International Journal of Scientific Research in Mathematical and Statistical Sciences
Research Paper Volume-1, Issue-1 E-ISSN: 2348-4519

Factors Influencing the use of Fertilizers in Agriculture of Madhya Pradesh in India

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Available online at www.isroset.org

Received: 06 July 2013 Revised: 18 July 2013 Accepted: 22 Oct 2013 Published: 28 Feb 2014

Abstract - Fertilizer is a significant input for the gross production in Indian agriculture. The present paper throws light on the use of fertilizer in context of Madhya Pradesh. This research paper expatiate the factors, affecting the use of fertilizers, which will indisputably contribute to the government's fertilizer policy. The analysis starts with the use and the percentage contribution of NPK in Madhya Pradesh. The percentage growth of the use of fertilizer is analyzed under two circumstances that are before and after liberalization.

Keywords- Fertilizer, NPK, Liberalization, The regression model, Madhya Pradesh

I. INTRODUCTION

Chemical Fertilizer is a crucial input in the agriculture development of Madhya Pradesh (M.P.), which is even more important for the rapid growth of food crops along with commercial crops. The use of fertilizer, in balanced quantity and in favorable atmosphere, offers the farmers a certain amount of profit, that's why with the passing of time the use of fertilizer and its demand is increasing rapidly. As per 2006-07, use of fertilizer in Madhya Pradesh was 1205.1 Tones, which was 28.1 per cent more in comparison with 2005-06. Similarly, the percentage growth of Nitrogen (N), Phosphorus (P_2O_5) and Potash (K_2O) reached up to 11.0, 10.0 and 3.0 per cent respectively in 2006-07. Per hectare consumption of chemical fertilizer in M.P. has also increased from 52 kg. / Hectare in 2005-06 to 63 kg. / Hectare in 2006-07 (FAI 2007-08).

According to agronomists the balanced standard for fertilizer (N: P: K) should be (4: 2: 1) but it is (6: 2: 1) in ratio, yet in India. Similarly as per 2005-06 the utilization of N, P and K was (10: 6: 1), which has been increased up to (11: 6: 1) in ratio. There were two main reasons for this imbalance. Firstly, due to the advantage of subsidy the rate of nitrogenic fertilizer became low and at the same time prices of Phosphorus (P) and Potash (K) was also uncontrolled.

With the use of fertilizer, cereal production and area of food crops has taken an expected growth in Madhya Pradesh. It was 72.8 Lakh hectares in the year 2005-06, which produced 91.4 Lakh tones food crops. The data took and steady growth and increased up to 78.5 Lakh hectares which further produced 109.2 Lakh tones of food crops. In this duration food area and food production both increased at its best and has reached up to 5.7 Lakh hectare and 17.9 Lakh tones respectively.

Now after knowing the importance of chemical fertilizers, it is essential to know the factors, which are affecting the use of fertilizer at Macro level. To have this kind of queries in conscience, research objective has been chosen.

To Study per hectare consumption of chemical fertilizer in M.P., two Objectives have been taken in to account, as fallows –

(i) To know per hectare use of fertilizer in M.P. (as in per hectare / year).
(ii) To know factors those are influencing the use of fertilizer (before liberalization and after liberalization).

II. REVIEW OF LITERATURE

Researchers in their studies at macro level find the factors, effectively crucial, that are contributing to the growth of fertilizer. Such factors have been explained in this section.

Progress in use of fertilizer at macro level: At macro level un-irrigated area too have a promising role to play in the supply process of fertilizer. If production in this regions increase, credit facilities expanse, fundamental variables like Seeds of HYVs and Modernization etc. increases then supply process of fertilizer and its uses, will definitely increase (see, Parikh (1966)). The combined result of it attracts our attention to make the policy in different / right direction (Five Year Plane 1969-74 Govt. of India, New Delhi, pp. 130-131). The demand for fertilizer depends on various factors like;

(A) Changes in fertilizer prices,

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(B) Changes in yielding of crops due to the use of fertilizer.
(C) Changes in price of Agricultural products (Sah and Shah (1966)).

If any single factor, out of the three mentioned above changes than the demand for fertilizer will take place. as per year 1960-61, Indian states utilized 75 % of chemical fertilizer, whereas in 1968-69 there was 70 % use fertilizers states that used the fertilizer excessively was Punjab, Haryana, Uttar Pradesh, Maharashtra, Andhra Pradesh and Tamil Nadu.

Desai and Singh (1973) tried to point out use of fertilizer at micro level and came at the conclusion that there were three main reasons for the difference in growth rate:
(A) Proper resources for irrigation in different districts.
(B) Size of holdings.
(C) Seeds of HYVs.

On the contrary Namboodiri and Desai (1994) gave importance to the analysis at macro level. They suggested that changes in various factors will enhance the growth in the use of fertilizer at various steps.

The aim of this kind of research is to know that in the use of chemical fertilizer both demand and supply plays an important role along with state government. Un-irrigated area too can play an important role in the supply process. If the production in this regions increase credit facilities expanse, fundamental variables like irrigation, raining, seeds of HYVs and modernization in agriculture etc., increase then supply process of fertilizer and its use will naturally increase. By the help of demand model, we explain functional relation, which shows that in un-irrigated area, the changes in source of irrigation, use of HYVs and give the training facilities etc. will make the demand for fertilizer higher than before (Namboodiri and Desai (1994)).

Parikh (1966) makes a comparison among various states and illustrates in his research studies that in long term, deficiency in actual prices of fertilizers and expansion of irrigated area became the reason for the excessive use of fertilizer. He illustrates with the medium of Co-Variance analysis that in short-term, economic components do not affect the use of fertilizer (Parikh (1966)). Maharaja (1975) tried to explain causes for the demand of chemical fertilizer and found that expansion of irrigation facilities and HYVs are the two main factors which determines growth rate of fertilizer.

Fertilizer price policy is another factor which conducts the economic environment. Government policies in relation to fertilizer seems adverse for the last five years, the subsequent result is that government in having extra fiscal burden. Although giving subsidy is a necessary step for the developing Indian agriculture, new techniques and HYVs. But it gave rise to many economic crimes. A large amount of subsidy becomes the pride of their (producers) pocket because they show the cost of products excessively or in other words they do not show the actual price of the products. This kind of crime is known as 'Gold Plating'.

On the other hand because of subsidy the ratio of NPK has become absurd. Farmers are gaining profit by buying nitrogenic Fertilizer, as it is available on subsidy rates, worthy of low price than its actual price. Hence the ratio has shaken too (Sagar (1991)). Tropical and subtropical regions offer special occasion for Indian agriculture. Firstly, we can sow various crops within a same year and can measure it's per day yield. Secondly availability of water resources are easy going today, that will visibly contributed to the excessive use of Fertilizer in future (Swaminathan (1969)).

III. RESEARCH METHODOLOGY

According to research objectives to know the analysis of NPK (in per hectare), I have taken secondary data's from 1980-81 to 2006-07. With the help of these secondary data's from 1980-81 to 2006-07, I analyzed:

(A) Use of NPK kg./ hectare (in initial and final year).
(B) N., P. and K. percentage changes.

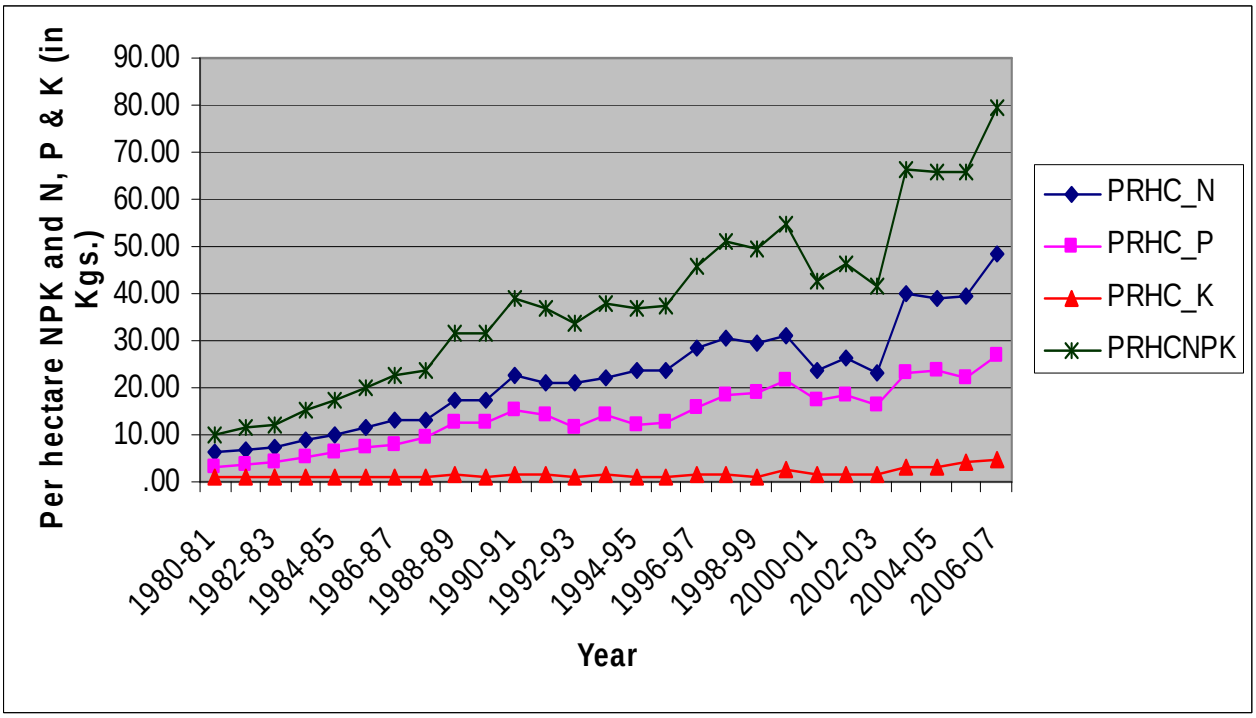
In this analysis (use of NPK Kg. / hectare) preference is given to the annual growth of NPK and than, with the help of multi- regression / regression model those factor have been explained, which are influencing the use of fertilizers.

The method of Secondary data analysis is divided in to two parts :
(i) Per hectare use of fertilizer in Madhya Pradesh (before liberalization).
(ii) Per hectare use of fertilizer in Madhya Pradesh (after liberalization).

Use and percentage contribution of NPK in Madhya Pradesh: In Madhya Pradesh the per hectare use of NPK has increased from 10 Kg. / Hectare in 1980-81 to 79.7 Kg. / Hectare in 2006-07, in which the percentage contribution of Nitrogen (N), Phosphorus (P) and Potash (K) also changed. It was 61%, 30% and 9% in 1980-81 and 60%, 33% and 6% in 2006-07 respectively. When we compare the data with India, it has increased from 32 Kg. / Hectare in 1980-81 to 112 Kg. / Hectare in 2006-07. In Madhya Pradesh, (before liberalization) from 1980-81 to 1991-92 NPK growth was 2.7 Kg. hectare / year, which has decreased from 1992-93 to 2006-07 and remained 2.6 Kg. hectare / year. The annual growth was 2.2 Kg. / Hectare from 1980-81 to 2006-07.

Now if we look the NPK growth in relation to India than we find before liberalization it was 3.5 Kg. / Hectare but has decreased after liberalization and remained 2.8 Kg. / Hectare / year. Annual growth of per / Hectare use of Fertilizer has been demonstrated by the following Graph 1.

Graph 1: Growth of Fertilizer use in M.P. (On the basis of Secondary Data).



Note: PRHC_N = per hectare nitrogen use, PRHC_P = per hectare Phosphate use, PRHC_K = per hectare Potash use, PRHCNPK = per hectare NPK use in Kg.

With respect to the factors that are maintaining the growth, two questions arise:

(i) What are the important factors that are maintaining the use of fertilizer?
(ii) What are the similarities and difference between the use of fertilizer after and before liberalization?

IV. Model Designing

In this present section we will try to know the factors influencing the use of fertilizer in Madhya Pradesh, with the help of regression model. The regression model includes only those independent variant in which there is no multi – correlation. In this way the structure of model designing is prepared as follows:

$$NPK = f\,(IA,\ HYV,\ CR)$$

NPK = NPK use Kg. / Hectare, *f* = Functional relation, *IA* = Per hectare percentage of irrigated area within various Crops (Gram, Sugarcane, Paddy, Maize and Wheat), *HYV* = Per hectare percentage of HYVs area and *CR* = Per hectare distributed institutional credit facilities.

$$\widehat{\ln NPK_t} = \hat{\alpha} + \hat{\beta}_1 \ln IA_t + \hat{\beta}_2 \ln HYV_t + \hat{\beta}_3 \ln CR_t + e_t \quad \text{.....(i)}$$

In regression equation;

$\widehat{\ln NPK_t}$ = Per year per hectare natural log value of NPK use (dependent variable).

$\ln IA_t$ = Per year per hectare atural log value of the percentage of irrigated area within various crops (Gram, Sugarcane, Paddy, Maize and Wheat).

$\ln HYV_t$ = Per year per hectare natural log value of the percentage of HYVs area includes various HYVs crops (Wheat, Jawar, Bajra and Maize).

$\ln CR_t$ = Per year per hectare natural log value of the distributed Institutional credit facilities (in Rs.)

e_t = Error term, t = Time duration*

$\hat{\alpha}$ = Constant value when there is no changes in independent variables ($\ln IA_t, \ln HYV_t, \ln CR_t$).

(Coefficient) $\hat{\beta}_1$ = Changes because of per hectare irrigated area ($\ln IA_t$) within various crops (Gram, Sugarcane, Paddy, Maize and Wheat), When other variable ($\ln HYV_t, \ln CR_t$) remain constant.

(Coefficient) $\hat{\beta}_2$ = Changes because of per hectare percentage of HYVs area ($\ln HYV_t$) when other variable ($\ln IA_t, \ln CR_t$) remain constant.

(Coefficient) $\hat{\beta}_3$ = Changes because of per hectare distributed Credit facilities ($\ln CR_t$) when other variable ($\ln IA_t, \ln HYV_t$) remain constant.

V. ANALYSIS

There are three factor affecting NPK use in Madhya Pradesh:
(i) Percentage of irrigated area (per hectare).
(ii) Percentage of HYVs Area (per hectare).
(iii) Distributed institutional credit facilities (per hectare).

All three factors have been explained with the help of regression model.

Factor affecting the use of Fertilizer (Before liberalization): For this analysis, data's are taken from year 1980-81 to 1991-1992 and subsequent result has shown in Table 1.

$\overline{R}^2$ = 0.96 and F = 132.64 (0.000 Per cent significant level) On the basis of Table 1, putting this value in equation *(i)*

$$\ln \widehat{NPK_t} = -0.538 + 0.584 \ln IA_t + 1.427 \ln HYV_t$$

…….(ii)

It is clear by equation no. *(ii)* that among the most important factors that are influencing the use are:
(i) Seeds of high yielding varieties.
(ii) Percentage of irrigated area within various crops.

These two factors are growing mathematically 1.427 Kg. (On 0.000 Per cent significant level) and 0.584 Kg. (On 0.021 Per cent significant level) respectively. Viz. (in Other words) if area (in HYVs) changes even 1 per cent than per hectare growth in the use of Fertilizer will be 1.427 Kg. and 0.584 Kg. respectively. t value of PRC_HY = 5.89 (On 0.000 Per cent significant level) IA_PRC = 2.8 (On 0.021 Per cent significant level).

Value of R^2 in the model is 0.96 and value of F is 132.64 (On 0.000 Per cent significant level) It means that 96 per cent changes taking place because of PRC_HY and IA_PRC and rest 4 per cent change are because of other factors.

Factor affecting the use of Fertilizer (After liberalization): For this analysis, data's are taken from year 1992-93 to 2006-07 and subsequent result has shown in Table 2.

$\overline{R}^2$ = 0.96 and F = 132.64 (0.000 Per cent significant level). On the basis of Table 2, equation *(iii)* is obtained by value of independent variable.

$$\ln \widehat{NPK_t} = 5.253 + 0.374 \ln CR_t \qquad (iii)$$

It is clear by regression equation *(iii)* that after liberalization, among all factors, that are influencing the use of fertilizer, Per hectare distributed credit facilities is the most important factor, because change in facilities in affecting the use 0.37 Kg. Hectare (On 0.000 per cent significant level) positively and mathematically. It means in Madhya Pradesh (after liberalization) because of 1 per cent extension of credit facilities the use of Fertilizer in increasing 0.374 Kg., t value of CRDT_PHC is 5.59 (On 0.000 per cent significant level).

Value of $\overline{R}^2$ in the model is 0.70 and value of F is 31.27 (On 0.000 Per cent significant level) It means that 70 per cent changes taking place because of CRDT_PHC and rest 30 per cent change are because of other factors.

* The time duration for the analysis of data has been divided into two parts- 1. time duration which includes total 13 years 'independent and dependent variable from the year 1980-81 to 1991-92 (before liberalization) and 2 time duration which includes total 15 years 'independent and dependent variable from the year 1992-93 to 2006-07 (after liberalization).

VI. Conclusion and Policy Implications

The main reason behind, this extraordinary growth in the use of fertilizer, is that after liberalization the central and state government is offering short term credit facilities. The interest rates are also flexible on agricultural loans, hence use of fertilizer is taking place at a very fast pace.

When we compared the NPK growth between India and M.P. we found that before liberalization the NPK growth in M.P. was very deficient but after liberalization states annual NPK growth approximately equaled with India. Similarly before liberalization there was an occurrence of certain difference among significant factors that are influencing the use of fertilizers because per hectare irrigated area among various crops and HYVs was affecting per hectare use of fertilizers significantly and positively, whereas after liberalization per hectare distributed credit facilities is influencing the use significantly. In this way it is necessary that while creating policies concerning per hectare use of fertilizer, the state / central government, should have in mind that factors which are affecting at macro level because any type of change in these factors, will directly and certainly affect the use of fertilizer.

The government of Madhya Pradesh is investing ample amount on the expansion of credit facilities, which is certainly adding for the demand of fertilizers in the upcoming future. Hence, after liberalization, to maintain the balance between demand and supply of Fertilizers, It is necessary to intensify the production of fertilizers by means of percentage growth (Coefficients) in above mentioned significant factors. If the government of Madhya Pradesh focus over this veracity/ authenticity then it will definitely possible to obtain the genuine goals of food production. This will unquestionably add to the agricultural development of the state and India as well.

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Table 1: Factors affecting NPK use in M.P. from 1980-81 to 1991-92.
(Regression result on the basis of secondary data's)

Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.538	.485		-1.110	.296
	IA_PRC	.584	.209	.326	2.789	.021
	PRC_HY	1.427	.242	.690	5.896	.000

a. Dependent Variable: NPK_KG_H

Source: On the basis of annual data analysis given by Fertilizer Association of India, Mumbai in context of M.P. from the year 1980-81 to 2006-07, the above mentioned variables have been found.

Note: IA_PRC = Percentage of irrigated area among various crops (Par hectare), PRC_HY = Percentage of under HYVs area (Par hectare) and NPK_KG_H = per hectare NPK use in Kg.

Table 2: Factors affecting NPK use in M.P. from 1992-93 to 2006-07.
(Regression result on the basis of secondary data's)

Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.253	.412		12.735	.000
	CRDT_PHC	.374	.067	.850	5.593	.000

a. Dependent Variable: NPK_KG_H

Source: On the basis of annual data analysis given by Fertilizer Association of India, Mumbai in context of M.P. from the year 1980-81 to 2006-07, the above mentioned variables have been found.

Note: NPK_KG_H = per hectare NPK use in Kg. and CRDT_PHC = Distributed institutional credit facilities (in Rs. Par hectare).

