this duration also potassium fertilizer was slow mover. TE2010-11 change in total consumption of fertilizer in absolute quantity increased positively change was significantin this period major contributor in this segment was potassium fertilizer and become 16978 tonnes from 3144 tonnes. Annual growth rate was for total 8.31 consumption of fertilizer in Kahaif season and it was highest in phosphorus as 10.37 percent followed by nitrogen 7.60 percent and potassium as 6.86 percent. Percentage instability was 1.5 lowest in nitrogen and highest 4.5 in potassium. Annual Growth Rates was higher in Phosphetic from TE 80-81 to TE 1990-91 as 19.00 percent and lowest in Potasic as 1.85 percent in TE 90-91 to TE 2000-01 in Kharif season.

Consumption of Fertilizer in the Rabi season was given in table 3 total consumption of fertilizer was 94807 tonnes in TE 80-81 which became more than double in TE 1990-91 as 203520 tonnes maximum contribution in this positive change was from nitrogen fertilizer in absolute terms followed by phosphorus fertilizer. In relative terms phosphorus gain highest 281.5 percent followed by nitrogen fertilizer with 85.01 percent. Potassium fertilizer consumption use in rabi crops was declined from 3986 tonnes in TE 80-81 to 2792 tonnes in TE 1990-91.

**Table 3: USE OF FERTILIZER IN RABI SEASON**

Years	Quantity in tonnes				Percentage change from Own previous level			Annual Growth Rate		
	TE 80-81	TE 90-91	TE 2000-01	TE 2010-11	TE 80-81 to TE 90-91	TE 90-91 to TE 2k-01	TE 2k-01 to TE10-11	TE 80-81 to TE 90-91	TE 90-91 to TE 2k-01	TE 2000-01 to TE2010-11
Nitrogen(N)	74181	137241	289001	459844	85.01	110.58	59.12	6.35	7.73	4.75
Phosphetic(P)	16640	63487	93405	154282	281.53	47.12	65.18	14.33	3.94	5.15
Potasic (K)	3986	2792	2798	14079	-29.95	0.21	403.18	-3.50	0.02	17.54
Total	94807	203520	385204	628205	114.67	89.27	63.08	7.94	6.59	5.01

Source: Compiled with the data collected from 50 Years of Agricultural Statistics of Rajasthan (1956-57 -2005-06) and Agricultural Statistics Rajasthan various issues



In TE 2000-01 consumption of total fertilizer were 628205 tonnes in which 459844 tonnes Nitrogenius 154282 tonnes Phosphetic and 14079 tonnes were Potasic (K) change from TE 1990-91 to TE 2000-01 was shown 89.27 percent it total and highest change was 110.58 percent in consumption of Nitrogenius fertilizer follwed by 47.12 percent change in Phosphetic and almost no change in consumption of Potasic fertilizer in this period. In TE2010-11 total consumption of fertilizer was 628205 tonnes gap from past measuring point was sufficiently wide and main contributor in this gap was Nitrogenius followed by Phosphetic and Potasic fertilizers. Between TE 2000-01 to TE2010-11 this period consumption of Potasic fertilizer wasincreased 403.18 percent. Growth rates in Potasic was negative in TE 80-81 to TE 1990-91 and recorded as 17.54 percent in TE 2000-01 to TE2010-11.

Growth and Instability in Consumption of Fertilizer was shown in table 4 season wise as well as combined also. Annual growth rate of fertilizer use was always higher in Kharf crops then Rabi crops. Highest annual growth rate was shown in consumption of Phosphetic(P) fertilizer as 10.37percent in Kharif crops followed by 7.6 percent in Nitrogenius (N) in Kharif crops. Lowest annual growth was 3.6 percent found in consumption of Potasic (K) used in Rabi crops.

Instability in consumption was highest in Potasic (K) as 4.73 in kharif and 5.98 in Rabi crop andlowest in Nitrogenius (N) fertilizer 1.5 in Kharif and 1.75 in Rabi crops.

**Table 4: GROWTH AND INSTABILITY IN CONSUMPTION OF FERTILIZER**

	Average Growth Rate				Instability			
	K	N	P	Total NPK	K	N	P	Total NPK
Kharif	6.86	7.6	10.37	8.31	4.73	1.5	2.24	1.47
Rabi	3.6	6.27	6.5	6.24	5.98	1.76	2.03	1.65
Total	4.94	6.75	8.1	7.02	4.07	1.43	1.7	1.36

Source: Same as above

N=Nitrogenius, P=Phosphetic, K= Potasic

Per hectare consumption of total fertilizer is also a good indicator and used by several researchers. As given in table 5 per hectare fertilizer used was always higher in Rabi crops then Kharif crops. In TE 80-81 only 4kg fertilizer was used in Kharif and 22 kg used in Rabi crops as weighted average 8 kg was consumed which became in TE2010-11 for Kharif 32 kg and in Rabi crops it was 87 kg per hectare and as weighted average 51 kg. Percent annual growth rate from 1978-79 to 2010-11 was higher as 7.48 percent in Kharif crops with higher instability as 7.94. Fertilizer used in Rabi crops was found with less instability with 5.67 and comparative slow annual growth as 5.06 percent in the study period.

Table 5: Per Hectare Consumption of Total Fertilizer in Kg and its growth and instability

YEARS/SEASON	TE 80-81	TE 1990-91	TE2K-01	TE2010-11	Percent Annual Growth Rate from 1978-79 to 2010-11	Percent Instability from 1978-79 to 2010-11
Kharif	4	11	28	32	7.48	7.94
Rabi	22	34	54	87	5.06	5.67
Total	8	18	37	51	6.33	3.93

Source: Compiled with the data collected from 50 Years of Agricultural Statistics of Rajasthan (1956-57 - 2005-06) and Agricultural Statistics Rajasthan various issues

Source: Compiled with the data collected from 50 Years of Agricultural Statistics of Rajasthan(1956-57 - 2005-06) and Agricultural Statistics Rajasthan various issues

### 5 CONCLUSION

In Kharif season it was found that in TE 1980-81 Nitrogenius (N) was 35003 tonnes and it was widely used then other two segments of fertilizers in the absolute terms consumption of fertilizer was heavily increased and became in TE 2010-11 307452 tonnes. Consumption of other fertilizers was relatively less in absolute terms in TE 1980-81 as Phosphetic (P) was 7222 tonnes and Potasic (K) was 1613 tonnes. Rise in rate of consumption of Phosphetic fertilizers was increased more rapidly than other two and it became 195221tonnes in TE 2010-11 which was around 27 times then in TE 1980-81. Use of Potasic fertilizers was with at stagnant till TE 2000-01 as it was 3144 tonnes and it was seen sudden rapid rise upto 16978 tonnes in TE 2010-11. Similar pattern was observed in Rabi season use of Nitrogenius fertilizer was seen increased continuously from 74181 tonns in TE 80-81 to 459844 tonnes in TE 2010- 11. Consuption of Potasic fertilizers was increased after TE 2000-01.

Consumption of Nitrogenius fertilizers was always higher than Phosphetic Potasic fertlisers. Potasic fertilizers were not poplar till TE 2000-01 after this period consumption of potasic (K) fertilizer increased dramatically. Growth of consumption was found highest in Phosphetic fertilizers and lowest potasic (K) fertilizers and instability was lowest in Nitrogenius (N) fertilizers. AGR was recorded high in Kharif crops in all kind of fertilizers. Instability was lower in Kharif crops in N and K. Per Hectare Consumption of Total Fertilizer in Kg was found always higher in Rabi crops but growth and instability was recorded higher in Kharif crops.

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