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DEMAND PROJECTION OF CHEMICAL FERTILIZER'S CONSUMPTION IN INDIA: DETERMINANTS AND OUTLOOK FOR 2020

Dr Jasbir Singh
Associate Professor, Maharaja Surajmal Institute, C-4, Janak Puri New Delhi 110058.
Affiliated From GGSIP University New Delhi

ABSTRACT

Chemical fertilizers are key element of modern technology and have played an important role in agricultural production growth in India. However, the demand-supply gap of fertilizer in India has increased in recent times due to dependency on imports. Indian imports, which were about 2 million tons in early part of 2000, has increased to 10.2 million tones consumption of fertilizers in 2008-09. In view of importance of fertilizers in agriculture growth and the possibility of an emerging demand-supply gap, there is a need to forecast future demand. The paper begins with an overview of fertilizer consumption trends and then identifies important determinants of fertilizer demand and develops projects demand scenarios for fertilizers in India in 2020-21. India is the second largest consumer of fertilizers in the world after China, consuming about 26.5 million tones. However, average intensity of fertilizer use in India remains much lower than mostly countries in the world but is highly skewed, with wide inter-regional, inter-state, and inter-district variations. In present study we want to find that how we can fulfill increasing gap between fertilizer consumption demand and supply. We would like to analysis that what is the estimated growth rate of fertilizer consumption in 1915-16 to 2020-21. The paper suggests that in order to ensure self-sufficiency in agricultural production in the country, availability of fertilizers at affordable prices should be prioritized over higher output prices. By 2020, fertilizer demand in the country is projected to increase to about 41.6 million tones and is expected to grow at a faster rate in eastern and southern region compared with north and west.

Key word: *Chemical fertilizers, technology, agricultural production, imports, demand-supply gap, Green Revolution, crop yields, macro and micro nutrients, tones, food grains, fertilizer consumption etc.*

INTRODUCTION

The role of chemical fertilizers for increasing agricultural production, particular in developing countries is well established. Some argue that fertilizer was as important as seed in the Green Revolution (Tomich et. al. 1995), contributing as much as 50 percent of the yield growth in Asia (Hopper 1993 and FAO 1998). We found that one-third of the cereal production world-wide is due to the use of fertilizer and related factors of production (Bumb 1995). During the last three decades, Indiahas relied on increasing crop yields to supply an ever increasing demand for food. According to Ministryof Agriculture data, total food grains production in the country rose from 151.2 million tons in 1980s (1981-82 to 1990-91) to 190.6 million tons in 1990s and 212 million tons in 2000s.

Meanwhile, total area under food grains, which accounts for nearly two-third of total cropped area, has declined by over 4 percent from its 1980s level and down 7.4 percent from the peak of 131.16 million hectares in 1983. This increase in food grains production was the result of about 46 percent increase in crop yields between1980s and 2000s. However rate of increase in crop yields has declined in the recent decade (12.4 percent in 2000s compared with over 30 percent in 1990s). During last decades, India lost about 2.5 million hectares of net sown area. The options for increasing food production are limited by availability of land as well as water. Increasing population, among other factors, limits any significant expansion of arable land. Fertilizer consumption in India has been increasing over the years and today India is one of the largest producer and consumer of fertilizers in the world. By 2009-10, total fertilizer consumption in the country was 26.49 million tones. Importance of fertilizers in yield improvement, which is essential for achieving increased agricultural production, further increases because there is little scope for bringing more area under cultivation as well as majority of Indian soils are deficient in many macro and micro nutrients. The application of essential plant nutrients, particularly major and micronutrients in optimumquantity and right proportion, through correct method and time of application, is the key to increased and sustained crop production. Therefore it is important to understand fertilizer use behavior in the country over time as well as role of factors influencing fertilizer consumption at the national and regional/state level because intensity of fertilizer use varies from state to state and area to area.

REVIEW OF LITERATURE

Vijay Paul Sharma and Hrima Thaker (2011), in their study **"**Demand for Fertilizer in India: Determinants and Outlook for 2020" found that Government of India has been consistently pursuing policies conductive to increased availability and consumption of fertilizers in the country. Over the last four and half decades, production and consumption of fertilizers has increased significantly. The country had achieved near self-sufficiency in N and P, with the result that India could manage its requirement of these fertilizers from indigenous industry and imports of all fertilizers except K were nominal. However, during the last 5-6 years there has been a significant increase in imports of N and P as well because there has not been any major domestic capacity addition due to uncertain policy environment. Indian imports, which were about 2 million tons in early part of 2000, increased to 10.2 million tones of fertilizers in 2008-09.

India was the third largest producer of fertilizers in the world next to China and USA and the second largest consumer after China during 2008. The overall consumption of fertilizers in the country has increased from 65.6 thousand tons in 1951-52 to 26.49 million tons in 2009-10. Accordingly, per hectare consumption of fertilizers, which was less than one kg in 1951-52, has gone up to the level of 135 kg in 2009-10. The average intensity of fertilizer use in India at national level is still much lower than in other developing countries but there are many disparities in fertilizer consumption patterns both between and within regions of India. The intensity of fertilizer use varied greatly from about 48 kg per hectare in Rajasthan to as high as 237 kg per hectare in Punjab. The fertilizer use has generally been higher in northern (91.5 kg/ha average) and southern (85.3 kg/ha average) region and lower in the

eastern (44.7kg/ha) and western region (40.7 kg/ha). In the TE2009-10, 112 out of 538 districts (20.8%) consumed more than 200 kg per hectare, 76 districts between 150-200 kg, 105 districts between 100-150 kg and 127 districts between 50-100 kg/ha. About 22 percent of the districts had less than 50 kg/ha fertilizer use, much lower than recommended levels. Between the TE2002-03 and TE 2009-10, number of districts using more than 200 kg/ha more than tripled from 36 in TE 2002-03 to 112 in TE 2009-10. Further about 18 per cent of the districts in the country account for half of total fertilizer use while bottom half of the districts account for only 15 per cent of total fertilizer used in the country. Therefore, there is a need have two pronged strategy, (i) to monitor districts with high intensity of consumption and take corrective actions to reduce environmental degradation and (ii) to promote fertilizer consumption in low-use districts to improve crop productivity.

While examining major determinants of fertilizer use, it was found that non-price factors such as irrigation, high yielding varieties, were more important in influencing demand for fertilizers. Of the two price policy instruments, affordable fertilizer prices and higher agricultural commodity prices, the former is more powerful in influencing fertilizer consumption. The high product price support policy benefits the large farmers who have net marketed surplus while low input prices benefit all categories of farmers. Therefore, in order to ensure self-sufficiency in food grains production in the country, availability of fertilizers at affordable prices to the producers is of utmost importance. The government should give due importance to non-price factors like better seeds, irrigation, credit, etc. to increase fertilizer use in the country. For this, more investment in irrigation, agricultural research and development, extension services and infrastructure are indispensable in the context of a country like India. The results also suggest fertilizer subsidy to be more appropriate means to achieve the stated objectives compared with price support policy. However, there is a need to contain and target these subsidies in a better way. By 2020, fertilizer demand in the country is projected to increase to about 41.6 million tones – 23 million tons of N, 11.5 million tons of P and 7.1 million tons of K. The projected fertilizer demand in eastern and southern region is expected to grow at a faster rate compared with north and west. To meet the projected demand of about 41.6 million tons in 2020, additional capacity will be needed. Overall, a conducive and stable policy environment, availability of raw materials, capital resources, and price incentives will play a critical role in meeting the fertilizer requirements of the country.

OBJECTIVES OF THE STUDY

Growth rate in fertilizer consumption in India.
Fertilizer product demand forecasts for 2015-16 and 2020-21.

RESEARCH METHODOLOGY

Present study based on secondary data. Data has been collected through various resources as like CMIE of Agriculture, Statistical abstract, Economic survey, Fertilizer Association of India etc. Present study is exploratory in nature.

Analysis of Data

Various statistical tools such as tabulation, percentage, ratio analysis, average growth rate, graphs and diagrams have been used for the purpose of analyzing the financial data in present study.

Fertilizer Consumption Trends in India

Fertilizer consumption trends expressed in terms of aggregate quantities consumed and intensity of use (i.e., kg per hectare of total cropped area) reflect both demand and supply decisions. Therefore, it is essential to understand fertilizer situation in the country. In this section growth trends in total fertilizer consumption and intensity of use at all-India level as well as regional/state level are discussed.

Total Fertilizer Consumption: All-India

India is the second largest consumer of fertilizers in the world, after China. It accounted for 15.3 per cent of the world's N consumption, 19 per cent of phosphatic (P) and 14.4 per cent of potassic (K) nutrients in 2008 (FAI, 2010). Fertilizer consumption was around 78 thousand tons in 1965-66 and it picked up very fast during the late-1960s and 1970s. At the time of onset of green revolution in 1966-67 consumption of fertilizers were about 1 million tones. In 1970-71, total fertilizer consumption increased to 2.26 million tones, which further increased to 12.73 million tons in 1991-92. During 1990s, total fertilizer consumption fluctuated between 12.15 and 16.8 million tones with the exception in 1999-00, when fertilizer consumption was over 18 million tones. Total fertilizer consumption reached a record level of 26.5 million tons during 2009-10.

Growth Rates in Fertilizer Consumption and Food grains Production

The growth rates in consumption of fertilizers and food grains during different time periods at all-India level are given in Table 1. The table shows that fertilizer consumption increased by more than 19 per cent in the pre-green revolution period (1950-51 to 1966-67) while food grains production increased by only 2.56 per cent. The reason for such a high growth in fertilizer consumption was that consumption in the base year (1950-51) was very low. This significant increase in total fertilizer consumption increased per hectare fertilizer use from less than one kg in 1951-52 to about 7 kg in 1966-67. in the post-green revolution period, fertilizer use increased by 9.9 per cent per year during the first phase of green revolution (1967-68 to 1980-81) when spread of high yielding varieties was limited to mainly Punjab, Haryana, western part of Uttar Pradesh and some southern states. Per hectare fertilizer consumption increased from 9.4 kg in 1967-68 to 31.9 kg in 1980-81. Increase in fertilizer use along with increase in area under irrigation and high yielding varieties increased food grains production from 95.5 million tons in 1967-68 to about 130 million tons in 1980-81 at an annual compound growth rate of 2.27 per cent. However, food grains productivity increased at a faster rate (1.87%) in the first phase of green revolution compared with pre-green revolution period (1.45%). During the second phase of green revolution (1981-82 to 1990-91), when technology spread to other parts of the country, total fertilizer

consumption increased an annual growth rate of 7.39 per cent. Per hectare fertilizer consumption increased more than doubled from 34.3 kg in 1981-82 to 69.8 kg in 1991-92. Total food grains production increased by about 2.8 per cent. The impressive growth of consumption of fertilizer in India in the post-green revolution period ensured increase in food grains production from 74.3 million tons in 1966-67 to 176.4 million tons during 1990-91.

Table 1: Growth rate in fertilizer consumption and food grains production

Period	Growth rate in fertilizer Consumption (%)		Growth rate in Period food grains (%)	
	Total	Per ha.	Production	Yield
Pre-green revolution period (1950-51to 1966-67)	19.41	18.11	2.56	1.45
Post-green revolution period	8.75	8.49	2.65	2.53
Phase I (1967-68 – 1980-81)	9.90	9.29	2.27	1.87
Phase II (1981-82– 1991-92)	7.39	6.61	2.77	3.13
Post-reforms Period (1991-92 to 2009-10)	3.98	3.69	1.33	1.38
8th Five Year Plan	4.51	5.63	1.26	1.10
9th Five Year Plan	1.35	0.43	-2.87	-0.98
10th Five Year Plan	7.57	7.40	2.52	2.05

Source: Fertilizer Association of India (2010)

However, in 1991-92, certain policy reforms were initiated in fertilizer sector as part of macro- economic reforms. The potash and phosphate fertilizers were decontrolled w.e.f. August 25, 1992, the low analysis nitrogenous fertilizers viz. calcium ammonium nitrate, ammonium chloride and ammonium sulphate were also decontrolled that brought under control several times in the past. These fertilizers were last decontrolled w.e.f. June 10, 1994. These policy interventions led to a serious slowdown in fertilizer consumption in the post-reforms period. Total fertilizer consumption declined from about 12.7 million tons in 1991-92 to 12.1 million tons in 1992-92. Similarly, per hectare fertilizeruse also declined from 69.84 kg in 1991-92 to 65.45 kg in 1992-93. This reduction was more pronouncedin case of phosphate and potash fertilizers. Total P consumption fell by about 14 per cent (from 3321.2 thousand tons in 1991-92 to 2843.8 thousand tons in 1992-93) and K by 35 percent (1360.6 thousand tons in 1991-92 to 883.9 thousand tons in 1992-93). Similar trend was observed in case of per hectare fertilizer

consumption. Due to introduction of concession scheme on decontrolled phosphate and potash fertilizers in 1992-93, fertilizer consumption started picking up and reached a level of 18.1 million tons in 1999-00, declined to 16.7 million tons in 2000-01 and remained below this level up to 2003-04. Per hectare fertilizer consumption reached a level of 95.89 kg in 1999-00 but remained below this level during the next four years. Last six years viz., 2004-05 to 2009-10 have seen significant recovery in fertilizer use in the country and total consumption reached a record level of 26.5 million Tones and per hectare consumption at 135.25 kg in 2009-10.

The impact of slow growth of fertilizer consumption on growth of food grains production and crop output in the post-reforms period is quite evident from growth rates. In post-reforms period (1991-92 to 2009-10) growth rate in fertilizer consumption was 3.98 per cent compared with over 8.75 per cent during 1966-67 to 1991-92. Total fertilizer consumption recorded the lowest growth (1.35%) during the 9th five year plan compared with about 7.57 per cent during 10th plan. There seems to be a very high positive association between growth rates of fertilizer consumption and food grains production. During 8th plan period fertilizer consumption increased at an annual growth rate of about 4.51 per cent and food grains production increased by 1.26 per cent. Fertilizer consumption growth rate fell to 1.35 per cent during 9th plan and food grains production growth rate also declined to -2.87 per cent. During 10th five year plan, fertilizer consumption grew by 7.57 per cent and food grains production growth rate increased to about 2.52 per cent. In the post-reforms period (1991-92 to 2009-10) growth rate in fertilizer consumption turned out to be less than half of what was achieved during the post-green revolution period (1966-67 to 1991-92). Similar trend is observed in case of food grains production. Growth rate in food grains production declined to about half (1.33%) during 1991-92 to 2009-10 compared with 2.65 per cent during 1967-68 to 1991-92.

Intensity of Fertilizer Use

Looking at the total fertilizer consumption is not a good indicator as there are large differences in total cropped area across states. It would be more appropriate to examine trends in fertilizer consumption per hectare of cropped area. On per hectare basis, fertilizer consumption was less than 2 kg during the 1950s and increased to about 5 kg in 1965-66. However, after introduction of green revolution in 1966- 67, per hectare fertilizer consumption increased more than doubled in the next five years from about 7 kg in 1966-67 to about 16 kg in 1971-72, which further increased and reached a level of 50 kg in mid-1980s. Average fertilizer consumption on per hectare basis crossed 100 kg in 2005-06 and reached a record level of 135 kg in 2009-10.

However, per hectare fertilizer consumption fell during 1973-74 and 1974-75 due to oil shock of 1973 when oil prices quadrupled almost overnight. The next reversal in intensity of fertilizer use came in 1992-93 when government decontrolled phosphate and potash fertilizers and increased fertilizer prices significantly. The decline in use of fertilizers was the highest (36.3%) in case of potassic and about 16 per cent in phosphatic fertilizers. The total fertilizer consumption (N+P+K) fell by about 6 per cent from 69.84 kg per hectare to 65.45 kg per hectare. Due to severe drought in many parts of the country, per

hectare fertilizer consumption declined from 91.64 kg in 2002-03 to 88.38 kg per hectare in 2003-04. However, during the last five years, intensity of fertilizer use has increased substantially (53%) from about 88 kg in 2005-06 to135 kg per hectare in 2009-10.

Fertilizer consumption in terms of kg per hectare of total cropped area by region from 1971-72 to 2009-10. Overall, the average intensity of fertilizer use in the country increased from about 16 kg per hectare in 1971-72 to 135 kg per hectare in 2009-10. This level has been lower than that of north and south regions whose average intensity has been about 91.5 kg per hectare between 1971-72 and 2009- 10 with a low of 23.1 kg in 1974-75 and a peak of 182.9 kg per hectare in 2009-10 in case of north region and about 85 kg per hectare on an average with a low of 14.9 kg in 1973-74 and a peak of 188.3 kg in 2009-10 in south region.

Fertilizer consumption in India is highly skewed, with wide inter-regional, inter-state, inter district and inter-crop variations. Intensity has generally been higher in northern (91.5 kg/ha average) and southern (85.3 kg/ha average) region and lower in the eastern (44.7 kg/ha) and western region (40.7 kg/ha). Sustained growth in intensity is quite apparent in all the regions. However, some of these regional averages are heavily influenced by individual state observations. For example during the triennium ending (TE) 2009-10, in western region Gujarat had a high rate of 143.8 kg per hectare while Rajasthan had a very low rate of 47.1 kg per hectare. Similarly, in northern region, Punjab had a very high level of 223.9 kg per hectare while Himachal Pradesh had a low rate of about 55.7 kg. Similar variations are quite apparent in other regions as well.

Region-wise trends in growth rates of per hectare fertilizer use. The figure shows that during the 1970s, north zone registered the highest growth (11.3%), while western region had the lowest growth rate (7.5%). The high growth in consumption of fertilizer in northern region was due to spread of high yielding varieties and expansion of irrigation facilities in late 1960s and 1970s. During the decade of eighties, new technology spread to other regions of the country (east and western region) which led to increase in consumption of fertilizers in these regions. Eastern region experienced the highest growth (12.7%), followed by western region (10.2%). During the 1990s growth in intensity of fertilizer use decelerated in all regions and western region had the highest growth rate (8.2%).This growth in western region was driven by high rate of growth in states like Gujarat (9.6%) and Madhya Pradesh (8.9%). At all-India level growth rate in per hectare fertilizer consumption was the highest (9.3%) during the 1970s, declined to 7.5 per cent in the eighties and 4.3 per cent in the 1990s. However, the growth rate improved in the 2000s and reached a level of 4.8 per cent.

Factors Affecting Demand for Chemical Fertilizers in India

The purpose of this section is to estimate three nutrients and total fertilizer demand functions from time series data and to make demand projections for proper planning for production, imports and supply of feed stocks and raw materials. Separate nutrient demand functions are estimated for nitrogen (N), phosphorous (P), potassium (K) and total fertilizers (N+P+K) in the country. The fertilizer demand function is often referred to as a “derived” demand because it is determined to a large extent by the final

demand for the crop produced. In general, the demand for fertilizer depends on (a) the price of the crop(s), (b) the price of fertilizer, (c) prices of other inputs that substitute for or complement fertilizer, and (d) the parameters of the production function that describe the technical transformation of the inputs into an output (i.e., the fertilizer response function) (Debertin 1986). Though prices may be important in determining fertilizer consumption, they are possibly less important than other non-price factors such as introduction of new technology, high yielding crop varieties, expanded irrigation, availability of credit, changing cropping pattern, etc., causing the derived demand for fertilizers to shift over time. Specifying a forecasting model is always a challenge, especially the model type and relevant variables. The common models are time series models where the forecast is based on past observations of the variable being forecasted. Causal models and qualitative methods have also been used. Causal models such as simple linear regression models are preferable when projections of the exogenous variables are available. Qualitative methods such as expert opinion are popular when insufficient data is available to estimate a model or when there is a need to augment the results of a quantitative method. In a single equation approach, which has been used widely, typically demand function is estimated using time series of total fertilizer use or per hectare use with some price and non-price variables and often a linear trend.

DETERMINANTS AND OUTLOOK FOR 2020

This study uses causal model because time series data on fertilizer consumption as well as variables influencing fertilizer use are available. We estimated fertilizer demand model using annual time series data, from 1976-77 to 2009-10 using simple linear regression model using ordinary least squares (OLS) method. We hypothesized that the demand for fertilizer is a function of prices (specifically price of fertilizers and food grains), subsidy, as well as non-price factors such as irrigated area, coverage of high yielding varieties, area under food grains and non-food grains, cropping intensity, rainfall, capital availability, etc. Among a large number of factors considered in the study, the following variables were finally used in the model based on their statistical significance and stability of the functional relationship to estimate demand for the period 2010-11 to 2020-21. The fertilizer requirement forecast shown in Table 2 is generated by an estimated model using historical fertilizer consumption data. The total demand for fertilizers (N+P+K) is projected to increase to about 35 milliontons by 2015-16 and 41.6 million tons by 2020-21. The demand for N is expected to increase to about
19.9 million tones and 23 million tons during the corresponding period. In case of P fertilizers demand is projected at 9.6 in 2015-16 and 11.5 million tons in 2020-21. For K fertilizers the demand is projected to reach about 5.5 million tones and 7.1 million tons by 2015-16 and 2020-21, respectively.

Table 2. Annual fertilizer nutrient projections for 2015-16 and 2020-21

	N	P	K	N+P+K	Total
2010-11	16.5	7.6	3.9	28.0	28.2

2011-12	17.2	8.0	4.2	29.5	29.6
2012-13	17.9	8.4	4.6	30.9	31.0
2013-14	18.6	8.8	4.9	32.3	32.5
2014-15	19.3	9.2	5.2	33.7	33.8
2015-16	19.9	9.6	5.5	35.1	35.2
2016-17	20.6	10.0	5.8	36.4	36.6
2017-18	21.2	10.4	6.2	37.8	37.9
2018-19	21.8	10.8	6.5	39.1	39.2
2019-20	22.4	11.1	6.8	40.4	40.5
2020-21	23.0	11.5	7.1	41.6	41.7

Source: Fertilizer Association of India (2010)

Projections for total nutrients demand is based on regression equation estimated for total fertilizer nutrient consumption while demand forecasts for N+P+K are sum of demand for N, P and K estimated by regression equations for N, P and K separately. Therefore there is a marginal difference between two estimates.

The demand for fertilizer products such as urea, DAP, SSP, MOP and complex fertilizers is estimated by using averages of their percentage shares in N, P and K consumption, respectively, using data over the period 2005-06 to 2009-10 (Table 3). Taking into account the average consumption level of 80.9 per cent of N through urea, 63 per cent of P through DAP, 29.3 per cent through complex fertilizers, 7.2 per cent P through SSP and 70.1 per cent K through MOP during 2005-06 and 2009-10, the product-wise demand for fertilizer products for the period 2015-16 and 2020-21 were worked out and the figure are presented in Table 4. The demand for urea is projected to be around 34.8 million tons by 2015-16 and reach a level of 40.3 million tons by 2020-21. The demand for DAP, complex fertilizers (excluding DAP) and SSP would be nearly 13.1, 4.3 and 11.4 million tons in 2015-16 and 15.8, 5.2 and 13.6 million

tons by 2020-21. The demand for MOP would be around 6.4 million tons by 2015-16 and 8.3 million tons in 2020-21. These projections of demand for fertilizer products are based on existing product nutrient ratio. However, with introduction of nutrient-based pricing scheme and programmes like national project on Management of Soil and Fertilizer Health to promote balanced use of fertilizer nutrients, the demand for SSP and complex fertilizer might increase at a faster rate in the coming years.

Table 3. Share of major fertilizer products in total consumption of N, P and K nutrients: 2005-10

Year	Share of Urea in Total N	Share of DAP in Total P	Share of SSP in Total P	Share of MOP in Total K	Share of Complex fert. in Total P
2005-06	80.6	59.8	8.5	67.9	30.1
2006-07	81.3	61.2	8.4	66.4	28.7
2007-08	82.8	63.0	7.0	65.6	29.8
2008-09	81.2	65.3	6.4	73.9	28.1
2009-10	78.8	66.0	6.0	76.5	27.9
Average	80.9	63.0	7.2	70.1	29.3

Source: FAI (2010)

Table 4: Region-wise fertilizer product demand forecasts for 2010-11 and 2020-21

Year	Urea	DAP	SSP	MOP	Complex Fertilizer
2010-11	28.9	10.4	3.4	4.6	9.0
2011-12	30.1	11.0	3.6	4.9	9.5
2012-13	31.3	11.5	3.8	5.4	10.0
2013-14	32.6	12.1	4.0	5.7	10.4
2014-15	33.8	12.6	4.1	6.1	10.9
2015-16	34.8	13.1	4.3	6.4	11.4
2020-21	40.3	15.8	5.2	8.3	13.6

Table 5 shows the share of different regions in all-India consumption of fertilizer nutrients during the last five years from 2005-06 to 2009-10. The share of consumption of N is the highest (36.2%) in North region, followed by West (27.9%), South (21.8%) and the lowest in East region (14.1%). The share of P in total nutrient consumption is the highest in West zone (35.5%), followed by North (26.7%), South (26.0%) and the East (13.8%). In case of K fertilizer nutrients, the share of South region is the highest (41.1%), followed by West (26%), East (21.1%) and the lowest (11.8%) in North zone. Based on these regional shares, zone-wise demand forecasts of fertilizer nutrients is worked out under different scenarios and the results are presented in Tables 6.

Table 5: Region-wise share (%) to all-India consumption of fertilizer nutrients: 2005-06 to 2009-10 average

Region	N	P	K
East	14.1	13.8	21.1
North	36.2	26.7	11.8
South	21.8	26.0	41.1
West	27.9	33.5	26.0

Source: FAI (2010)

Total demand for fertilizer (N+P+K) in the eastern region is projected to reach a level of about 5.3 million tons by the end of 2015-16 and 6.35 million tons by 2020-21. In case of North region, total fertilizer demand is expected to be about 10.4 million tons in 2015-16, and in South and Western region about 9.1 and 9.8 million tones, respectively. The demand for fertilizers is projected to reach about 12.2 million tons in north, 10.9 million tons in south and 12.1 million tons in western region by 2020-21. But with renewed focus on agricultural development in eastern region we expect the demand for fertilizer to increase at a faster rate in the region. The highest increase in fertilizer consumption is expected in southern Region, followed by east, north and western region.

Table 6: Zone-wise fertilizer nutrients demand forecasts for 2015-16 and 2020-21

year	N	P	K	Total (million tons)
East Zone				
010-11	2.34	1.04	0.83	4.22
011-12	2.44	1.10	0.90	4.44
012-13	2.54	1.16	0.97	4.67
013-14	2.63	1.22	1.04	4.89
014-15	2.73	1.27	1.11	5.11
015-16	2.82	1.33	1.17	5.32
020-21	3.26	1.58	1.51	6.35
North Zone				
010-11	5.98	2.02	0.46	8.46
011-12	6.23	2.13	0.50	8.87
012-13	6.48	2.25	0.54	9.26
013-14	6.72	2.36	0.57	9.65
014-15	6.96	2.46	0.61	10.04
015-16	7.20	2.57	0.65	10.42
020-21	8.33	3.07	0.83	12.23
South Zone				
010-11	3.61	1.97	1.61	7.19
011-12	3.76	2.08	1.74	7.58
012-13	3.91	2.19	1.88	7.97
013-14	4.06	2.30	2.01	8.36
014-15	4.20	2.40	2.14	8.74
015-16	4.34	2.50	2.27	9.12
020-21	5.03	2.99	2.91	10.93
West Zone				

010-11	4.61	2.54	1.02	8.17
011-12	4.80	2.68	1.10	8.59
012-13	4.99	2.82	1.19	9.00
013-14	5.18	2.96	2.96	9.41
014-15	5.36	3.10	1.35	9.81
015-16	5.55	3.23	1.44	10.21
020-21	6.42	3.85	1.84	12.12

Source: Fertilizer Association of India (2010)

SUMMARY AND CONCLUSIONS

With the limited arable land resources, and burden of increasing population, development of new technologies and efficient use of available technologies and inputs will continue to play an important role in sustaining food security in India. It is expected that India's available arable land might drop below the current level of about 140 million hectares, if the use of farmland for commercial/non- agricultural purpose is not restricted in the near future. Therefore, the only way to improve food production is to increase crop yields through the scientific use of fertilizers along with other inputs like high yielding variety seeds, irrigation, etc. using the limited arable land, with an emphasis on protecting the environment. The Government of India has been consistently pursuing policies conductive to increased availability and consumption of fertilizers in the country. Over the last four and half decades, production and consumption of fertilizers has increased significantly. The country had achieved near self-sufficiency in N and P, with the result that India could manage its requirement of these fertilizers from indigenous industry and imports of all fertilizers except K were nominal. However, during the last 5-6 years there has been a significant increase in imports of N and P as well because there has not been any major domestic capacity addition due to uncertain policy environment. India is the third largest producer of fertilizers in the world next to China and USA and the second largest consumer after China during 2009-10. The overall consumption of fertilizers in the country has increased from 65.6 thousand tons in 1951-52 to 26.49 million tons in 2009-10. Accordingly, per hectare consumption of fertilizers, which is less than one kg in 1951-52, has gone up to the level of 135 kg in 2009-10. The average intensity of fertilizer use in India at national level is still much lower than in other developing countries but there are many disparities in fertilizer consumption patterns both between and within regions of India.

Therefore, there is a need have two pronged strategy, (i) to monitor districts with high intensity of consumption and take corrective actions to reduce environmental degradation and (ii) to promote fertilizer consumption in low-use districts to improve crop productivity. While examining major determinants of fertilizer use, it was found that non-price factors such as irrigation, high yielding varieties, were more important in influencing demand for fertilizers. Of the two price policy instruments, affordable fertilizer prices and higher agricultural commodity prices, the former is more

powerful in influencing fertilizer consumption. The high product price support policy benefits the large farmers who have net marketed surplus while low input prices benefit all categories of farmers. Therefore, in order to ensure self-sufficiency in food grains production in the country, availability of fertilizers at affordable prices to the producers is of utmost importance. The government should give due importance to non-price factors like better seeds, irrigation, credit, etc. to increase fertilizer use in the country. For this, more investment in irrigation, agricultural research and development, extension services and infrastructure are indispensable in the context of a country like India. The results also suggest fertilizer subsidy to be more appropriate means to achieve the stated objectives compared with price support policy.

However, there is a need to contain and target these subsidies in a better way. By 2020, fertilizer demand in the country is projected to increase to about 41.6 million tones – 23 million tons of N, 11.5 million tons of P and 7.1 million tons of K. The projected fertilizer demand in eastern and southern region is expected to grow at a faster rate compared with north and west. To meet the projected demand of about 41.6 million tons in 2020, additional capacity will be needed. Overall, a conducive and stable policy environment, availability of raw materials, capital resources, and price incentives will play a critical role in meeting the fertilizer requirements of the country.

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