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RESEARCH PAPER

Factor Affecting Consumption of Fertilizer Nutrient in Haryana

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ABSTRACT

Fertilizers are essential for enhancing agricultural productivity, and their consumption is influenced by various factors such as irrigation, high-yielding seeds, credit availability, cropping patterns, and nutrient requirements. This study examines the factors affecting fertilizer consumption in the state of Haryana, India, The study was conducted in four districts of Haryana, namely Bhiwani, Faridabad, Fatehabad, and Yamuna Nagar, representing both the Western and Eastern zones. The primary objective of the study was to analyze fertilizer consumption under major crops in these districts. The study analyzes data from four districts in Haryana and employs multiple regression models to identify significant factors. The findings highlight the importance of cropping intensity, irrigated area, high-yielding varieties, credit availability, and fertilizer prices in shaping fertilizer consumption. The study emphasizes the need to address nutrient imbalances and ensure proper fertilizer distribution to improve agricultural productivity and food security in Haryana.

HIGHLIGHTS

- Fertilizer consumption in Haryana, India is influenced by various factors such as irrigation, high-yielding seeds, credit availability, cropping patterns, and nutrient requirements.

Keywords: Fertilizer, Haryana, factor affecting, Crop intensity, irrigation

The Green Revolution, which was adopted in the 1960s, substantially boosted food production in the country. Which help us to achieving the target of food production, introduction of the new agricultural strategy, which propagate the use of critical inputs like high yielding variety; fertilizers, manures etc. Fertilizer has been a vital input which accounts for about 50 to 60 percent of the total increase in cereal product. Further evidence suggests that increasing fertilizer use in the right proportion boosts agricultural productivity and output. As a result, chemical fertilizers have become an important aspect of Indian agriculture in increasing production. India's fertilizer consumption has increased significantly over the years, reaching 29.36 million tons in 2019-20. The country consumes about 19.10 million tonnes of fertilizers, mostly nitrogen, followed by phosphorous and potassium. The average fertilizer consumption in India was 28 kg ha^{-1} during 1977-78, and it increased to 133.44 kg ha^{-1} during 2018-2019 (Sharma *et al.* 2022). Similary in Haryana consumption of fertilizer continuously increased from 586.29 thousand tonnes in 1990-91 to 1410.45 thousand tonnes in 2019-20 (Sharma 2023).

Haryana is one of the leading agricultural states in India, with a high cropping intensity and productivity. However, the consumption of fertilizer

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nutrients in the state has been declining over the years, posing a challenge for sustaining the agricultural growth and food security. In this Paper, we will explore some of the factors that affect the consumption of fertilizer nutrients in Haryana and suggest some possible solutions to improve the situation.

Fertilizer consumption is influenced by various factors. According to the Food and Agriculture Organization (FAO), the potential for fertilizer consumption is dependent on the extent of available land, actual area cultivated, amount, distribution and reliability of rainfall, area under irrigation which determines the scope for multiple cropping, availability and adoption of fertilizer-responsive seed varieties, cropping pattern which determines the quantity of nutrients needed, soil characteristics and nutrient content .

Studies have shown that factors such as machinery type, fertilization mode, tillage mode, soil type and climate differences on farmland fertilization through field experiments; farm size, household income, education level, and planting structure on fertilizer application; fertilization intensity, planting structure, and planting area on chemical fertilizer consumption with statistical data also affect chemical fertilizer consumption.

In addition to these factors, the availability of fertilizer and its proper distribution are factors severely limiting fertilizer use in most developing countries. Correction of these factors can bring about an immediate increase in consumption. Rainfall and its distribution over time and space is the basic determinant of fertilizer consumption.

The current levels of three nutrients, nitrogen, potassium, and phosphate, appear to be unbalanced. The imbalance is due to problems such as all the nitrogen is being used and lower use of Phosphates and Potash by the soil. Many states are taking measures to correct the imbalances. Thus, to check the factor that affects fertilizer consumption in Haryana, this study entitled "Factors affecting consumption of fertilizer in Haryana" was conducted.

MATERIALS AND METHODS

The present study was conducted in four districts (two from each zone) of Haryana, namely Bhiwani, Faridabad, Fatehabad and Yamuna Nagar districts, based on the fertilizer consumption under major crops. Primary data was used for attaining the objectives of the study. Four districts (two from each zone) *i.e.,* Fatehabad, Bhiwani from Western Zone and Yamuna Nagar and Faridabad from the Eastern zone were selected purposively. Fatehabad and Yamuna Nagar districts having maximum chemical fertilizer consumption while Bhiwani and Faridabad with minimum chemical fertilizer consumption per hectare area. The secondary data for the period 1990-91 to 2019-20 was collected for analyzing the factor affecting fertilizer consumption in Haryana.

To find out the factors influencing fertilizer consumption in Haryana, two multiple regression models were used on time series data for the period 1990-91 to 2019-20. In the model, stepwise regression analysis was used.

Model 1

$$Y_1 = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + u$$

Where,

Y = Total fertilizer consumption (thousand tonnes)

a = intercept

X_1 = Price of P_2O_5 per Kg

X_2 = Price of K_2O per Kg

X_3 = Cropping intensity (%)

X_4 = Area Under HYV ('000 ha)

X_5 = Gross irrigated area ('000 ha)

X_6 = credit in agriculture (₹ in Crore)

u = Error term

Model 2

$$Y_2 = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + u$$

Where,

Y = Total fertilizer consumption (thousand tonnes)

a = intercept

X_1 = Area Under Rice ('000 ha)

X_2 = Area Under Wheat ('000 ha)

X_3 = Area Under Jowar ('000 ha)

X_4 = Area Under Bajra ('000 ha)

X_5 = Area Under Maize ('000 ha)

X_6 = Area Under Barley ('000 ha)

X_7 = Area Under Mustard ('000 ha)

X_8 = Area Under Cotton ('000 ha)

X_9 = Area Under Sugarcane ('000 ha)

u = Error term

RESULTS AND DISCUSSION

Fertilizer consumption is influenced by various elements such as irrigation, high-yielding variety seeds, farm credit size, etc. Increased area planted with high-yielding cultivars resulted in more food grains being produced. Chemical Fertilizers are more effective on high-yielding cultivars. Nitrogen, Phosphorus, and potassium are the three most important elements that must be given to the soil in the form of Fertilizers. At times, micronutrients such as calcium, magnesium, manganese, boron, and others may be necessary.

A composite analysis of the factors affecting fertilizer consumption in the selected districts of Haryana was done. Two multiple linear regression analyses were used to determine the factors influencing the consumption of total fertilizer in Haryana. Stepwise linear regression analysis was estimated to determine fertilizer consumption's most important determinants.

Model - 1

For each district, the total (NPK) fertilizer consumption of gross cropped area regressed upon a set of independent variables such as the price of Phosphorus per kg (X_1), price of potash per kg (X_2), cropping intensity (X_3), area under HYV (X_4), irrigated area (X_5), credit in agriculture (X_6). The regression coefficient of the multiple linear regression model indicates the unit change, positive or negative, depending upon the sign and statistical significance in the consumption of total fertilizer in response to a one-unit increase in the factor concerned. In contrast, other factors are held at a constant. The results of the estimated multiple linear regression analysis for Haryana state as a whole and selected states' overall period, viz., 1990-91 to 2019-20, have been presented in Table 1.

The most important factors affecting fertilizer consumption were identified by stepwise regression analysis (Table 1). The cropping intensity highly influenced the growth of fertilizer. A significant positive impact of cropping intensity on fertilizer consumption was noticed in Faridabad and Fatehabad districts. A one per cent change in cropping intensity would lead to an increase in 923.82 thousand tonnes of fertilizer in the Faridabad district. The cropping intensity has increased over the years. The increase in cropping intensity has led to an increase in fertilizer application. More crops grown in a year lead to exhaustion of soil fertility which is only replenished through applying fertilizers.

The irrigated area has a significant effect on fertilizer use. The irrigated area is increased over the year as irrigated area increases, the consumption of the fertilizer also increases. The irrigated area showed a positive and significant impact on fertilizer consumption in all the districts of Haryana. Chadha and Meera (2019) also reported similar results in their study on factors affecting fertilizer consumption in Rajasthan, implying that the irrigation area is the most important variable influencing fertilizer consumption.

HYVs have higher potential than traditional seeds. After introducing HYVs seeds, the area under its cultivation has increased. One of the factors influencing fertilizer consumption is an increase in the percentage of gross cropped area under HYVs. The significance value for the area under HYVs was observed in Bhiwani and overall Haryana. Similarly, Sharma and Thakur (2011) discovered in their study that non-price factors such as cropping, better seeds, and irrigation were more influential than fertilizer prices.

Availability of Credit has a significant effect on fertilizer use. Credit is necessary for small and marginal farmers to buy inputs like fertilizers. A significant and positive impact was observed in all the districts except Fatehabad. It reveals how important credit availability is to the farmers as far as fertilizer consumption is concerned. Existing studies on fertilizer demand in Africa and some developing countries, such as Zhou *et al.* (2010) and Chianu and Tsujii (2005) have found that relatively low income and lack of assessing to credit are

Table 1: Estimated coefficient of linear regression (Model-1) showing factors affecting fertilizer consumption in the selected districts of Haryana (1990-91 to 2019-20)

Districts	Constant	Price P_2O_5 (per kg)	Price K_2O (per kg)	Cropping Intensity (%)	Area under HYV ('000 ha)	Irrigated area ('000 ha)	Credit (₹ in Crore)	R^2
Yamuna Nagar	-43079.44	—	-1847.35* (0.15)	—	—	893.65* (143.32)	147.20* (14.76)	0.91
Faridabad	-172004.79	—	-1795.86* (522.21)	923.82* (154.10)	—	587.00* (89.03)	65.50* (28.78)	0.81
Fatehabad	-538217.5	—	—	1351.948* (470.08)	—	1704.64* (259.48)	—	0.92
Bhiwani	-5002.41	—	—	—	90.08** (17.32)	35.55* (20.12)	67.57* (23.04)	0.94
Haryana	-2527139.36	—	—	15610.04* (3892.79)	226.61* (56.18)	—	410.26* (139.61)	0.93

, **, * denotes significant at 10 per cent, 5 per cent, 1 per cent level, respectively.*

Figure in parenthesis are standard error.

Table 2: Estimated coefficient of linear regression (Model-2) showing factors affecting fertilizer consumption in selected districts in Haryana (1990-91 to 2019-20)

Districts	Constant	Rice	Wheat	Jowar	Bajra	Maize	Barley	Mustard	Cotton	Sugarcane	R^2
Yamuna Nagar	-11878.98	1234.698* (148.58)	—	—	-8585.86* (3710.52)	—	—	—	—	—	0.91
Faridabad	10468.24	741.05** (392.56)	—	—	—	—	-11481.04* (392.56)	—	—	5693.27* (392.56)	0.81
Fatehabad	-199203.20	—	1617.05* (152.02)	—	—	—	—	-793.64* (155.74)	—	—	0.92
Bhiwani	11834.78	1818.23* (183.32)	—	—	—	—	—	—	223.2* (76.09)	—	0.94
Haryana	-2527139.36	15610.04* (3892.79)	226.61* (56.18)	—	—	—	—	985.97* (224.51)	—	—	0.93

, **, * denotes significant at 10 per cent, 5 per cent, 1 per cent level, respectively.*

Figure in parenthesis are standard error.

the factors responsible for low fertilizer demand. The study by Ouattara *et al.* (2020) also indicates that credit supports small-scale farmers' increased fertilizer use intensity.

The cropping intensity highly influenced the growth of fertilizer. The cropping intensity has increased over the years. The increase in cropping intensity has led to an increase in fertilizer application. More crops grown in a year lead to exhaustion of soil fertility which is only replenished through applying fertilizers. Similarly, Jaga and Patel (2012) found that irrigation, cropping intensity, and HYVs were more important in deterring fertilizer consumption in their study.

Fertilizers are costly inputs, and their price strongly influences their consumption. The price of potash fertilizer showed a negative and significant effect in Yamuna Nagar and Faridabad districts. As the price of fertilizer increased, fertilizer consumption also decreased in these districts.

Numerous factors influence fertilizer consumption patterns. According to some studies, fertilizer consumption is influenced by various factors such as irrigation, high-yielding variety seeds, and farm credit size (Chadha and Meena, 2019). However, other factors influence fertilizer consumption, such as fertilizer supply, the availability of credit for input purchase, the relative prices of fertilizers

(Zhou *et al.* 2010), (Jadhav and Ramappa, 2021), and government policy (Wang *et al.* 2018). The study conducted in Rajasthan from 1990-1991 to 1999-2002 found that both variables, rainfall, and gross irrigated area, were statistically significant and positive (Meena, 2002).

Model - 2

Model-2 was used to check the effect of the different crop areas on fertilizer consumption in the selected district and overall Haryana. For each district, the total (NPK) fertilizer consumption of gross cropped area regressed upon a set of independent variables such as area under rice (X_1), Wheat (X_2), Jowar (X_3), bajra (X_4), maize (X_5), barley (X_6), mustard (X_7), cotton (X_8), Sugarcane (X_9).

The cropping area under different crops highly influenced the growth of fertilizer. Rice is the main crop that affects fertilizer consumption in all districts except Fatehabad. The area under rice was significant and positive. The area under rice has increased over the years. The increase in rice area has led to an increase in fertilizer application. The more crops grown in a year leads consumption of more fertilizer.

Wheat also showed a positive and significant effect on fertilizer consumption in Fatehabad and all of Haryana. This means fertilizer consumption will also increase if the area under wheat increases. Results were supported by the study by Usama and Khalid (2018). They reported similar results in their study that crops, like rice and wheat, are a major consumer of fertilizer and play a very important role in fertilizer consumption.

Bajra and barley showed significant negative effects for Yamuna Nagar and Faridabad District, respectively. On the other hand, jowar and maize do not significantly affect fertilizer consumption in the study area. Mustard showed a significant and positive effect for Haryana, whereas Fatehabad district showed a significant and negative effect on fertilizer consumption. cotton shows a positive and significant effect in the Bhiwani district, whereas sugarcane has a significant and positive effect on the Faridabad district.

CONCLUSION

The research findings from Model-1 and Model-2 provide valuable insights into the factors influencing fertilizer consumption in the studied districts and overall Haryana.

Cropping intensity, irrigated area, and the adoption of high-yielding variety (HYV) seeds were identified as key factors impacting fertilizer consumption. As cropping intensity and the area under HYVs increase, there is a corresponding rise in fertilizer application, highlighting the need to replenish soil fertility due to increased crop production. The availability of credit for farmers also significantly influences fertilizer use, emphasizing its importance for input purchase.

Additionally, the research highlights the role of specific crop areas in fertilizer consumption. Rice and wheat were identified as major crops positively affecting fertilizer consumption, while crops like bajra, barley, jowar, and maize showed less significant or negligible effects. Mustard, cotton, and sugarcane demonstrated both positive and negative impacts on fertilizer consumption depending on the district.

Furthermore, the price of fertilizers was found to have a significant influence on consumption, with higher prices leading to reduced usage in certain districts. This indicates that affordability plays a role in farmers' decision-making process regarding fertilizer utilization.

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