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Original Research Article

Growth and Determinants of Fertilizer Use in India- An Economic Analysis

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A B S T R A C T

Fertilizer is one of the strategic inputs for enhancing productivity which enables to meet the growing demand for food in the country. The present study was conducted to know the growth and determinants of fertilizers in India. The secondary data on production of major chemical fertilizer, consumption of (NPK) fertilizers, etc. from 1988-89 to 2017-18 were collected. There was a substantial growth in production and consumption of chemical fertilizers in India over the years. The production of chemical fertilizer showed an increasing trend. The country witnessed an increase in the consumption of NPK. The consumption of fertilizer during overall period showed a positive and significant growth. Among the period I recorded the highest consumption of NPK. The average consumption of nitrogenous fertilizers was more compared to phosphorous and potash. Compound growth rate for consumption of fertilizers (NPK) was recorded high during period I in all India. During period III the consumption of fertilizers registered mostly negative growth rates in all India. The non-price factors were more important determinants of fertilizer consumption compared to price factors. Among the non-price factors, area under irrigation was the most important factor influencing fertilizer consumption followed by price of SSP and fertilizer subsidies. It is necessary to encourage domestic fertilizer production to meet out our future fertilizer consumption requirement. Government has to maintain stability in the fertilizer prices, which encourages the farmers to use more fertilizers.

Keywords

Production, Consumption, Growth rate

Introduction

The agricultural production can be increased either by bringing more area under the plough or through increased productivity. In the Indian context, land is becoming a shrinking resource for agriculture owing to competing demand for its use. Also, the population growth has resulted in lower carrying capacity of land. Hence, in order to realize the need-based targets of agricultural production, the pattern of production enhancement will have to rest heavily on increased yield. This essentially calls for optimizing the usage of the existing farm land by adopting new strategy for agricultural development. The new strategy among others includes judicious use of fertilizers. Fertilizer is one of the key elements to maintain the tempo of agricultural production as studies have indicated that it has contributed about 50 per cent of increased food grain

production in the world. Maintenance of soil fertility is essential to sustain agricultural production. Soil degradation, mainly the decline in soil organic matter both in quality and quantity, is one of the major reasons linked to stagnation and decline in yields in most of intensive agriculture areas in India. The response of additional fertilizer application to food grain production has shown a distinct declining trend in recent years: the increased use of synthetic fertilizers no longer contributes to higher soil productivity. High use of chemical fertilizers is mostly associated with high level of water consumption and micro-nutrient deficiency in soil leading to decline in water table and further deterioration of the soil.

Among all the strategic inputs, fertilizer plays a key role in modern agriculture. Fertilizer has been universally accepted as an integral part of package of practice for raising Indian agriculture to a higher technological plank. It is estimated that the fertilizers in association with water can enhance output by about 70 per cent. Nearly 50 per cent of the increased food grain production in the last decade in the world comes from the balanced use of fertilizers (Borlaug, 1996). It is accepted that fertilizer is an expensive agricultural input and therefore, its efficient use is indispensable for reducing the cost per unit of agricultural produce.

The production of total fertilizer nutrients (N+P2O5) showed a more increase of 1 per cent in 2017-18 compared to marginal increase of 0.7 per cent in 2016-17.

Nutrient-wise break up shows while the production of N at 13.42 MMT during 2017-18 registered a positive growth of 0.5 per cent over 2016-17; production of P2O5 at 2.43 MMT recorded an increase of 2.7 per cent during the period. The production of Urea during the year 2016-17 was 24.20 MMT and the production of DAP & Complex fertilizers were 123.31 LMT. The production of Urea during 2017-18 were 24.25 MMT, which is more than to previous year and the production of DAP & Complex fertilizers were 14.07 MMT, representing a growth rate of approximately 14 per cent in comparison with previous year.

Total nutrient consumption (N+P2O5+K2O) increased from total of 25.94 million metric ton (MMT) during 2016-17 to 26.59 MMT during 2017-18. N consumption at 16.95 MMT, P2O5 at 6.85 MMT and K2O at 2.77 MMT registered marginal increase of 0.14 per cent, 2.2 per cent, 10 per cent respectively, during 2017-18 over the previous year 2016-17. All-India NPK use ratio changed from 6.7:2.7:1 during 2016-17 to 6.3: 2.5: 1 during 2017-18.

The use of fertilizers is affected by a number of factors like irrigation, high yielding variety seeds, size of the farm credit etc. Increased area under high yielding varieties led to increased food grains production. These high yielding varieties respond more to the use of chemical fertilizers. There exists a large gap between actual and potential level in fertilizers use. Increased fertilizer use efficiency leads to a number of benefits to Indian agriculture. They are economy in use of fertilizers, reduction in unit cost of production, prevention of fall in agricultural productivity, production of environmental quality and efficient use of other inputs such as irrigation and high yielding varieties in developing countries actual fertilizer use is usually below the economic potential.

The present study has been undertaken to analyze production and consumption pattern of chemical fertilizers at macro level in India and to study various factors influencing the consumption pattern in a country.

Materials and Methods

Selection of fertilizer

For the present study the NPK (Nitrogenous, Phosphates, and potash) fertilizer use in India was selected purposively.

Selection of period

For growth and determinants of NPK fertilizer use in India - an economic analysis the period selected was 30 years and divided into 10 years and overall, as shown below.

Period I - 1988-89 to 1997-98.
Period II - 1998-99 to 2007-08.
Period III - 2008-09 to 2017-18.
Overall period - 1988-89 to 2017-18

Nature and sources of data

In the present study secondary data were used for evaluating the specific objectives of the study. The secondary data on production of major chemical fertilizer, consumption of major chemical (NPK) fertilizers were collected from the publication of Fertilizer Association of India, Department of Fertilizers Ministry of Chemicals and Fertilizers Government of India, Agricultural Statistics at a Glance, Directorate of Economics and Statistics, Department of agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture, Government of India, www.Indiastat.com, www.fert.nic.in etc.

Analytical tools used

Keeping in view the specific objectives of the study, the data collected were subjected to following statistical analysis.

1 Tabular analysis
2 Compound Growth rate analysis
3 Instability analysis
4 Regression analysis

Tabular analysis

Tabular analysis involving the computation of means, percentages etc., were employed to present the data regarding all-India production and consumption of fertilizer.

Compound growth rate analysis

In order to analyze the growth in all-India production and consumption of major chemical fertilizers. The compound growth rate analysis was carried out.

$Y=a^{b^t}$
Log Y = Log a + t log b
CGR = (Antilog (logb)-1) × 100

Where,

Y = Fertilizer production/ consumption
t = Time period in year
b = Regression parameters
a = Intercept

Instability analysis

The coefficient of variation (CV) was used as a measure to study the variability in all-India production and consumption f major chemical fertilizers. The coefficient of variation or indices of instability were computed by using the following formula,

$$CV\ (\%) = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

Regression analysis

Multiple regression model was used to study the determinants of major fertilizer consumption. Linear regression model applied.

$$Y = a_0 + a_1x_1 + a_2x_2 + ---- + a_8x_8 + u$$

Where,
Y = Total quantity of fertilizer consumed
X1 = Area under irrigation
X2 = Area under HYV crops
X3 = Fertilizer subsidies
X4 = Gross cropped area
X5 = Price of the urea
X6 = Prices of DAP
X7 = Prices of MOP
X8 = Prices of SSP
u = Random error.

Results and Discussion

The study aims at evaluating the production and consumption performance of chemical fertilizers in India. In consistence with the objectives of the study the necessary data collected from different sources were analyzed and presented in the form of tables. The results of the investigation and analysis are presented under the following heads.

1. Production of fertilizer
2. Consumption of fertilizer
3. Factors affecting fertilizer use in India

Production of fertilizer

Chemical fertilizers have been an important element of Indian agriculture. However, there have been wide variations in the fertilizers production over the periods. The Nutrient-wise production of fertilizer materials in India has been discussed below.

Growth rate and co-efficient of variation of nutrient-wise production of fertilizer materials in India (1988-89 to 2017-18) has been presented in Table 1. In period I (1988-89 to 1997-98) the average production of nitrogenous fertilizer was 77.82 lakh M.T. which rose to 109.46 lakh M.T. and 120.63 lakh M.T. in period II (1998-99 to 2007-08) and period III (2008-09 to 2017-18) respectively. The average production of phosphorus fertilizers was increased about 38.29 lakh M.T and 41.94 lakh M.T. in period II and III respectively which was only 23.36 lakh M.T. in period I. Potassic fertilizers were not produced in India, so production was nil. The total average N and P production were increased, which was 93.26 lakh M.T. in period I to 162.63 lakh M.T. in period III. Overall (1988-89 to 2017-18) the average production of nitrogenous and phosphorus fertilizers in India were 103.87 lakh M.T. and 34.55 lakh M.T. respectively.

The growth rate of production of nitrogen and phosphorus were shown positive growth rate. The growth rate of production of nitrogen was highest in period I (4.16 per cent), followed by (1.98 per cent) in period III and (0.68 per cent) in period II, in which period I and III with (One per cent level of significance). Whereas the growth rate of production of phosphorus was highest in period I (3.55 per cent), followed by (2.69 per cent) in period II and (2.00 per cent) in period III. In period II (One per cent level of significance) and (Five percent level of significance) in periods I and III). In the total nitrogen and phosphorus production, the highest growth rate was observed in period I (4.00 per cent) followed by period II and period III, which were having the growth rates of (1.18 per cent) with (Five per cent level of significance) and (2.68 per cent)with (One per cent level of significance) respectively. Overall (1988-89 to 2017-18) the growth rate of production of nitrogen and phosphorus were shown positive growth rate of (2.38 per cent) and (2.98 per cent) respectively with (One per cent level of significance).

Nutrient-wise and period-wise instability index were presented in Table 1. The results revealed that the growth of production of nitrogen was in period I (13.87 per cent) followed by (9.27 per cent) in period III and

(3.36 per cent) in period II. Whereas, growth of production of phosphorus was in period I (15.84 per cent), followed by period II and period III which were having the instability index of (10.26 per cent) and (8.88 per cent) respectively. In the total nitrogen and phosphorus production, period I was recorded as (15.01 per cent) followed by (7.82 per cent) in period III and (4.90 per cent) in period II. Overall (1988-1989 to 2017-18) the instability index of nitrogen and phosphorus production were (20.40 per cent) and (25.95 per cent) respectively, in which instability index was high in overall N and P production together (21.22 per cent).

Consumption of fertilizer

Chemical fertilizers have been an important element of Indian agriculture. However, there have been wide variations in the fertilizer's consumption over the periods. The Nutrient-wise consumption of fertilizer materials in India has been discussed below.

Growth rate and co-efficient of variation of nutrient-wise consumption of fertilizer materials in India (1988-89 to 2017-18) are presented in Table 2. In period I (1988-89 to 1997-98), the average consumption of nitrogenous fertilizer was 88.42 lakh M.T. which rise to 119.35 lakh M.T.in period II (1998-99 to 2007-08) and 166.11 lakh M.T. in period III (2008-09 to 2017-18) respectively. The average consumption of phosphorus fertilizers was88.42 lakh M.T which was increased about 46.53 lakh M.T and 68.46 lakh M.T. in period II and III.

The growth rate of consumption to all the nutrients has shown positive growth rate (except phosphorus and potash in period III). The growth rate of nitrogen was the highest in period I (4.69 per cent), followed by (2.62 per cent) in period II and (1.05 per cent) in period III, Whereas, the growth rate of phosphorus was the highest in period II (3.00 per cent), followed by (1.35 per cent) in period I and (-1.15 per cent) in period III. The growth rate of potash was the highest in period II (7.05 per cent) and the lowest in period III (-3.63 per cent). In the total NPK consumption the highest growth rate was observed in period I (3.48 per cent) followed by period II and period III which were having growth rates of (2.58 per cent) and (-0.08 per cent) respectively. Overall (1988-89 to 2017-18) the growth rate of nitrogen, phosphorus and potash were shown positive growth rate of (3.19 per cent), (3.78 per cent) and (4.06 per cent in period I, II, and III respectively with (One per cent level of significance).

Nutrient-wise and period-wise instability index were presented in Table 2. The results revealed that the consumption of nitrogen was in period I (14.07 per cent) followed by (10.80 per cent) in period II and (4.36 per cent) in period III. Whereas, consumption of phosphorus was in period I (11.91 per cent), followed by period II and period III which were having the instability index of (12.61 per cent) and (10.86 per cent) respectively. The potash consumption was in period II (23.25 per cent), followed by (20.40 per cent) in period III and (15.35 per cent) in period I. In the total NPK consumption, period I recorded as (11.50 per cent) followed by (12.25 per cent) in period II and (4.42 per cent) in period III. Overall (1988-89 to 2017-18) the instability index of nitrogen, phosphorus and potash were (27.45 per cent), (34.64 per cent) and (40.59 per cent) respectively, in which instability index was in overall NPK consumption (29.81 per cent).

Factors affecting fertilizer use in India

In this section, we examine the factors influencing fertilizer use in India. For this purpose, variables *viz.* area under irrigation, price of fertilizer, area under HYVP crops and agriculture credit, were considered from 1988-89 to 2017-18. Multiple linear

regression model was used to study simultaneous impact of area under irrigation, area under HYVP crops, fertilizer subsidies, gross cropped area, price of the urea, DAP, MOP, SSP.

In order to examine the factors influencing the consumption of fertilizer, multiple linear regression was fitted and the estimates of the same has been presented in Table 3.

Table.1 Growth rates and co-efficient of variation of nutrient – wise production of fertilizer materials in India (1988-89 to 2017-18)

Periods	***Nutrients***	***Average (lakh Tonne)***	***CGR***	***CV***
Period I (1988-89 to 1997-98)	Nitrogen	77.82	4.16**	13.87
	Phosphorus	23.36	3.55*	15.84
	Potash	0.00	0.00	0.00
	Total	93.26	4.00**	15.01
Period II (1998-99 to 2007-08)	Nitrogen	109.46	0.68	3.36
	Phosphorus	38.29	2.69**	10.26
	Potash	0.00	0.00	0.00
	Total	147.76	1.18*	4.90
Period III (2008-09 to 2017-2018)	Nitrogen	120.63	1.98**	9.27
	Phosphorus	41.99	2.00*	8.88
	Potash	0.00	0.00	0.00
	Total	162.63	2.68**	7.82
Overall (1988-89 to 2017-18)	Nitrogen	103.87	2.38**	20.40
	Phosphorus	34.55	2.98**	25.95
	Potash	0.00	0.00	0.00
	Total	138.43	2.52**	21.22

Note: ** significant at 1 per cent level, * significant at 5 per cent level

Table.2 Growth rates and co-efficient of variation of nutrient-wise consumption of fertilizer materials in India (1988-89 to 2017-18)

Periods	Nutrients	Average (lakh tone)	CGR	CV
Period I (1988-1989 to 1997-98)	Nitrogen	88.42	4.69**	14.07
	Phosphorus	30.51	1.35	11.91
	Potash	11.40	0.08	15.35
	Total	130.33	3.48**	11.50
Period II (1998-99 to 2007-08)	Nitrogen	119.36	2.62*	10.80
	Phosphorus	46.53	3.00*	12.61
	Potash	18.89	7.05**	23.25
	Total	184.78	2.58*	12.25
Period III (2008-09 to 2017-2018)	Nitrogen	166.11	1.05*	4.36
	Phosphorus	68.46	-1.15	10.86
	Potash	27.41	-3.63	20.46
	Total	261.99	-0.08	4.42
Overall (1988-89 to 2017-18)	Nitrogen	124.63	3.19**	27.45
	Phosphorus	48.50	3.78**	34.64
	Potash	19.23	4.06**	40.59
	Total	192.37	3.42**	29.81

Note: ** significant at 1 per cent level, * significant at 5 per cent level

Table.3 Factors contributing to fertilizer consumption in India

Particulars	Contribution of factors in fertilizer consumption
Intercept	-110.34
X1 = Area under irrigation (000 ha)	0.006**
X2 = Area under HYV crops (million ha)	-0.241
X3 = Fertilizer subsidies (Rs. in Crore)	0.0006**
X4 = Gross cropped area (000ha)	-0.0007
X5 = Prices of urea (Rs. /Tone)	-0.004
X6 = Prices of DAP (Rs. /Tone)	0.007*
X7 = Prices of MOP (Rs. /Tone)	-0.012
X8 = Prices of SSP (Rs. /Tone)	0.012
R^2	0.96
F	65.16
Functional form	Linear

Note: ** Significant at 1 per cent level, * Significant at 5 per cent level

The multiple linear regression model gave a good fit to the sample data of the country from (1988-89 to 2017-18), and the equation explained 96 per cent variation in the consumption of fertilizer due to variation in the eight independent variables. The F ratio

was significant which indicated good fit of the function. The regression coefficients area under irrigation (0.006) with significant at one per cent significant level were positively related with fertilizers and proportion of area under HYV crops (-0.241) were regression coefficients of fertilizer subsidies (0.0006) with one per cent significant level and gross cropped area (0.0007). Whereas, proportion prices of DAP (0.007) with (Five per cent significant level) and prices of SSP (0.012), prices of urea (-0.004), prices of MOP (-0.012).

Conclusions of the study are as follows:

1. Compound growth rate for consumption of fertilizers (NPK) was recorded high during period I (1988-89 to 1997-98) in all India.
2. The production and consumption of all fertilizer in India over the period was found with mostly one percent level of significance.
3. The following factors were mostly responsible for consumption of fertilizers such as area under irrigation, fertilizer subsidies and price of SSP as compare to other factors.

References

Anjurani, R. 2014. Consumption of chemical fertilizer in Haryana: An empirical study. *Int. J. of Business Econ. Man. Res.*, 4(7): 105-112.

Bagal, Y. S., L. K. Sharma, P. G. Kaur, A. Singh, P. Gupta, 2018. Trends and Patterns in Fertilizer Consumption: A Case Study.*Int. J. of Curr. Microbiol. App. Sci*, 7(4): 480-487.

Jaga, P. K. and P. Yogesh, 2012. An Overview of Fertilizers Consumption in India: determinants and outlook for 2020-a review. *Int. J. of Sci. Eng. Tech.*, 1(6): 285-291.

Jasbir, S. 2013. Demand projection of chemical fertilizer's consumption in India: determinants and outlook for 2020. *International J. of Transformations in Busi. Mktg.*,2(3): 62-76.

Kumar., S. Akshu, 2017 Growth and Pattern of Fertilizer Consumption in Haryana. *International J. of Res. in Econ. and Social Sci. 7(4): 138-148.*

Mala, P. 2013. Fertilizer scenario in India. *International J. of Social Sci. Interdisciplinary Res.*, 2(1): 62-72.

Sharma, V.P. and H. Thaker, (2011), "Demand for Fertilizers in India: Determinants and Outlook for 2020", *Ind. J. Of Agri. Econ*., 66 (4): 638-661.

Vijay, P. and T. Hrima, 2011. Demand for Fertiliser in India: Determinants and Outlook for 2020. Research and publications, IIM Ahmedabad, 1-32.

Yuan, J., Y. Hong, J. M. Hans, and C. A Karim, 2010. Factors affecting farmer's decisions on fertilizer use: A case study for the Chaobai watershed in Northern China. *J. Sustainable Dev.*, 3(1): 80-102.