ReSAKSS asia
FACILITATED BY IFPRI

WORKING PAPER 06 | NOVEMBER 2014

The Role of Fertilizer in Transforming Agriculture in Asia

A CASE STUDY OF THE INDIAN FERTILIZER SECTOR

Vijay Paul Sharma

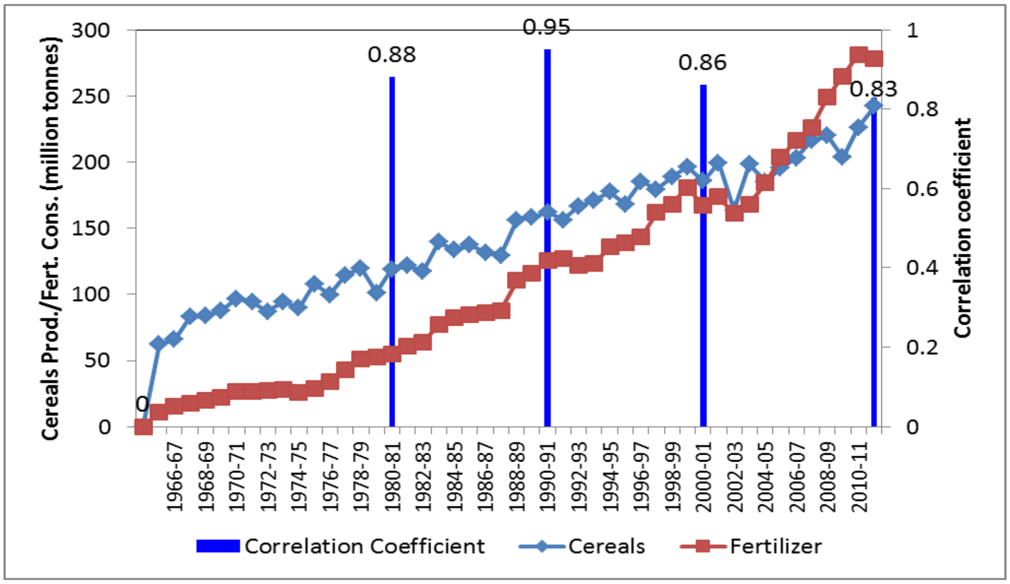
INTRODUCTION

The role of chemical fertilizers for increased agricultural production, particularly in developing countries such as India, 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 to the yield growth in Asia (Hopper 1993, FAO 1998). Others have found that one-third of worldwide cereal production is due to the use of fertilizer and related factors of production (Bumb 1995).

For the past four decades, India has relied on increasing crop yields to supply an ever-increasing demand for food. According to Ministry of Agriculture data, total food grains production rose from about 102 million tons in the triennium ending (TE) 1973–1974 to about 253 million tons in TE2012–2013, a 148 percent increase (GoI 2013). Meanwhile, the total area under food grains, which accounted for nearly three-fourths of the total cropped area in early 1970s, declined to 63.6 percent in TE2011–2012 and total area under food grains declined from 125 million hectares (ha) in the 1970s to 122 million ha in the 2000s. This dramatic increase in food grains production was the result of a 133 percent increase in crop yields between TE1973–1974 and TE2011–2012. During the past two decades, India has lost 2 to 3 million ha of net sown area to nonagriculture purposes.

Food security has been and will continue to be one of the major challenges confronting the world, including India, as the country faces the challenge and pressure to feed more than 1 billion people today. The agricultural policy has focused on increasing productivity and modern inputs, such as high-yielding variety (HYV) seed, chemical fertilizers, and irrigation, and subsidies that supported intensive farming played an important role during the 1970s and 1980s. Trends in fertilizer consumption and cereal production in India, shown in Figure 1, clearly indicate that the increased consumption of fertilizer has been a dominant factor underlying increases in crop production in the country. However, the association between fertilizer use and cereals production has weakened over time; for example, the correlation coefficient between fertilizer consumption and cereals production increased from 0.88 during the first phase of the Green Revolution (1965–1966 to 1970–1971) to 0.95 in the second phase (1980s) but declined during the 1990s (0.86) and 2000s (0.83).

Figure 1—Trends in cereals production and fertilizer consumption in India: 1965–1966 to 2011–2012



Source: FAI 2012.

The options for increasing food production are limited by the availability of land and water and the increasing population, among other factors. Fertilizers can play an increasingly important role in agricultural production as the opportunity to bring new area under cultivation diminishes and the majority of Indian soil becomes deficient in many macro- and micronutrients. The application of essential plant nutrients, particularly macro- and micronutrients, in the optimum quantity and the right proportion, by using the correct method and time of application and efficient and environmentally sound management, is the key to increasing and sustaining agricultural production. Therefore, it is important to understand fertilizer use behavior and efficiency over time and space, the changing structure of fertilizer markets, the policy environment, and the role of various factors influencing fertilizer consumption. This paper is an attempt to address some of these issues.

THE EVOLUTION OF FERTILIZER POLICY

Fertilizer use has been and will continue to be a major factor in increasing agricultural production, and very few countries, even advanced ones, have relied entirely on the free market system for fertilizer pricing. Fertilizer prices at both producer and farmer levels are determined directly or indirectly by the government in most developing countries, including India. Such government interventions generally have two basic objectives, (1) to provide fertilizers to farmers at stable and affordable prices to increase agricultural production through higher fertilizer use, and (2) to encourage domestic production by allowing fertilizer producers a reasonable return on their investments. This section provides a brief overview of fertilizer sector policies in India. The policy review is based on different publications or documents, such as various committee reports, fertilizer statistics, and notifications from the Department of Fertilizers, the Ministry of Chemicals and Fertilizers, and the Government of India.

India’s fertilizer policy environment can be broadly classified into four periods, (1) Pre-Retention Price Scheme (RPS) Regime (up to the mid-1970s), (2) Post-RPS Era (mid-1970s to 1980s), (3) Post-Reforms Period (1991–2009), and (4) Nutrient-Based Subsidy Scheme (2010–present).

Figure 2 shows a brief review and the main highlights of key policy changes during different phases.

Figure 2—Highlights of fertilizer policy changes during different phases

Phase 1: Pre-RPS Regime

1944: Central fertilizer pool established to ensure equitable distribution of fertilizers at fair prices through pooling domestic and imported fertilizers and distribution through state agencies.

1957: Fertilizer Control Order under the Essential Commodities Act (ECA) passed to regulate sale, price, and quality of fertilizers.

1965: Committee on Fertilizers constituted to examine problems related to production, pricing, and distribution of fertilizers.

1969: Domestic manufacturers given freedom to sell their produce but discontinued.

1973: Due to fertilizer shortages in early 1970s, government passed Fertilizer Movement Control Order to bring distribution and interstate movement under government control

1974–76: Global oil and fertilizer crisis led to shortages and very steep increase in prices. Government introduced fixed subsidy per ton on phosphatic fertilizers in 1976.

Phase 2: RPS Regime

1976: Government constituted Fertilizer Pricing Committee (Marathe Committee) to recommend pricing policy with the objective of ensuring remunerative returns to producers/investors and affordable prices to farmers. The committee recommended Retention Pricing scheme. Under RPS, the difference between retention price (cost of production as assessed by the government plus 12 percent post-tax return on net worth) and the statutorily notified sale price was paid as subsidy to each urea unit.

1977–79: RPS introduced for nitrogenous fertilizers in 1977 and extended to phosphatic and complex fertilizers in 1979.

1980–81: Prices of ammonium sulphate and calcium ammonium nitrate decontrolled in June 1980. Government introduced block delivery scheme by opening up retail outlets in interior areas and provided freight subsidy in such areas.

1982: Single super phosphate brought under RPS.

1984: Ammonium sulphate and calcium ammonium nitrate brought under price controls.

1986: High Powered Committee of Secretaries examined RPS but none of recommendations was accepted.

1987: High Powered Committee on Fertilizer Consumer Price recommended developing dryland areas, better soil-testing facilities, incentives for fertilizer promotion, and monitoring fertilizer use efficiency.

Phase 3: Post-Reforms Regime

1991: Government introduced dual pricing scheme (low prices for small and marginal farmers) in August 1991 but discontinued in March 2012. Ammonium sulphate, ammonium chloride, and calcium ammonium nitrate prices decontrolled.

1992: Committee recommended a normative approach for retention price of fertilizers but recommendations were not implemented.

1992: Joint Parliamentary Committee (JPC) on Fertilizer Pricing constituted to review methodology of computing RPS and suggest appropriate alternatives. The committee did not recommend total decontrol but recommended decontrol of P and K fertilizers and 10 percent increase in urea prices.

1992: Based on recommendations of JPC, the pricing, movement, and distribution of all phosphatic and potassic fertilizers decontrolled from August 25, 1992. Ammonium sulphate, ammonium chloride, and calcium ammonium nitrate brought back under control. Imports of raw materials, intermediates, and diammonium phosphate (DAP) decanalized. Concession on decontrolled P and K fertilizers introduced to contain rising prices, and rates of concession revised from time to time to improve N:P:K ratio.

1993–94: Muriate of potash (MOP) decanalized and ad hoc concession on single super phosphate (SSP) introduced. Ammonium sulphate, ammonium chloride, and calcium ammonium nitrate prices decontrolled.

1998: High Powered Fertilizer Pricing Policy Review Committee constituted to review existing policy and suggest alternatives. Committee recommended discontinuation of unit-wise RPS and fix uniform normative referral price for existing gas-based urea units and for DAP. Feedstock differential cost reimbursement to be given to non-gas urea units for five years.

2000: Expenditure Reforms Commission looked at rationalization of fertilizer subsidies and recommended dismantling the control system in a phased manner (four phases) and fixation of farmgate prices to promote balanced use of NPK.

2001: Expert Committee on Reassessment of Production capacity of urea constituted.

2003: Committee on Cost Price Study of DAP (indigenous and imported) and MOP (imported) constituted to work out delivered prices of imported and indigenous DAP.

2002: Based on recommendations of various committees, a new pricing scheme for urea approved in December 2012. The policy was implemented in three stages. Stage 1: April 1, 2003, to March 31, 2004; stage 2: April 1, 2004, to March 31, 2006; stage 3: April 1, 2006, onward based on review of stage 1 and stage 2.

Normative price based on group average instead of unit-specific RP and six groups based on vintage and feedstock formed, pre- and post-1992 gas-based, pre- and post-1992 naphtha-based, foil/LSHS–based, and mixed energy–based units.

The policy for stage 2 of NPS, which was originally valid until March 31, 2006, was extended until September 30, 2006. The CRC were reduced for some plants, and energy norms tightened.

Stage 3 of NPS was notified on March 8, 2007, and was for a period of three and a half years, from October 1, 2006, until March 31, 2010.

2008: Government introduced Nutrient-Based Pricing of subsidized fertilizer to promote balanced use of nutrients, and this policy intervention led to decline in prices of many complex fertilizers.

Phase 4: Nutrient-Based Subsidy Regime

2010: GoI notified the policy on Nutrient-Based Subsidy for P and K fertilizers, which went into effect on April 1, 2010, and announced fixed quantum of subsidy on N, P, K, and S macronutrients. Micronutrients Zn and B were also covered under the policy with additional subsidy. In addition to NBS, freight for the movement and distribution of the decontrolled fertilizers by rail and road provided to enable wider availability of fertilizers in the country. Production, import, distribution, and movement of fertilizers monitored through the Fertilizer Management System (FMS).

Government regulates movement of 20 percent of the imported/indigenous fertilizers to bridge supplies in underserved areas; import of P and K fertilizers are under Open General License, while urea imports are still canalized. Department of Fertilizers releases 85 percent (90 percent with bank guarantee) "on account" payment of a monthly subsidy to the manufacturers/importers of P and K fertilizers (SSP) based on receipt of fertilizers in the districts/states.

In view of the availability of fertilizers in the country and the subsidy paid thereon, the government put the export of fertilizers in the restrictive category to discourage export and smuggling.

2013: The subsidy on N, P, K, and S reduced from Rs. 27.153/kg in 2011–12 to Rs. 20.875 in 2013–14 for N, from Rs. 32.338/kg in 2011–12 to Rs. 18.679 in 2013–14 for P, and from Rs. 26.756/kg in 2011–12 to Rs. 18.833 in 2013–14 for K.

2013: Due to unprecedented increase in P and K prices, government introduced Reference Maximum Retail Price for P and K fertilizers and asked the companies to reduce maximum retail prices of P and K fertilizers in June 2013.

DEMAND-SIDE ISSUES

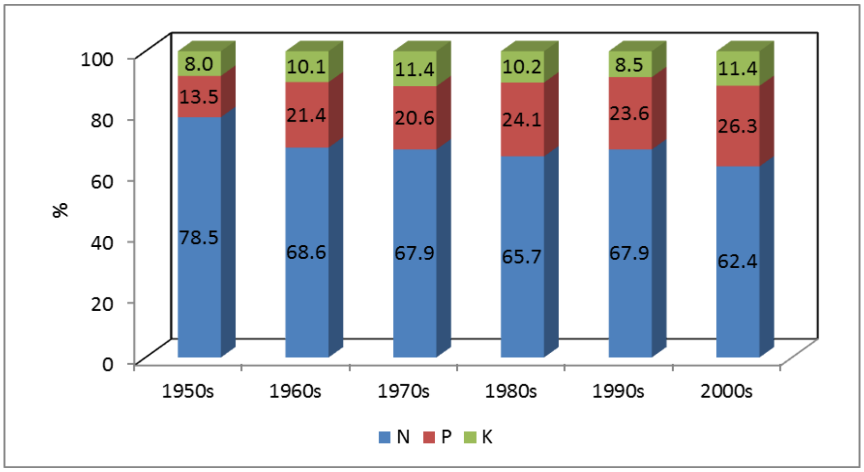
Trends in Total Fertilizer Use

India is the second largest consumer of fertilizers in the world, with an estimated consumption of 28.1 million tons in 2010, after China (49.8 million tons). It accounted for 15.8 percent of the world's consumption of N, 19.9 percent of phosphatic (P_2O_5), and 12.7 percent of potassic (K_2O) nutrients in 2008 (FAI 2012). At the onset of the Green Revolution in 1966–67, consumption of fertilizers was about 1 million tons and increased to 2.26 million tons in 1970–71, which further increased to 12.73 million tons in 1991–92. The rapid expansion of irrigation, spread of HYV seed, introduction of Retention Price Scheme (RPS), distribution of fertilizers to farmers at affordable prices, expansion of dealers' networks, improvement in fertilizer availability, and virtually no change in farmgate fertilizer prices during the 1980s were major reasons for the increase in fertilizer consumption from 1971 to 1990. During the 1990s, total fertilizer consumption fluctuated between 12.15 and 16.8 million tons, with the exception in 1999–00, when fertilizer consumption was more than 18 million tons. In the past decade, fertilizer consumption increased at a faster rate, and total fertilizer consumption reached a record level of 28.1 million tons during 2010–11 and marginally declined to 27.8 million tons in 2011–12.

Nutrient Share in Total Fertilizer Consumption

Figure 3.1.1 shows the share of primary nutrients in total fertilizer consumption. Nitrogenous fertilizers accounted for 62.4 of total nutrient consumption in the country during the 2000s. The share of N was 78.5 percent in the 1950s, and declined to 68.6 percent in the 1960s, to 67.9 percent in the 1970s, and to 65.7 percent in the 1980s. However, the share of N increased to 67.9 percent in the 1990s, then fell to 62.4 percent in the 2000s. for P fertilizers, the share increased from 13.5 percent in the 1950s to 21.4 percent in the 1960s, then marginally declined during the 1970s and again picked up during the 1980s (24.1 percent). During the 1990s the share of P in the total consumption declined to 23.6 percent and then increased during the 2000s to 26.3 percent. Likewise, the share of K increased from 8 percent in the 1950s to 11.4 percent in the 1970s, declined to 10.2 percent in the 1980s, and fell further to 8.5 percent in the 1990s. The share of K increased to 11.4 percent in the 2000s. The rise in the share of N and the decline in the share of P and K fertilizers during the 1990s was mainly because of slow growth in the consumption of P and K fertilizers compared with N fertilizers due to the decontrol of P and K fertilizers and the relatively high increase in their prices vis-à-vis N fertilizers, which remained almost stable during the decade. Concerned with the problem of increasing imbalance in the use of primary nutrients, the government introduced a concession scheme on the sale of decontrolled P and K fertilizers to farmers in the mid-1990s, but still prices of these fertilizers were higher than nitrogenous fertilizers. In the late- 990s and early 2000s, the government hiked the concession rates for P and K fertilizers, which led to an increase in their consumption and a higher share in total fertilizer use during the 2000s. The consumption of N fertilizers increased from about 4.5 million tons in TE1983–84 to about 16.6 million tons during TE2011–12 (about 266 percent increase), P consumption increased from about 1.5 million tons to about 7.5 million tons (418 percent increase), and K consumption from 726 thousand tons to 3.2 million tons (346 percent increase). The share of N declined from 66.9 percent to 60 percent, while the share of P increased from 22.2 percent to 28.2 percent and K consumption from 10.8 percent to 11.8 percent during the past three decades.

Figure 3.1.1—Share of primary nutrients (N, P, and K) in total consumption of fertilizers



Source: FAI 2012.

The government introduced Nutrient-Based Subsidy (NBS) of subsidized fertilizers in 2008 and prices of all fertilizers were refixed by benchmarking to prices of urea, DAP, and MOP, which led to a reduction in prices of complex fertilizers, a decline in the share of N (from 63.9 percent in 2007–08 to 60.6 percent in 2008–09), an increase in the share of P (from 24.4 percent to 26.1 percent), and a decline in the share of K (from 11.7 percent to 13.3 percent). However, the government partially decontrolled the fertilizer sector and introduced the NBS scheme on phosphatic and potassic fertilizers in April 2010, which led to a very steep increase in P and K prices and a marginal decline in the share of P (from 28.6 percent in 2010–11 to 28.5 percent in 2011–12) and a significant decline in K fertilizers (from 12.5 percent in 2010–11 to 9.3 percent in 2011–12). On the other hand, the share of N consumption increased from 58.8 percent in 2009–10 (pre-NBS) to 62.3 percent in 2011–12 (post-NBS).

Product Shares

Table 3.2.1 shows the major fertilizer products consumed in India. Urea is by far the most widely used product. Together with other straight nitrogen fertilizers, such as ammonium sulphate (AS) and ammonium chloride (ACl), they make up nearly half the total market share. NP/NPK complex fertilizers (excluding DAP) are the second largest products, accounting for 20 percent of the market share, followed by DAP (18 percent) and SSP (7.5 percent) during 2011–12. The share of NP/NPK complex fertilizers, which witnessed a declining trend between 1981–82 and 1991–92, increased during the post-reforms period and more particularly during the past five years (after introducing Nutrient-Based Subsidy of fertilizers in 2008).

Table 3.2.1—Share (percent) of various fertilizer products in total sales of fertilizers in India, 1981–82 and 2011–12

Product	1981–82	1991–92	2007–08	2011–12
Urea	50.1	47.5	57.1	48.4
AS/CAN/ACl	6.8	3.5	1.3	1.1
MOP	8.3	8.0	8.8	5.0
SSP	8.7	10.9	4.8	7.5
DAP	5.4	17.2	14.6	18.0
NP/NPK	20.7	12.8	13.3	20.0

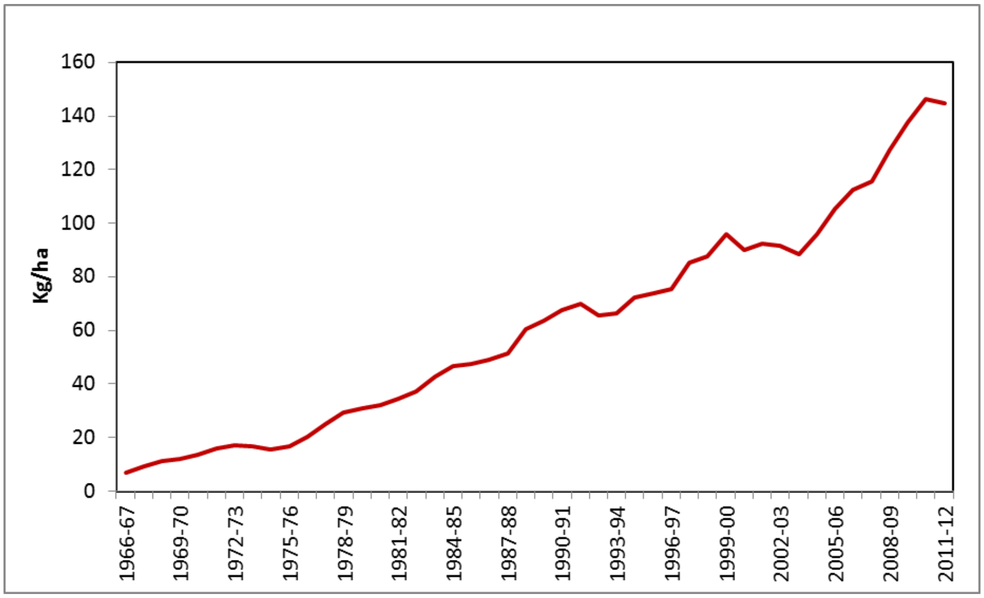
Source: FAI 2012.

Urea accounts for about 80 percent of India's total nitrogen consumption, and the other nitrogenous fertilizers—calcium ammonium nitrate (CAN), ammonium sulphate, and ammonium chloride—account for only a 1 percent share during 2011–12. In the case of phosphatic fertilizers, DAP accounts for about 59 percent of the total phosphorus consumption, single superphosphate accounts for 10 percent, and NK/NPK complex fertilizers account for 30.9 percent. The main reason for the predominant share of these two products (urea and DAP) is that the subsidy/concession was available on these products. Under earlier pricing regimes, the price of nutrients in complex fertilizers and other decontrolled fertilizer products were higher than the price of the same nutrient in other straight fertilizers, such as urea, DAP, MOP, and SSP. This led to a comparatively higher usage of straight fertilizers vis-à-vis complex fertilizers. However, in order to promote balanced use of fertilizers and provide more choice to farmers, the government took a positive step and introduced the Nutrient-Based Subsidy (NBS) scheme to cover other products, including complex fertilizers, in June 2008. This policy intervention increased the choice of products within three primary nutrients as well as a more balanced use of fertilizers in terms of the N:P:K ratio. NBS significantly reduced the price of complex and other fertilizers, which led to some improvement in the share of complex fertilizers in total nutrient consumption.

Intensity of Fertilizer Use

On a per hectare (ha) basis, fertilizer consumption was less than 2 kg during the 1950s and increased to about 5 kg in 1965–66. However, after the introduction of the Green Revolution in 1966–67, per hectare fertilizer consumption 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 the mid-1980s. Average fertilizer consumption crossed 100 kg per ha in 2005–06 and reached a record level of 146.3 kg in 2010–11, and then marginally declined to 144.6 kg in 2011–12 (Figure 3.2.2). However, per hectare fertilizer consumption fell during 1973–74 and 1974–75 due to the oil shock of 1973, when oil prices quadrupled almost overnight. The next reversal in intensity of fertilizer use came in 1992–93, when the government decontrolled phosphatic and potassic fertilizers and increased fertilizer prices significantly. The decline in use of fertilizers was the highest (36.3 percent) in the case of potassic and about 16 percent in the case of phosphatic. The total fertilizer consumption (N+P+K) fell by about 6 percent, from 69.84 kg per hectare in 1991–92 to 65.45 kg per hectare in 1992–93. Due to severe drought in many parts of the country in 2002–03, per hectare fertilizer consumption declined from 91.64 kg in 2002–03 to 88.38 kg per hectare in 2003–04. The intensity of fertilizer use increased substantially (53 percent) between 2003–04 and 2010–11, from about 88 kg to 146.3 kg per hectare. However, fertilizer consumption witnessed a marginal decline (144.6 kg/ha) in 2011–12, mainly due to the steep increase in prices of phosphatic and potassic fertilizers after introduction of the Nutrient-Based Subsidy (NBS) scheme in 2010–11.

Figure 3.2.2—Intensity of fertilizer use (kg/ha) in India, 1965–66 to 2011–12

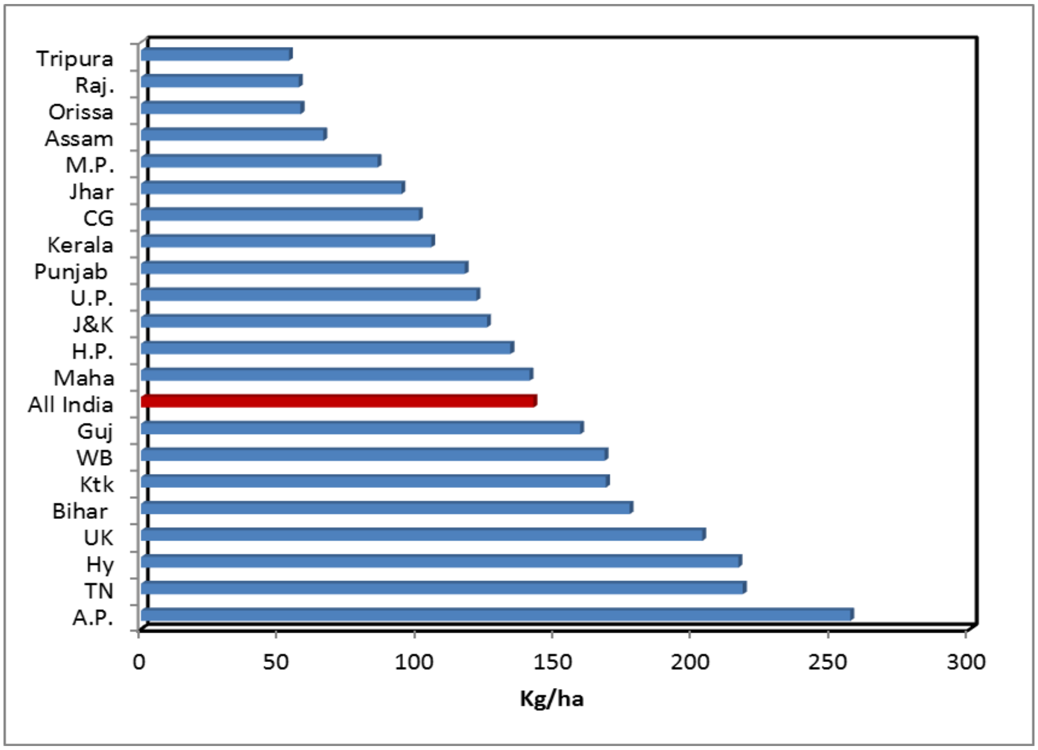


Source: FAI 2012.

Fertilizer consumption in India is highly skewed, with wide interregional, interstate, interdistrict, and intercrop variations. Intensity has generally been higher in the southern (215.5 kg/ha) and northern regions (187.4 kg/ha) and lower in the eastern (119.1 kg/ha) and western regions (104.1 kg/ha). The sustained growth in fertilizer use during the past three to four decades is quite apparent in all regions. However, some of these regional averages are heavily influenced by individual state fluctuations. For example, during

2011–12 in the western region, Gujarat had a high rate, at 155.6 kg per hectare, while Rajasthan had a very low rate, at 62.3 kg per hectare. Similarly, in the northern region, Punjab had a very high rate, at 243.6 kg per hectare, while Himachal Pradesh had a low rate, at 55.2 kg per hectare (Figure 3.2.3). In the south, fertilizer consumption varied from about 674 kg per ha in Puducherry to 112.9 kg in Kerala. Similar variations are quite apparent in the eastern region as well (less than 10 kg in the northeastern states to 184 kg in Bihar). Out of 32 states/union territories (UTs) for which fertilizer consumption data are available, 22 states/UTs had less than the national average consumption and the remaining 10 states had higher than the national average during 2011–12.

Figure 3.2.3—Per hectare fertilizer use (kg/ha) by major states, TE2011–12



Source: FAI 2012.

The average intensity of fertilizer use in India at the 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. During the triennium ending (TE) 1986–87, only three districts were using more than 200 kg per hectare of fertilizer and another 12 districts were consuming between 100 and 150 kg per hectare. In contrast, about 60 percent of the districts were using less than 50 kg of fertilizer (N+P+K) per hectare. However, the number of districts in the high-fertilizer use category (>200kg/ha) increased significantly during the second half of the 1990s and 2000s. In TE1999–00, out of 470 districts, 31 districts (6.6 percent) were using more than 200 kg per hectare, while about one-third of the districts were consuming less than 50 kg. Between TE2002–03 and TE2011–12, the number of districts consuming more than 200 kg/ha more than tripled, from 36 in TE2002–03 to 135 (24.7 percent) in TE2011–12. The increasing number of districts consuming consistently higher amounts of fertilizer (>200 kg/ha) is a cause for concern because it may lead to environmental degradation, particularly land and water resources. On the other hand, about 20 percent of the districts still use less than 50 kg/ha of fertilizer. Therefore, there is a need have a two-pronged strategy, one to monitor districts with a high intensity of consumption and take corrective actions to reduce adverse effects on environmental resources and the second to promote fertilizer consumption in low-use districts to improve crop productivity.

Fertilizer Use by Crops and Farm Size

Understanding the share of different crops in fertilizer consumption is a key component of fertilizer market analysis and a prerequisite to the development of sound fertilizer demand forecasts. It is generally expected that the major benefit of fertilizers goes to the areas having better access to technology, irrigation facilities, and infrastructure, and growing fertilizer-intensive crops like rice, wheat, sugarcane, fruits, and vegetables. Table 3.3.1 shows the trends in fertilizer usage in India by various crops/crop groups. It shows that in 2006–07, rice was the largest user of fertilizer (about one-third of the total consumption), followed by wheat (24.2 percent). Rice and wheat accounted for more than 60 percent of total fertilizer consumption in the country in 1995–96, and the share declined to 56.8

percent in 2006–07. Fruits, vegetables, and sugarcane combined represented another 11 percent of fertilizer use. Cotton accounted for about 5.6 percent of total use. In all the years, rice was the dominant crop fertilized. Fruits and vegetables appear to be increasing in importance. Fertilizer intensity, measured as the average kg per hectare, does not follow exactly the same pattern across crops; intensity tends to be higher on sugarcane (234.9 kg/ha), vegetables (253.8 kg/ha), cotton (183 kg/ha), and fruits (158.6 kg/ha) and lower on cereals (rice 129.2 kg/ha and wheat 162.6 kg/ha) and pulses (Table 3.3.2). It is evident that farmers growing input-intensive crops are the main beneficiaries of fertilizer use.

Table 3.3.1—Share of usage of fertilizer nutrients (N+P+K) by various crop groups (percent share)

Crop	1996–97	2001–02	2006–07
Rice	36.5	36.8	32.6
Wheat	24.2	23.8	24.2
Pulses	1.4	3.0	3.3
Total food grains	69.8	71.9	69.1
Oilseeds	7.9	8.6	9.5
Cotton	5.4	2.9	5.6
Sugarcane	4.9	5.1	5.6
Fruits & vegetables	1.8	5.4	5.7
Other crops	10.2	6.1	13.6

Source: GoI 2007, GoI 2008, and GoI 2012.

Note: GCA = gross cropped area.

Table 3.3.2—Usage of fertilizer nutrients (N+P+K) by various crop groups (kg/ha of GCA)

Crop	1991–92	1996–97	2001–02	2006–07
Rice	79.8	100.0	125.5	129.2
Wheat	85.3	119.3	132.4	162.6
Pulses	-	21.6	27.6	39.6
Total food grains	-	86.3	94.7	110.0
Oilseeds	-	52.5	64.8	31.0
Cotton	88.8	143.0	146.8	183.3
Sugarcane	160.9	185.4	202.0	234.9
Fruits	-	94.5	145.5	158.6
Vegetables	-	165.3	169.9	253.8
Spices & condiments	-	162.2	124.9	125.9

Source: GoI 2007, GoI 2008, and GoI 2012.

Note: GCA = gross cropped area.

Table 3.3.3 shows farm size–wise consumption of fertilizers in India in 1991–92, 1996–97, 2001–02, and 2006–07. It is evident from the table that the average use of fertilizers was higher with small and marginal farmers compared to medium and large farmers. The average fertilizer consumption per hectare of gross cropped area (GCA) was the highest (139.74 kg) on marginal farms and the lowest on large farms (67.64 kg) in 2006–07. A similar trend was observed during 1991–92, 1995–96, and 2001–02. Moreover, there has been a significant increase in fertilizer intensity per hectare of GCA on all farm size holdings during the periods 1991–92 and 2006–07. However, the increase was the largest (95.9 percent) on small farms, followed by marginal holdings (93.5 percent), and the lowest (47 percent) was on large farms.

Table 3.3.3—Pattern of fertilizer use intensity by farm size

	Marginal	Small	Semi-medium	Medium	Large	All
Fertilizer consumption per hectare of gross cropped area (kg)						
1991–92	72.2	65.5	61.7	56.3	46.0	60.7
1996–97	103.8	82.6	75.3	68.1	51.1	77.1
2001–02	126.2	100.6	88.8	75.8	55.9	92.6
2006–07	139.7	128.3	108.3	95.1	67.6	112.8
Fertilizer consumption per hectare of fertilizer area (kg)						
1991–92	113.4	104.6	101.3	97.0	98.1	102.8
1996–97	162.1	131.8	123.9	118.6	113.6	131.1
2001–02	164.7	134.7	122.8	113.3	108.4	131.7
2006–07	189.8	167.5	143.4	133.1	116.5	155.3

Source: GoI (2007), GoI (2008), and GoI (2012).

Because the fertilizer subsidy is universal and not targeted at a particular category of farmers, we computed the average subsidy rate (Rs./ton) based on the total fertilizer subsidy and the actual consumption of nitrogenous, phosphatic, and potassic fertilizers. It is estimated that the average fertilizer subsidy per ha of cropped area is significantly higher in cases of small and marginal farmers compared with large farmers because average fertilizer consumption is also higher on small and marginal farms. Sharma and Thaker (2010) have reported that the benefits of fertilizer subsidies are not restricted to only resource-rich states but have spread to other states also. It is worth mentioning that the benefits of fertilizer subsidy have spread to unirrigated areas because the share of area treated with fertilizers has increased on unirrigated lands. Likewise, the share of unirrigated areas in total fertilizer use has also increased during the past decade, indicating that fertilizer subsidies have benefited farmers in rainfed areas.

As is evident from the Table 3.3.4, with a share of just over 6 percent in total holdings, medium and large farmers consumed about 25 percent of total fertilizers used in the country in 2006–07. Semi-medium farmers accounted for about 11 percent of holdings, but consumed 22 percent of total fertilizers. On the other hand, small and marginal farmers, which constitute 82.5 percent of total holdings, consumed nearly 53 percent of total fertilizers. However, when we look at relative shares of different farm size groups in area operated and fertilizer used, the picture changes dramatically. For example, in 2006–07, the share of small and marginal farmers in gross cropped area was 44.4 percent, and they consumed about 53 percent of total fertilizer used in the country. On the other hand, the share of medium and large farmers in gross cropped area was nearly one-third, but they consumed about one-fourth of total fertilizers. Significantly, 73.6 percent of gross cropped area on marginal farms and 76.6 percent on small farms were fertilized compared with only 58 percent on large farms in 2006–07. The share of fertilized area to gross cropped area has increased on all farm sizes, but the increase was higher on small and semi-medium farms than on large farms. However, small farms witnessed some decline in the share of fertilized area to gross cropped area between 2001–02 and 2006–07. The subsidy has encouraged greater use of fertilizers in general and small and marginal farmers in particular.

Table 3.3.4—Pattern of fertilizer consumption by size of farm in India, 1991–92 to 2006–07

	Marginal (<1 ha)	Small (1–2 ha)	Semi-medium (2–4 ha)	Medium (4–10 ha)	Large (>10 ha)	All households
Distribution of holdings (percent)						
1991–92	57.1	20.3	13.7	7.3	1.6	100.0
1996–97	60.7	18.9	12.5	6.5	1.4	100.0
2001–02	64.0	18.2	11.0	5.6	1.2	100.0
2006–07	63.9	18.65	11.15	5.30	1.00	100.0
Share in gross cropped area (percent)						
1991–92	17.3	19.6	23.8	25.8	13.5	100.0
1996–97	19.0	19.1	23.5	25.1	13.3	100.0
2001–02	22.3	20.3	22.8	22.9	11.7	100.0
2006–07	23.42	20.95	22.95	22.46	10.22	100.0
Proportion of fertilized area to gross cropped area (percent)						
1991–92	63.6	62.6	60.9	58.0	46.9	59.1
1996–97	64.1	62.7	60.8	57.4	45.0	58.8
2001–02	77.1	74.2	71.3	65.1	49.7	69.2
2006–07	73.63	76.62	75.54	71.48	58.07	72.62
Share in total fertilizer consumption (percent)						
1991–92	20.6	21.1	24.2	23.9	10.2	100.0
1996–97	25.6	20.4	23.0	22.2	8.8	100.0
2001–02	29.9	22.1	22.1	18.9	7.0	100.0
2006–07	29.03	23.84	22.05	18.95	6.13	100.0

Source: GoI (2007), GoI (2008), and GoI (2012).

Nutrient Use Efficiency

One of the major constraints to fertilizer use efficiency in India is imbalanced use of nutrients. Nitrogen (N) applications tend to be higher in comparison to potassium (K) and phosphate (P). This is partly the result of the price differential and partly due to the lack of knowledge among farmers about the need for balanced fertilizer application. Table 3.4.1 shows the consumption ratio of N and P in relation to K in India for the period 1975–76 to 2011–12.

Table 3.4.1—Consumption ratio of N and P_2O_5 in relation to K_2O and N in relation to P_2O_5 in India, 1971–72 to 2012–13

Year	N:P_2O_5:K_2O			N:P_2O_5:K_2O	
	N	P_2O_5	K_2O	N	P_2O_5
1975–76	7.7	1.7	1	4.6	1
1979–80	5.8	1.9	1	3	1
1990–91	6.0	2.4	1	2.5	1
1991–92	5.9	2.4	1	2.4	1
1992–93	***9.5***	***3.2***	***1***	***3***	***1***
1993–94	***9.7***	***2.9***	***1***	***3.3***	***1***
1994–95	8.5	2.6	1	3.2	1
1996–97	***10.0***	***2.9***	***1***	***3.5***	***1***
1997–98	7.9	2.9	1	2.8	1
2000–01	7.0	2.7	1	2.6	1
2002–03	6.5	2.5	1	2.6	1
2005–06	5.3	2.2	1	2.4	1
2007–08	5.5	2.1	1	2.6	1
2008–09	4.6	2.0	1	2.3	1
2009–10	4.3	2.0	1	2.1	1
2010–11	4.7	2.3	1	2.1	1
2011–12	***6.7***	***3.1***	***1***	***2.2***	***1***
2012–13	***8.7***	***3.4***	***1***	***2.6***	***1***

Source: FAI 2012.

The N:P:K ratio was a little skewed toward N in the mid-1970s but started improving in the late 1970s and 1980s and reached a level of 5.9:2.4:1 in 1991–92. This improvement was due to the government's tight controls on fertilizer prices, sales, and distribution during the 1980s, when fertilizer prices remained unchanged. However, in August 1992, prices, distribution, and movement of phosphatic and potassic fertilizers were decontrolled while urea remained under statutory price control. The subsidy on phosphatic and potassic fertilizers was withdrawn, resulting in a sudden increase in retail prices of these fertilizers. For example, the price of DAP in terms of nutrient content increased from Rs. 7.57 per kg of P_2O_5 in July 1991 to about Rs. 12 in August 1992 and reached a level of Rs. 19.45 in rabi 1995–96. Similarly, the price of MOP in terms of nutrient content (K_2O) increased from Rs. 2.83 per kg in July 1991 to Rs. 7.50 in August 1992 and reached a level of Rs. 7–8 in rabi 1995–96. On the other hand, the retail price of urea was reduced by 10 percent. The retail price of DAP and urea was in the ratio of 1.5:1 in 1991–92. MOP and urea prices were in the ratio of 0.56:1. However, with the decontrol of P and K fertilizers, the ratio of retail prices of DAP and urea widened to 2.4:1 in rabi 1991–92 and the ratio of MOP and urea also distorted to 1.6:1. The NPK use ratio got distorted significantly from 5.9:2.4:1 during 1991–92 to 9.5:3.2:1.0 in 1992–93. The share of N, P, and K in total fertilizer consumption was 63.2, 26.1, and 10.7 percent, respectively, in 1991–92. The N share increased to about 71 percent in 1993–94, while the share of P declined to 21.6 percent and that of K to 7.3 percent.

To correct the imbalance in use of N, P, and K fertilizers, the government implemented a scheme of ad hoc concession on the sale of decontrolled fertilizers to farmers from October 1, 1992, but still there was significant disparity in prices of N, P, and K fertilizers, which led to more use of N and less use of P and K, resulting in more imbalance in use (the NPK ratio reached a level of 10.0:2.9:1.0 in 1996–97). Concerned with this deteriorating NPK ratio, the government announced a substantial increase in concession on P and K fertilizers, effective from July 6, 1996. The rate of concession on indigenous diammonium phosphate (DAP) was raised by three times from Rs. 1,000 per ton to Rs. 3,000 per ton. A concession to the extent of Rs. 1,500 per ton was extended to imported DAP to bring its selling price on par with indigenous DAP. Similarly, the concession on muriate of potash (MOP) was increased from Rs. 1,000 per ton to Rs. 1,500 per ton. The rate of concession on single super phosphate (SSP) was also enhanced from Rs. 340 to Rs. 500 per ton. Further increases in concessions on phosphatic and potassic fertilizers in subsequent years and an increase in price of urea in February 1997 led to improvement in the NPK ratio and reached a level of 4.3:2.0:1.0 in 2009–10, which was very close to the desired ratio of 4:2:1.

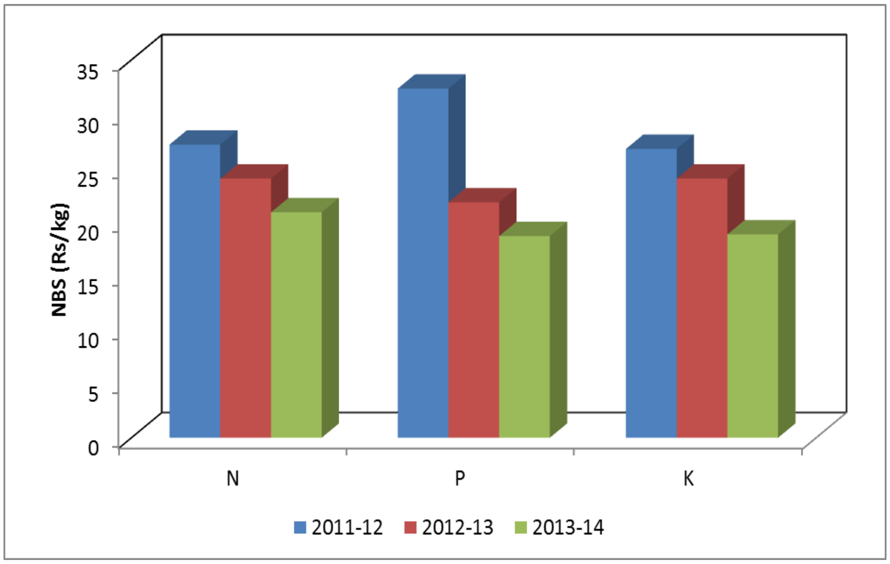
To ensure a balanced use of fertilizers, the government moved toward a Nutrient-Based Subsidy (NBS) regime instead of a product pricing regime. The government introduced an NBS policy for P and K fertilizers on April 1, 2010, and market prices of all fertilizers (except urea) were to be determined by market forces based on a demand-supply situation. The subsidy was also given on sulphur and additional subsidy on micronutrients, namely, zinc and boron. Imports of all P and K fertilizers were placed on Open General License

(OGL) but import of urea remained canalized. Exclusion of urea from NBS and decontrol of P and K fertilizers led to imbalanced application of nitrogen vis-à-vis phosphatic and potassic fertilizers. The retail price of urea remained stagnant (Rs. 4830/ton) between 2002–03 and 2010, increased marginally to Rs. 5310 per ton in April 2010, and recently increased to Rs. 5360. The increase was about 11 percent during the past decade.

On the other hand, prices of decontrolled P and K fertilizers increased significantly due to a reduced level of subsidy, higher world prices of raw materials, and depreciation of Indian currency. The retail price of DAP and MOP remained constant (Rs. 9350/ton for DAP and Rs. 4455/ton for MOP) in the pre-NBS period, from February 2003 to March 2010, but the subsidy kept on changing depending on the cost of production and import parity prices. The average subsidy on DAP varied from Rs. 2134 per ton on indigenous DAP in 2003–04 to Rs. 36488 per ton in 2008–09 (Rs. 53056/ton was the highest, reached in September 2008) in the pre-NBS era. In the case of MOP, the average subsidy varied from Rs. 2822 per ton in 2003–04 to Rs. 22528 per ton in 2008–09 (Rs. 29804/ton was the highest, reached in March 2009).

After the NBS policy was introduced in April 2010, which moved from a "fixed-price-floating subsidy" regime to a "fixed-subsidy-floating price," the prices of phosphatic and potassic fertilizers registered a sharp increase. For example, price of DAP more than doubled between March 2010 and June 2012, from Rs. 9,350 per ton to more than Rs. 24,000 per ton, while the subsidy declined from Rs. 19,763 per ton in 2011–12 to Rs. 14,350 per ton in 2012–13. In the case of MOP, prices witnessed a very sharp increase in the post-NBS period and the price of MOP increased from Rs. 4,455 per ton in March 2010 to about Rs. 17,000 per ton in June 2012, an increase of about 280 percent (Sharma 2013). The average price of urea in India is one of the lowest (US$98/ton) compared with prices in the US (US$503), China (US$348), Pakistan (US$344), and Bangladesh (US$250). The current ratio of international prices of DAP, MOP, and urea is around 1.4:1.1:1; however, the ratio is much distorted (4.5:3.1:1) in India due to policy distortions. The subsidy on decontrolled P and K fertilizers has also witnessed a declining trend during the past three years, and NBS rates for N, P, and K have declined by about 23, 42, and 30 percent, respectively, in 2013–14 compared to 2011–12 (Figure 3.4.1). All these developments have led to worsening of the NPK ratio; it reached a level of 6.7:3.1:1 in 2011–12 (post-NBS period) and became even worse (8.7:3.4:1) in 2012–13.

Figure 3.4.1—Nutrient-Based Subsidy (NBS) for P and K fertilizers in India, 2011–12 to 2013–14



Source: FAI 2012.

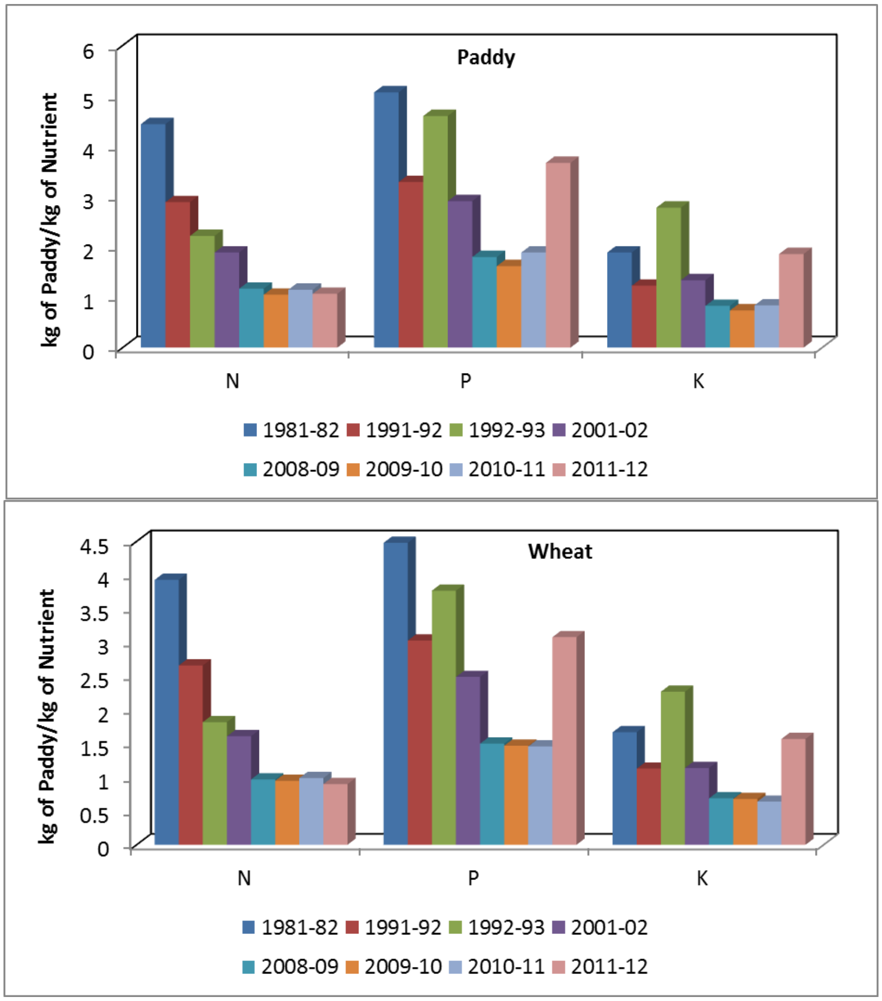
The NPK ratio, which is a measure of balanced use of fertilizer, shows wide interregional and interstate disparities and consumption ratios. While existing variation from the ideal ratio (4:2:1) was nominal in the south (3.9:2.2:1) and eastern regions (4.2:1.8:1), it was very wide in the north (20.4:6.8:1) and western regions (7.3:4.0:1). The state-wise consumption ratio of N and P in relation to K shows that the greatest degree of N:P:K imbalance was seen in Rajasthan (34.9:15.9:1), followed by Haryana (27.2:9.8:1) and Punjab (26.8:8.5:1) in 2011–12. It is also interesting to note that the NPK ratio has deteriorated in almost all states in the post-NBS period, which is a cause for concern.

Economics of Fertilizer Application

Fertilizer is a key component in improving agricultural production and productivity, but fertilizer use efficiency has become much more important in the market-driven economy. Fertilizer use efficiency can be expressed in several ways. Mosier et al. (2004) described four agronomic indices commonly used for nutrient use efficiency, partial factor productivity (kg crop yield per kg nutrient applied), agronomic efficiency (kg crop yield increase per kg nutrient applied), apparent recovery efficiency (kg nutrient taken up per kg nutrient applied), and physiological efficiency (kg yield increase per kg nutrient taken up). Crop removal efficiency (removal of nutrient in harvested crop as percent of nutrient applied) is also commonly used to explain nutrient efficiency. Available data and objectives determine which term best describes nutrient use efficiency. Since data on farm trials are very limited, we used physical returns data (kg of crop required to buy 1 kg of N/P/K) to understand trends in nutrient use efficiency.

Figure 3.4.2 shows the relationship between fertilizer nutrient prices and paddy and wheat prices during the past three decades. The figure shows that farmers had to sell more quantity of paddy rice to buy 1 kg of P than for N and K fertilizers. In 1981–82, farmers had to sell 5.07 kg of paddy to buy 1 kg of P through DAP, 4.44 kg of paddy to buy 1 kg of N through urea, and 1.89 kg of paddy to buy 1 kg of K through MOP. However, with the steady increase in the procurement prices of crops over the years and almost stable fertilizer prices during the 1980s, the profitability increased for all three nutrients. The profitability of P and K use declined significantly after the decontrol of the prices of these fertilizers in 1992, and farmers needed 4.6 kg of paddy to buy 1 kg of P and 2.78 kg to buy K compared with 3.29 kg and 1.23 kg, respectively, in 1991–92. However, after the reintroduction of subsidy on P and K fertilizers as well as a significant increase in output prices, the profitability of fertilizer use increased significantly and farmers needed 1.15 kg of paddy to buy 1 kg of N, 1.89 kg for P, and 0.84 kg for K in 2010–11. After the NBS scheme for P and K fertilizers was implemented in 2010, with unprecedented increases in the prices of these fertilizers, the profitability of P and K use declined significantly (3.67 kg of paddy to buy 1 kg of P and 1.86 kg for 1 kg of K) during 2011–12. An almost similar trend was observed in the case of wheat.

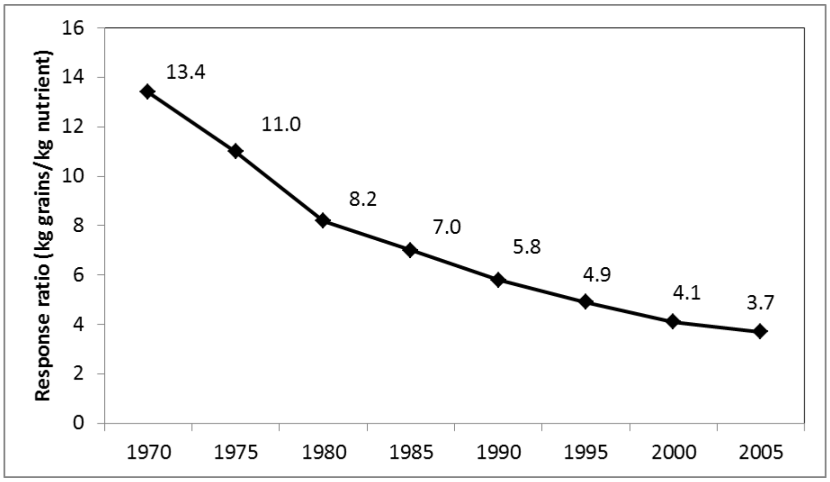
Figure 3.4.2—Economics of application of N (based on urea), P (based on DAP), and K (based on MOP) on paddy and wheat in India, 1981–82 to 2011–12



Source: FAI 2012.

Inadequate application of potassium and phosphates combined with over-application of nitrogen is a serious problem in intensive agricultural production systems. It leads to large N losses, environmental pollution, and low nitrogen use efficiency. Although fertilizer consumption has increased significantly during the past four decades, the corresponding yield increase per unit of nutrient has diminished over the years (Samra and Sharma 2011, Benbi and Brar 2011). The response ratio (kg grain/kg nutrient) in food grain crops in irrigated areas in India has substantially declined. The fertilizer response ratio in irrigated areas in the country declined from 13.4 kg of grain per kg of nutrient in 1970 to 3.7 kg of grain per kg nutrient in 2005 (Figure 3.4.3). While only 54 kg per ha was required to produce around 2 tons/ha in 1970, about 218 kg per ha is being added to sustain the same yield level now. The impaired soil health due to imbalanced fertilizer use, along with less use of organic manure, is mainly responsible for declining fertilizer response and crop productivity. There is a need to improve nutrient use efficiency for both economical and environmental reasons.

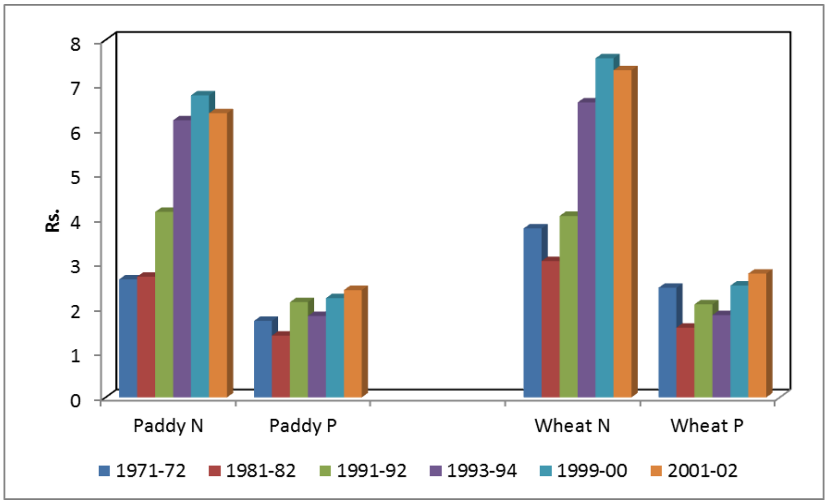
Figure 3.4.3—Fertilizer response of food grain crops in irrigated areas in India



Source: Biswas and Sharma 2008.

Although the nutrient response ratio has declined during the past two to three decades, financial profitability of fertilizer use has improved (Figure 3.4.4). For example, gross financial returns from rice per rupee invested in nitrogen has increased from Rs. 2.64 in 1971–72 to Rs. 6.36 in 2001–02, and from Rs. 1.71 to Rs. 2.40 during the same period in the case of P. An almost similar trend was observed in the case of wheat.

Figure 3.4.4—Returns from paddy and wheat per rupee invested in N (based on urea) and P (based on DAP) in India, 1971–72 to 2001–02

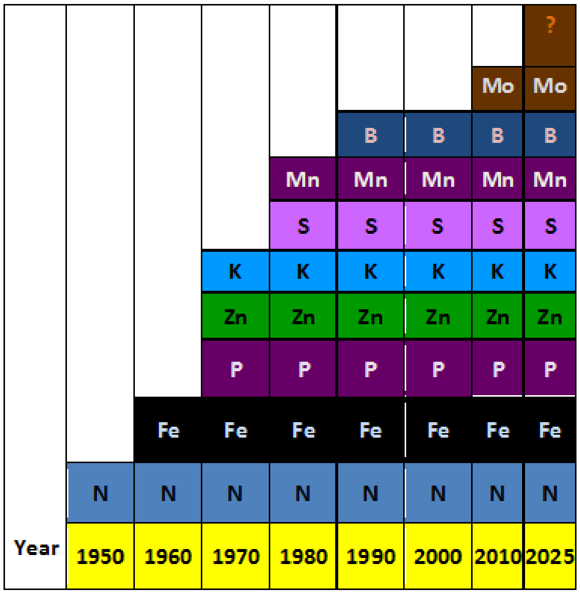


Source: FAI 2003.

Micronutrient Deficiency

The continuous application of higher amounts of N, lower doses of P, and organic manure has led to the emergence of secondary and micronutrient (Zn, B, Fe, Mn, Mo) deficiencies in Indian soils. As a result, the rate of response of crops to applied fertilizers, factor productivity of crops, and nutrient use efficiencies have declined over the years. Deficiencies of essential elements in Indian soils and crops started emerging in the 1950s and as food production increased, the number of elements becoming deficient in soils also increased (Figure 3.5.1).

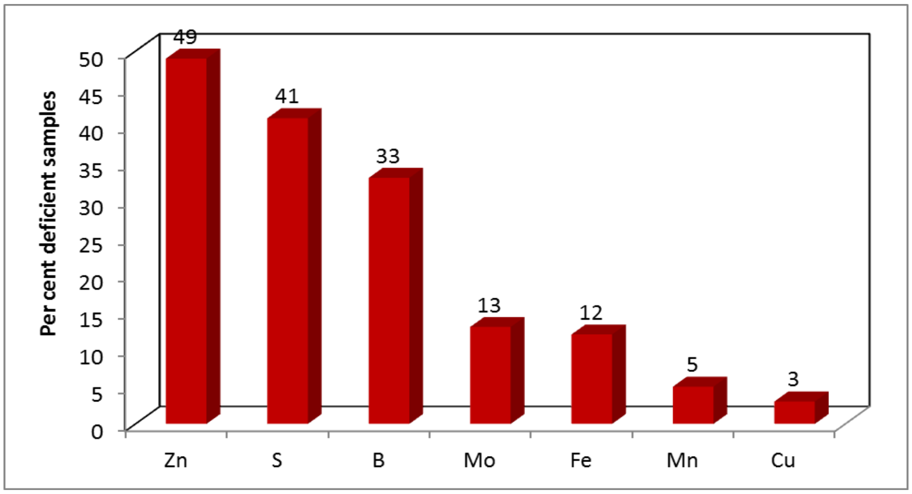
Figure 3.5.1—Emerging nutrient deficiencies in Indian soils



Source: Singh 2008 and Kumar (undated).

Analysis of more than 25 thousand soil samples revealed widespread deficiency of Zn (49 percent) followed by S (41 percent), B (33 percent), Fe (12 percent), Mo (13 percent), Cu (3 percent), and Mn (5 percent) (Figure 3.5.2). While 130 districts were deficient in sulphur in the 1990s, the number has crossed to 240 in recent years. The states having serious deficiency in S include Himachal Pradesh (84 percent), Kerala (81 percent), Rajasthan (65 percent), Andhra Pradesh (56 percent), and Jharkhand (51 percent).

Figure 3.5.2—Extent of secondary and micronutrient deficiency in soils in India



Source: Singh 2008.

Recognizing the importance of secondary nutrients and micronutrients, the government included sulphur under the NBS scheme and an additional Rs. 300 and Rs. 500 per ton for subsidized fertilizer fortified with boron (B) and zinc (Zn), respectively, was provided to encourage their application along with primary nutrients. During 2013–14, the subsidy on nitrogen was reduced to Rs. 20.875 per kg from Rs. 24 per kg in 2012–13. Similarly, the subsidy for phosphate was cut to Rs. 18.679 per kg from Rs. 21.804 per kg, while the subsidy on potash was reduced to Rs. 18.333 per kg from Rs. 24 per kg. However, the subsidy for sulphur was kept unchanged at Rs. 1.677 per kg for the 2013 fiscal year.

STRUCTURE OF THE FERTILIZER INDUSTRY

Fertilizer production in India has grown, from very low levels after independence (38.7 thousand tons in 1951–52) and still low levels in the 1960s and early 1970s (1.24 million tons) to a total production of 16.6 million tons in 2011–12. There are about 145 fertilizer plants in operation in the country, which comprises 29 urea, 19 DAP and NP/NPK complex, 85 SSP, 10 ammonium sulphate (AS), one calcium ammonium nitrate (CAN), and one ammonium chloride unit (FAI 2012). Currently, India produces various kinds of both nitrogenous and phosphatic fertilizers domestically, which include straight nitrogenous fertilizers (urea, ammonium sulphate, ammonium chloride, and calcium ammonium nitrate), straight phosphatic fertilizers (single super phosphate, and NP/NPK complex fertilizers, like diammonium phosphate (DAP). Potassic fertilizers are not manufactured domestically due to lack of commercially viable indigenous reserves of potash, the main raw material.

Fertilizer Capacity and Production Trends

N Fertilizers

At the time of independence in 1947, total fertilizer capacity in the country was about five thousand tons each of N and P_2O_5 with an investment of Rs. 5.9 crore. The capacity of nitrogenous fertilizers remained stagnant during the 1950s and early part of the 1960s. The real growth of the nitrogenous sector started only after the mid-1960s. During the period from 1969 to 1974, ten urea plants based on naphtha as feedstock were set up. The N capacity increased more than fourfold from 470 thousand tons at the end of the third five-year plan to 1,947 thousand tons in the fourth five-year plan due to more focus on agricultural development and the introduction of high-yielding varieties of rice and wheat in the mid-1960s (Table 4.1.1). The capacity creation was much faster during the fourth, fifth, and sixth five-year plans. The introduction of a retention price scheme (RPS) in the late 1970s contributed to this increase in N capacity. However, there has not been much capacity addition and it has remained stagnant at about 12–13 million tons during the past decade due to lack of an encouraging policy framework. Capacity utilization has increased considerably from around 67 percent during the fifth year of the five-year plan to 95.8 percent at the end of the tenth plan and reached 100 percent during 2010–11. Production shares are distributed slightly differently, due to sector-specific capacity utilization and efficiencies. The capacity utilization in N is considerably high in all sectors, but public units have relatively lower capacity utilization (91 percent) compared with the private sector (96 percent) and the cooperative sector (Table 4.1.2).

Table 4.1.1—Installed capacity and capacity utilization of N fertilizer industry in India

('000 tons)

Plan Period	Installed Capacity	Capacity Utilization (percent)	Sectoral Share: Public	Sectoral Share: Private	Sectoral Share: Coop.	Production
Plan I (1951–56)	100	-	-	-	-	76.9
Plan II (1956–61)	121	-	-	-	-	112.0
Plan III (1961–66)	470	-	-	-	-	237.9
Plan IV (1969–74)	1947	-	1140 (51.7)	849 (38.5)	215 (9.8)	1049.9
Plan V (1974–79)	3274	67.0	2843.1 (62.0)	1299.8 (28.3)	443 (9.7)	2173.0
Plan VI (1980–85)	5241	74.0	3690.1 (62.3)	1745.5 (29.5)	488 (8.2)	3917.3
Plan VII (1985–90)	8147	82.8	4339.7 (53.3)	2275.1 (27.9)	1532 (18.8)	6747.4
Plan VIII (1992–97)	9332	93.2	4304.8 (43.2)	3716.8 (37.3)	1935 (19.4)	8593.1
Plan IX (1997–02)	12104	87.9	3870.3 (32.4)	5416.5 (45.3)	2664.6 (22.3)	10689.5
Plan X (2002–07)	12260	95.8	3591.5 (29.3)	5499.7 (44.9)	3169.2 (25.8)	11524.9
November 1, 2012	12947	99.6	3511.4 (27.1)	6012.4 (46.4)	3423.4 (26.5)	12288.1

Source: FAI 2012.

Note: Figures in parentheses show sectoral shares in total installed capacity.

Table 4.1.2—N fertilizer production shares and capacity utilization (percent) by sectors in India

	1981–82		1991–92		2011–12	
	Production Share (percent)	Capacity Utilization	Production Share (percent)	Capacity Utilization	Production Share (percent)	Capacity Utilization
Public	57.7	51.3	51.1	90.0	25.9	90.6
Private	32.7	64.3	30.9	65.9	46.8	95.7
Cooperative	9.6	32.4	18.0	82.1	27.3	98.0

Source: FAI 2012.

For nitrogenous fertilizer capacity, the public sector share has been declining over time. In the early 1970s the public sector accounted for about 62 percent of nitrogenous fertilizer capacity. The private sector held a share of about 28–29 percent and the cooperative sector about 8–9 percent. With policy changes toward greater investment in the private sector induced by the introduction of RPS in 1977, the public sector share started to decline and that of the private and cooperative sectors improved. As of November 2012, the public sector share was 27.1 percent, the private sector share was about 46.4 percent, and the cooperative share was 26.5 percent.

Product Shares

Urea is the largest straight nitrogenous fertilizer in terms of capacity and in 2012 accounted for 78.9 percent of installed capacity, followed by DAP (9.7 percent) and NP/NPK (4.4 percent). Small quantities of other straight nitrogenous fertilizers, such as ammonium sulphate, calcium ammonium nitrate, and ammonium chloride, are also produced, but their share in total N capacity is small (2.4 percent).

Table 4.1.3 shows sector- and product-wise capacity of the Indian fertilizer industry. The private sector share is higher for urea, ammonium sulphate, SSP, and complex fertilizers. There has been no capacity addition between 2001–02 and 2011–12 in almost all products except for some addition in urea and complex fertilizers. This additional capacity has been created mainly in the private and cooperative sectors. There has been a decline in the capacity of ammonium sulphate, ammonium chloride, and SSP fertilizers during the period.

Table 4.1.3—Sector-wise capacity of fertilizer products in India

	Public	Private	Cooperatives	Total
		2001–02		
Urea	6413.8	7932.6	4669.5	19015.9
	(33.7)	(41.7)	(24.6)	(100.0)
Ammonium sulphate	507.9	356.6	0	864.5
	(58.7)	(41.3)	(0)	(100.0)
CAN	800.0	142.5	0	942.5
	(84.9)	(15.1)	(0)	(100.0)
Ammonium chloride	0	171.0	0	171.0
	(0)	(100.0)	(0)	(100.0)
SSP	622.5	7093.1	0	7715.6
	(8.1)	(91.9)	(0)	(100.0)
NP/NPK complex	2854.5	6391.0	1600.0	10845.5
	(26.3)	(58.9)	(14.8)	(100.0)
		2011–12		
Urea	6594.3	9639.8	5971.3	22205.4
	(29.7)	(43.4)	(26.9)	(100.0)
Ammonium sulphate	480.0	142.5	0	622.5
	(77.1)	(22.9)	(0)	(100.0)
CAN	800.0	142.5	0	942.5
	(84.9)	(15.1)	(0)	(100.0)
Ammonium chloride	0	105.0	0	105
	(0)	(100.0)	(0)	(100.0)
SSP	0	8219.7	0	7526.0
	(0)	(100.0)	(0)	(100.0)
NP/NPK complex	2163.5	7613.6	4335.4	14112.5
	(15.3)	(53.9)	(30.7)	(100.0)

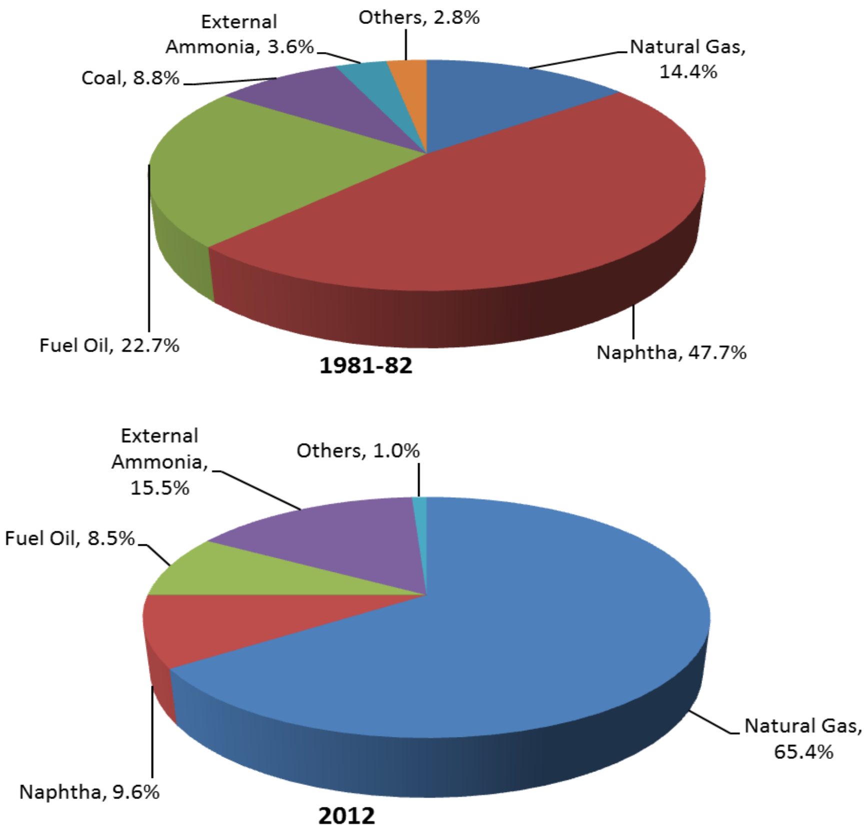
Source: FAI 2012.

Raw Materials

In the early years, the N capacity was based almost entirely on coke oven gas. By the 1970s, naphtha had become the most common feedstock, a position that was taken over by natural gas later on. In the 1970s, due to a shortage of naphtha for the fertilizer sector, coal and fuel oil raw material stock–based plants for producing urea and ammonia were set up. In 1981–82, naphtha was the major feedstock for N fertilizers, accounting for a 47.7 percent share, followed by fuel oil (22.7 percent) and natural gas (14.4 percent) (Figure 4.1.1). However in the late 1970s, with the discovery of gas fields off the west coast and on-shore in the northeastern parts of the country, the feedstock policy was amended in 1975–76 and new capacities were added in the 1980s and 1990s. Most of the capacity addition in the nitrogenous fertilizer sector was in natural gas feedstock–based units due to a new pricing scheme that sought to promote the use of natural gas, the efficient and comparatively cheaper feedstock, for urea production and encouraged naphtha/fuel oil/LSHS–

based units to switch over to using gas as feedstock. Consequently, the share of natural gas increased to 65.4 percent, followed by external ammonia (15.5 percent) and naphtha (9.6 percent) in 2012.

Figure 4.1.1—Feedstock-wise share of N capacity



Source: FAI 2012.

Natural gas is the preferred feedstock for urea production because it is a clean fuel and energy source. However, its availability, even to existing gas-based plants, has been under severe pressure because demand for gas is quite competitive since it serves as a major input to electricity generation and provides the preferred input to many other industrial processes. From the mid-1990s, the supply of gas to the fertilizer sector has decreased (42 percent in 1995–96 to about 26 percent in 2007–08) despite an initial allocation to meet the full requirements (Sharma and Thaker 2010). Consequently, gas-based units started facing a supply shortage and had to meet the shortfall using naphtha. Against the total requirement of 36.33 Million Metric Standard Cubic Meter Per Day (MMSCMD of gas for the existing gas-based fertilizer units, the actual average supply was 27.29 MMSCMD, a shortfall of about 24.8 percent (GoI 2012a). The nitrogenous fertilizer sector has suffered during the past decade because there has not been any addition to its capacity.

At present, the fertilizer sector gets gas under the priority sector at a price decided under the Administrative Price Mechanism (APM) of the government. However, there is a pressure to give equal priority to the power sector in gas allocation as well as increase gas prices. Currently, APM and New Exploration Licensing Policy (NELP) gas are priced at US$4.2 per mmBtu, with gas from pre-NELP blocks costing between US$3.5 and US$5.73 per mmBtu. The basic price of imported gas is around US$14.17 per mmBtu. As per government estimates, India's fertilizer sector requires 62 MMSCMD and is expected to reach 113 MMSCMD in 2014–15. However, the Cabinet Committee on Economic Affairs (CCEA) has approved the Rangarajan Committee formula, which would lead to an increase in domestic gas prices to US$8.4/mmbtu for 2014–15 and to over US$10/mmbtu from 2015–16 onward. The move will have a significant impact on the domestic fertilizer industry.

The government has also announced a New Investment Policy (NIP) for urea. Under the New Investment Policy 2012, in order to facilitate fresh investments in the urea sector, a system of a floor price and a ceiling price for the amount payable to urea units calculated based on the delivered gas price (inclusive of charges and taxes) to respective urea units was introduced. The floor and ceiling price of each urea unit is operative with respect to the computed Import Parity Price (IPP). The IPP defined for urea under the investment policy of 2008 is the average C&F price without any applicable custom duties and handling and bagging charges at the port. If the computed IPP (payable) is between the floor and the ceiling price for that gas cost, it is the IPP (payable) that will be used. If the IPP (payable) is above or below the ceiling or the floor, respectively, it is the ceiling or floor price that will be acceptable as the case may be. Table 4.1.4 shows the base price for gas, the floor and ceiling prices for urea, and the increase in floor price for an increase in gas price beyond USD$14/mmbtu for different categories of investment.

Table 4.1.4: New Investment Policy for the urea sector

Particulars	Greenfield/ Revival of Closed Units	Brownfield/ Substantial Expansion Projects	Revamp Projects
Delivered gas price (US$/mmbtu)	6.50	6.50	7.50
Floor price of urea (US$/MT)	305	285	245
Ceiling price of urea (US$/MT)	335	310	255
Recognition at a percent of IPP (C&F) (percent)	95	90	85
Revision in floor and ceiling price of urea (US$/MT) for every US$0.1/mmbtu revision in delivered gas price up to the gas price of US$14/mmbtu	2.00	2.00	2.20
Revision in floor price of urea (US$/MT) for every revision of US$0.1/mmbtu in gas price exceeding US$14/mmbtu	2.00	2.00	2.20

Source: GoI 2013b.

P Fertilizers

Capacity

The capacity of phosphatic fertilizers in the country remained stagnant during the 1950s and early part of the 1960s. However, the capacity more than doubled from 274 thousand tons at the end of the third five-year plan to 581 thousand tons in the fourth five-year plan (Table 4.1.5). The capacity creation was much faster during the third, fourth, and fifth five-year plans. The new capacity addition during the eighth five-year plan was much less (from 2,716 thousand tons at the end of the seventh plan to 2,948 thousand tons at the end of the eighth plan). The main reason for this was decontrol of phosphatic fertilizers in 1992. Investment in the P sector picked up during the ninth plan but again became stagnant during the tenth plan. The total capacity addition during the tenth plan was 422,000 tons versus 2,301 thousand tons during the ninth plan. As of November 1, 2012, installed capacity of phosphate (P) nutrients was 6,242.9 thousand tons and production was 4,363.7 thousand tons.

Table 4.1.5—Installed capacity and capacity utilization ('000 ton nutrient) of P_2O_5 fertilizer industry in India

Period	Installed Capacity	Capacity Utilization	Sectoral Share Public	Sectoral Share Private	Sectoral Share Coop.	Production
Plan I (1951–56)	106	-	-	-	-	12.4
Plan II (1956–61)	128	-	-	-	-	53.7
Plan III (1961–66)	274	-	-	-	-	118.8
Plan IV (1969–74)	581	-	192 (27.1)	382 (54.0)	134 (18.9)	324.5
Plan V (1974–79)	1117	71	690.4 (51.8)	515.9 (38.7)	127 (9.5)	778.0
Plan VI (1980–85)	1722	86	657.6 (37.1)	856.1 (48.3)	260 (14.7)	1317.9
Plan VII (1985–90)	2716	67.2	814 (29.6)	1628.4 (59.2)	309 (11.2)	1795.3
1991–92	2770.5	94.0	798.6 (28.8)	1662.9 (60.0)	309 (11.2)	2561.6
1992–93	2818.7	83.3	791.4 (28.1)	1718.3 (61.0)	309 (10.9)	2320.8
1993–94	2824.4	68.5	791.5 (28.1)	1723.9 (61.0)	309 (10.9)	1874.3
Plan VIII (1992–97)	2948	87.5	825.3 (26.1)	2030.5 (64.2)	309 (9.8)	2578.6
Plan IX (1997–02)	5249	75.5	825.1 (16.2)	3697.2 (72.7)	561 (11.0)	3837.3
Plan X (2002–07)	5671	79.6	386.7 (6.8)	3602.1 (63.2)	1712.8 (30.0)	4440.0
2011–12	6242.9	69.9	386.3	4143.8	1712.8	4363.7

	(6.2)	(66.4)	(27.4)		

Source: FAI 2012.

Note: Figures in brackets indicate sectoral share in installed capacity.

Capacity utilization of phosphatic fertilizers in the country has increased considerably, from around 71 percent during the fifth five-year plan to 86 percent at the end of the sixth plan. However, capacity utilization witnessed some decline during the seventh five-year plan. The long-term trend of a progressive step-up in capacity utilization suffered a setback in the wake of the partial decontrol of phosphatic fertilizers in 1992–93, and capacity utilization reached a level of 68.5 percent in 1993–94. However, with the introduction of a concession scheme, it was revived in 1994–95 and reinforced in 1995–96, when the capacity utilization attained the level of 90.7 percent. The capacity utilization was at an all-time high in 1997–98, at 100 percent, but witnessed a declining trend since 2007–08 and was about 70 percent in 2011–12. Private and cooperative units have higher capacity utilization compared with the public sector, but those declined between 1991 and 2012 (Table 4.1.6).

Table 4.1.6—P fertilizer production, capacity, and capacity utilization (percent) by sector in India

(Production and capacity in '000 tons nutrient)

Sector	1991–92			2011–12		
	Production	Capacity	Capacity Utilization (percent)	Production	Capacity	Capacity Utilization (percent)
Public	730.2 (28.5)	791.4 (28.1)	92.3	237.5 (5.4)	386.3 (6.2)	61.5
Private	1481.9 (57.8)	1718.3 (61.0)	86.2	2796.4 (64.1)	4143.8 (66.4)	67.5
Cooperative	349.9 (13.7)	309 (11.0)	113.2	1329.8 (30.5)	1712.8 (27.4)	77.6
Total	2562 (100.0)	2818.7 (100.0)	90.9	4363.7 (100.0)	6242.9 (100.0)	69.9

Source: FAI 2012.

Note: Figures in brackets indicate sectoral share in installed capacity and production.

Over the years, the public sector has lost its share to the private and cooperative sectors. About two-thirds of phosphatic fertilizer capacity is in the private sector. In 2012, 66.4 percent (61 percent in 1991–92) of installed capacity was held by private-sector units. The cooperative sector accounted for 27.4 percent (11.0 percent in 1991–92) and the public sector for only 6.2 percent (28.1 percent in 1991–92). The public sector has lost its share in production while cooperatives have increased their share significantly during the past two decades. Public units have lower capacity utilization and their share in production is only 5.4 percent, while the share of the private and cooperative sectors in phosphatic fertilizer production is 64.1 and 30.5 percent, respectively. There has been a substantial reduction in capacity utilization in all sectors between 1991–92 and 2012.

Products

DAP constituted about 51.6 percent of the total P_2O_5 capacity of about 7 million tons in 2012. SSP is the only straight phosphatic fertilizer manufactured in India, and it constituted about 21 percent of the total phosphate capacity. The remaining 27 percent of phosphate capacity was constituted by NP/NPK fertilizers (other than DAP).

Raw Materials

The raw materials and intermediates for phosphatic fertilizers are rock phosphate, sulphur, ammonia, phosphoric acid, and sulphuric acid. India meets a large part of its requirements in the phosphatic sector through imports of phosphatic raw materials/intermediates, such as rock phosphate and phosphoric acid. India imported 7.5 million tons of rock phosphate, 2 million tons of phosphoric acid, and 1.8 million tons of sulphur during 2011–12. In addition, India imports significant quantities of finished products, such as DAP fertilizer. India's share in the global trade of rock phosphate is about 21.3 percent, because the indigenous production is extremely limited. India's indigenous production of phosphoric acid is also very low and the country imports more than half of the global trade in phosphoric acid and uses 11–12 percent of world consumption.

Sulphur is the main feedstock for phosphatic fertilizers and accounts for nearly half of the total capacity. The share of sulphur has remained almost stable during the past two and half decades, but the share of imported phosphoric acid, which is the most important feedstock, has increased significantly (from 26.9 percent in 1981–82 to 54 percent in 2011–12). The share of other raw materials/intermediates has declined significantly. The share of imports in total feedstock supply for phosphatic fertilizers is quite high. Therefore, a high dependence on imports of raw materials exposes the Indian phosphatic industry to external factors such as high variability in prices.

Trends in Fertilizer Supply

Fertilizer Imports

The fertilizer consumption in India has generally exceeded the domestic production in both nitrogenous and phosphatic fertilizers except for a few years. The entire requirement of potassic fertilizers is met through imports because India does not have commercially viable sources of potash. India mainly imports urea, DAP, and MOP. During the 1950s and 1960s, about two-thirds of the domestic requirement of N fertilizers was met through imports. Total imports of N fertilizers increased from 97 thousand tons in the 1950s to 482.4 thousand tons in the 1960s and 923.2 thousand tons in the 1970s (Table 4.2.1). The level of P imports was very low in the 1950s, and it increased significantly during the 1960s and 1970s. With the introduction of high-yielding varieties of wheat and rice in the mid-1960s, fertilizer imports increased significantly in 1966–67 and thereafter. Fertilizer imports increased dramatically in 1977–78 and 1978–79, in 1984–85, and again in 1988–89 and 1989–90. However, during the 1990s imports were at low levels except in 1995–96 and 1997–98. There appears to be a cycle of about eight to nine years when imports jump significantly.

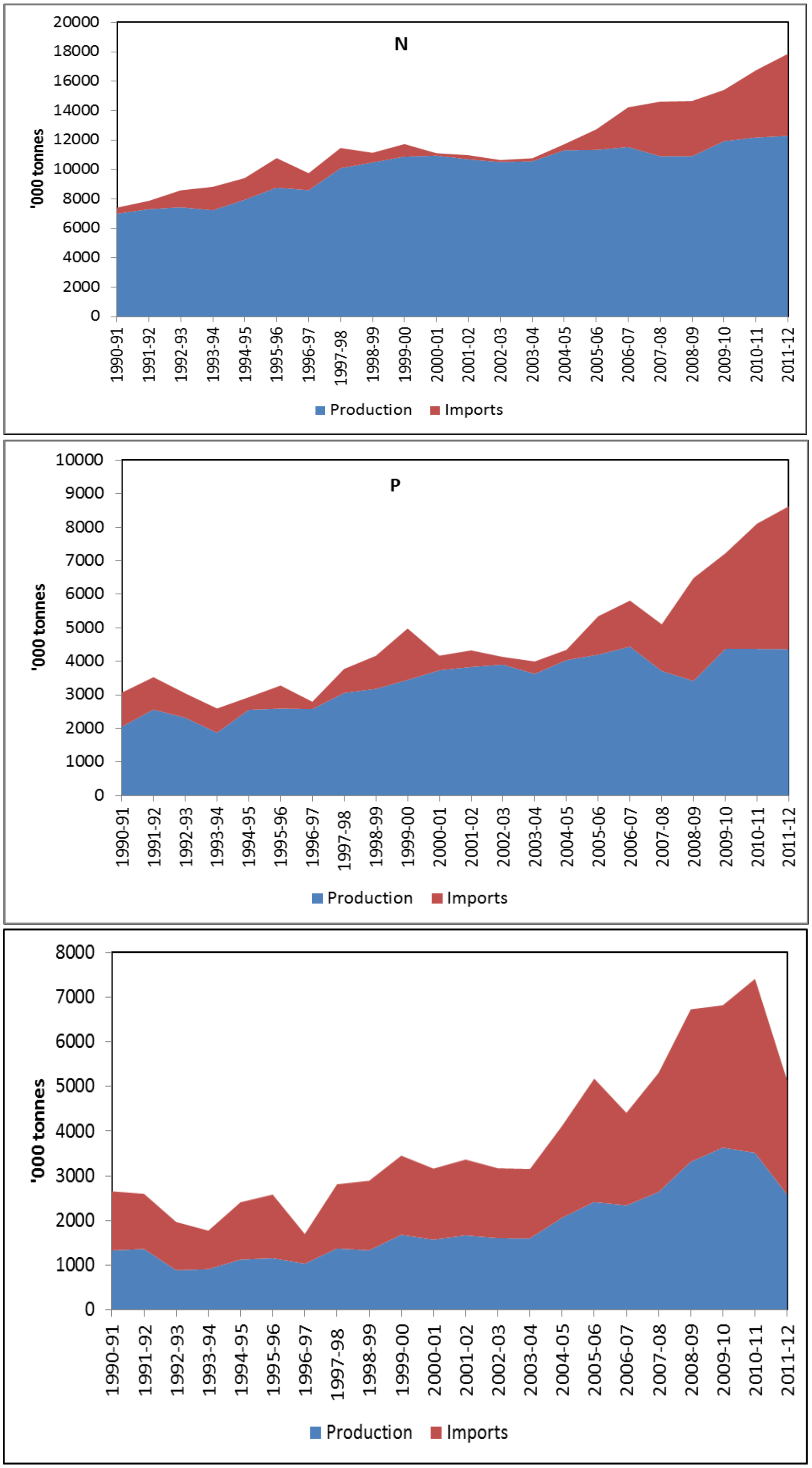
Table 4.2.1—Growth and share of imports of fertilizers in total production and consumption in India, 1951–52 to 2011–12

Period	N	P_2O_5	K_2O	Total
		Total Imports (‘000 tons)		
1950s	97.0	9.8	14.2	113.1
1960s	482.4	90.0	112.7	676.1
1970s	923.2	243.2	437.1	1603.5
1980s	819.5	511.3	890.1	2220.8
1990s	1099.9	736.9	1291.6	3128.4
2000s	2384.4	1748.1	2495.4	6627.9
		Share (percent) of imports in total consumption		
1950s	64.4	-	-	61.8
1960s	67.6	27.0	113.2	64.0
1970s	36.6	35.3	102.3	43.8
1980s	15.1	22.2	96.8	25.3
1990s	11.3	21.0	103.9	21.6
2000s	15.7	26.5	100.2	28.0
		Share (percent) of imports in total production		
1950s	117.1	16.6	-	104.1
1960s	137.9	43.5	-	130.7
1970s	58.0	55.7	-	78.3
1980s	19.4	32.6	-	36.3
1990s	12.9	26.8	-	27.2
2000s	20.5	42.8	-	55.7

Source: FAI 2012.

During the past decade, due to low/no addition in domestic capacity coupled with a rise in demand for fertilizers, imports have increased significantly in the 2000s (Figure 4.2.1). India imported 12.4 million tons of NPK fertilizer nutrients in 2011–12 compare with less than 1 million tons in the early 2000s. The growth of imports was rather slow in the 1980s and 1990s and accelerated in the 2000s. Fertilizer imports increased significantly in 2005–06 and the trend continued thereafter. Along with the quantity, the value of imported fertilizer nutrients also increased significantly during the past few years due to increases in international prices of feedstocks and the cost of imported fertilizers.

Figure 4.2.1—Trends in production, consumption, and imports of N, P, and K fertilizers in India, 1990–91 to 2011–12



Source: FAI 2012.

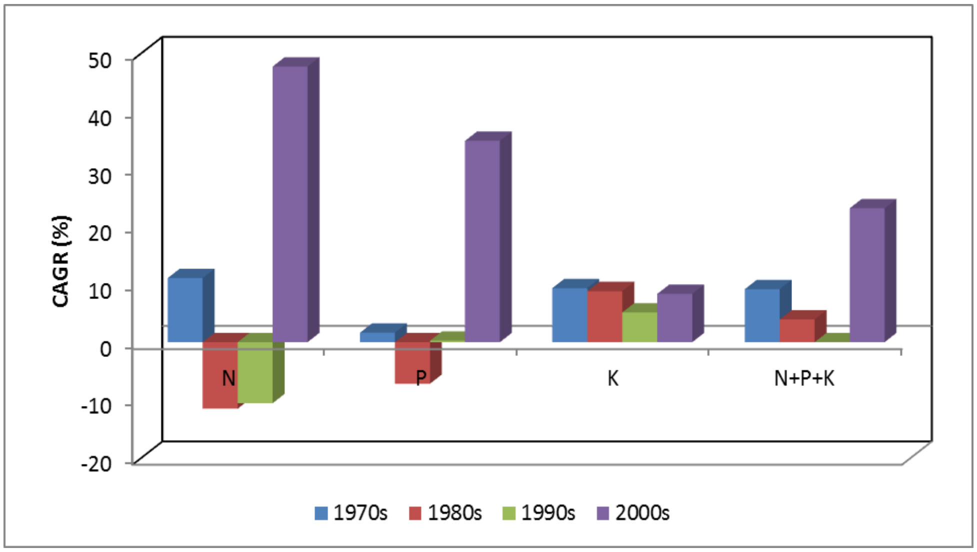
The share of imports in total fertilizer consumption declined from more than 60 percent in the 1960s to 43.8 percent in the 1970s, then further to about 25.3 percent in the 1980s and reached a level of 21.6 percent in the 1990s. However, imports increased significantly during the past decade and import share in total consumption increased to about 28 percent. Almost similar trends were observed for nitrogenous and phosphatic fertilizers. However, in terms of volume of imports, N fertilizer imports declined during the 1980s, marginally increased during the 1990s, and dramatically increased in the 2000s, while phosphatic fertilizers imports have increased consistently over time.

Growth Rates in Fertilizer Imports

Figure 4.2.2 shows the growth rates in fertilizer imports during the period 1971–72 to 2011–12. Fertilizer imports grew at an annual compound rate of 9.2 percent during the 1970s and 3.9 percent the following decade. During the 1990s, the growth rate in fertilizer imports was almost zero due to a negative growth rate in N fertilizer imports. However, fertilizer imports grew at an annual compound rate of about 23 percent during the period 2001–02 to 2011–12. Nutrient-wise, import trends show a different pattern. After the introduction of high-yielding varieties in the mid-1960s, demand for N fertilizers increased and so India's imports grew at an annual compound rate of more than 11 percent. However, due to domestic capacity additions during the 1970s (because of the introduction of RPS), domestic production increased significantly and thus reduced dependence on imports; as a result, N fertilizer imports recorded negative growth rates during the 1980s and 1990s. However, due to uncertainty in the N fertilizer sector policy environment during the past decade, there was no capacity addition and therefore imports grew at a rate of 47.4 percent.

In the case of P fertilizers, imports grew at an annual rate of 1.6 percent in the 1970s, decelerated to -7.2 percent in the 1980s, and rose to 0.2 percent in the 1990s. However, in the 2000s, P fertilizer imports increased at a rate of 34.8 percent. In the case of K fertilizers, because all demand is met through imports, imports have registered a steady growth rate of about 8–9 percent during the past four decades, with the exception of the 1990s, when imports increased at a rate of 5.2 percent. This deceleration in the growth of imports was mainly because of slow growth/reduction in consumption of K fertilizers due to decontrol of K fertilizers in 1992–93 and subsequent price increases.

Figure 4.2.2—Rate of growth (percent) in imports of N, P, and K fertilizers in India, 1970s to 2000s

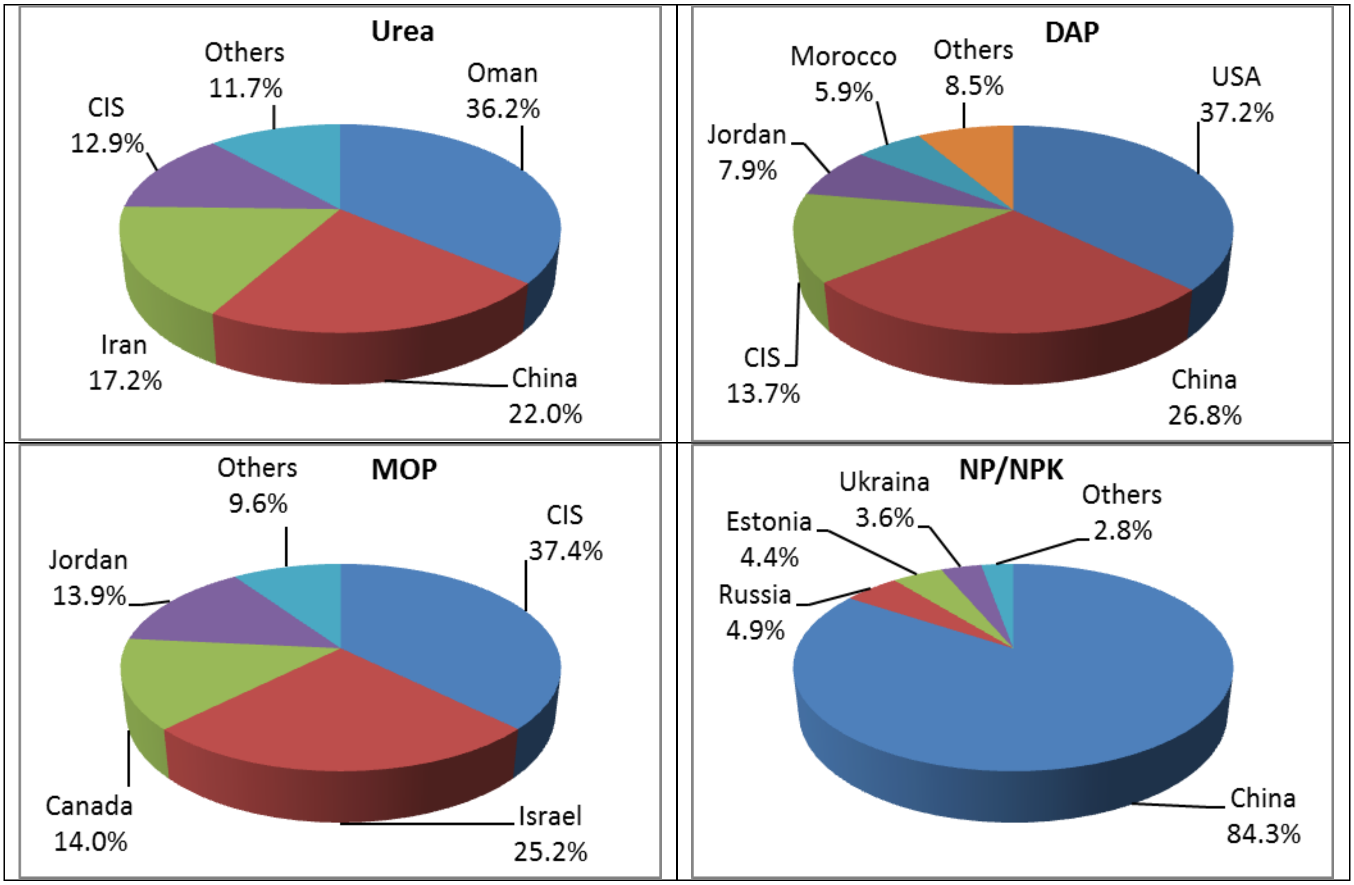


Source: FAI 2012.

Fertilizer Product Imports

The main fertilizer products imported in India are urea (7.8 million tons), DAP (6.9 million tons), and MOP (about 4 million tons). Urea imports have increased significantly during the last six or seven years. This increase in imports and rising international prices of urea and other fertilizer products have led to a substantial increase in fertilizer subsidies in the country. Oman (36.2% percent, China (22 percent), Iran (17.2 percent), and Commonwealth of Independent States (CIS) (12.9 percent) were major exporters of urea to India during TE2011–12 (Figure 4.2.3).

Figure 4.2.3—Imports of urea, DAP, MOP, and complex fertilizers from major importing countries during TE2011–12



Source: FAI 2012.

Note: CIS = Commonwealth of International States.

Unlike the nitrogenous fertilizers, the imports constituted a small proportion of the total supply of phosphatic fertilizers in India until the mid-1960s. However, with the introduction of HYVs of wheat and rice in the mid-1960s, the imports of P_2O_5 increased. In the case of phosphatic fertilizers, domestic raw material shortage hinders the achievement of self-sufficiency in the country. The phosphatic fertilizers are mostly imported in the form of complex fertilizers, and among complex fertilizers, DAP occupies an important place (about 95 percent of total P imports). USA (37.2 percent), China (26.8 percent), CIS (13.7 percent), and Jordan (7.9 percent) account for nearly 85 percent of total DAP exports to India.

MOP is the single largest potassic fertilizer imported in the country. A small quantity of sulphate of potash (SOP) is also imported for meeting crop-specific requirements. Imported MOP is used partly for direct consumption and partly for manufacture of complex fertilizers. India is an important player in the world markets and is among the top importers of potassic fertilizers. CIS (37.4 percent), Israel (25.2 percent), and Canada (14 percent) are major exporters of MOP to India. In the case of complex fertilizers, the share of China is more than 84 percent.

Imports of nitrogenous fertilizers are canalized through state trading enterprises, while imports of P and K fertilizers and raw materials/intermediates have been decontrolled and placed under Open General License (OGL) and anyone (public/private/cooperatives) can import these fertilizers. Import of urea is done to bridge the gap between the indigenous availability and the requirement through designated agencies like Metals and Minerals Trading Corporation, Ltd. (MMTC), State Trading Corporation (STC), and Indian Potash, Ltd. (IPL).

Role of the State in Improving Fertilizer Supply

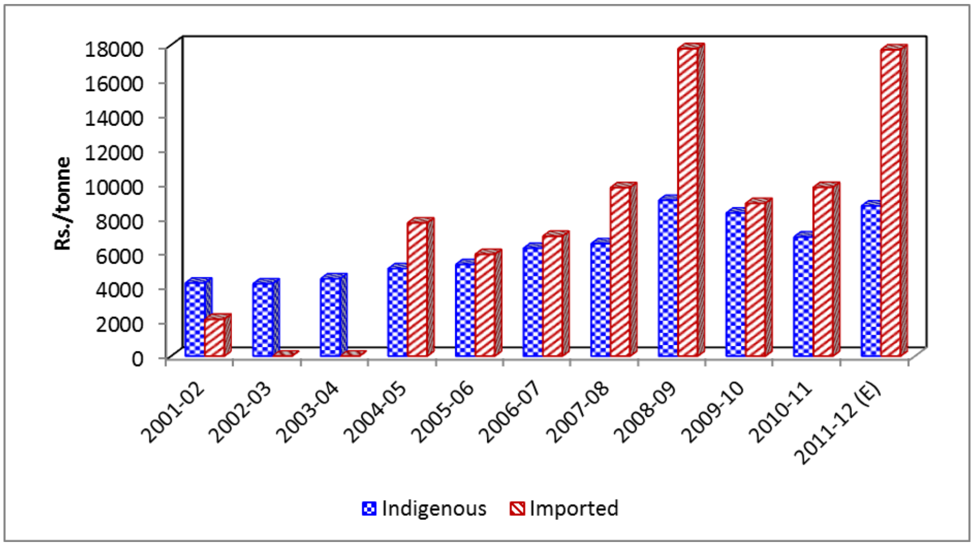
In order to ensure adequate supply of fertilizers in all regions/areas of the country, the distribution and movement of fertilizers is controlled under the Essential Commodities Act 1955 (ECA) to bridge the supplies in underserved areas. Urea is under partial movement and distribution control of the government, and 50 percent of the indigenous production of urea is regulated by issue of movement orders to the manufacturers for dispatch to the states on a month-to-month basis, keeping in view the assessed requirement. In addition, 20 percent decontrolled fertilizers produced/imported in India are under movement controls.

The government provides a subsidy to fertilizer companies for transportation of fertilizers on the basis of three components. (1) "Primary movement" is the movement of fertilizers from port or plant by rail to various rake points, and the cost is reimbursed on the basis of railway receipts; (2) "secondary movement" is transportation of fertilizers from the railway rake points to the district headquarters, which the government scrapped on April 1, 2012; and (3) the government provides freight subsidy on direct road movement of P and K fertilizers (except single super phosphate) from plant or port to district headquarters as per the actual distance up to a maximum of 500 km.

Role of Trade and Investment

Currently, more than 40 percent (up from about 13 percent in the early 2000s) of total fertilizer nutrients used in India are sourced through imports. The capacity to produce more fertilizer in the country is currently limited due to availability and/or cost of raw materials/feedstocks, and installed capacity has remained stagnant during the past decade. The recent increases in fertilizer prices due to rising demand and rising feedstock/raw material costs has led to renewed discussions about the role of imports versus domestic production and the role of fertilizer subsidies and government-controlled imports and distribution, usually through state enterprises. Figure 4.3.1 shows the average subsidy on imported urea and domestic urea during the past decade.

Figure 4.3.1—Trends in average subsidy (Rs./ton) on domestic and imported urea in India[1], 2001–02 to 2011–12



Source: FAI 2012, GoI 2013a, and PIB 2012.

Some studies have led to a common perception that domestic industry, particularly urea, has been overprotected and less efficient than imports. For example, Gulati (1990), Gulati and Sharma (1995), and Gulati and Narayanan (2003) calculated the implicit fertilizer subsidy accruing to industry/farmers and argued that about half of the subsidy goes to the fertilizer industry. Panagariya (2001) wrote an article on fertilizer subsidy in the *Economic Times* on February 28, 2001, in which he stated that the bulk of the fertilizer subsidy rewards the gross inefficiency of urea manufacturers, and thus all subsidies to fertilizer manufacturers must go and imports opened up. However, these arguments were based on the fact that international price of urea was very low and varied from US$70 to US$140 per ton between January 1998 and February 2001 and assumed that the import price of urea will remain at about US$150 per ton.

Empirical evidence clearly shows that the perception of the domestic urea industry being overprotected and less efficient than imports does not hold true, as is evident from Figure 4.3.1, which shows that the average subsidy per ton of imported urea is much higher than indigenously produced urea. The average subsidy on imported urea varied from about Rs. 2136 per ton in 2001–02 to about Rs. 18000 per ton in 2008–09 and 2011–12. In contrast, the subsidy on domestic urea varied from Rs. 4183 per ton in 2002–03 to about Rs. 9020 per ton in 2008–09, much lower than for imported urea. The average subsidy on domestic urea was higher (Rs. 4233/ton) than imported urea (Rs. 2136/ton) in only one year (2001–02) during the past decade whenever India imported urea. Because domestic urea is cheaper and more competitive vis-à-vis imported urea, the government must encourage domestic production, which will insulate Indian farmers from highly unpredictable, cartelized, and volatile world fertilizer markets.

---

[1] Estimated from urea production and import figures from Fertilizer Statistics 2001–02 to 2011–12 and subsidy data on indigenous and imported urea from Expenditure Budget, Vol. I, Ministry of Finance, Government of India.

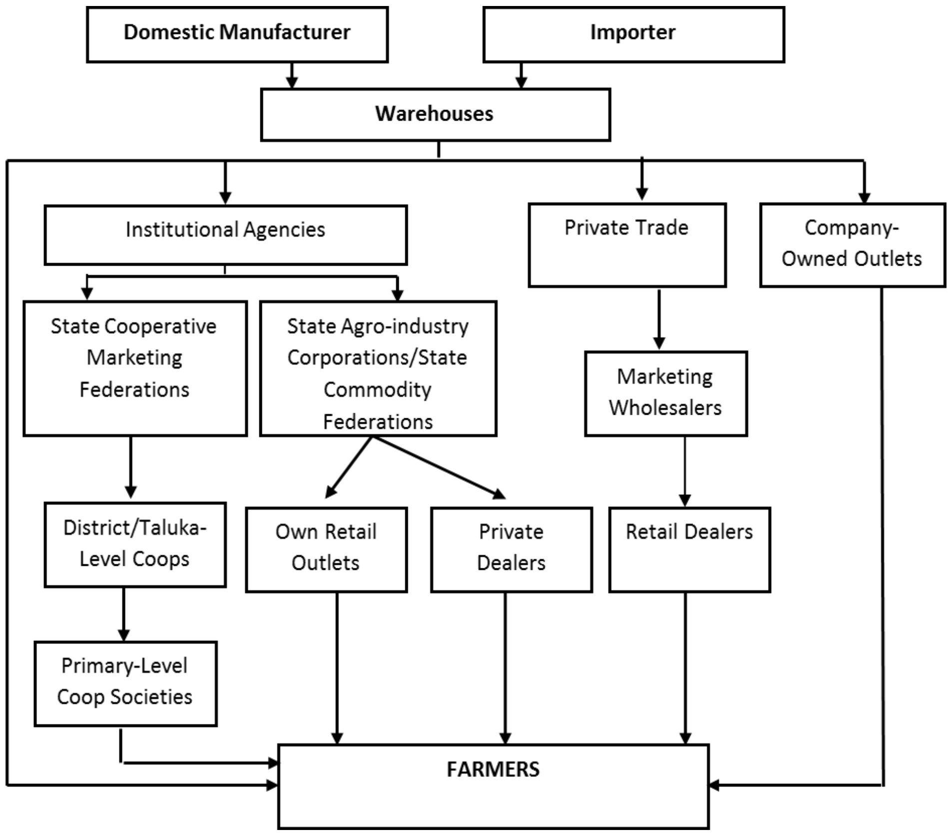
Keeping in view the availability of fertilizers in the country and the subsidy paid thereon, the government has put the export of all fertilizers in the restrictive category in order to discourage exports and smuggling. However, large quantities of subsidized fertilizers, particularly urea, are exported illegally to neighboring countries like Nepal, Bangladesh, and Myanmar, where prices are much lower than Indian prices. For example, the price of urea in India is INR 5360 per ton, while it costs about INR 28800 per ton in Nepal (1 INR = 1.6 NPR). Some estimates show that 60–65 percent of fertilizers supplied in Nepal are through the channels of informal imports, mainly from India.

SUPPLY-SIDE ISSUES

Fertilizer Marketing and Distribution Channels

Fertilizers are produced at about 140 locations in the country and distributed to farmers scattered throughout the length and breadth of the country in more than 600,000 villages by a network made up of the private and cooperative sectors and other institutional agencies. Some quantities are also sold through the manufacturers' own outlets. Figure 5.1.1 shows the present fertilizer distribution system in India.

Figure 5.1.1—Fertilizer distribution channels in India



Source: Based on discussions with industry.

Private trade accounts for about 65 percent of the total fertilizer distributed in the country, followed by institutional agencies, including cooperatives, at 35 percent; marginal quantities are distributed through manufacturers' own outlets. Among institutional agencies, cooperatives are the main distribution organizations. The cooperative marketing structure varies from state to state (two to four tiers). The total number of fertilizer sale points in India is 269,175, out of which about 62,637 (23 percent) are cooperative and other institutional agency sale points; private trade controls the remaining 206,538 (77 percent). The number of fertilizer sale points increased up to the mid-2000s (from 66,576 in 1969 to 292,692 in 2006) and then declined to 258,718 in in 2008. The share of institutional agencies also declined, while the private-sector share increased over the years. On average, one fertilizer sale point covers more than two villages. The northeastern states—Bihar, Orissa, Himachal Pradesh, Madhya Pradesh, Jharkhand, Chhattisgarh, and Rajasthan—have a very thin spread of sale points. Distribution networks in these states require intensification. Railways are the major share of transportation. During 2011–12, railways moved about 75 percent of the fertilizers produced and/or imported in the country; about 25 percent was moved through road transport.

Transportation costs are a major component in the marketing cost of fertilizers, and over the years its share in price has increased. The steep increase in marketing costs is mainly due to increases in fuel prices, cost of manual laborers, cost of packing and packaging materials, and services like transport, handling, and storage. Several studies show that the transportation costs assume a major component in the marketing cost of fertilizers, followed by packing and storage (Meane and Weddershoven 1984, Ramarao 1988, FAO 2005, Patra 2009, and Singh et al. 2011). Table 5.1.1 summarizes results from several empirical studies from India showing that the transportation cost of fertilizer is a major component of marketing cost. Figure 5.1.2 shows the current system of fertilizer transportation. In the case of urea, which is under government control, private agencies get a net distribution margin of Rs. 230 per ton and for institutional agencies the distribution margin is Rs. 250 per ton.

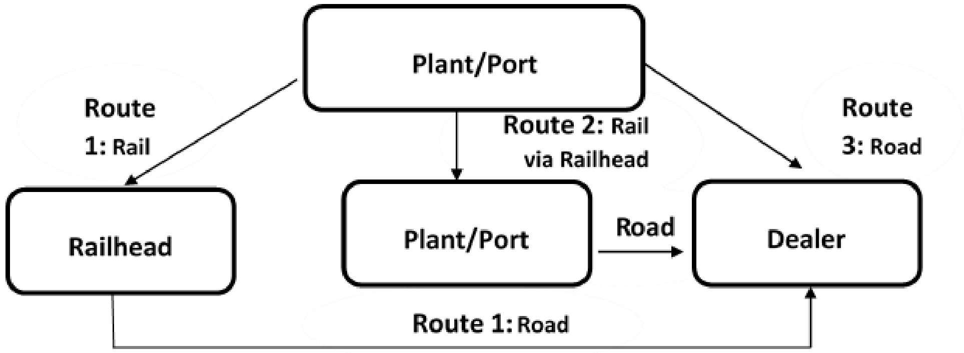
Table 5.1.1—Marketing costs (percent) of fertilizers in India

Particulars	Meane & Weddershoven (1984)	Ramarao (1988)	FAO (2005)	Patra (2009)	Singh et. al. (2011)
Transportation	37.3	46	55	70–75	86#
Packaging materials		25			
Bagging	20.2				
Storage/warehousing	7.3	13	10*	3–4	
Handling charges	5.2			5–7	
Physical losses	5.0				1@
Capital cost	5.3				
Administration		11	10		
Dealer/distribution margin	5.2		18		
Financial charges		5			
Selling cost			3		10
Advertisement and promotion					3
Other costs	15.5		4**		

* Storage and handling charges; ** inventory carrying costs; # logistics costs like freight, handling, warehousing, and inventory management; @ losses including transit shortages and standardization losses.

Source: Kumar 2011.

Figure 5.1.2—Logistics cost estimates for fertilizer movement in India



	Cost (Rs/ton)
Primary transport by road under recovery	500
Railhead handling	100
Storage at railhead buffer/month	50
Secondary transport (average)	500
Route 1	600
Route 2	650
Route 3	500

Source: Ravi Prasad 2013.

Quality of Fertilizers

The government of India has declared fertilizer to be an essential commodity under the Essential Commodities Act 1955 (ECA) and has notified Fertilizer Control Order 1985 (FCO) under this act. Accordingly, it is the responsibility of the state governments to ensure the supply of quality fertilizer from manufacturers/importers (GoI 2011). As per the provision of the FCO, the fertilizers, which meet the standard of quality laid down in the order, can only be sold to the farmers. There are 71 fertilizer-testing laboratories, including four government laboratories, with an annual analyzing capacity of 134,000 samples. The government laboratories invariably check the quality of imported fertilizers.

The state governments are adequately empowered to draw samples of fertilizer anywhere in the country and take appropriate action against sellers of nonstandard fertilizer. The penal provision includes prosecution of offenders and, if convicted, up to seven years of imprisonment, in addition to cancellation of the authorization certificate and other administrative action (GoI 2011). During 2006–07, 2007–08, and 2008–09, the percentage of fertilizer samples declared nonstandard were 6.0 percent, 6.2 percent, and 5.5 percent, respectively. Payment of concession for P and K fertilizers and for single super phosphate (SSP) is made by the department responsible for quality certification in the state. Further, SSP units are required to produce monthly "quality certificates" issued by the state governments in which the units are located. The units are required to have a well-equipped laboratory to test SSP samples. SSP units are also required to bear a "quality certified" stamp on each bag released in the market.

Key Constraints Affecting Fertilizer Supply

The major deficiencies that constrained sustained rapid growth in fertilizer production also constrain fertilizer supply: shortage of raw materials, intermediates, and feedstocks such as natural gas for urea production and rock phosphate and phosphoric acid for phosphates; lack of a consistent long-term policy; constraints on working capital for the distribution channels; and physical infrastructure problems in some regions of the country. Due to constraints in raw material availability, the share of indigenous production of fertilizers has been decreasing, while imports have risen.

It is more energy efficient and cheaper to produce urea using natural gas as feedstock. However, due to declining supplies of natural gas, even the existing gas-based units may face shortages. Although the fertilizer sector has been treated as a priority for the allocation of low Administrative Price Mechanism (APM) gas, the proportion of gas for the fertilizer sector has been declining (Sharma 2013). At present, the availability of gas to urea units is around 41 MMSCMD compared with their requirement of 43.14 MMSCMD (GoI 2012a). The new investment policy for the urea sector based on the Import Price Parity benchmark announced in 2008 was expected to attract much-required investment, but no major investment has been made. Suitable amendments to the new investment policy are required to create a conducive, incentive-based environment for new investments in urea sector.

In the case of phosphates, the paucity of domestic raw material constrains the attainment of self-sufficiency. Indigenous rock phosphate (the main raw material) supplies meet only 5–10 percent of the total requirement of P_2O_5. At present, most of the indigenous rock is used in SSP plants. The rock phosphate exploitable reserves in the country are limited, and it is expected that the country will continue to depend on imported rock phosphate for meeting its demand in the years to come.

Sulphuric acid is an intermediate in the manufacture of P_2O_5 fertilizers. India does not have any reserves of sulphur, and only moderate quantities of sulphur are available as recovered from the oil and gas sector. Sulphur is mostly imported from Iran, United Arab Emirates, Saudi Arabia, Kuwait, Bahrain, and Qatar. The indigenous production of phosphoric acid (an intermediate for phosphate production) has remained stagnant during the past few years. Approximately 85 percent of the world production of phosphoric acid is for captive consumption and only 15 percent is traded in the international market. It is reported that the trade of phosphoric acid is not a free trade and more than half of the international trade is by way of long-term supply arrangements between the producers and the importers. Out of the total trade of approximately 5 million tons of phosphoric acid, India imports more than 2.5 million tons every year, which exposes the Indian fertilizer industry to volatile world markets. With the expected increase in demand for fertilizer, the import of intermediates and raw materials is expected to grow significantly in the coming years.

THE PRICING ENVIRONMENT

Factors Affecting Fertilizer Use and Prices

As a critical input in agricultural production, fertilizer consumption is affected by both price and non-price factors. The factors that affect fertilizer consumption cover a wide range of issues at different stages of its use. These can be classified into three groups: economic factors, such as fertilizer prices, output prices, and other input prices; physical and technological factors like soil quality, fertilizer-use management, availability of other inputs, climate, extent of micronutrient deficiency, and imbalanced use of various fertilizer nutrients; and institutional factors, including inadequate credit availability for farmers and dealers, insufficient extension activities, inadequate infrastructure (roads, transportation), inadequate distribution facilities, domestic production, and nonavailability of quality fertilizers (Raju 1989). These factors have a significant influence on fertilizer use patterns, although their relative importance varies across farm size, region, season, and other location-specific characteristics. Several studies have attempted to examine the role of price and non-price factors in the growth of fertilizer use in India (Raju 1989, Kundu and Vashist 1991, Subramaniyan and Nirmala 1991, Sharma 1993, Sidhu and Sidhu 1993, Dholakia and Majumdar 1995, Sharma 1999, Schumacher and Sathaye 1999, Rabobank 2005, and Sharma and Thaker 2011a).

Sharma and Thaker (2011a) reported that non-price factors such as irrigation and high-yielding varieties were more powerful in influencing demand for fertilizer compared with price factors. The price of fertilizer had an adverse effect on consumption and was more powerful than output price. The results suggest that to increase fertilizer consumption in the country, policymakers should prioritize non-price factors such as better irrigation facilities, high-yielding varieties, and easy access to credit over agricultural price policy as an instrument. Second, there is a need to keep fertilizer prices at an affordable level because the price is more powerful in influencing fertilizer demand than higher output prices and benefits for small and marginal farmers.

Role of Subsidies in Price Determination

As discussed earlier, governments in developing countries, including India, promote fertilizer use through various policy instruments, such as subsidies. The fertilizer price at both producer and farmer levels are determined directly or indirectly by the government, and such interventions generally have two basic objectives, to provide fertilizers to farmers at stable and affordable prices to increase agricultural production and to encourage domestic production by allowing fertilizer producers a reasonable return on their investments. To achieve this objective, the government introduced the Retention Price cum Subsidy Scheme (RPS), a cost-plus approach, for nitrogenous fertilizers in November 1977 and extended it to complex fertilizers in February 1979. Under RPS the retail price of fertilizers was fixed and was uniform throughout the country, and the difference between the retention price (adjusted for freight and dealer’s margin) and the price at which the fertilizers were sold to the farmer was paid back to the manufacturer as subsidy. RPS did achieve its objectives of developing a large domestic industry, near self-sufficiency in fertilizer production, and increased consumption of chemical fertilizers, but it has not been free from criticism of fostering inefficiency and leading to a huge burden of subsidies. The mounting burden of subsidies compelled the policy planners to make a serious attempt to reform fertilizer price policy to rationalize fertilizer subsidies. As part of the economic reforms initiated in the early 1990s, the government decontrolled the import of complex fertilizers such as diammonium phosphate (DAP) and muriate of potash (MOP) in 1992, and extended a flat-rate concession on these fertilizers. Urea imports continue to be restricted and canalized. Based on the recommendations of various committees, including the High Powered Fertilizer Pricing Policy Review Committee (HPC) and the Expenditure Reforms Commission (ERC), a New Pricing Scheme (NPS) for urea units was implemented in a phased manner starting in April 2003 with the objectives of bringing transparency, uniformity, efficiency, and reduced cost of production. Similarly based on the recommendations of the Expert Group on P and K fertilizers, the policy for phosphatic and potassic fertilizers was implemented. The government implemented the Nutrient-Based Subsidy (NBS) policy on April 1, 2010, for phosphatic, potassic, and complex fertilizers and from May 1, 2010, for single super phosphate (SSP). Under the NBS, the market price is determined based on supply and demand factors, and the government pays a fixed subsidy. The main objective of all policy interventions has been to contain and target fertilizer subsidies.

However, estimates of the fertilizer subsidy as per central government budgets over the years in the post-reforms era show that fertilizer subsidy has increased significantly. Table 6.2.1 presents the estimates of major subsidies, including the food and fertilizer subsidies in the post-reforms period (1991–92 to 2011–12). It is evident from the table that fertilizer subsidy has increased from Rs. 5185 crore in 1991–92 to Rs. 70012 crore in 2011–12, representing an increase of more than 13 times. Fertilizer subsidy in India as percentage of the GDP varied from 0.47 in 2002–03 to 1.9 percent in 2008–09 and declined to about 0.8 percent in 2011–12. However, a steep increase in the cost of inputs to fertilizer production, high import prices of fertilizers, and constant farmgate prices have led to a substantial increase in fertilizer subsidy in the recent period. Fertilizer subsidy increased by more than 5.5 times between TE2003–04 and TE2010–11, from Rs. 11853 crore to over Rs. 66000 crore. The share of fertilizer subsidy in total subsidies varied from about 25 percent in 2002–03 to about 59 percent in 2008–09. Fertilizer subsidy reached a peak of Rs. 99495 crore in 2008–09 and then witnessed a declining trend. After two consecutive annual decreases in 2009–10 and 2010–11, fertilizer subsidy increased during 2011–12, mainly due to a rise in world prices of fertilizers. Fertilizer prices in 2011 averaged 43 percent higher than in 2010. However, after introduction of the NBS scheme, fertilizer subsidy recorded a decline during 2012–13 and was budgeted to be at almost the same level during 2013–14.

Table 6.2.1—Trends in fertilizer subsidy (Rs. crore) in India, 1991–92 to 2011–12

Period	*Concession on decontrolled fertilizers*		*Subsidy on urea*		*Total fertilizer subsidy*	*Share (percent) in total subsidies*[2]
	Indigenous P&K	*Imported P&K*	*Indigenous*	*Imported*		
1991–92	-	-	3500	1300	5185[3]	42.3
1992–93	-	-	4800	996	5796	48.3
1995–96	500[4]		4300	1935	6735	53.2
1998–99	3790	-	7433	333	11596	49.2
2001–02	3760	744	8044	148	12695	40.4
2002–03	2488	737	7799	1.2	11016	25.3
2003–04	2606	4720	8521	0.8	11848	26.7
2004–05	3977	1165	10243	742	16128	34.6
2005–06	4499	2097	10653	2141	19390	38.8
2006–07	6648	3650	12650	5071	28019	42.0
2007–08[5]	10334	32598	1640	9935	43319	43.7
2008–09	32957	32598	20969	12971	99495	59.1
2009–10	16000	23452	17580	7000	64033	43.3
2010–11	40766[6]		15081	6454	62301	35.9
2011–12	36089		20208	13716	70013	33.1
2012–13 *(RE)*	30576		20000	15398	65974	26.6
2013–14 *(Budgeted)*	29427		21000	15545	65971	29.9

Source: GoI 2011, PIB 2012, and GoI 2013b.

Most of the time it is argued that domestic fertilizer prices are higher than world prices and the domestic industry is protected from import competition. However, it is not always true and in order to establish the fact we compared domestic prices with international prices (Figure 6.2.1). It is evident from the figure that domestic prices were lower than international prices in the first half of the last decade, but the situation changed dramatically during the second half of the decade and world prices were much higher and more volatile than domestic prices.

[2] Share was computed from subsidy figures given in various issues of Expenditure Budget Vol. I, Ministry of Finance, Government of India.

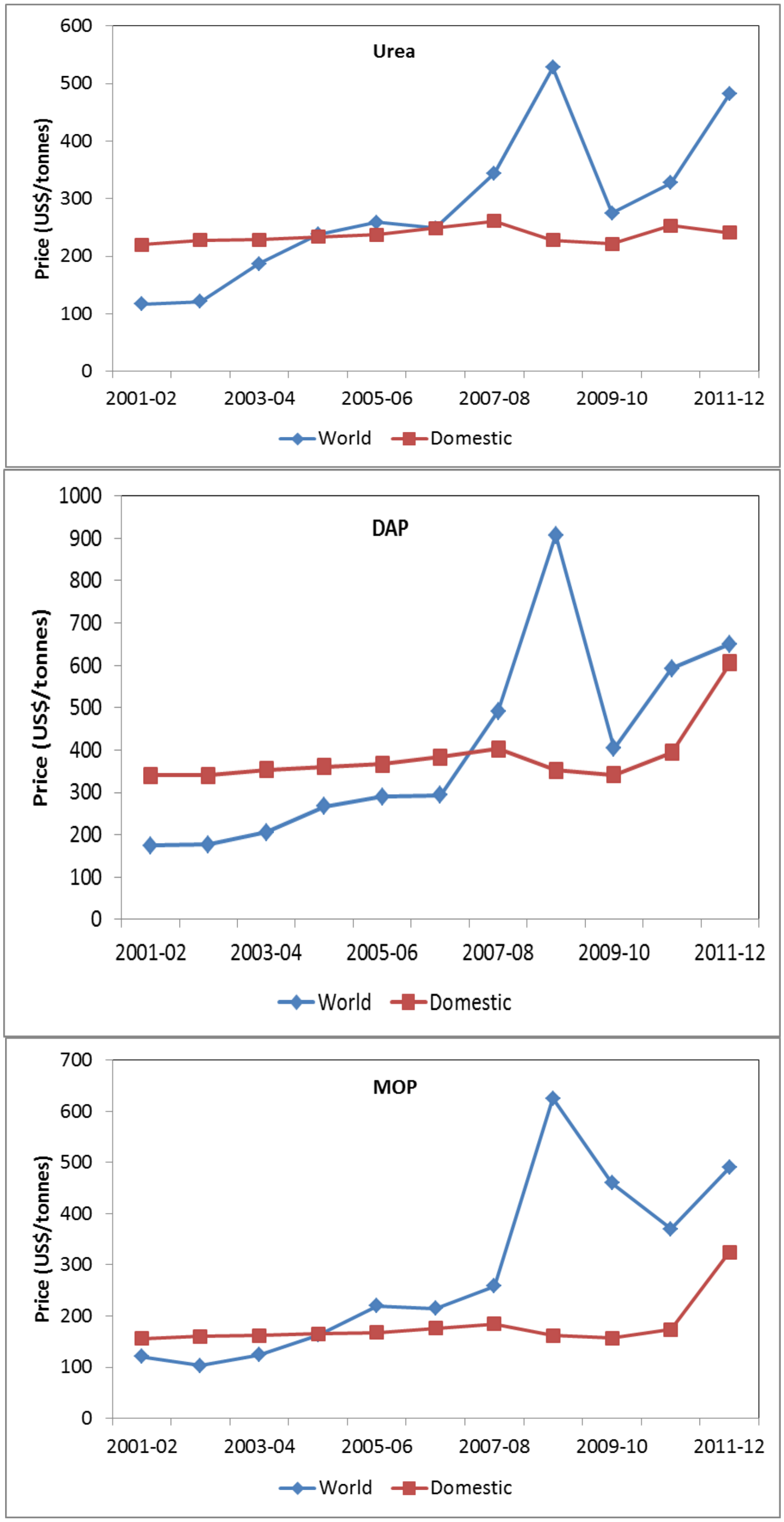
[3] Includes Rs. 385 crore fertilizer subsidy given to small and marginal farmers.

[4] Total subsidy on imported and indigenous P and K fertilizers.

[5] Subsidy figures for 2007–08 and 2008–09 include both cash and bonds for both urea and decontrolled fertilizers.

[6] Data on subsidies on sale of decontrolled fertilizers for 2010–11, 2011–12, and 2012–13 are a total of imported and indigenous P and K fertilizers because separate data are not available after NBS.

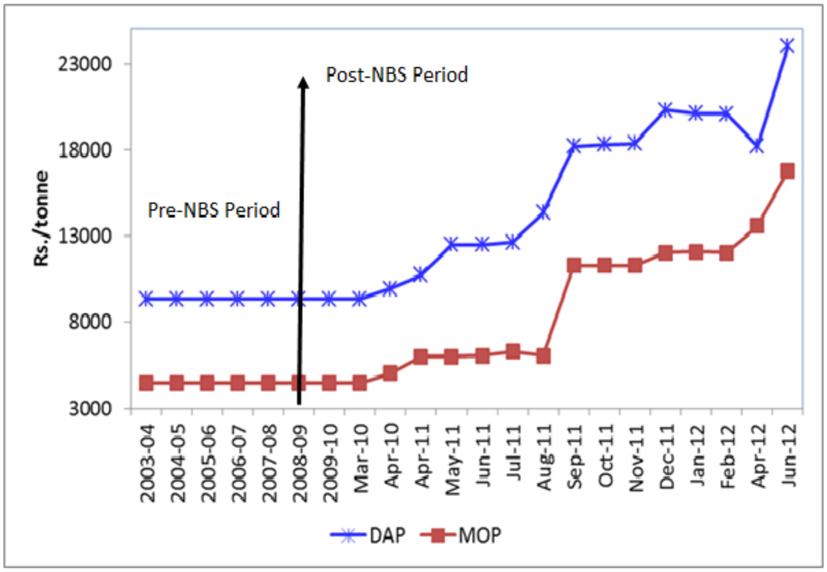
Figure 6.2.1—Trends in domestic farmgate prices and world prices (CFR) of major fertilizers in India, 2001–02 to 2011–12



Source: FAI 2012.

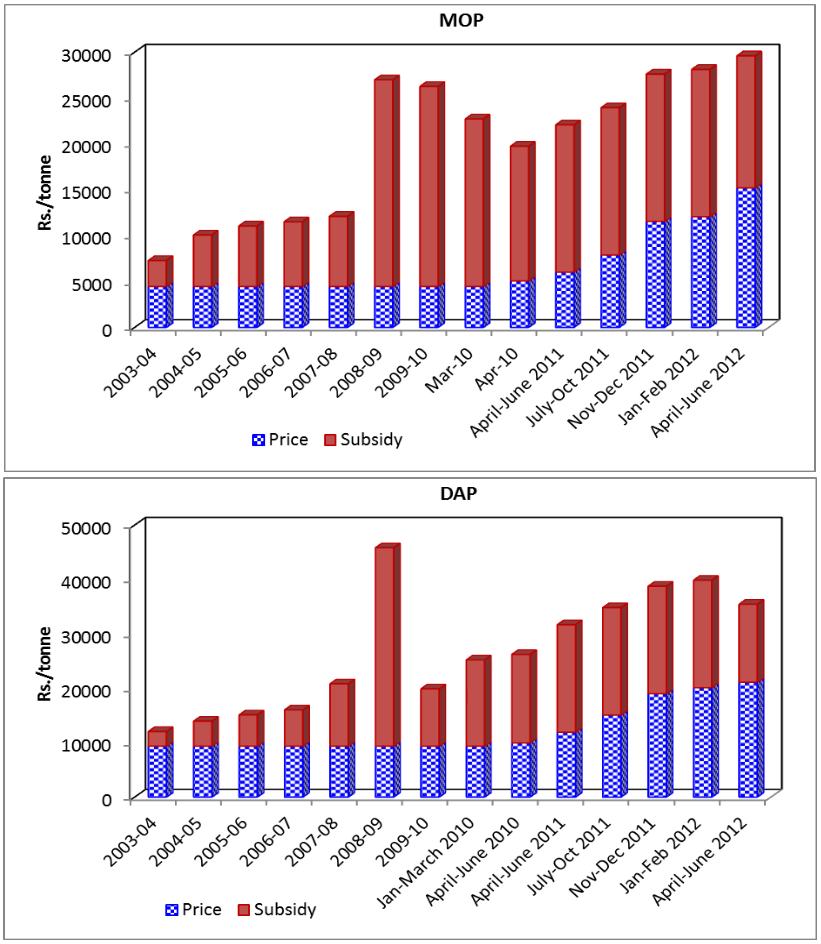
Under NBS, P and K prices were decontrolled and fertilizer companies were allowed to fix the prices of these fertilizers. After the decontrol of P and K fertilizers, the prices increased very significantly, and this raises some questions about complete deregulation of fertilizer prices. Figure 6.2.2 shows trends in prices of DAP and MOP in the pre- and post-NBS period and Figure 6.2.3 provides additional information on changes in fertilizer prices and subsidy during the past decade.

Figure 6.2.2—Trends in prices of DAP and MOP in India, pre-and post-NBS period



Source: FAI 2012, GoI 2012b, and industry sources.

Figure 6.2.3—Trends in price and subsidy[7] of DAP and MOP during pre- and post-NBS period, 2003–04 to June 2012



Source: FAI 2012, GoI 2012b, and industry sources.

[7] Subsidy on DAP for the period 2003–04 to 2007–08 is the average of imported and indigenous DAP.

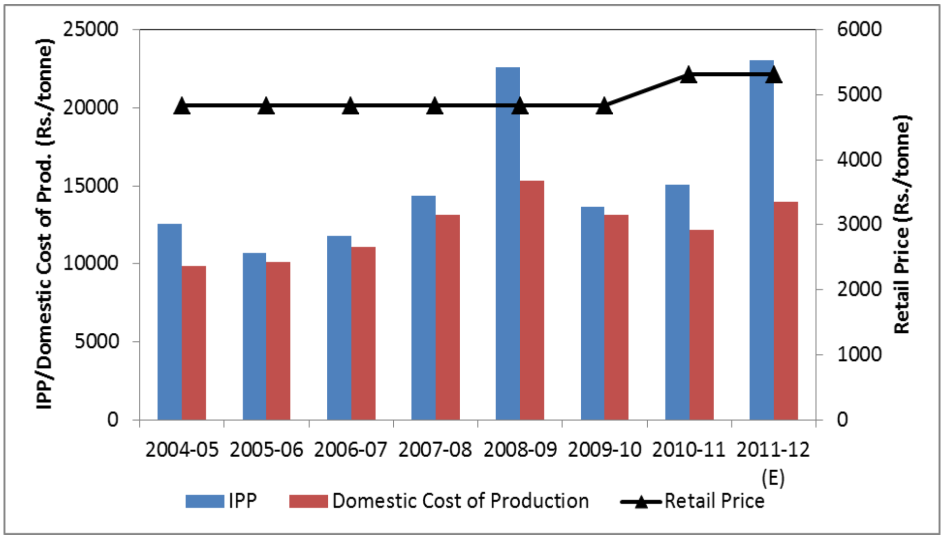
It is evident from Figure 6.2.1 that the retail price of DAP and MOP remained constant (Rs. 9350/ton for DAP and Rs. 4455/ton for MOP) in the pre-NBS period, from February 2003 to March 2010, but the subsidy kept on changing, depending on the cost of production and import parity prices. The average subsidy on DAP varied from Rs. 2134 per ton on indigenous DAP in 2003–04 to Rs. 36488 per ton in 2008–09 (Rs. 53056/ton was the highest, reached in September 2008) in the pre-NBS era. In the case of MOP, the average subsidy varied from Rs. 2822 per ton in 2003–04 to Rs. 22528 per ton in 2008–09 (Rs. 29804/ton was the highest, reached in March 2009). After the NBS policy was introduced in April 2010, the "fixed-price-floating subsidy" regime was changed to a "fixed-subsidy-floating price" regime, and the prices of phosphatic and potassic fertilizers registered a sharp increase, particularly during the past year. For example, the price of DAP more than doubled between March 2010 and June 2012, from Rs. 9350 per ton to more than Rs. 24000 per ton, while the subsidy declined from Rs. 19763 per ton in 2011–12 to Rs. 14350 per ton in 2012–13 (Figure 6.2.2). In the case of MOP, prices witnessed a very sharp increase in the post-NBS period and the price of MOP increased from Rs. 4455 per ton in March 2010 to about Rs. 17000 per ton in June 2012, an increase of about 280 percent.

The government of India has recently (as of June 26, 2103) asked the fertilizer companies to reduce the retail prices because demand for these fertilizers is largely met from imports, and local prices should fall in line with the decline in international prices. This has again raised the issue of indirect government controls in fertilizer pricing in the country.

The share of subsidy in the total cost (retail price + subsidy) of DAP fertilizer was the highest (79.6 percent) during 2008–09 and declined in the post-NBS era to about 40 percent during April–June 2012. In the case of MOP, the share of subsidy in the total cost was as high as 83.5 percent in 2008–09 and declined significantly during the past two years due to a reduction in subsidy under the NBS scheme (Figure 6.2.3). If the subsidy on fertilizers is withdrawn in one go, the market price of DAP would increase to over Rs. 38000 per ton and MOP to about Rs. 31000, which are very high and unaffordable even for large farmers.

Urea is being currently sold to farmers at the maximum retail price (MRP) of Rs 5360 per ton. The difference between the MRP and the production/imported cost is paid by the government to producers. A comparison of the domestic cost of production with import parity prices (IPP) of urea during the period 2004–05 to 2011–12 clearly shows that the IPP has been much higher than the domestic cost of production (Figure 6.2.4). On the other hand, maximum retail prices have remained constant during 2004–05 and 2009–10 and marginally increased during 2010–11. The Indian urea industry is quite diverse and the average subsidy varied from Rs. 8998 per ton in pre-1992 gas-based plants to Rs. 25772 per ton in pre-1992 naphtha-based plants and Rs. 22736 per ton in FO/LSHS feedstock–based units. It may be observed that FO/LSHS units account for 11 percent of capacity, but their share in subsidy is 23 percent (Table 6.2.2). However, the government has advocated for rapid conversion of existing naphtha-based urea units into gas-based units because gas is a much more efficient and cheaper fuel than naphtha. This would help in containing fertilizer subsidies.

Figure 6.2.4—Trends in domestic cost of production, import parity prices, and retail prices of urea in India, 2004–05 to 2011–12



Source: FAI 2012.

Table 6.2.2—Estimated share of production and subsidy on urea, 2010–11

Feedstock	Capacity (lakh tons)	Share in capacity (percent)	Weighted average subsidy rate (Rs./ton)	Share in subsidy (percent)
Pre-1992 gas	49.68	25.0	8998	12.0
Post-1992 gas	55.18	28.0	9509	15.0
Gas	104.86	53.0	9267	27.0
Pre-1992 naphtha	28.17	14.0	25772	35.0
Post-1992 naphtha[8]	17.29	9.0	12603	8.0
Naphtha	45.46	23.0	20731	43.0
FO/LSHS	21.38	11.0	22736	23.0
Mixed feed	26.22	13.0	9683	7.0
Total	200.32	100.0	13406	100.0

Source: GoI 2012a.

Who Benefits from Fertilizer Subsidies in India

There is debate about whether the fertilizer subsidy benefits the farmers or the fertilizer industry (Gulati 1990, Gulati and Narayanan 2003). Furthermore, the benefits of the fertilizer subsidy are heavily tilted to large farmers growing water-intensive crops in a handful of states. As per the estimates by Gulati and Narayanan (2003), the share of farmers in the fertilizer subsidy increased from 24.54 percent in TE1983–84 to 75.62 percent in TE1995–96, with an average share of 67.5 percent for the period 1981–82 to 2000–01. The the rest went to the fertilizer industry. These estimates of the shares of fertilizer subsidy going to farmers and/or industry have been computed by comparing subsidy estimates through import parity price and farmgate prices of fertilizers with the amount of subsidy given in the central government budget. Some of the recent policy announcements, such as the government's intention to move to a system of direct subsidy transfer to farmers, are based on such findings, which are based on unrealistic assumptions. For example, the study assumes that India's entry into the world fertilizer market as an importer would not affect world prices and that world fertilizer markets are perfectly competitive. However, both of these assumptions are not valid (Sharma and Thaker 2010).

The benefits of fertilizer subsidies are analyzed using two All India Input Survey Reports (1996–97 and 2006–07) by the Agricultural Census Division of the Ministry of Agriculture. It is evident from Table 6.3.1 that small and marginal farmers, on average, use more fertilizer per hectare of gross cropped area than do larger farmers. In 2006–07, the marginal farmers used twice as much fertilizer per hectare (140 kg/ha) than large farmers (68 kg/ha). For small farmers, the average fertilizer consumption was about 90 percent higher than for large farmers. Between 1996–97 and 2006–07, average fertilizer use had the highest increase for small farmers (55.4 percent), followed by semi-medium farmers (43.9 percent); the lowest was on large farms (32.2 percent). The data on fertilizer consumption show that small and marginal farmers use more fertilizer compared to large farmers.

Table 6.3.1—Trends in fertilizer consumption per hectare of gross cropped area and total fertilizer area by major size groups during 1996–97 and 2006–07

Farm size group	Per ha of gross cropped area (kg)		Per ha of fertilizer area (kg)	
	1996–97	2006–07	1996–97	2006–07
Marginal (<1.0 ha)	104	140 (34.6)	162	190 (17.1)
Small (1.00–1.99 ha)	83	128 (55.4)	132	168 (27.1)
Semi-medium (2.00–3.99 ha)	75	108 (43.9)	124	143 (15.8)
Medium (4.00–9.99 ha)	68	95 (39.6)	119	133 (12.2)
Large (>10.0 ha)	51	68 (32.2)	114	117 (2.5)
All groups	77	113 (46.2)	131	155 (18.5)

Source: Computed from GoI 2007 and 2012b.

Note: Figures in parentheses show the percent increase in consumption between 1996–97 and 2006–07.

Small and marginal farmers, who accounted for 82.6 percent of the total operational holdings in 2006–07, had a 44.3 percent share in the gross cropped area (Table 6.3.2). On the other hand, the proportion of large farmers in total holdings was 1 percent and

[8] Post-1992 naphtha and mixed feedstock units have been converted to gas.

their share in gross cropped area was more than 10 percent. However, it is interesting to note that the share of small and marginal farmers in total fertilizer consumption was much higher (52.9 percent) than their share in gross cropped area (42.8 percent). For large farmers, the share in fertilizer consumption was lower (6.1 percent) than their share in total cropped area (10.2 percent). These results show that small and marginal farmers have a significant share in fertilizer subsidies (higher than their share in total cropped area).

Table 6.3.2—Distribution of number of holdings, gross cropped area, and fertilizer consumption by major size groups in India, 2006–07

Size group (ha)	Percentage share in total		
	Number of holdings	Cropped area	Fertilizer consumption
Marginal	63.9	23.4	29.1
Small	18.7	20.9	23.8
Semi-medium	11.1	23.0	22.1
Medium	5.3	22.5	18.9
Large	1.0	10.2	6.1
All groups	100.0	100.0	100.0

Source: Computed from GoI 2012.

To assess the benefits of fertilizer subsidies in irrigated and unirrigated areas, Sharma (2013) analyzed fertilizer consumption trends between 1996–97 and 2006–07. The data showed that although farmers in irrigated areas use more fertilizer (172 kg/ha) than those in unirrigated areas (59 kg/ha), fertilizer consumption has increased at a much higher rate in unirrigated areas (64.5 percent) compared with irrigated areas (32.2 percent). A similar trend was observed in all farm size groups.

Sharma and Thaker (2010) found that there was a high concentration of fertilizer subsidies in only a few states but over time the inequalities in subsidy distribution among states have declined sharply. The coefficient of variation in the share of states with total fertilizer subsidy declined from 96.5 percent in 1992–93 to 82.1 percent in 1999–00 and further to 76.7 percent in 2007–08. The coefficient of variation in the per hectare fertilizer subsidy at the state level was substantially lower and has declined more sharply, from 79.3 percent in 1992–93 to 51.9 percent in 2007–08. This has happened due to improvements in rural infrastructure and irrigation facilities, coverage of area under high-yielding variety seeds, easy access to fertilizers, affordable prices, and a shift in crop patterns toward fertilizer-intensive crops in some of the less developed states during the past decade. The benefits of fertilizer subsidy are not restricted to only resource-rich states but have spread to other states.

The analysis in this section supports the argument that public spending to subsidise fertilizers is desirable because a larger share of the benefits is captured by small and marginal farmers, who use higher quantities of fertilizers and have a greater share in total fertilizer consumption. Because there is no targeting of fertilizer subsidies and all categories of farmers pay the same price, it can be inferred that small and marginal farmers receive a higher subsidy per hectare as well as a larger proportion of the total subsidy. These findings are corroborated by the fact that earlier studies and input surveys show a similar distribution of benefits (Sharma and Thaker 2010). However, as fertilizer subsidies have become financially unsustainable, significant fiscal savings can be made through better targeting of fertilizer subsidies and an affordable increase in fertilizer prices. Having explored the distribution of benefits of fertilizer subsidies in the country, one question remains unanswered. Will dismantling the subsidy adversely affect fertilizer consumption and thereby farmers' income?

Profitability of Crops: Role of Fertilizer Subsidy

A simple exercise using cost of production data from the Commission for Agricultural Costs and Prices reports on Price Policy for Kharif and Rabi Crops for the Marketing Season 2012–13 (CACP 2011 and 2012) examined the impact of removing fertilizer subsidies on farm incomes. Sharma (2013) examined the changes in net income (gross value of output from main and by-product - cost C_2^*) and farm business income (gross value of output [main and by-product] - cost A_2+Family Labor) (Table 6.4.1).

Table 6.4.1—Likely impact of fertilizer subsidy withdrawal on farm income in major states: paddy and wheat

Crop/State	Actual 2009–10		Scenario I		Scenario II[9]	
	Net Income[10]	Farm Business Income[11]	Net Income	Farm Business Income	Net Income	Farm Business Income
Wheat						
Bihar	5308	12840	2801	10332	-765	6766
Gujarat	18642	27891	14761	24010	9478	18727
Haryana	14944	35568	10691	31315	5051	25675
Madhya Pradesh	9377	20240	7210	18073	4344	15207
Maharashtra	705	10162	-3648	5809	-8723	734
Punjab	12907	31313	7778	26184	982	19388
Rajasthan	20357	32493	17543	29680	13725	25861
Uttar Pradesh	7167	20355	3472	16660	-1696	11492
Paddy						
Andhra Pradesh	10653	30162	5378	24887	-396	19113
Assam	-2234	4165	-2492	3908	-2948	3451
Chhattisgarh	2478	9365	691	7577	-1921	4965
Haryana	20966	46357	16673	42063	11005	36396
Karnataka	15901	28939	9525	22563	1585	14623
Odisha	1800	11579	-578	9201	-3049	6730
Punjab	20844	42462	15548	37167	9385	31004
Tamil Nadu	9269	21406	2831	14968	-3264	8873
Uttar Pradesh	5809	17770	1324	13285	-4179	7782
West Bengal	3032	13041	-294	9715	-3964	6046

Source: Computed from CACP 2011 and 2012 and Sharma 2013.

The analysis indicates that the share of fertilizer in the total cost of production of wheat varied from about 5.4 percent in Rajasthan to 9 percent in Gujarat, while for rice the fertilizer cost accounted for 1.2 percent of the total cost in Assam and 8.8 percent in Karnataka. The average net income per hectare of wheat production varied from Rs. 705 in Maharashtra to Rs. 20357 in Rajasthan, while farm business income was the highest (Rs. 35568) in Haryana. In the case of rice, farmers in Assam incurred a net loss of Rs. 2234 per hectare in 2009–10, while Haryana farmers realized the highest net income (Rs. 20966/ha), closely followed by Punjab (Rs. 20844/ha); the lowest was in Chhattisgarh (Rs. 2478/ha).

Under Scenario I, assuming that the fertilizer subsidy was withdrawn and farmers paid the actual market price (exclusive of local taxes) for all fertilizers in 2009–10, the net income from wheat would be negative in Maharashtra, and farmers on average would incur a net loss of Rs. 3648 per hectare. In other states, net income would fall by about 27 percent and the main losers would be Uttar Pradesh (-51.6 percent), Bihar (-47.2 percent), Punjab (-39.7 percent), Haryana (-28.5 percent), Madhya Pradesh (-23.1 percent), and Gujarat (-20.8 percent). The effect of fertilizer price rise would be more severe in the case of rice. Rice farmers in Assam, Odisha, and West Bengal would incur a net loss of Rs. 2492, Rs. 578, and Rs. 294 per hectare, respectively. The average reduction in net income in other major producing states would be about 50 percent, and the main losers would be Uttar Pradesh (-77.2 percent), Chhattisgarh (-72.1 percent), Tamil Nadu (-69.5 percent), Andhra Pradesh (-49.5 percent), Karnataka (-40 percent), and Punjab (-25.4 percent).

Because fertilizer prices were normally low during 2009–10 and then increased significantly during 2010–11 and 2011–12, we considered total withdrawal of fertilizer subsidy and actual market prices (retail price + subsidy) during April–June 2012 under Scenario II. The results show that wheat cultivation would become unprofitable in many states and farmers in Bihar, Maharashtra, and Uttar Pradesh would incur a loss of Rs. 765, Rs. 8723, and Rs. 1696 per hectare, respectively. Other states would also witness a significant decline in farm income. The net income in Punjab would decline by 92.4 percent, followed by Haryana (-66.2 percent), Madhya Pradesh (-53.7 percent), Gujarat (-49.2 percent), and Rajasthan (-32.6 percent). The situation of rice farmers would be even more disturbing because rice farmers in seven out of ten major producing states would realize negative net incomes.

For example, rice farmers in Uttar Pradesh would incur a net loss of Rs. 4179 per hectare, followed by West Bengal (Rs. 3964), Tamil Nadu (Rs. 3264), Odisha (Rs. 3049), and Chhattisgarh (Rs. 1921). In other states, net income would decline significantly, ranging from about 47 percent in Haryana to 55 percent in Punjab and 90 percent in Karnataka. Comparing the two scenarios, we find that the net income of Haryana farmers, who received Rs. 35910 per hectare from rice-wheat cultivation in 2009–10, would decline to Rs. 27364

[9] Scenario II considers import parity price (IPP) under NPS-III for urea during the quarter January–March 2012 and actual market prices of phosphatic and potassic fertilizers during April–June 2012.

[10] Net Income = Gross value of production (main and by-product) - Cost C_2.

[11] Farm Business Income = Gross value of production (main and by-product) - Cost A_2+FL.

under Scenario I and to Rs. 16056 per hectare under Scenario II. In Punjab, the net income would fall from Rs. 33571 to Rs. 23326 and Rs. 10376 under Scenario I and II, respectively. Uttar Pradesh farmers would incur a net loss of Rs. 5876 per hectare under Scenario II.

The above results clearly indicate that if fertilizer subsidies were withdrawn in one go it would have very severe adverse effects on net income of rice and wheat farmers, and consequently farming would become unprofitable, leading to a serious agrarian crisis. An optimistic view on the role of market forces and imports in fertilizer pricing and distribution in combination with the removal of the fertilizer subsidy would eventually lead to increased exposure to volatile global markets and compromise the country's social goals of poverty reduction, self-sufficiency, and equity. Therefore, there is a need to have a long-term, consistent fertilizer policy without compromising food security and the livelihood of millions of smallholders in the country.

Role of Information and Communication Technology in the Fertilizer Industry

There had been good progress in the deployment of information and communication technology (ICT) in the fertilizer sector during the past decade, but the potential of ICT is yet to be fully tapped in the overall growth of the industry, particularly with respect to demand and supply, agricultural development, and plant maintenance. Most fertilizer companies have used ICT in most of their operations quite successfully. The fertilizer companies are also using ICT to improve the efficiency and effectiveness of their extension activities for farming technologies, input/output–related information, soil analysis, nutrient-related issues, plant diseases, and weather conditions and forecasts.

The government of India created a task force to recommend and implement a solution for the direct transfer of subsidies. To implement the proposed system in a phased manner, the government developed an application called "mFMS" (Mobile-Based Fertilizer Management System) to facilitate the transition and meet the initiative's overall objective, which is to monitor the movement and stock position of fertilizer from manufacturers to warehouses to wholesalers and from wholesalers to retailers. The system also acts as a tool for the government to track and ensure the timely distribution of fertilizer to farmers. The software also provides information on the rate of subsidy/concession, prices and product-wise/state-wise details of dispatch, and receipts at different destinations across the country. The information provided through this portal is useful not only to the industry but also to the states and, more importantly, to farmers.

THE WAY FORWARD: THE FUTURE ROLE OF FERTILIZERS

With limited arable land resources, and the burden of an increasing population, new technology development and the 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 may drop below the current level of about 140 million hectares if the use of farmland for commercial/nonagricultural purposes is not restricted in the near future. Therefore, the only way to improve food security is to increase crop yields through the scientific use of fertilizers along with other inputs, such as high-yielding variety seeds and irrigation on limited arable land, with an emphasis on protecting the environment.

The importance of fertilizer hardly needs to be emphasized, as it provides a very vital input for agricultural growth. Therefore, the government has been consistently pursuing policies conducive to increasing the availability and consumption of fertilizers in the country. Over the past four decades, fertilizer production and consumption have increased significantly. The country had achieved near self-sufficiency in urea and DAP, with the result that India could manage its requirement of these fertilizers from indigenous industry and imports of all fertilizers, except MOP, were nominal. However, during the past decade, there has been a significant increase in imports of urea and DAP because there has not been any major domestic capacity additions due to an uncertain policy environment. India imported 7.8 million tons of urea, 6.9 million tons of DAP, and about 4 million tons of MOP in 2011–12 to meet the indigenous demand. Imports of total fertilizers ($N + P_2O_5 + K_2O$) have increased significantly, from about 1.9 million tons in 2002–03 to nearly 12.4 million tons in 2011–12.

India is the second largest consumer of fertilizer in the world, with total consumption (in nutrient terms) of about 28 million tons in 2010–11. However, India ranks low in terms of intensity of fertilizer use (kg/ha) in comparison to most of the developing and developed countries in the world. The overall consumption of fertilizers has increased from 65.6 thousand tons in 1951–52 to nearly 28 million tons in 2011–12. Accordingly, per hectare consumption of fertilizers, which was less than 1 kg in 1951–52, has gone up to the level of 144.6 kg in 2011–12. However, fertilizer consumption in India is highly skewed, with wide interregional, interstate, interdistrict, and intercrop variations. About 17 percent of the districts in the country accounted for half of the total fertilizer use, while the bottom 56 percent of the districts accounted for only 15 percent of the total fertilizer use. The intensity of fertilizer use varied greatly, from less than 60 kg per hectare in Himachal Pradesh, Odisha, and Rajasthan, to 266 kg per hectare in Andhra Pradesh. The average intensity of fertilizer use in India remains much lower than most countries in the world, but in certain states/districts fertilizer use is consistently high. The number of districts consuming higher than 200 kg/ha has more than tripled, from 36 in TE2002–03 to 135 in TE2011–12.

In many developed countries, there has been a decline in fertilizer use efficiency, and one of the major constraints to fertilizer use efficiency in India is an imbalance of applied nutrients, partly as the result of a difference in the price of nutrients and partly due to the lack of knowledge among farmers about the need for balanced fertilizer application. The N:P:K ratio was a little skewed toward N in the mid-1970s but started improving in the late 1970s and 1980s and reached a level of 5.9:2.4:1 in 1991–92. However, decontrol of P and K fertilizers and a steep increase in prices in 1992 resulted in a decline in their consumption and a consequent imbalance in fertilizer use. The NPK ratio, which was 5.9:2.4:1 during 1991–92, widened to 9.7:2.9:1.0 during 1993–94 and reached a level of 10.0:2.9:1 in 1996–97. However, due to the government's concerted efforts, such as increasing concessions on phosphatic and potassic fertilizers and marginally increasing the price of urea in 1997, the NPK ratio improved, and it reached a level of 4.3:2.0:1.0 in 2009–10. However, recent policy changes, such as the introduction of NBS in 2010 and a reduction in subsidies on P and K fertilizers in the post-NBS period, led to a worsening of the NPK ratio. It reached a level of 6.7:3.1:1 in 2011–12 and became worse (8.7:3.4:1) in 2012–13. There are also wide interregional and interstate disparities in N:P:K ratios.

There is a high degree of inequality in fertilizer consumption among crops. Rice, wheat, and sugarcane are the prime beneficiaries, with rice being the largest user of fertilizer (about one-third of total consumption), followed by wheat (24.2 percent). Fruits, vegetables, and sugarcane combined represent another 11 percent of fertilizer use. Given the importance of food grains and the government's recent efforts to increase their production, these crops have the potential to stimulate fertilizer use. In addition, the rising demand for high-value crops (fruits and vegetables), due to increasing income levels, urbanization, and changing lifestyles, is also expected to increase the demand for fertilizer, as these crops are fertilizer-intensive.

Fertilizer intensity measured as average kg per hectare does not follow the exact same pattern across crops; intensity tends to be higher on sugarcane (234.9 kg/ha), vegetables (253.8 kg/ha), cotton (183 kg/ha), and fruits (158.6 kg/ha) and lower on cereals (rice 129.2 kg/ha and wheat 162.6 kg/ha) and pulses. Farmers growing input-intensive crops are the main beneficiaries of fertilizer use.

Fertilizer consumption also varies across farm sizes, but there is a fair degree of inter-farm size equity in fertilizer consumption. The share of small and marginal farmers in gross cropped area was 44.4 percent and they consumed 52.8 percent of the total fertilizer used in the country in 2006–07. On the other hand, the share of medium and large farmers in gross cropped area was nearly one-third and they consumed about 25 percent of the total fertilizer used in the country.

The relationship between fertilizer nutrient prices and paddy and wheat prices during the past three decades reveals that with the steady increase in the procurement prices of crops and almost stable fertilizer prices, the profitability has increased for all three nutrients. However, profitability of P and K use declined significantly after the decontrol of their prices in 1992 and the introduction of NBS for P and K fertilizers in 2010. Furthermore, the response ratio (kg grain/kg nutrient) in food grain crops in irrigated areas in India has substantially declined during the past four decades, from 13.4 kg of grain per kg of nutrient in 1970 to 3.7 kg of grain per kg of nutrient in 2005. The continuous application of higher amounts of N, lower doses of P, and organic manure has led to the emergence of secondary and micronutrient (Zn, B, Fe, Mn, Mo) deficiencies in Indian soils.

Fertilizer consumption in India has generally exceeded the domestic production in both nitrogenous and phosphatic fertilizers except for a few years. The entire requirement of potassic fertilizers is met through imports, as India does not have commercially viable sources of potash. During the past decade, due to low/no addition in domestic capacity coupled with a rise in demand for fertilizers, imports have increased significantly in the 2000s. The main fertilizer products imported in India are urea (7.8 million tons), DAP (6.9 million tons), and MOP (about 4 million tons). Urea imports have increased significantly during the past six or seven years. This increase in imports and rising international prices of urea and other fertilizer products have led to a substantial increase in fertilizer subsidies in the country. Oman (36.2 percent), China (22 percent), Iran (17.2 percent), and CIS (12.9 percent) were major exporters of urea to India during TE2011–12.

To ensure an adequate supply of fertilizers in all regions/areas of the country, the distribution and movement of fertilizers is controlled under the Essential Commodities Act 1955 (ECA) to bridge supplies in underserved areas. Urea is under partial movement and distribution control of the government, and 50 percent of the indigenous production of urea is regulated by issue of movement orders to the manufacturers for dispatch to the states on a month-to-month basis, keeping in view the assessed requirement. Twenty percent of decontrolled fertilizers produced/imported in India are under movement controls.

Imports of nitrogenous fertilizers are canalized through state trading enterprises, while imports of P and K fertilizers and raw materials/intermediates have been decontrolled and placed under Open General License (OGL). Currently, more than 40 percent (up from about 13 percent in the early 2000s) of total fertilizer nutrients used in India is sourced through imports. The capacity to produce more fertilizer in the country is currently limited due to the availability and/or cost of raw materials/feedstocks, and installed capacity has remained stagnant during the past decade. On the fertilizer supply side, the major deficiencies that constrained sustained rapid growth in fertilizer production include shortage of raw materials, intermediates, and feedstocks, such as natural gas for urea production and rock phosphate and phosphoric acid for phosphates; lack of a consistent long-term policy; lack of working capital in the distribution channels; and poor physical infrastructure in some regions of the country. Due to constraints in raw material availability, the indigenous production of fertilizers has been decreasing, while imports have risen.

Private trade accounts for about 65 percent of the total fertilizer distributed in the country, followed by institutional agencies, including cooperatives, at 35 percent; marginal quantities are distributed through manufacturers' own outlets. Among the institutional agencies, cooperatives happen to be the main distribution agencies.

The demand for fertilizer depends on price factors, such as the price of outputs, the price of fertilizer, and the prices of other inputs that substitute for or complement fertilizer, and non-price factors, including production and market infrastructure. The non-price factors such as irrigation and high-yielding varieties were more powerful in influencing demand for fertilizer compared with price factors. Within price factors, the price of fertilizers had an adverse effect on fertilizer consumption and was more powerful than output price.

The fertilizer subsidy has been one of the most hotly debated issues in the country over the past two decades. Fertilizers, after oil and food, account for the third biggest share of India's total subsidy bill, and several attempts have been made to contain subsidies. However, estimates show that fertilizer subsidy has increased significantly over the years in the post-reforms period, from Rs. 5185 crore in 1991–92 to Rs. 70012 crore in 2011–12, representing an increase of more than 13 times. Fertilizer subsidy in India as a percentage of the GDP varied from 0.47 in 2002–03 to 1.9 percent in 2008–09 and declined to about 0.8 percent in 2011–12. However, a steep increase in the cost of inputs to fertilizer production, high import prices, and constant farmgate prices have led to a substantial increase in fertilizer subsidy in recent years. For example, fertilizer subsidy increased by over 5.5 times between TE2003–04 and TE2010–11, from Rs. 11853 crore to over Rs. 66000 crore. It is well known that the fertilizer subsidy has helped increase the availability and consumption of fertilizers at affordable prices and thereby increased agricultural production, but it has also led to some unintended negative consequences, such as imbalanced use of nutrients, declining fertilizer use efficiency, adverse impacts on land and water resources in certain areas, and unsustainable levels of subsidy.

There is a debate about whether fertilizer subsidy benefits farmers or the fertilizer industry and whether domestic industry is overprotected from world markets. The general perception that about one-third of the fertilizer subsidy goes to the fertilizer industry is misleading because the underlying assumptions do not hold true. The world fertilizer markets and trade flows are highly concentrated and volatile, and Indian imports have a significant impact on world prices. Moreover, with the shift from the earlier cost-plus based approach to import parity pricing (IPP), the Indian fertilizer industry has been exposed to world competition, which would drive out inefficient units. Empirical evidence also shows that the perception of the domestic urea industry being overprotected and less efficient than imports does not hold true because the average subsidy per ton of imported urea is much higher than that for indigenously produced urea.

On the issue of whether fertilizer subsidy is distributed equitably across crops, states, and farm classes, the results indicate that it is concentrated in a few states. Interstate disparity in fertilizer subsidy distribution is still high, though it has declined over the years. Rice, wheat, sugarcane, and cotton account for about two-thirds of the total fertilizer subsidy. However, the study shows that fertilizer subsidy is more equitably distributed among farm sizes. The small and marginal farmers have a larger share in fertilizer subsidy in comparison to their share in cultivated area. The benefits of fertilizer subsidy have spread to unirrigated areas as the share of area treated with fertilizers and share of unirrigated areas in total fertilizer use have also increased. A reduction in fertilizer subsidy is, therefore, likely to have adverse impacts on farm production, income of small and marginal farmers, and unirrigated areas, because they do not benefit from higher output prices but do benefit from lower input prices.

It is evident that withdrawal of subsidies will make farming unprofitable, particularly for small and marginal farmers and those in less developed states/regions. Therefore, there is a need for subsidizing fertilizers for small and marginal farmers as well as for less developed regions. There is a need to contain these subsidies without hurting millions of smallholders, including tenant cultivators who produce for self-consumption and have no or very small marketed surplus. These farmers do not benefit from high output prices but higher fertilizer prices would certainly reduce their income. Targeting and rationing are important tools to contain subsidies and ensure that they are largely provided to those farmers/regions/crops where fertilizer use is constrained by high prices, insufficient institutional credit support, and low productivity levels. Rationing, for example by limiting the volume of subsidized fertilizer that a farmer can get, is a better option compared to targeting and is also more acceptable politically and administratively. Rationing will provide proportionately greater benefits to small and marginal farmers compared to large farmers, and it will promote fertilizer consumption on small and marginal farms, but it will not solve the problem of informal tenants. Sharp increases in both domestic and imported fertilizer prices, rising raw material/feedstock prices, rising imports, and reduction in subsidies on phosphatic and potassic fertilizers have made markets more volatile and, to the extent that higher prices have led to a decrease in the consumption of phosphatic and potassic fertilizers, led to a deterioration in the N:P:K ratio. There is a need for periodic and affordable increases in fertilizer prices, particularly urea, to contain subsidies and promote the balanced use of nutrients.

APPENDIX A

Table A.1—Consumption ratios of N and P in relation to K in major states in India, 2011–2012

	Pre-NBS Period (2008–09)			Post-NBS Period (2011–12)		
State	**N**	**P**	**K**	**N**	**P**	**K**
East	**2.9**	**1.2**	**1.0**	**4.2**	**1.8**	**1**
Assam	2.0	0.8	1.0	2.0	0.6	1
Bihar	5.7	1.5	1.0	8.4	2.6	1
Jharkhand	7.0	3.6	1.0	10.4	3.7	1
Orissa	3.3	1.7	1.0	5.8	2.4	1
Tripura	2.7	1.3	1.0	3.8	2.0	1
West Bengal	1.7	1.0	1.0	2.7	1.5	1
North	**14.7**	**4.5**	**1.0**	**20.4**	**6.8**	**1**
Haryana	32.6	10.8	1.0	27.2	9.8	1
Himachal Pradesh	3.2	1.0	1.0	3.7	1.1	1
Jammu & Kashmir	8.1	3.3	1.0	12.5	5.4	1
Punjab	23.5	6.7	1.0	26.8	8.5	1
Uttar Pradesh	11.6	3.6	1.0	18.4	6.2	1
Uttaranchal	8.8	2.4	1.0	12.0	3.1	1
South	**2.5**	**1.3**	**1.0**	**3.9**	**2.2**	**1**
Andhra Pradesh	3.5	1.7	1.0	6.1	3.2	1
Karnataka	2.1	1.4	1.0	3.7	2.4	1
Kerala	1.2	0.6	1.0	10.4	0.7	1
Tamil Nadu	1.8	0.7	1.0	2.6	1.2	1
Pondicherry	2.6	0.9	1.0	4.8	1.3	1
West	**5.0**	**2.6**	**1.0**	**7.3**	**4.0**	**1**
Gujarat	5.8	2.5	1.0	8.9	3.1	1
Madhya Pradesh	9.0	5.9	1.0	13.4	9.4	1
Chhattisgarh	4.4	2.2	1.0	5.8	2.9	1
Maharashtra	2.8	1.6	1.0	4.0	2.5	1
Rajasthan	29.0	13.1	1.0	34.9	15.9	1
India	**4.6**	**2.0**	**1.0**	**6.7**	**3.1**	**1**

Source: FAI 2012.

REFERENCES

Benbi, D. K., and M. S. Brar. 2011. "Evaluation of Soil Fertility and Nutrient Balances under Intensive Agriculture." In *Potassium Role and Benefits in Improving Nutrient Management for Food Production, Quality and Reduced Environmental Damages*, edited by M.S . Brar and S. S. Mukhopadhyaya, Volume I, 499–518.

Biswas, P. P., and P. D. Sharma. 2008. "A New Approach for Estimating Fertiliser Response Ratio—The Indian Scenario." *Indian Journal of Fertiliser* 4 (7): 59–62.

Bumb, B. 1995. *Global Fertiliser Perspective, 1980–2000: The Challenges in Structural Transformation.* Technical Bulletin T-42. Muscle Shoals, AL: International Fertiliser Development Center.

CACP (Commission for Agricultural Costs and Prices). 2011. *Price Policy for Rabi Crops—The Marketing Season 2012–13*. Department of Agriculture and Cooperation, Ministry of Agriculture. New Delhi, India.

———. 2012. *Price Policy for Kharif Crops—The Marketing Season 2012–13*. Department of Agriculture and Cooperation, Ministry of Agriculture. New Delhi, India.

Dholakia, Ravindra H., and Jagdip Majumdar. 1995. "Estimation of Price Elasticity of Fertiliser Demand at the Macro Level in India." *Indian Journal of Agricultural Economics* 50 (1): 36–46.

FAI (Fertiliser Association of India). 2003. *Fertiliser Statistics 2001–02*. New Delhi, India.

———. 2012. *Fertiliser Statistics 2011–12.* New Delhi, India.

FAO (Food and Agriculture Organization of the UN). 1998. *Guide to Efficient Plant Nutrition Management*. Rome, Italy.

———. 2005. *Fertilizer Use by Crop in India*. Rome, Italy.

GoI (Government of India). 2007. *All India Report on Input Survey 1996–97*. Agricultural Census Division, Ministry of Agriculture. New Delhi, India.

———. 2008. *All India Report on Input Survey 2001–02*. Agricultural Census Division, Ministry of Agriculture. New Delhi, India.

———. 2011. *Annual Report 2010–11*. Department of Fertilizers, Ministry of Chemicals and Fertilizers, 103. New Delhi, India.

———. 2012. *All India Report on Input Survey 2006–07*. Agricultural Census Division, Ministry of Agriculture. New Delhi, India.

———. 2012a. *Report of the Working Group on Fertilizer Industry for the Twelfth Plan (2012–13 to 2016–17).* Ministry of Chemicals and Fertilizers, Department of Fertilizers, 131, 134. New Delhi, India.

———. 2012b. *Rates of P&K Fertilizers for 2011–12*. Department of Fertilizers, Ministry of Chemicals and Fertilizers. New Delhi, India.

———. 2013. *Fourth Advance Estimates of Production of Foodgrains for 2012–13*. Agricultural Statistics Division, Ministry of Agriculture. New Delhi, India.

———. 2013a. *New Investment Policy—2012*. Department of Fertilizers, Ministry of Chemicals and Fertilizers. New Delhi, India.

———. 2013b. *Union Budget.* Various Issues from 1991–92 to 2013–14. Ministry of Finance. India, New Delhi.

Gulati, Ashok. 1990. "Fertilizer Subsidy: Is the Cultivator 'Net Subsidised'?" *Indian Journal of Agricultural Economics* 45 (1): 1–11.

Gulati, Ashok, and Sudha Narayanan. 2003. *The Subsidy Syndrome in Indian Agriculture*. New Delhi, India: Oxford University Press.

Gulati, Ashok, and Anil Sharma. 1995. "Subsidy Syndrome in Indian Agriculture." *Economic and Political Weekly* 30 (39): A93–A110.

Hopper, W. 1993. "Indian Agriculture and Fertiliser: An Outsider's Observations." Keynote address to the FAI Seminar on Emerging Scenario in Fertiliser and Agriculture: Global Dimensions, New Delhi, India.

Kumar, D. S. 2011. *Improving the Effectiveness, Efficiency and Sustainability of Fertilizer Use in India*. Country report prepared for the South Asia Regional Network for Economic Research Institutes (SANEI) and the Global Development Network (GDN). Dhaka, Bangladesh, and New Delhi, India.

Kumar, Ramesh. n.d. *Major Issues in Soil Health Management*. Department of Agriculture and Cooperation, Ministry of Agriculture. New Delhi, India.

Kundu, T. R., and D. C. Vashist. 1991. "Demand for Intermediate Inputs in Indian Agriculture." *Indian Journal of Agricultural Economics* 46 (2): 152–58.

Maene, L. M., and T. N. Weddershoven. 1984. "Productivity and Cost Reduction in Fertilizer Marketing in Developing Countries in Asia." Paper presented at the FAI Seminar on Productivity, Cost Reduction and Subsidy in Fertilizer Industry, New Delhi, India.

Panagariya, Arvind. 2001. "Fertilizer Subsidy." *Economic Times*, February 28, 2001.

Patra, D. P. 2009. "Logistics Planning for the Fertilizer Sector." Paper presented at the FAI Workshop on Business Intelligence, Forecasts and Planning for the Fertiliser Sector, Gangtok, Sikkim, July 12–15, 2009.

PIB (Press Information Bureau). 2012. *Year-wise Amount of Fertilizer Subsidy Released during 2009–10 to 2011–12*. Ministry of Chemicals and Fertilizers. New Delhi, India.

Rabobank International. 2005. *Indian Fertiliser Industry: A Snapshot of Urea and DAP Business*. Food & Agribusiness Research and Advisory. Utrecht, The Netherlands.

Raju, Sunitha. 1989. "Fertiliser Use in Andhra Pradesh: An Analysis of Factors Affecting Consumption." *Artha Vijnana* 31 (4).

Ramarao, G. M. 1988. "Cost Effectiveness in Marketing." *Fertilizer News* 33 (8): 23–26.

Ravi Prasad, G. 2013. "Logistics Strategy: Post Nutrient Based Subsidy. *Indian Journal of Fertilizers* 9 (9): 52–59.

Samra, J. S., and P. D. Sharma. 2011. "Food Security—Indian Scenario." In *Potassium Role and Benefits in Improving Nutrient Management for Food Production, Quality and Reduced Environmental Damages*, edited by M. S. Brar and S. S. Mukhopadhyaya, Volume 1, 15–43. Horgen, Switzerland: International Potash Institute.

Schumacher, Katja, and Jayant Sathaye. 1999. *India's Fertiliser Industry: Productivity and Energy Efficiency*. Energy Analysis Program, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory. Berkeley, CA.

Sharma, A. K. 1993. "Sources of Differences in Input Use: The Case of Fertiliser in India." *Journal of Indian School of Political Economy* 5 (2): 320–29.

Sharma, Vijay Paul. 1999. "Domestic Support Commitments under WTO and Their Implications for Indian Agriculture." Paper presented at FAI Seminar on Maintaining Fertiliser and Food Security in the Emerging World Trade Order, New Delhi, India, December 9–11.

———. 2013. "Withdrawal of Fertilizer Subsidy: Some Issues and Concerns for Farm Sector Growth in India." *Indian Journal of Fertilizers* 9 (5): 16–28.

Sharma, Vijay Paul, and Hrima Thaker. 2010. "Fertilizer Subsidy in India: Who Are the Beneficiaries?" *Economic and Political Weekly* 45 (12): 68–76.

———. 2011a. "Demand for Fertilizers in India: Determinants and Outlook for 2020." *Indian Journal of Agricultural Economics* 66 (4): 638–61.

———. 2011b. *Economic Policy Reforms and Indian Fertiliser Industry*. New Delhi: Allied Publishers.

Sidhu, D. S., and J. S. Sidhu. 1993. "Demand for Fertiliser and Foodgrains Production in India." In *Fertiliser Pricing: Issues Related to Subsidies*, edited by Vidya Sagar, 115–130. Jaipur, India: Concept Publishing House.

Singh, Maha V. 2008. "Micronutrient Deficiencies in Crops and Soils in India." In *Micronutrient Deficiencies in Global Crop Production*, edited by Brian J. Alloway, 93–125. Dordrecht, The Netherlands: Springer.

Subramanian, G., and V. Nirmala. 1991. "A Macro Analysis of Fertiliser Demand in India (1966–67 to 1985–86)." *Indian Journal of Agricultural Economics* 46 (1): 12–19.

Tomich, T., P. Kilby, and B. Johnson. 1995. *Transforming Agrarian Economies: Opportunities Seized, Opportunities Missed*. Ithaca, NY: Cornell University Press.

ABOUT THE AUTHORS

Vijay Paul Sharma is Professor and Chair of the Post Graduate Programme in Agribusiness Management of Centre for Management in Agriculture (CMA) at the Indian Institute of Management, India.

ACKNOWLEDGMENT

The author would like to thank the International Food Policy Research Institute (IFPRI) for financial support and Dr. Balu Bumb and conference participants of the International Conference on "Agricultural Transformation in Asia: Policy Options for Food and Nutrition Security" in Siem Reap Angkor, Kingdom of Cambodia, September 25–27, 2013, for their constructive and insightful suggestions and comments.

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
A member of the CGIAR Consortium | A world free of hunger and malnutrition
2033 K Street, NW | Washington, DC 20006-1002 USA
T: +1.202.862.5600 | F: +1.202.467.4439
Email: ifpri@cgiar.org | www.ifpri.org
www.ReSAKSS-Asia.org