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Research Paper

Fertilizer consumption and production in India

Pragati Tiwari*
*Research Scholar, Department of Commerce, CMP Degree College (University of Allahabad), Prayagraj, U.P., India.

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ABSTRACT

Fertilizers are one of the most important sectors in India. It is an essential input for agricultural production. Fertilizers play an important role in increasing agricultural productivity. The paper tells about fertilizer's consumption and production of Indians well as analyze fertilizer sector. This is a conceptual and descriptive nature paper. It is based on secondary data. Companies should prepare their production and distribution plans as per the needs and interests of farmers. Today the farmers do not accept any product that does not satisfy them. Production of crops is increasing due to fertilizer consumption in India. But more usage of urea is misbalancing the ideal fertilizer application ratio. So, Farmers have to shift from straight fertilizers towards NPKS complex fertilizers for supplying the vital nutrients are needed by the crops for growth to improve this ratio.

Corresponding Author:
Pragati Tiwari
Research Scholar, Department of Commerce, CMP Degree College (University of Allahabad), Prayagraj, U.P., India.
Email: pragativnstiwari2@gmail.com

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1. INTRODUCTION

India is one of the oldest agricultural economies in the World. The key to India's economy is agriculture. Pests create harm to agriculture and reduce it. There will be insufficient stocks of crops to meet the needs of human. Therefore, the importance of using fertilizers is increasing. Fertilizer is one of India's key industries, which represents a major input for agricultural production. Increased fertilizer production and consumption were responsible for increase of agricultural output in our country.

Fertilizers are an important industry in India. Substantial increases in the production and consumption of fertilizers were responsible for our country's significant increase in agriculture. It is estimated that, through the combination of water and fertilizers, an increase in output could be around 70%. The fact that fertilizer is a costly agricultural input has been recognized as having an essential role to play in reducing the costs per unit of produce. Fertilizer is an organic or inorganic product which has been mixed into a soil from natural or synthetic sources. Organic fertilizers derived from one or more of those sources include animal manure, household waste, plant materials and soil organic material including the crops residues. Organic farming contributes to soil quality by increasing the structure, chemistry and bioactivity of soils. Inorganic fertilizers are the major nutrients provided for plant growth, such as nitrogen, phosphorus and potassium. Secondary inorganic nutrient fertilizers are calcium, magnesium, sodium and sulphur. Inorganic micro-nutrient fertilizers are required in small quantities such as boron, cobalt, copper, iron, manganese, etc. This organic and inorganic fertilizer made through the fertilizer companies such as IPL, SPIC, MFL, KRIBHCO, IFFCO, RCF, COROMONDEL, and FACT. The number of people in our country increases continuously. And now it's a huge challenge for our country to provide food to that population because we can't grow the land area of this country. The use of fertilizers may be a way to increase yields up to an upper limit. The aim of this paper is to discuss several aspects related to the fertilizer sector. The production of fertilizers in India began in 1960 as a result of EID parry's introduction of single superphosphate (SSP) at Ranipet, Tamil Nadu.

India's Green revolution brought situation of self-sufficiency in crop production during the 1960s. India need to import food grain from the US and Mexico before then so that population can be fed. After almost 50-60 years of Green Revolution India is in a stage of exporting food grain to other countries also. India has to rely on imports of phosphatic and potassium fertilizer. There is a central administration Department of Fertiliser to manage the production scenario, transport of fertilizers to different states, necessary and affordable price and availability to all farmers.

The Government of India has been actively working in order to improve availability and optimize fertilizer use in India. A series of policy actions have been adopted to ensure that fertilizers are available and distributed in the timely and proportionate way. Two types of subsidies shall be granted to fertilizer companies for the purposes of taking care of them production subsidy and freight subsidy.

The adoption of the Green Revolution in the 1960s had a major impact on the production of food grains in the country, which was largely dependent on imports to meet demand. Further experience shows that productivity and output increase through the increased use of fertilizers in an appropriate proportion. Therefore, fertilizers have become an integral part of India's agricultural sector in order to increase yields. There are a number of factors that influence the use of fertilizers, such as irrigation, high yield variety seed, size of agricultural credit etc. The increase in the area under high yield varieties has contributed to a growth of food grain production.

Nitrogen, Phosphorus and Potassium are essential nutrients to be added to soil by means of fertilizers. It is also necessary to add micronutrients such as calcium, magnesium, manganese, boron etc. There must be sufficient balance between the three components of nutrients nitrogen, potassium and phosphate. The imbalance is result of usage of more nitrogen and less soil use for phosphorus and potassium. Various states are taking measures in order to correct imbalances. India has seen a growth in fertilizer consumption over recent years. The key to enhancing and sustaining crop production is the application of essential plant nutrients, according to their optimal quantities and respective proportion through proper methods and periods of application. Generally, demand for fertilizer depends upon the price of a crop, price of fertilizer and price of other inputs complementary to fertilizer. India's Population has grown after independence. Farmers were no longer able to produce huge amounts of food grains due to natural farming. Therefore, Government had to import food grains in 1950 to 1960.

The green revolution was launched in 1960s. This was the time for a fresh start. India has attained self-sufficiency in food grain production slowly over the last few years. Fertilization has a significant role to play in the cultivation of crop and food grains, as fertilizers increase soil fertility. That's why the farmer started using it more. India was incapable of producing that much fertilizer at this point in time to meet the needs of farmers, then started to import it.

Government has established some joint venture outside India also. Government of India is Having Seven Joint Ventures Abroad. These are as follows -

- FOSKOR (Pty) Limited South Africa supplying phosphoric acid
- ICS Sengel & ICS Sengel (exp.) for supplying phosphoric acid
- Indo Maroc Phosphore S.A (IMACID) at Morocco for supplying phosphoric acid
- Tunisian Indian Fertilizers (TIFERT), Skhira Tunisia for supplying phosphoric Acid
- Jor dan India Fertilizer Company, Eshidiya Jordan for supplying phosphoric acid
- Oman India Fertilizer Company, Muscut Oman for supplying urea
- One more joint venture is proposed names JV at Gabon

2. RELATED WORK

- [1] Paper focuses on the growth rate of India's fertilizer sector, demand and supply side. The consumption patterns of fertilizers in Indian states are also discussed. Secondary data shall be obtained from publicly available sources and information provided in the open market.
- [2] Paper suggests that priority should be given to the availability of fertilizers at affordable prices in order to ensure sustainable agricultural production in India. Fertilizer demand in the country is projected to increase with a higher growth rate in Eastern and Southern regions than North and West.
- [3] In this study an in-depth analysis is done with fertilizer consumption pattern at Kotli village in Jammu and Kashmir. A total of 79 farmers were randomly without replacement selected and were interviewed with the help of well-structured interview schedule. The findings showed that the majority of farmers were marginal.
- [4] Paper examines the role of research and development in the growth of productivity in the fertilizer and pesticide sector. It is empirical analysis of the firm level data of the Indian fertilizer and pesticide sector in order to estimate the total factor productivity.
- [5] Provides an overview of the market, circumstances, range and overall situation of fertilizer marketing in India. Fertilizer marketing plays an essential role in order to meet the needs of farmers. The farmer class, academics, and marketers are included in its reach.

2.1 Objectives

- To study consumption of fertilizer in India.
- To know about fertilizers production of food grains.
- To analysis of the fertilizer industry using Porter's five force model.

2.2 State Wise & Zone Wise Consumption of Fertiliser in India

The states of Jharkhand, Assam, West Bengal and Orrisa are in the East Zone [6]. The states of Rajasthan, Madhya Pradesh, Gujarat, Goa and Maharashtra are part of the West Zone. States of the northern zone are Delhi, J&K, Punjab, Haryana, Uttarakhand, Himachal Pradesh and Uttar Pradesh. South Zone states are Karnataka, Lakshadweep, Kerala, Tamil Nadu and Andhra Pradesh. North East zone includes Sikkim, Tripura, Assam, Mizoram, Meghalaya, Nagaland and Arunachal Pradesh.

Table 1. State-wise Consumption of Fertilizers in India by Zone, 2019–20

State Wise Consumption of Fertilizers Year 2019-20 (in Thousand Tons)		
South Zone		
1	Pondicherry	30.76
2	Karnataka	2058.48
3	Andhra Pradesh	3061.37
4	Tamil Nadu	1196.85
5	Lakshadweep	0.00
6	A&N Islands	0.71

7	Kerala	264.89
	Sub-Total (South Zone)	6613.06
West Zone		
8	D&N Haveli	1.21
9	Chhattisgarh	537.14
10	Goa	9.1
11	Maharashtra	3065.46
12	Madhya Pradesh	1661.17
13	Gujarat	1799.72
14	Daman & Diu	0.46
15	Rajasthan	1073.21
	Sub-Total (West Zone)	8147.47
North Zone		
16	Uttarakhand	155.31
17	Punjab	1865.62
18	Jammu & Kashmir	111.67
19	Chandigarh	0
20	Himachal Pradesh	53.24
21	Haryana	1355.69
22	Delhi	2.35
23	Uttar Pradesh	4261.5
	Sub-Total (North Zone)	7805.38
East Zone		
24	West Bengal	1644.56
25	Jharkhand	167.35
26	Bihar	1309.86
27	Orissa	519.34
	Sub-Total (East Zone)	3641.11
North East Zone		
28	Sikkim	0
29	Tripura	14.2
30	Arunachal Pradesh	0.82
31	Meghalaya	3.68
32	Nagaland	0.94
33	Assam	242.27
34	Mizoram	5.47
35	Manipur	12.04
	Sub-Total(North East Zone)	279.42
All India		26486.4

The three most fertilizer consumption states for the period from financial year 2019-20 were Uttar Pradesh, Andhra Pradesh and Maharashtra [7]. No fertilizer is used by three Indian States and Union Territories namely Chandigarh, Lakshadweep and Sikkim. Because it does not have any agriculture related practices and its farming methods are completely based on organic agriculture. Very less amount of fertilizers is used by Arunachal Pradesh, Nagaland, Daman & Diu and Andaman & Nicobar. The share of overall fertilizer use by region is shown. East and North East regions of India are using less fertilizer while the southern, northern and western areas of India tend to use more. The share of Western India was the highest, followed by North and South.

Table 2. Consumption of Fertilizers in India

Year	(In Thousand Tons)
2011-12	27,790.20
2012-13	25,536.20
2013-14	24,482.40
2014-15	25,581.30
2015-16	26,752.60
2016-17	25,949.90
2017-18	26,593.40
2018-19	27,228.20
2019-20	29,370.40
2020-21	32,535.60
2021-22	29,796.30

Analysis: Here, Fertilizer consumption is increasing from 2011-12 to 2021-22. Consumption is 27790200 tons in year 2011-12 in India. It is decreasing till 2014-15. But after that, it is increasing continuously till 2020-21. Financial Year 2021-22 shows reduction in consumption with 29796300 tons [8]. Overall, there is incensement in this decade in terms of fertilizer consumption.

Table 3. Fertiliser Production in India

Year	Total Fertilizers Productions
2011-12	38,858.30
2012-13	37,606.90
2013-14	38,180.60
2014-15	38,718.80
2015-16	41,597.70
2016-17	41,427.70
2017-18	41,560.80
2018-19	41,564.00
2019-20	42,752.20
2020-21	43,483.50
2021-22	43,743.00

Analysis: Here, Fertilizer production is increasing from 2011-12 to 2021-22. Production is 38858300 tons in year 2011-12 in India. It is decreasing till 2014-15. But after that, it is increasing continuously till 2020-21. There is highest production in Financial Year 2021-22 with 43743000 tons. Overall, there is incensement in this decade in terms of fertilizer production.

3. METHODOLOGY

This paper is conceptual and based on secondary data. Different information is obtained from a number of government websites which are available for the public in order to meet these objectives. Information about fertilizer production and consumption is available on the Fertilizer Management System website, which were analyzed in MS Excel [9]. Various reports made public by the Indian Government's Department of Agricultural Cooperation & Farmers Welfare collect data on food grains. Tables and graphs are drawn to illustrate these data. There are three categories of fertilizer straight, complete and complex fertilizers. Straight fertilizers have one of the main nutrients whereas complete fertilizers have two nutrients and complex fertilizers contain three or more plant nutrients. There must be three major nutrients needed for plant growth. Those three main nutrients are nitrogen (N), phosphorus (P) and potassium (P). Nitrogenous straight fertilizer includes Urea widely used by farmers of India.

Straight nitrogenous fertilizers include Ammonium Sulphate, Calcium Ammonium Nitrate and Ammonium Chloride with 25% of Nitrogen. Complete fertilizer includes Mono Ammonium Phosphate and Di Ammonium Phosphate. The complex fertilizer consists of three important nutrients. They also contain micronutrients such as sulphur along with nitrogen, phosphorus and potassium. There are some varieties of complex fertilizers that farmers in India like to use [10].

3.1 Porters Five Force Model Analysis of Indian Fertilizer Industry

- **Competition Among Existing Competitors is High:** The private sector has captured a large part of fertilizer market followed by the public and cooperative sectors. Costs competitiveness and product quality are the result of different suppliers of raw materials used by various companies. Companies come up with different products like completely water soluble fertilizers, spray fertilizers, fertilizers with micro nutrients.
- **Threat of New Entrants is Moderate:** Production of fertilizers is characterized by a high degree of capital intensive. Production cost of materials remains high while returns on investment are low. The public and cooperative fertilizer sector receives fertilizer subsidies from the government. It has captured almost all the rural market. They create difficulties for new entrants to maintain low prices with high production costs.
- **Bargaining Power of Suppliers is High:** Natural products are the major raw material source for fertilizer production. Natural gas suppliers are very limited and imported. Thus, it is hard to deal with rising natural gas prices for Urea production. There are very limited supplies of rock phosphate and phosphoric acid to produce phosphorous fertilizers. Thus, this production is highly dependent upon the importation of rock phosphate.
- **Bargaining Power of Buyers is Low:** It is difficult to provide optimum supply of all fertilizers due to very high differentiation of crops grown, area of production, climatic variations. There is less availability and more demand of fertilizers. Fertilization costs are high, except for urea. The buying power of farmers is low. Moreover, less than two hectares of land are owned by most of the farmers and therefore they do not stand in the bargaining position.
- **Threat of Substitutes is Moderate:** Private players are placing bio fertilizers on the market. Farmers are also applying organic fertilizers such as cow dung and manure from the farm yard. Farmers are growing green manures crops like Daincha and doing vermi-compost side by side.

4. RESULTS AND DISCUSSION

It is recommended that the producer of branded fertilizers focus its attention on quality characteristics and create a feeling of reliability for farmers. The majority of farmers feel that price of branded fertilizer is high. It shows that farmers can be dissatisfied with their prices for long period of time. Thus, the manufacturer of branded fertilizers must maintain pricing strategies that are adapted to the market conditions. Better advertising is also necessary for any fertilizer product. This advertising will not only raise awareness, but also influence farmers to buy the product. However, fertilizer is not marketed for a number of brands on the market. It is proposed to give more importance to be advertised on a variety of media.

Companies must analyze the market to draw up these marketing strategies that will allow them to seize and maintain their dominant position on the market. Companies can take part in agricultural exhibitions and fairs, awareness events or sponsor specific contests in order to provide farmers with the opportunity to experience quality, price of products as promotional activities.

5. CONCLUSION

The use of fertilizers increases crop productivity because they provide a vital nutrient to the soil. Nitrogen, Phosphorus and potassium are three basic plant nutrients essential for the growth of plants. India

achieved a self- sufficient level in urea. Five closed fertilizer plants have been revived by the Government with a view to reducing urea imports. Another alternative is to increase the installed capacities for fertilizer plants by use of new technologies.

The most commonly used fertilizers by farmers are urea, which leads to incorrect balance of the ideal fertilizer use ratio. The ideal ratio for N, P and K is 4: 2: 1. There is a difference in the price of all NPK complexes compared to Urea. There is higher consumption of urea, DAP and MOP fertilizers in north zone followed by west zone. The consumption of NPK complexes fertilizers is highest in South Zone followed by the West Area, East Area and North Area. The threat of new entrants is moderate in the fertilizers sector. Bargaining power of suppliers is high but bargaining powers of buyers (farmers) are low. There is a moderate risk of substitutes and rivalry among competitors.

Developing new technologies and efficient use of available technology and inputs will play an important role in protecting food security in India. Policies that promote better availability and consumption of fertilizers in the country have been pursued by the Indian Government. Fertilization production and use have grown substantially in the last four and a half decades. India had become near self-sufficient in N and P. while import of all other fertilizers except K was negligible.

However, in the last five years N and P imports were also significantly increased due to a lack of large capacity additions as a result of an unpredictable policy environment. The average intensity of fertilizer usage in India at national level is still low compared to other developing countries. There are a number of differences between regions when it comes to fertilizer consumption patterns. The fertilizer usage has been higher in northern (91.5 kg/ha average) followed by southern (85.3 kg/ha average) region, eastern (44.7 kg/ha) and western region (40.7 kg/ha).It was noted that factors other than price had a more important impact on demand for fertilizers.

Government needs to take into account factors other than prices such as better seeds, irrigation and credit in order to increase the use of fertilizers in this country. Fertilizer subsidy is a more appropriate means of achieving the objectives in comparison with price support policy. More effective targeting of these subsidies is needed.

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Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Pragati Tiwari	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

C: **C**onceptualization
M: **M**ethodology
So: **So**ftware
Va: **Va**lidation
Fo: **Fo**rmal analysis
I: **I**nvestigation
R: **R**esources
D: **D**ata Curation
O: Writing - **O**riginal Draft
E: Writing - Review & **E**diting
Vi: **Vi**sualization
Su: **Su**pervision
P: **P**roject administration
Fu: **Fu**nding acquisition

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

Ethical Approval

Not applicable.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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BIOGRAPHY OF AUTHOR



Pragati Tiwari, is a Research Scholar in the Department of Commerce at CMP Degree College, which is affiliated with the University of Allahabad, based in Prayagraj, Uttar Pradesh, India. She is currently working on academic research in the commerce space, and she contributes to scholarly outputs at one of India's well regarded institutions. As a focused researcher, she is also interested in pushing the boundaries of knowledge, in her own discipline, and it shows the long standing academic heritage that the University of Allahabad is known for. Email: pragativnstiwari2@gmail.com