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Economic Policy Reforms
and
Indian Fertilizer Industry

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Foreword

The Center for Management in Agriculture (CMA) at the Indian Institute of Management, Ahmedabad (IIMA) is engaged in applied, policy and problem solving research in agribusiness management as well as broader goals of agricultural and rural development since its inception. The research studies have been done on a wide range of issues in agribusiness sector including agri-input supply management, commodity systems, raw material procurement, agro-processing, rural credit, livestock, fisheries, forestry, public-private-community partnership, agri-business organizations and cooperatives, agri and rural infrastructure and rural development, indigenous innovations, international trade including WTO issues, global competitiveness, food safety and quality issues..

The present study sponsored by the Ministry of Agriculture, Govt. of India provides a comprehensive overview of the Indian fertilizer sector under changing policy environment. The study examines the current situation with regard to fertilizer demand and supply in the country, systematically identifies main factors that limit fertilizer demand and supply, analyze main causes of these constraints, and discuss a range of technical, economic and policy options for strengthening demand and supply.

Fertilizer subsidies that encourage production and productivity have been widely criticized because of the huge cost of subsidies and also their benefits are perceived to be far from uniformly distributed. There is a general view in academic, policy and political circles that fertilizer subsidies are concentrated geographically, on relatively few crops and few producers and in many cases do not reach the targeted group(s). One of the most contentious issues surrounding input subsidies in general and fertilizer in particular in India is how much of what is paid out actually finds its way into the pocket of the farmer, and how much is siphoned away by the fertilizer companies. There has also been a debate about the issue of real beneficiaries of fertilizer subsidy like small vs. large farmers, well-developed vs. less developed regions, etc. The present study examines trends in fertilizer subsidy and the issue of distribution of fertilizer subsidies between farmers and fertilizer industry, across regions/states, crops and different farm sizes.

The report comes at a critical time, when the country is seriously deliberating on the issue of and road-map for fertilizer sector reforms. It is a timely and interesting contribution in this area, which seems to have challenged two popular beliefs on this subject. First, based on secondary data and evidences, it has questioned the general perception that a large share of fertilizer subsidy goes to the industry. The study also argues that the proposed policy of direct transfer of fertilizer subsidy to farmers is misconceived and inappropriate and its adverse effects outweigh the perceived benefits. Second, the study also seems to indicate existence of a fair degree of equity in distribution of fertilizer subsidy among farm sizes, besides arguing that this reduction in fertilizer subsidy is likely to have adverse impact on farm production and income of small and marginal farmers.

I am sure policy planners, managers, entrepreneurs, academicians, and others involved in fertilizer business will find the arguments and conclusions of the study worth of careful consideration in logical pursuit of their interests.

Prof. Samar K. Datta
Chairman
Centre for Management in Agriculture (CMA)

Ahmedabad
Date: 30.09.2009

Preface

Agriculture plays a crucial role in the Indian economy, accounting for close to 17 percent of gross domestic product but more importantly, about 60 per cent of the India's workforce is dependent on agriculture and allied activities for their livelihood. Successive Five Year plans have stressed on self-sufficiency and self-reliance in foodgrains production and concerted efforts in this direction have resulted in substantial increase in agricultural production and productivity. This is clear from the fact that from a level of about 52 million tonnes in 1951-52, foodgrains production rose to above 230 million tonnes in 2007-08. Substantial evidence has demonstrated that chemical fertilizers have played a vital role in the success of India's green revolution and consequent self-reliance in food-grain production.

The fertilizer policy in India has been mainly driven by socio-political objectives of making fertilizer available to farmers at affordable prices and increasing fertilizer consumption. The Indian fertilizer sector has, therefore, been under strict government control for most of the period since independence. A price and distribution control system was considered to be necessary not only to ensure fair prices and equal distribution all over the country but also to provide incentives for use of fertilizers to improve agricultural productivity and production. However, increasing level of subsidy is a matter of concern. Given the socio-political importance of fertilizer pricing on one hand and ever increasing subsidies on the other hand, the need for streamlining the sector has been felt for a long time. The fertilizer has become the most contentious issue in reforming Indian economy exposing deep contradictions between economics and politics in the democratic set-up. Recognizing the important role of fertilizers in Indian agriculture, the present study was undertaken to study Indian fertilizer sector under the new economic policy regime.

The study provides a comprehensive overview of growth of Indian fertilizer sector and analyzes trends and patterns in consumption of fertilizers at all-India, regional, state and district level. Various issues related to imbalance in fertilizer use and pattern of fertilizer use by farm size and crops have been studied. Macro aspects of India fertilizer sector policy environment, fertilizers price policy objectives, relations between fertilizers prices and consumption over-time, and economics of fertilizer use have analyzed. The extent, nature and causes of fertilizers subsidies, as well as issues related to equity in distribution of fertilizer subsidy have been addressed.

We are sure policy planners, academicians, managers, entrepreneurs, and other stakeholders from fertilizer industry will find this study to be useful as it provides valuable insights into various issues, perspectives and interest of industry under changing economic environment.

Acknowledgements

Several individuals and institutions have helped us during this study. Acknowledging all individually would be impossible but we would like to mention a few without whose support it would have been difficult to complete this study. We would, therefore, like to thank people who have helped and guided us in our study as well as those who have offered suggestions and comments on our earlier draft. First and Foremost we would like to thank the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, for their generous financial support to the Centre for Management in Agriculture (CMA) for undertaking this study.

Our special thanks to Prof. Bakul H. Dholakia, former Director and Prof. Samir K. Barua, present Director, Indian Institute of Management, Ahmedabad, for their administrative and unstinting moral support. We owe much for the support and encouragement of Prof. Samar K. Datta, Chairman, Centre for Management in Agriculture (CMA). We remain grateful to him for his kind appreciation and moral support. We had very useful discussions with CMA colleagues and people from fertilizer industry in various stages of this study and for which we are thankful to them. We would like to thank Ms. Jasleen, Mr. Rajnikant, Ms. Deepti Singh, Mr. Kalpesh Kumar, and Dr. Ajay Joshi for providing research assistance and helping in collecting and analysis of data at different stages of the project. Ms. Sumitha Nair provided the secretarial help and Ms. Barathi, In charge, CMA office arranged for the review of the report and provided other necessary administrative support. We would like to thank the Institute of Economic Growth (IEG), New Delhi for offering useful comments and suggestions on the draft report of this study.

We are indebted to Sh. Satish Chander, Director General, Fertilizer Association of India, and Dr. R L Shiyani, Professor and Head, Department of Agricultural Economics, Junagarh Agricultural University for their helpful comments and suggestions. We are highly grateful to Sh. S Krishnan, IAS, Secretary, Department of Fertilizers, Government of India for his invaluable suggestions.

Needless to mention while we owe debt to the numerous persons with whom we interacted during the study, the responsibility of data and views in this report and any omissions or errors that remain in the text are ours alone.

Vijay Paul Sharma

February 5, 2010 ***Hrima Thaker***

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Chapter 1

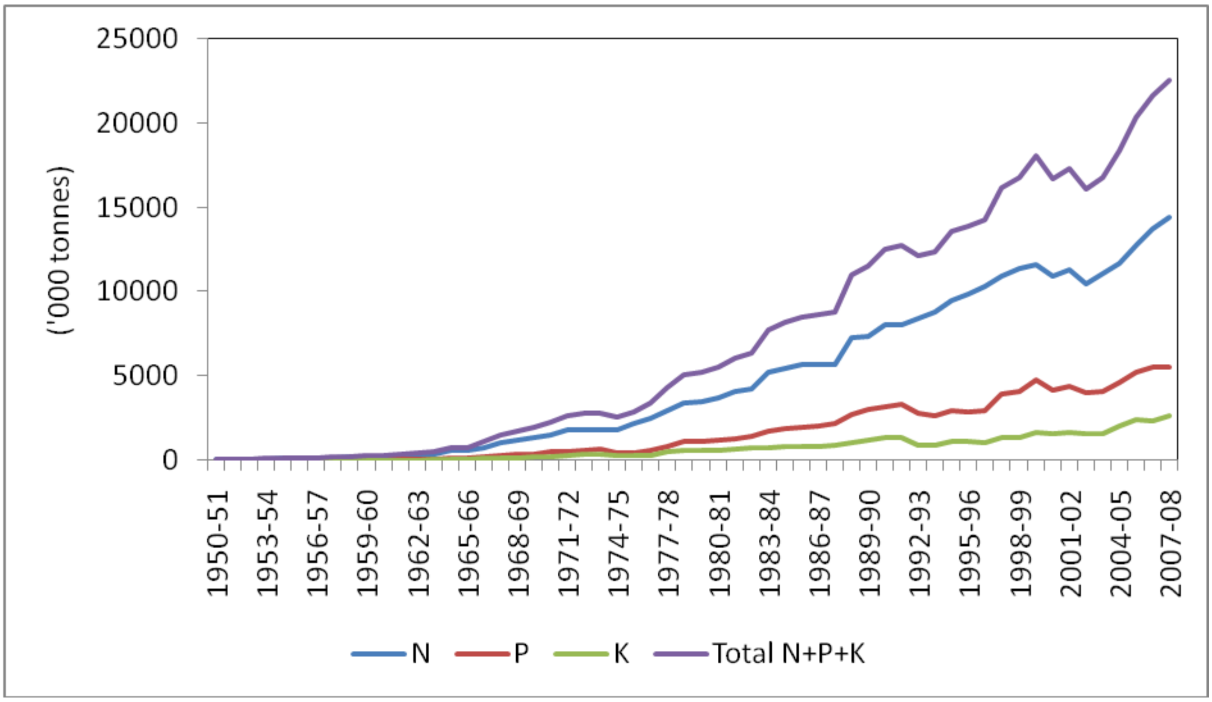
INTRODUCTION

Agriculture sector is the mainstay of the Indian economy, contributing about 17 per cent of national Gross Domestic Product (GDP) and more importantly, about 60 per cent of the India's population and workforce is dependent on agriculture and allied activities for their livelihood. Successive Five Year plans have stressed on self-sufficiency and self-reliance in foodgrains production and concerted efforts in this direction have resulted in substantial increase in agricultural production and productivity. This is clear from the fact that from a level of about 52 million tonnes in 1951-52, foodgrains production rose to above 230 million tonnes in 2007-08. More and more food will be needed to meet the demand of an increasing population in the country, and the world in general. Substantial evidence has demonstrated that chemical fertilizer have played an important role in sustaining food production (Borlaug and Dowswell, 1994; Stewart et al. 2005). Chemical fertilizers have played a vital role in the success of India's green revolution and consequent self-reliance in food-grain production. The increase in fertilizer consumption has contributed significantly to sustainable production of foodgrains in the country.

With the limited arable land resources, and burden of increasing future population numbers, chemical fertilizers will continue to play an important role in sustaining food security in India. It is expected that India's available arable land (net sown area) might drop below the current level of about 140 million hectares, if the use of farmland for commercial/non-agricultural purpose is not restricted in the near future. Therefore, the only way to improve food security is to increase crop yields through the scientific use of fertilizers using the limited arable land, with an emphasis on protecting the environment.

The Government of India has been consistently pursuing policies conductive to increased availability and consumption of fertilizers in the country. Over the last five and half decades, production of nitrogen (N) and phosphorus (P_2O_5) fertilizer together has increased from mere 38.7 thousand tonnes in 1951-52 to about 14.6 million tonnes in nutrients terms in 2007-08. Since there are no commercially viable sources of potash (K_2O) in the country, its entire requirement is met through imports. The overall consumption of fertilizers in nutrients terms (N, P_2O_5 and K_2O) has increased from 65.6 thousand tonnes to 22.57 million tonnes during the same period (Figure 1.1). Accordingly, per hectare consumption of fertilizers, which was less than one kg in 1951-52, has gone up to the level of 117 kg in 2007-08. The country had achieved near self-sufficiency in production capacity of 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 have been nominal. However, in the recent years there has been a significant increase in imports of urea and DAP as well. India imported 6.9 million tonnes of urea and 2.72 million tonnes of DAP in 2007-08 to meet their indigenous demand. Imports of fertilizers ($N+P_2O_5+K_2O$) have increased significantly during the last 5 years, from about 1.9 million tonnes in 2002-03 to nearly 7.8 million tonnes in 2007-08 In India, the large differences between states in fertilizer consumption are likely to have an impact on future distribution of nutrients.

Figure 1.1: Trends in fertilizer consumption in India: 1950-51 to 2007-08



Source: FAI (2008)

The state-wise consumption of N, P, and K fertilizers during 2007-08 is shown in Table 1.1. The amount of fertilizer applied per unit of cropped area varied greatly from 45 kg/ha in Rajasthan to 210 kg/ha in Punjab. These differences reflect the large variability in the intensity of crop production between these regions/states (128.9% cropping intensity in

Rajasthan to 190.5% cropping intensity in Punjab), the yield levels, area under irrigation and high yielding varieties. Future food production needs in India will require that yields increase in all regions, and that the intensity of cropping be optimized where possible. This will require both the continued use of fertilizers as well as balanced fertilizer use to ensure that yields are not limited by an imbalance between macro, secondary and micro nutrients. In order to increase food production in a sustainable manner, farmers will need to use the right fertilizer at the right rate, right time and right place.

Fertilizer Sector Policy Environment

The significance of fertilizer industry and its related policy in India arises from the fact that agriculture still contributes a sizeable share of country's GDP and more importantly, it supports nearly two-third of population. Therefore, fertilizer policy in India has been mainly driven by the socio-political objectives of making fertilizer available to farmers at affordable prices and increasing fertilizer consumption.

The Indian fertilizer sector has been under strict government control for most of the period since independence. A price and distribution control system was considered to be necessary not only to ensure fair prices and equal distribution all over the country but also to provide incentives for more intensive use of fertilizers. The goal of government intervention was to improve agricultural productivity and thus the basic supply of food.

Government policy in the fertilizer sector has gone through three phases: a period of less control (1950s and 1960s), a period of tight controls (1970s and 1980s) and a period of post-reforms (1990s to present). Until 1970, straight fertilizers were under price control and there were no distribution controls. In October 1970, Indian fertilizer policy was reviewed and controls on prices and distribution of fertilizers were introduced in 1973 (Fertilizer Movement Control Order) and movement of fertilizer was brought under the Essential Commodity Act (ECA). In 1977, the Retention Price cum Subsidy Scheme (RPS) was implemented, which encouraged investment in the sector by assuring a 12 per cent post-tax return over net worth to the fertilizer producers. Under the RPS, the government fixed the farm-gate price for urea and other fertilizers and also decided on the retention price for manufacturers and the difference between two was given to the manufacturer as subsidy. This helped in achieving self-sufficiency in fertilizer production but at a very high price because the RPS provided no incentive for manufacturers to improve efficiency and also failed to penalize inefficient manufacturers.

Table 1.1: Fertilizer consumption, cropping intensity, foodgrains yield, area under irrigation and high yielding varieties in selected States in India: 2007-08

States/UTs	*Fertilizer consumption (kg/ha)*	*Cropping intensity (%)*	*FG Yield (kg/ha)*	*Gross irrigated area (%)*	*Area under HYV (%)*
East	103.5	146.8	1770	39.7	18.8
Arunachal Pradesh	2.7	133.5	1216	16.9	-
Assam	57.3	134.5	1286	4.3	-
Bihar	162.8	132.9	1656	57.0	42.9
Jharkhand	68.5	119.6	1550	10.0	-
Manipur	85.2	100.0	2241	22.9	-
Meghalaya	15.8	121.7	1800	24.8	-
Mizoram	39.9	100.0	822	19.6	-
Nagaland	2.2	125.2	1482	27.4	-
Orissa	51.8	151.9	1359	30.8	34.9
Tripura	41.2	106.8	2399	34.8	-
West Bengal	144.2	180.0	2511	57.5	-
North	161.6	161.9	2576	76.3	23.3
Haryana	187.6	182.4	3393	83.7	54.1
Himachal Pradesh	53.1	173.8	1714	18.8	-
Jammu & Kashmir	71.8	144.9	1733	41.7	32.0
Punjab	210.0	190.5	4017	96.6	75.8
Uttar Pradesh	149.6	150.5	2057	73.1	-
Uttarakhand	118.9	165.1	1760	44.2	-
South	154.9	123.8	1913	38.1	11.1
Andhra Pradesh	199.6	124.4	2231	44.9	-
Karnataka	115.7	124.0	1289	27.9	28.1
Kerala	69.8	140.1	2331	15.4	8.3
Tamil Nadu	178.3	115.0	2610	56.3	-
Pondicherry	1032.5	171.4	2180	80.6	69.4

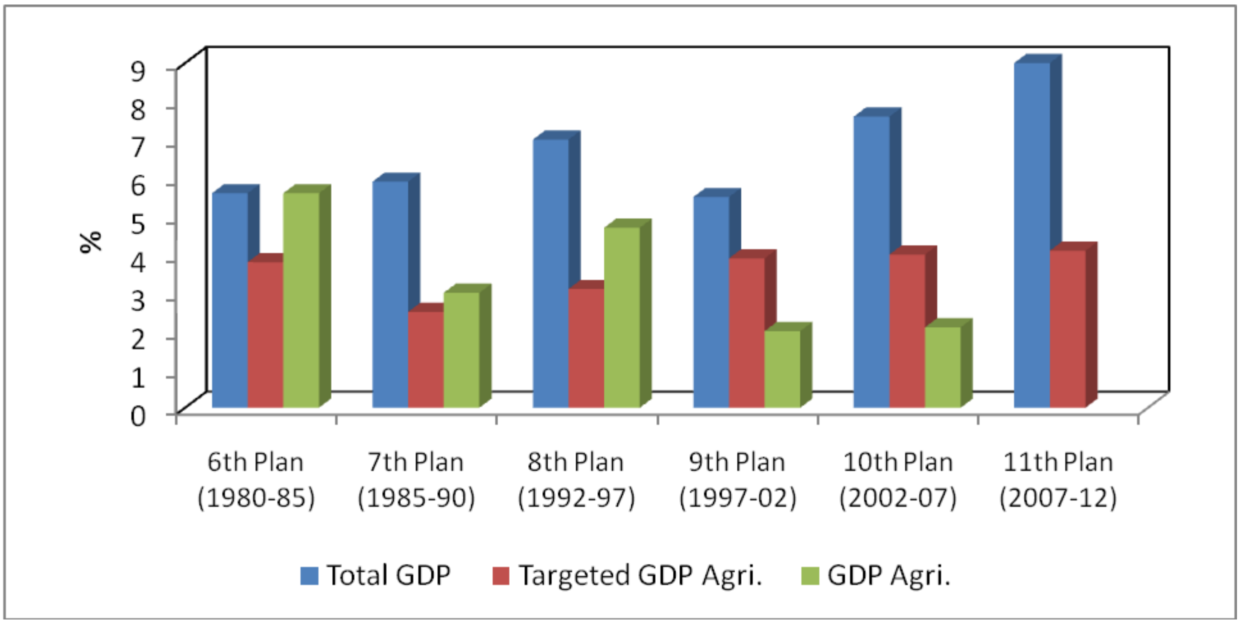
West	82.5	126.6	1114	28.5	18.6
Gujarat	143.6	114.7	1423	38.0	21.4
Madhya Pradesh	66.4	131.0	1167	30.0	13.0
Chhattisgarh	76.9	120.6	1148	23.9	13.5
Maharashtra	103.1	129.1	940	16.5	22.2
Rajasthan	45.5	128.9	1119	36.0	19.6
Goa	41.9	124.1	2254	22.4	30.6
All-India	117.1	135.9	1756	42.9	18.3

Area under HYV (%) - for the year 2004-05; Cropping intensity (%) & Gross irrigated area (%) - for the year 2005-06; FG Yield (kg/ha) - for the year 2006-07
Source: FAI (2008)

Given the socio-political importance of fertilizer pricing on one hand and ever increasing subsidies on the other hand, the need for streamlining the sector has been felt for a long time. However, fertilizer has become the most contentious issue in reforming Indian economy exposing deep contradictions between economics and politics in the democratic set-up. The economic reforms initiated in 1991 marked the first major attempt at fertilizer sector reforms in India and set the stage for major policy changes in the sector. In August 1992, government decontrolled prices, distribution and movement for phosphatic and potassic fertilizers. The low analysis nitrogenous fertilizers were also decontrolled in June 1994. However, urea, the main nitrogenous fertilizer continued to remain under government controls. The government's efforts at initiating reforms in fertilizer sector in general and urea in particular has involved the appointment of a number of committees including High Powered Fertilizer Pricing Policy Review Committee (1997-98), Y.K. Alagh Committee (2000), Expenditure Reforms Commission (2000), and Group of Ministers (GoM, 2002). The recommendations of the GoM formed the basis for the New Pricing Scheme (NPS) announced in 2003, which aims at inducing urea units to achieve efficiency besides bringing transparency and simplification in subsidy administration. The NPS is being implemented in stages (3 stages) and phased decontrol of urea has been undertaken under the NPS. Due to partial decontrol/deregulation of phosphatic and potassic fertilizers, complete decontrol of complex fertilizers and controls on urea, there has been imbalanced use of fertilizers. However, in order to promote balanced use of fertilizers and improve soil health, government took a positive step and introduced nutrient-based pricing of subsidized fertilizers including complex fertilizers in June 2008, which would promote use of complex fertilizers.

Although there has been significant progress in agricultural production and productivity growth in India during the past several decades, current growth is well below the targeted growth rate to meet demand for food and poverty reduction goals (Figure 1.2). In order to achieve 4 per cent growth in agricultural sector during the XIth Five Year Plan, demand for various agricultural inputs and services including fertilizers will increase significantly. The supply of fertilizers has not increased much in the recent years as a result demand-supply gap has increased over the years. Moreover low investment in fertilizer industry in recent times coupled with developments in the global markets has created high dependence on import of fertilizers. Under the present fertilizer policy, government spends a huge amount of money for fertilizer subsidy and this burden is increasing every year. Fertilizer subsidy in its present form is leading to inefficient use of fertilizers at the farm level. There is need to have a comprehensive overview of the technical, economic, and policy issues of relevance to fertilizer policy design and implementation for achieving the targeted growth in agricultural sector.

Figure 1.2: Trends in growth of total GDP, targeted agricultural GDP and actual agricultural GDP during plan periods



Source: CSO (2008)

Taking into account importance of the fertilizer sector to the Indian agriculture, the present study attempts a comprehensive and in-depth analysis of the Indian fertilizer sector under the new economic policy regime.

The report is organized as follows. The second chapter following the introduction provides a comprehensive overview of the growth of Indian fertilizer sector in terms of capacity expansion and utilization, production of various types of fertilizers, sectoral shares in production, imports of fertilizers and diversification in the use of feedstock and intermediates at national as well as regional/state level.

Chapter 3 analyzes the trends and patterns in consumption of fertilizers at all-India, regional, state and district level. Various issues related to imbalance in fertilizer use and pattern of fertilizer use by farm size and crops have also been studies in the chapter.

Chapter 4 deals with macro aspects of India fertilizer sector policy environment, fertilizers price policy objectives, relations between fertilizers prices and consumption over-time, and economics of fertilizer use. The extent, nature and causes of fertilizers subsidies, issues related to inter-crop, inter-state and inter-farm size equity in distribution of fertilizers subsidy have also been analyzed in this chapter.

Chemical fertilizers contributed significantly to the increase in Indian agricultural production and productivity, but use of these chemicals has been associated with some environmental, human health, and economic concerns. Chapter 5 briefly describes the role of fertilizer use in India agriculture. An overview of performance of Indian agriculture and association between fertilizer use and agricultural production has been discussed in the chapter.

Designing appropriate policies and interventions to stimulate fertilizer demand and supply, calls for a good understanding of past trends and the relative importance of various factors that influence fertilizer use. Chapter 6 attempts to better understand dynamics of fertilizer use, specifically with regards to the trends in fertilizer consumption at the national and state level and the factors associated with changes in fertilizer use. The chapter presents nitrogen (N), phosphate (P_2O_5) and potash (K_2O) fertilizer medium-term demand projections for the period 2008-09 to 2015-16.

Chapter 7 reviews the international fertilizer industry with regard to demand, supply and trade for nitrogen, phosphate and potassium fertilizers. Demand and supply and their balances are given at global and regional level for each of the three nutrients and major fertilizer products.

The conclusions and implications of the findings are presented in Chapter 8. In this chapter, the findings of this project are summarized and broad implications for policy makers are presented.

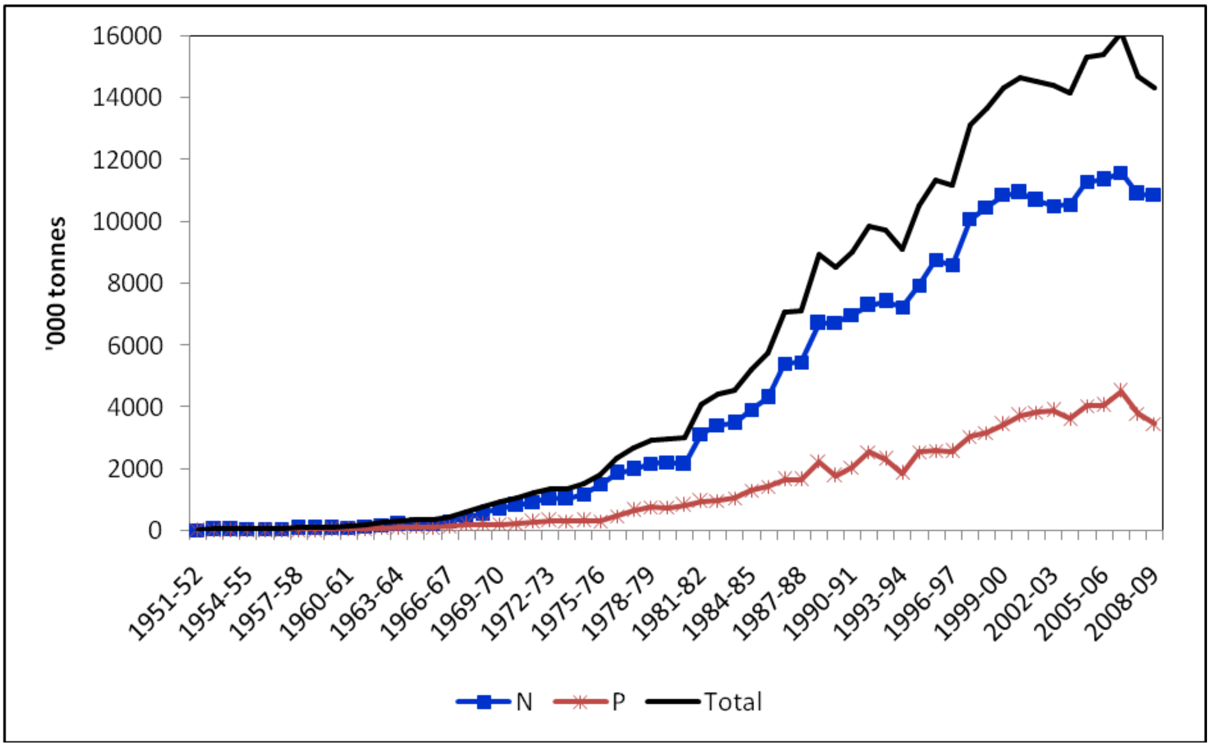
Chapter 2

CAPACITY, PRODUCTION AND IMPORTS OF FERTILIZERS AND FEEDSTOCKS AND INTERMEDIATES

India is the third largest producer as well as consumer of fertilizer after China and the U.S. in the world. India accounted for about 12 per cent of the world consumption and about 10 per cent of the global production (N 12.0% and P 11.5%) in 2006. In addition, India is also a large importer of fertilizer products, raw materials and intermediates.

Fertilizer production in India has been growing at an accelerating rate, from very low levels after independence (38.7 thousand tonnes in 1951-52) and still low levels in the 1960s and early 1970s (1.24 million tonnes) to a total production of about 16.1 million tones in 2006-07 and then declined in next two years and reached a level of 14.3 million tonnes in 2008-09 (Figure 2.1).

Figure 2.1: Trends in production of N, P_2O_5 and total (N+ P_2O_5) fertilizer in India: 1951-52 – 2008-09



Source: FAI (2008)

There are about 137 fertilizer plants in operation in the country, which is comprised of 28 urea, 19 DAP and NP/NPK complex, 79 SSP, 10 ammonium sulphate (AS) and one calcium ammonium nitrate (CAN) unit (FAI, 2008). Currently, India produces various kinds of both nitrogenous and phosphatic fertilizers domestically (Table 2.1). These include straight nitrogenous fertilizers (urea, ammonium sulphate, ammonium chloride (ACl), and calcium ammonium nitrate), straight phosphatic fertilizers (single super phosphate) and NP/NPK complex fertilizers, like di-ammonium phosphate (DAP). Potassic fertilizers are not manufactured domestically due to lack of commercially viable indigenous reserves of potash, the main raw material.

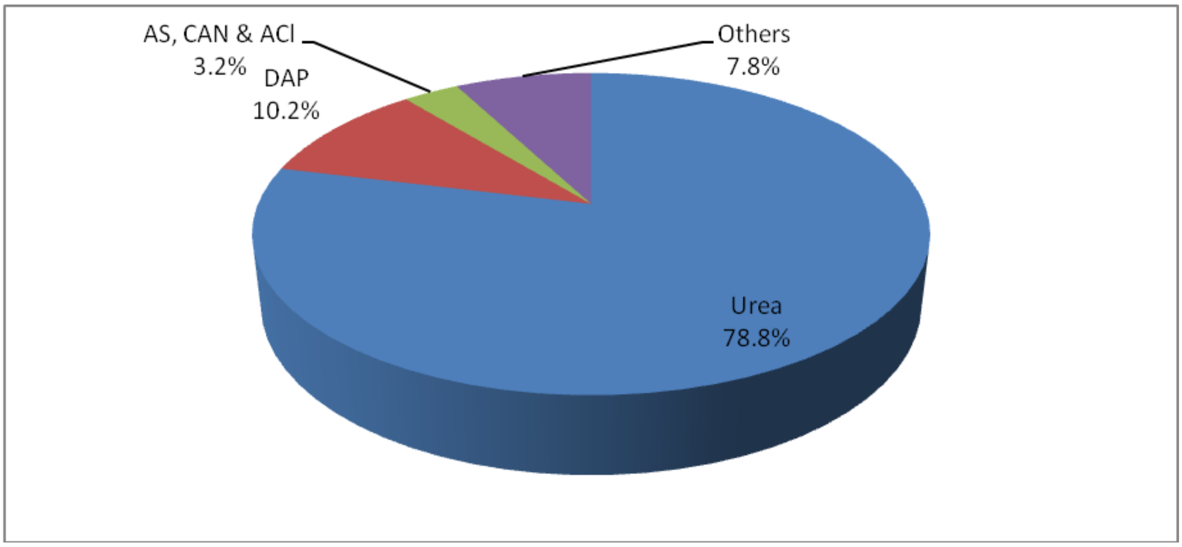
Fertilizer Capacity and Production Trends

N Fertilizers

Products

Urea is the largest straight nitrogenous fertilizer in terms of capacity and accounted for 78.8 per cent of installed capacity in 2007-08 (Figure 2.2). 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 (3.2%). DAP is the second largest fertilizer product in N capacity and its share in total N capacity was over 10 per cent during 2007-08.

Figure 2.2: Product-wise capacity of N fertilizers in India: 2007-08



Source: FAI (2008)

Table 2.1 Development of production of fertilizer products in India

Year of first manufacture	Fertilizer product	Factory which first manufactures	Total no. of manufacturing units (Nov. 2008)
1906	Single superphosphate	EID-Parry (India) Ltd., Ranipet (Now Coromandel Fertilizers Ltd)	79
1906	1906 Fertilizer mixtures		75#
	Ammonium sulphate		10
1933	As a by-product of steel industry	Tata Iron & Steel Co. Ltd., Jamshedpur*	6
1941	Using sulphuric acid	Mysore Chemicals & Fertilizers Ltd. Belagula*	
1947	Using gypsum as raw material	FACT, Udyogamandal	
1974	As a by-product of Polymer/caprolactum	GSFC, Baroda	4
1959	Ammonium sulphate nitrate	FCI Ltd., Sindri*	**
	Urea	FCI Ltd., Sindri*	28$
	Ammonium Chloride	New Central Jute Mills Co. Ltd., Varanasi*	**
1960	Ammonium phosphate	FACT, Udyogamandal	3@
1961	Calcium ammonium nitrate	Nangal	1$
1965	Nitrophosphate	RCFL, Trombay	2$
1967	Diammonium phosphate	State Fertilizers & Chemicals Ltd., Baroda	11
1968	Triple superphosphate	Dharamsi Morarji Chemical Co. Ltd. Ambernath	**
	Urea ammonium phosphate	Coromandel Fertilizers Ltd., Vizag	2
	NPK complex Fertilizers	RCFL, Trombay 10@@	10@@
1973	Pelofos	Orissa Fertilizers and Chemicals, Rourkela	**

** Now not manufactured; @ = During 2007-08, 9 plants manufactured Ammonium Phosphate Sulphate

@@ = Plants manufactured NPK complex fertilizers in 2007-08; * Closed

Total number of granulated mixing units. Data regarding powder mixing units are not available; $ = Plant(s) in operation.

Note: Fertilizer plants with multiple products have been counted more than once under respective product categories.

Source: FAI (2008)

Capacity

At the time of independence in 1947 total fertilizer capacity in the country was about five thousand tonnes 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 1960s. The real growth of nitrogenous sector started only after 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 four fold from 470 thousand tonnes at the end of 3rd five year plan to 1947 thousand tonnes in fourth five year plan due to more focus on agricultural development and introduction of high-yielding varieties of rice and wheat in mid-1960s (Table 2.2). The capacity creation was much faster during fourth, fifth and sixth five year plans. Introduction of retention price scheme in late 1970s contributed to this increase in N capacity. Capacity utilization has increased considerably from around 67 per cent during fifth five year plan to 95.8 per cent at the end of tenth plan and declined to 90.5 in 2007-08. Production shares are distributed slightly differently, due to sector specific capacity utilization and efficiencies. The capacity utilization in N sector is considerable high in all sectors but public units have relatively lower capacity utilization compared with private and cooperative sector (Table 2.3).

Raw Materials

In the early years, the N capacity was based almost entirely on coke oven gas. By 1970s, naphtha had become the most common feedstock, a position which was taken over by natural gas later on. In 1970s, due to shortage of naphtha for fertilizer sector, coal and fuel oil raw material stock based plants for producing urea and ammonia were set up. In 1981-82, naphtha was major feedstock for N fertilizers accounting for 47.7 per cent share, followed by fuel oil (22.7%) and natural gas share was 14.4 per cent (Figure 2.3). However in late-1970s, with the discovery of gas fields off the west coast and on-shore in the north-eastern parts, feedstock policy was amended in 1975-76 and new capacities were added in 1980s and 1990s. Most of the capacity addition in nitrogenous fertilizer sector was in natural gas feedstock based units due to new pricing scheme for urea which seeks to promote the use of natural gas, the efficient and comparatively cheaper feedstock, for urea production and encourage naphtha/fuel oil/LSHS based units to switch over to using gas as feedstock. Consequently the share of natural gas increased to 61.5 per cent, followed by naphtha (14.8%) and external ammonia (14.0%) in 2007-08.

Table 2.2: Installed capacity and capacity utilization of N fertilizer Industry in India

Plan period	Installed Capacity	Capacity Utilization	Sectoral share			Production
			Public	Private	Coop.	
1947	10	-	-	-	-	
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
2007-08 (As on Nov. 1, 2008)	12283.6	90.5	3591.5 (29.2)	5522.9 (45.0)	3169.2 (25.8)	10902.8

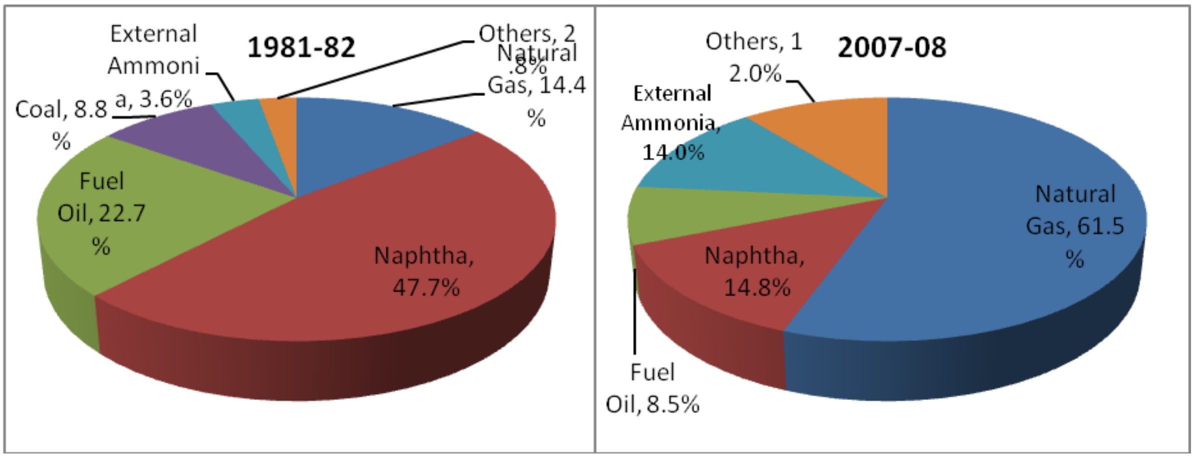
Source: FAI (2008)

Table 2.3: N fertilizer production shares and capacity utilization (%) by sectors in India

	1981-82		1991-92		2007-08	
	Production share (%)	Capacity utilization	Production share (%)	Capacity utilization	Production share (%)	Capacity utilization
Public	57.7	51.3	51.1	90.0	26.6	80.7
Private	32.7	64.3	30.9	65.9	45.6	90.1
Cooperative	9.6	32.4	18.0	82.1	27.8	95.6

Source: FAI (2008)

Figure 2.3: Feedstock-wise share of N capacity



Source: FAI (2008)

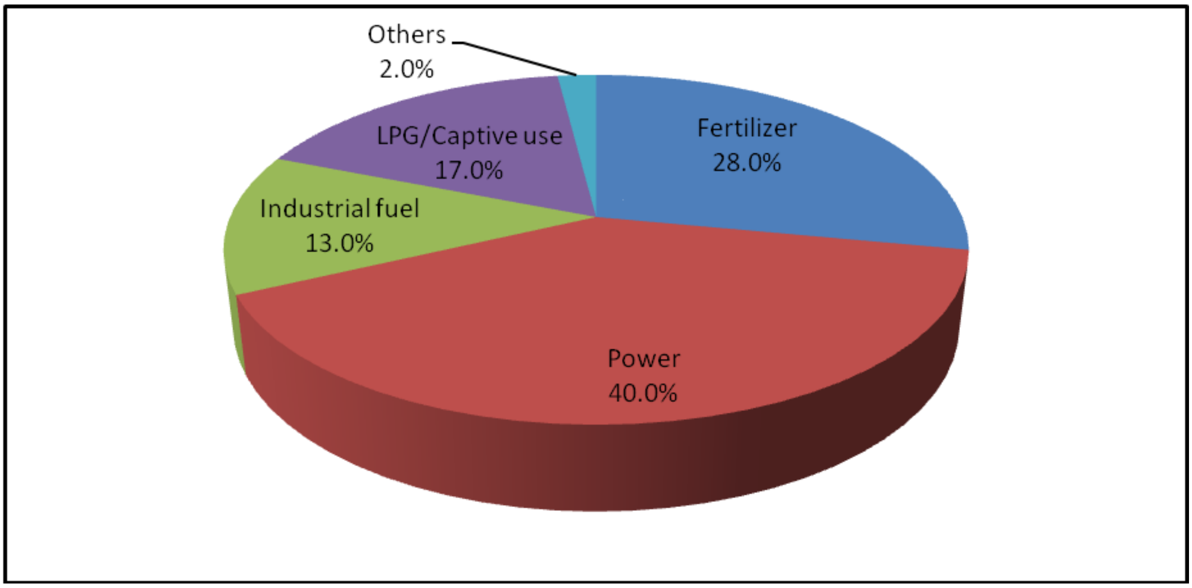
Natural gas is the preferred feedstock for urea production as it is a clean fuel and energy source. However, its availability, even to existing gas-based plants, has been under severe pressure because demand for gas is quite competitive since it serves as a major input to electricity generation and provides the preferred input to many other industrial processes (Figure 2.4). From the mid-1990s, supply of gas to fertilizer sector has reduced (42% in 1995-96 to about 26% in 2007-08) despite initial allocation to meet the full requirements (Figure 2.5). Consequently, gas-based units have started facing a supply shortage and had to meet the shortfall using naphtha. Against the total requirement of 36.33 MMSCMD of gas for the existing gas based fertilizer units, the actual average supply was 27.29 MMSCMD, a shortfall of about 24.8 per cent. Nitrogenous fertilizer sector has suffered during the last 5-6 years as there has not been any addition to its capacity.

Sectoral Shares

For nitrogenous fertilizer capacity the share of public sector has been declining over time. In early 1970s the public sector accounted for about 62 per cent of nitrogenous fertilizer capacity. The private sector held a share of about 28-29 per cent and cooperative sector about 8-9 per cent. With policy changes towards greater investment in private sector induced by introduction of RPS in 1977, the share of public sector started to decline and that of private and cooperative sector to improve. As on November 2008, the share of public sector was 28.3 per cent, private sector about 45 per cent and cooperative 25.8 per cent.

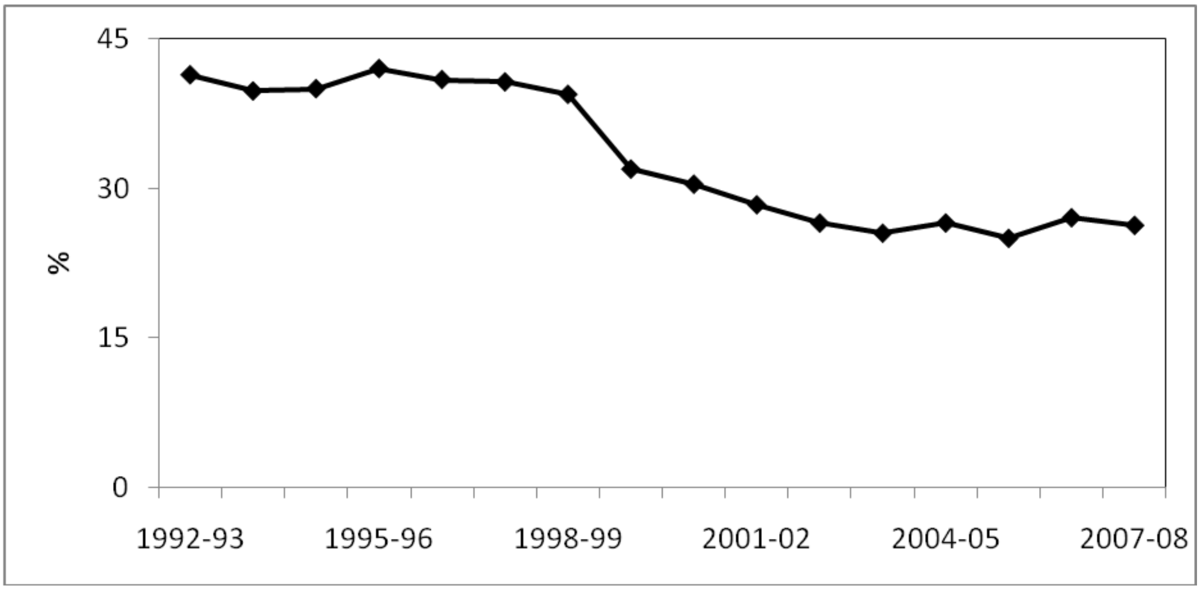
Sector and product wise capacity of fertilizer industry is given in Table 2.4. The share of private sector is higher in case of urea, ammonium sulphate, SSP and complex fertilizers. There has been no capacity addition between 2001-02 and 2007-08 in almost all products except some addition in urea and complex fertilizers. This additional capacity has been created mainly in private and cooperative sectors (Table 2.4).

Figure 2.4: Pattern of gas use in India, 2006-07



Source: FAI (2008)

Figure 2.5: Natural gas allocation for fertilizer sector: 1992-93 – 2007-08



Source: FAI (2008)

Table 2.4: Sector wise capacity of fertilizer products in India

	Public	*Private*	*Cooperatives*	*Total*
2001-02				
Urea	6413.8 (33.7)	7932.6 (41.7)	4669.5 (24.6)	19015.9 (100.0)
Ammonium sulphate	507.9 (58.7)	356.6 (41.3)	0 (0)	864.5 (100.0)
CAN	800.0 (84.9)	142.5 (15.1)	0 (0)	942.5 (100.0)
Ammonium chloride	0 (0)	171.0 (100.0)	0 (0)	171.0 (100.0)
SSP	622.5 (8.1)	7093.1 (91.9)	0 (0)	7715.6 (100.0)
NP/NPK Complex	2854.5 (26.3)	6391.0 (58.9)	1600.0 (14.8)	10845.5 (100.0)
2007-08				
Urea	6594.3 (31.3)	9024.5 (42.9)	5418.6 (25.8)	21037.4 (100.0)
Ammonium sulphate	407.9 (66.2)	208.6 (33.8)	0 (0)	616.5 (100.0)
CAN	800.0 (84.9)	142.5 (15.1)	0 (0)	942.5 (100.0)
Ammonium chloride	0 (0)	105.0 (100.0)	0 (0)	105 (100.0)
SSP	0 (0)	7526.2 (100.0)	0 (0)	7526.0 (100.0)
NP/NPK Complex	2134.5 (16.1)	6773.6 (51.2)	4335.4 (32.7)	13243.5 (100.0)

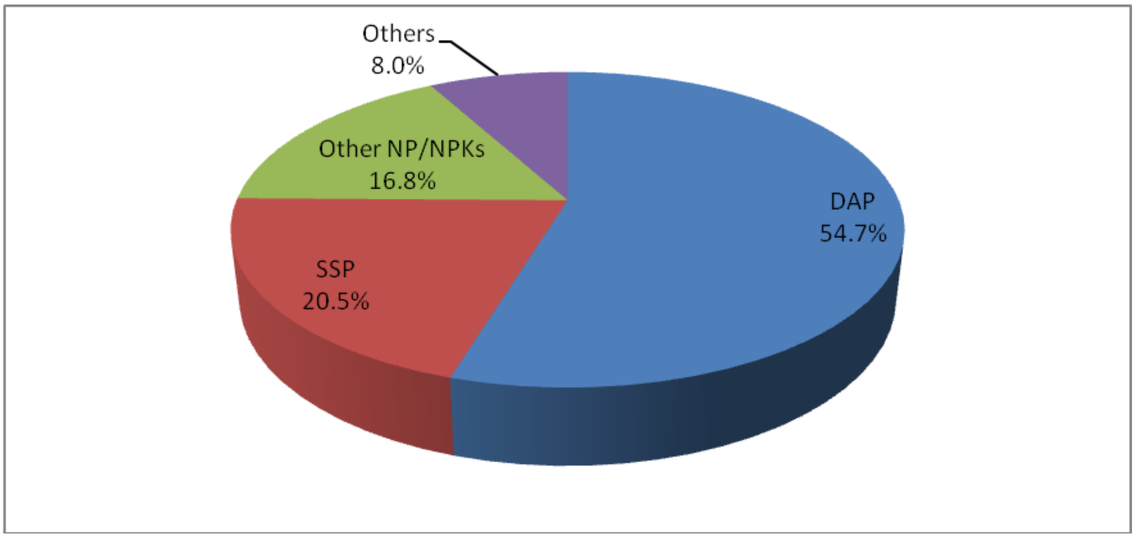
Source: FAI (2008)

P Fertilizers

Products

DAP constituted about 55 per cent of the total P_2O_5 capacity of 5.865 million tonnes in 2007-08 (Figure 2.6). SSP is the only straight phosphatic fertilizer manufactured in India, which constitute about 21 per cent of the total phosphate capacity. Remaining 24 per cent phosphate capacity is constituted by NP/NPK fertilizers (other than DAP). Among various grades of NP/NPK fertilizers, Ammonium Phosphate Sulphate of 20-20-0 grade is the most popular grade followed by 12-32-16 and 10-26-26 grades of NPK. Other NP/NPK grades being manufactured in India include nitro phosphate 20-20-0, 17-17-17, 15-15-15, 19-19-19, 14-35-14, 16-20-0, 28-28-0, 23-23-0 and 14-28-14.

Figure 2.6: Product-wise capacity of P fertilizers: 2007-08



Source: FAI (2008)

Capacity

The capacity of phosphatic fertilizers in the country remained stagnant during the 1950s and early part of 1960s. However, the capacity more than doubled from 274 thousand tonnes at the end of 3rd five year plan to 581 thousand tonnes in fourth five year (Table 2.5). The capacity creation was much faster during third, fourth and fifth five year plans. The new capacity addition during eighth five year plan was very less (from 2716 thousand tonnes at the end of seventh plan to 2948 thousand tonnes at the end of eighth plan). The main reason for this was decontrol of phosphatic fertilizers in 1992. Investment of P sector picked up during the ninth plan but again became stagnant during the tenth plan. The total capacity addition during tenth five year plan was 422 thousand tonnes against 2301 thousand tonnes during the ninth plan. As on November 2008, the installed capacity of phosphate (P) nutrients was 5865 thousand tonnes (FAI, 2008).

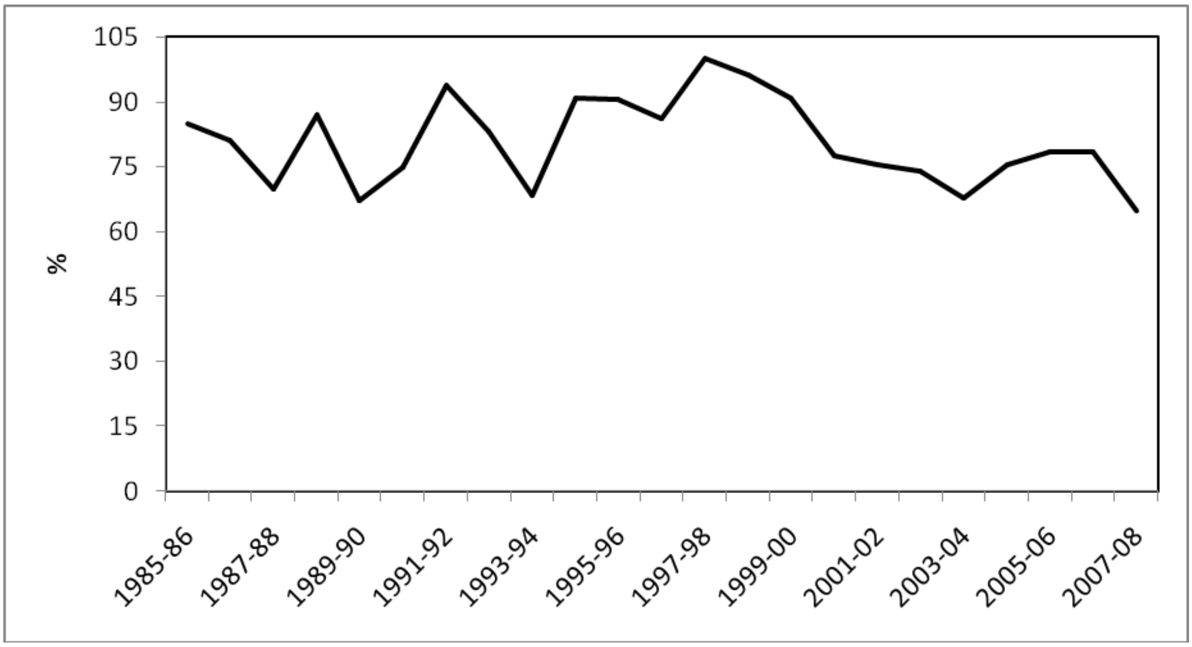
Capacity utilization of phosphatic fertilizers in the country has increased considerably from around 71 per cent during fifth five year plan to 86 per cent at the end of sixth plan. However, capacity utilization witnessed some decline during the seventh five year plan. The long term trend of a progressive step up in capacity utilization suffered a set back in the wake of the partial decontrol of phosphatic fertilizers effected in 1992-93 and capacity utilization reached a level of 68.5 per cent in 1993-94 (Figure 2.7). However, with introduction of concession scheme it was revived in 1994-95 and reinforced in 1995-96, when the capacity utilization attained the level of 90.7 per cent. The capacity utilization was an all time high in 1997-98 at 100 per cent. Private and cooperative units have higher capacity utilization compared with public sector (Table 2.6).

Table 2.5: Installed capacity and capacity utilization of P_2O_5 fertilizer Industry in India

	Installed Capacity	Capacity Utilization	Sectoral share			Production
			Public	Private	Coop.	
1947	68	-	-	-	-	-
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
2008-09	5865	64.9	386.7 (6.6)	3765.4 (64.2)	1712.8 (29.2)	3714.3

Source: FAI (2008)

Figure 2.7: Capacity utilization of P fertilizer industry: 1985 - 2007



Source: FAI (2008)

Sectoral Shares

Over the years public sector has lost its share to private and cooperative sectors. In 2007-08, 64.2 per cent (61% in 1991-92) of installed capacity was held by private sector units. The cooperative sector accounted for 29.2 per cent (11.0% in 1991-92) and the public sector only for 6.6 per cent (28.1% in 1991-92). However, production shares are distributed slightly differently, due to sector specific capacity utilization and efficiencies (Table 2.6). Public units have lower capacity utilization (41.9% in 2007-08) and their share in production is 4.4 per cent. While the share of private and cooperative sector in phosphatic fertilizer production is 69.6 and 26.1 per cent, respectively. There has been a substantial reduction in capacity utilization in the all the sectors between 1991-92 and 2007-08.

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 5.3 million tonnes of rock phosphate, 2.36 million tonnes of phosphoric acid, and 1.8 million tonnes of sulphur during 2006-07. In addition India also imports significant quantities of finished products such as DAP fertilizer. India's share in global trade of rock phosphate is about 18 per cent, as the indigenous production is extremely limited. India's indigenous production of phosphoric acid is also very low and it imports more than half of global trade in phosphoric acid and consumes about 11-12 per cent of world consumption.

Table 2.6: P fertilizer production, capacity and capacity utilization (%) by sectors in India

(Production and capacity in '000 tonnes nutrient)

	1991-92			2007-08		
	Production	Capacity	Capacity Utilization (%)	Production	Capacity	Capacity Utilization (%)
Public	730.2 (28.5)	791.4 (28.1)	92.3	161.9 (4.4)	386.7 (6.6)	41.9
Private	1481.9 (57.8)	1718.3 (61.0)	86.2	2583.7 (69.6)	3765.4 (64.2)	68.6
Cooperative	349.9 (13.7)	309 (11.0)	113.2	968.7 (26.1)	1712.8 (29.2)	56.6
Total	2562 (100.0)	2818.7 (100.0)	90.9	3714.3 (100.0)	5864.9 (100.0)	63.3

Figures in parentheses show percentage to total

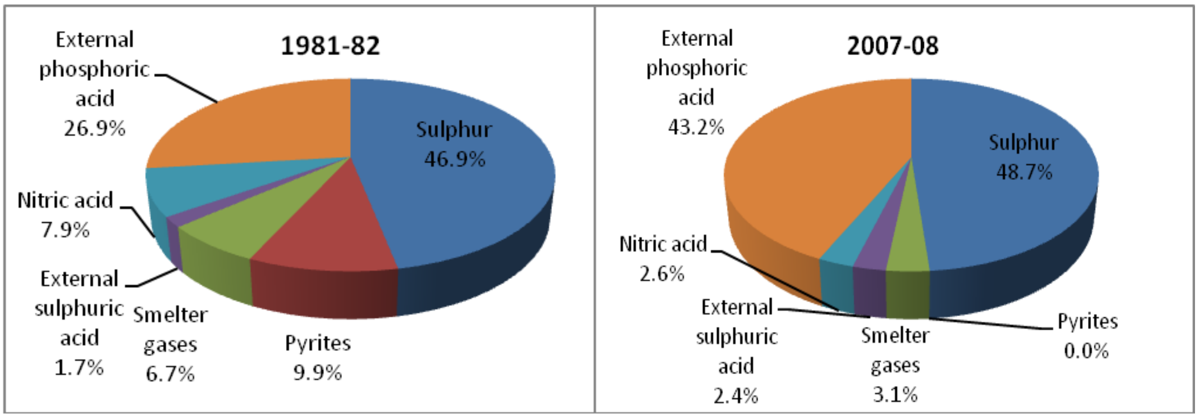
Source: FAI (2008)

Sulphur is the main feedstock for phosphatic fertilizers and accounts for nearly half of total capacity. The share of sulphur has remained almost stable during the last two and half decades but share of external phosphoric acid, which is the second most important feedstock, has increased significantly (26.9% in 1981-82 to 43.2% in 2007-08). 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, high dependence on imports of raw materials exposes the Indian phosphatic industry to external factors like high variability in prices of these raw materials.

Inter-regional Dispersal of Fertilizer Industry

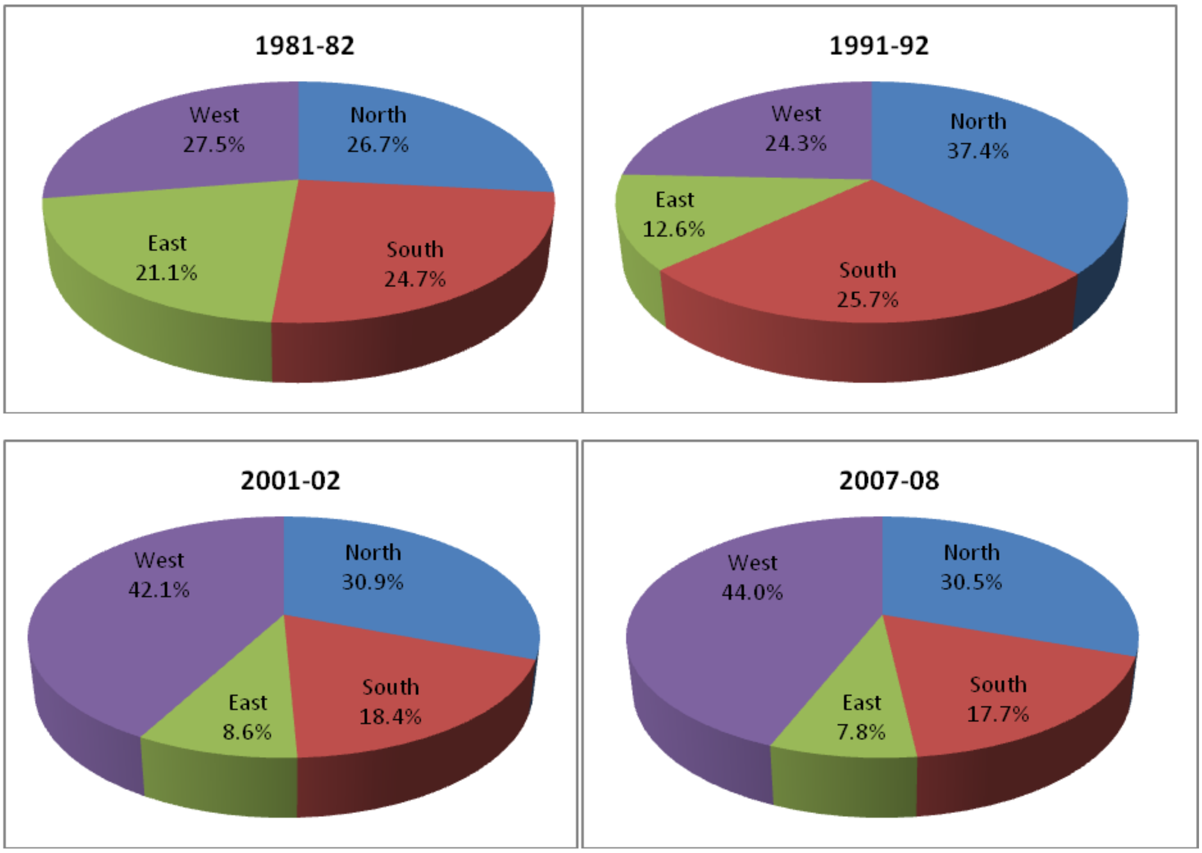
The policies adopted by the Government for reducing regional disparities were industrial licensing and location of public sector units in designated areas. However in case of fertilizer industry, availability of feedstock in certain regions led to some concentration in the areas where feedstock was available in abundance. The distribution of fertilizer capacity in different regions is given in Figure 2.9. The product and region-wise distribution of capacity in presented in Annexure Table 2.1.

Figure 2.8: Feedstock-wise share of P capacity



Source: FAI (2008)

Figure 2.9: Trends in zone-wise installed capacity of N fertilizers in India

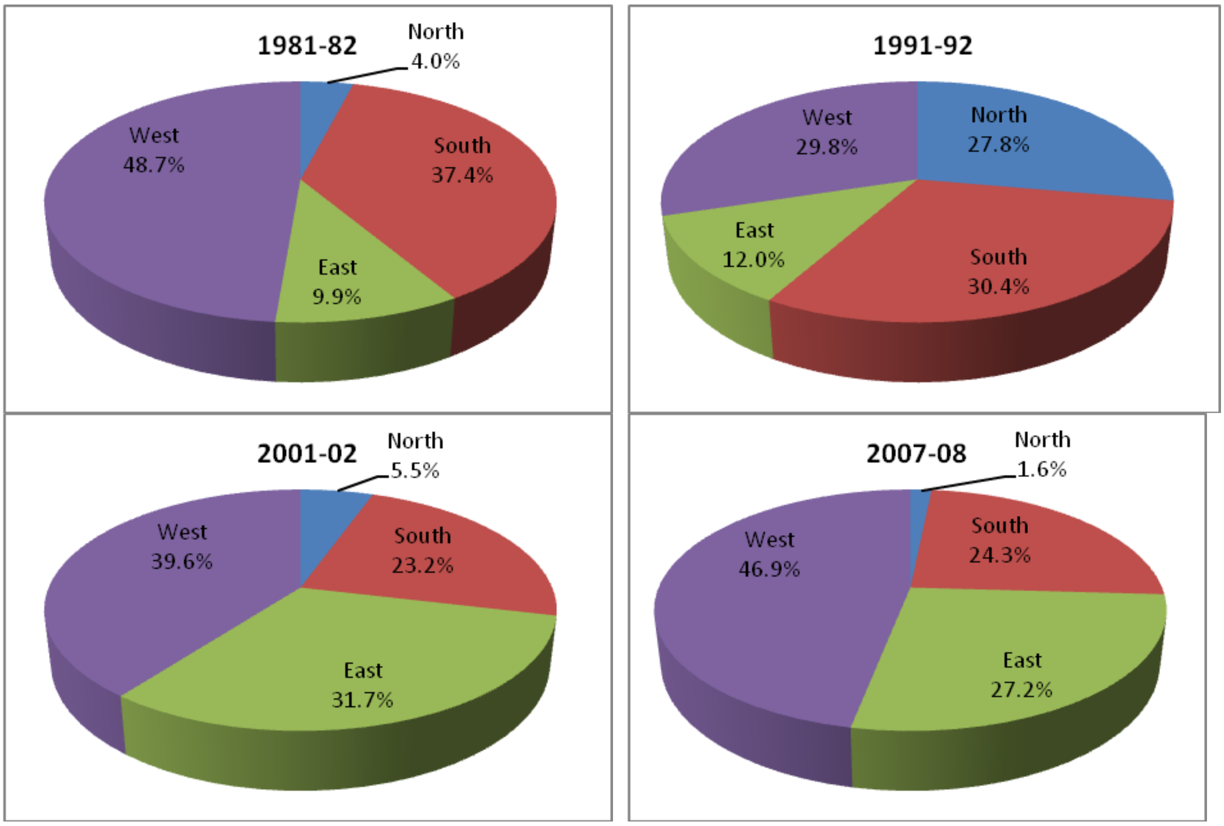


Source: FAI (2008)

In 1981-82, N fertilizer capacity was more evenly distributed in all regions. However, due to availability of natural gas and naphtha in western region and Hazira-Bijapur-Jagdighpur (HBJ) gas pipeline in northern region led to more capacity addition in these two regions. The share of north region increased from 26.7 per cent in 1981-82 to 30.5 per cent in 2007-08 while share of western region increased from 27.5 per cent to 44 per cent during the corresponding period. The share of eastern region fell significantly from about 21 per cent to 7.8 per cent. Southern region also lost its share in N capacity.

In case of P_2O_5 the maximum capacity creation is in western region accounting for about 47 per cent of total installed capacity in 2007-08. The share of south zone has declined from 37.4 per cent in 1981-82 to 24.3 per cent in 2007-08, while eastern region has increased its share from less than 10 per cent in 1981-82 to 27.2 per cent in 2007-08. The share of north region has been small during all the years except for 1991-92 when its share was 27.8 per cent.

Figure 2.10: Trends in zone-wise installed capacity of P fertilizers in India



Source: FAI (2008)

Production Trends

Fertilizers have played an important role in increased crop production, especially in cereals, and will continue to be a cornerstone of the technology-driven agriculture required to feed the expanding population. Fertilizers replenish the nutrients removed from soils by harvested crops, encourage adoption of high-yielding varieties, and increase biomass in the nutrient-poor soils of the tropics.

N Fertilizers

As can be seen from Table 2.7 about 85 per cent of nitrogen nutrient comes from straight nitrogenous fertilizer products, mainly from urea (83.7%). The remaining share is contributed through use of complex fertilizers such as DAP and others. Small quantities of other straight fertilizer such as Ammonium Sulphate, Calcium Ammonium Nitrate and Ammonium Chloride are also produced but their share has declined significantly (25.2% in 1971-72 to 1.2 per cent in 2007-08). On the other hand share of urea has increased from 59.9 per cent in 1971-72 to 83.7 per cent in 2007-08. The share of NP/NPK complex fertilizers has remained almost stagnant at about 15 per cent during the last three and half decades.

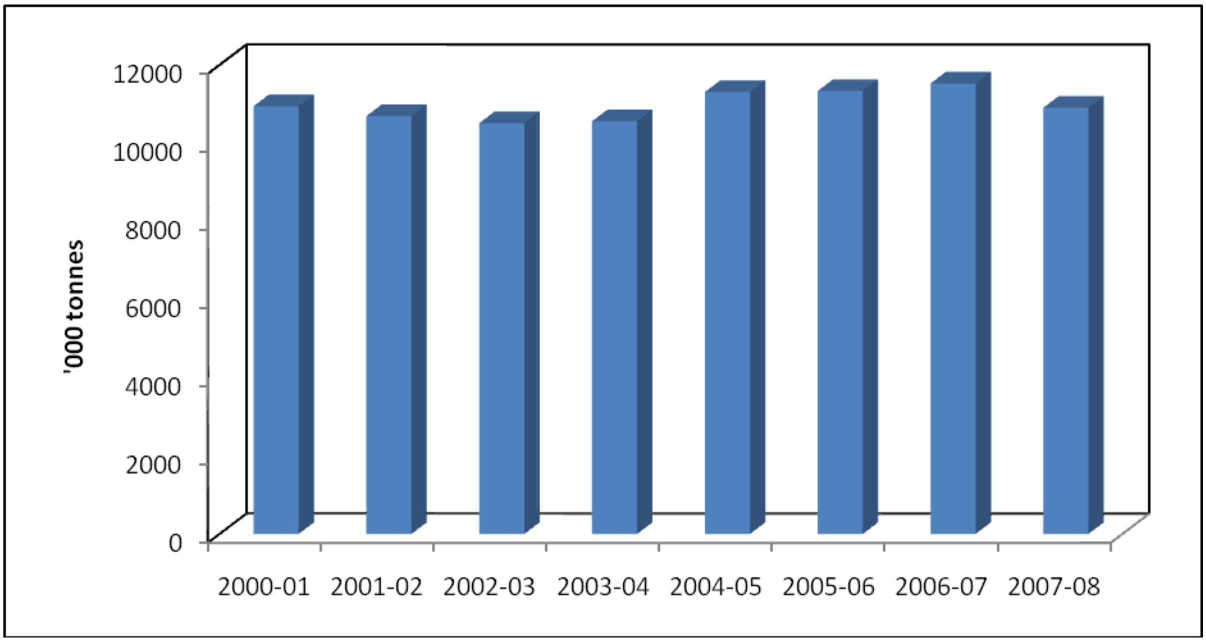
Table 2.7: Share of fertilizer products in total N nutrient production

Product	1971-72	1981-82	1991-92	2001-02	2007-08
Straight nitrogenous fertilizers	85.1	85.1	84.3	83.5	84.9
Urea	59.9	78.8	80.8	81.8	83.7
Others	25.2	6.3	3.5	1.7	1.2
NP/NPKs (complex)	14.9	14.9	15.7	16.5	15.1

Source: FAI (2008)

At the time of commencement of planning in India in 1951-52, total production of nitrogenous fertilizers was 28.9 thousand tonnes and crossed 10 million tonnes in 1997-98. Production of nitrogenous fertilizers increased substantially during the decade of 80s, especially after the introduction of Retention Pricing Scheme (RPS) in 1977. Production of N increased from 3.14 million tonnes in 1981-82 to 7.30 million tonnes during 1991-92. It further increased to 11.52 million tonnes during 2006-07 but declined to 10.9 million tonnes in 2007-08. The trends in production of N for the period 1951-52 to 2007-08 are given in Figure 2.1. The production of N fertilizers during 2007-08 was almost same as 2000-01 levels of 10.9 million tonnes. N fertilizer production has been stagnant over the last 7 years as shown in Figure 2.11.

Figure 2.11: Trends in production of N fertilizers during the 2000s



Source: FAI (2008)

P Fertilizers

Although, indigenous phosphatic fertilizer industry in India started with manufacturing of Single Super Phosphate (SSP) in 1906, but today DAP is the most popular source of phosphate in the country. Other higher P nutrient fertilizers like Triple Super Phosphate (TSP) or Mono Ammonium Phosphate (MAP) are not used in India. DAP constitutes over 50 per cent of total phosphate produced in the country. The share of SSP has come down from 42.8 per cent in 1971-72 to 18.6 per cent in 1991-92 and reached a level of 9.7 per cent in 2007-08. The balance of phosphate comes from other NP/NPK complex products.

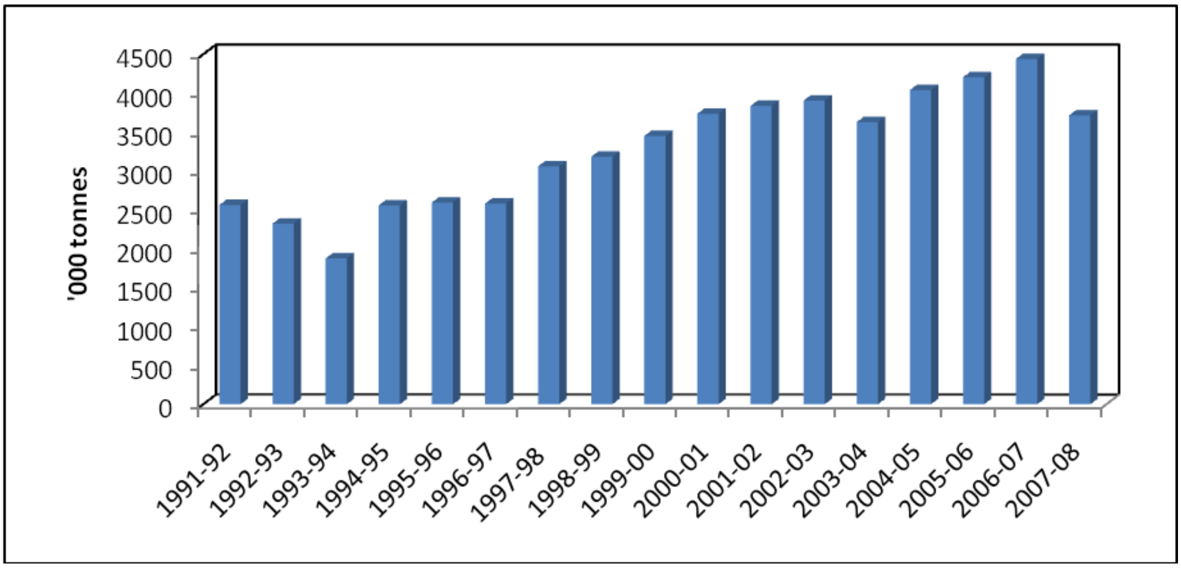
The production of phosphatic fertilizers increased from 9.8 thousand tonnes in 1951-52 to 4.4 million tonnes in 2006-07. However, the growth in production of P was slow till the decade of 1970s. It picked up during the next decade following the introduction of Retention Pricing Scheme (RPS) in 1979. Production of P increased from less than one million tonnes in 1981-82 to 2.562 million tonnes in 1991-92. However, the production of P fertilizers fell significantly in 1992-93 due to decontrol of P and K fertilizers in August 1992 which resulted in an increase in prices of these fertilizers. Production of P declined to 2.321 million tonnes during 1992-93 and further to 1.874 million tonnes in 1993-94 (Figure 2.12). The decline in production and significant increase in prices of phosphatic fertilizers affected NPK use ratio resulting in an imbalance in consumption of these essential plant nutrients. The government took some corrective measures (concession on P and K fertilizers) in 1993-94 and the production trends improved in the subsequent years. Total production of P fertilizers reached a level of 4.44 million tonnes in 2006-07 and then declined to 3.714 million tonnes in 2007-08. The growth in P production has decelerated significantly during the last 6-7 years leading to higher imports.

Table 2.8: Share of fertilizer products in total P_2O_5 nutrient production

Product	1971-72	1981-82	1991-92	2001-02	2007-08
SSP	42.8	20.3	18.6	10.4	9.7
DAP	7.9	13.5	51.6	61.0	52.2
Other NP/NOK complexes	48.2	63.9	29.8	28.5	38.2
Others	1.2	2.3	0.0	0.0	0.0

Source: FAI (2008)

Figure 2.12: Trends in production of P_2O_5 in India: 1991-92 to 2007-08



Source: FAI (2008)

Growth Rates

N fertilizer production increased at an annual growth rate of 26.4 per cent in the pre-green revolution period (from 28.9 thousand tonnes in 1951-52 to 309 thousand tonnes in 1966-67), while P production increased at the rate of over 40 per cent during the same period. In the next 14 years (first phase of green revolution) N production increased at a growth rate of 10.5 per cent and P production at an annual compound growth rate of 10 per cent. Growth in production of N fertilizer accelerated (12.4%) during the second phase of green revolution (1981-82 to 1991-92) due to introduction of RPS scheme and spread of new technologies to more regions of the country. P production also increased significantly at an annual growth rate of 11.9 per cent.

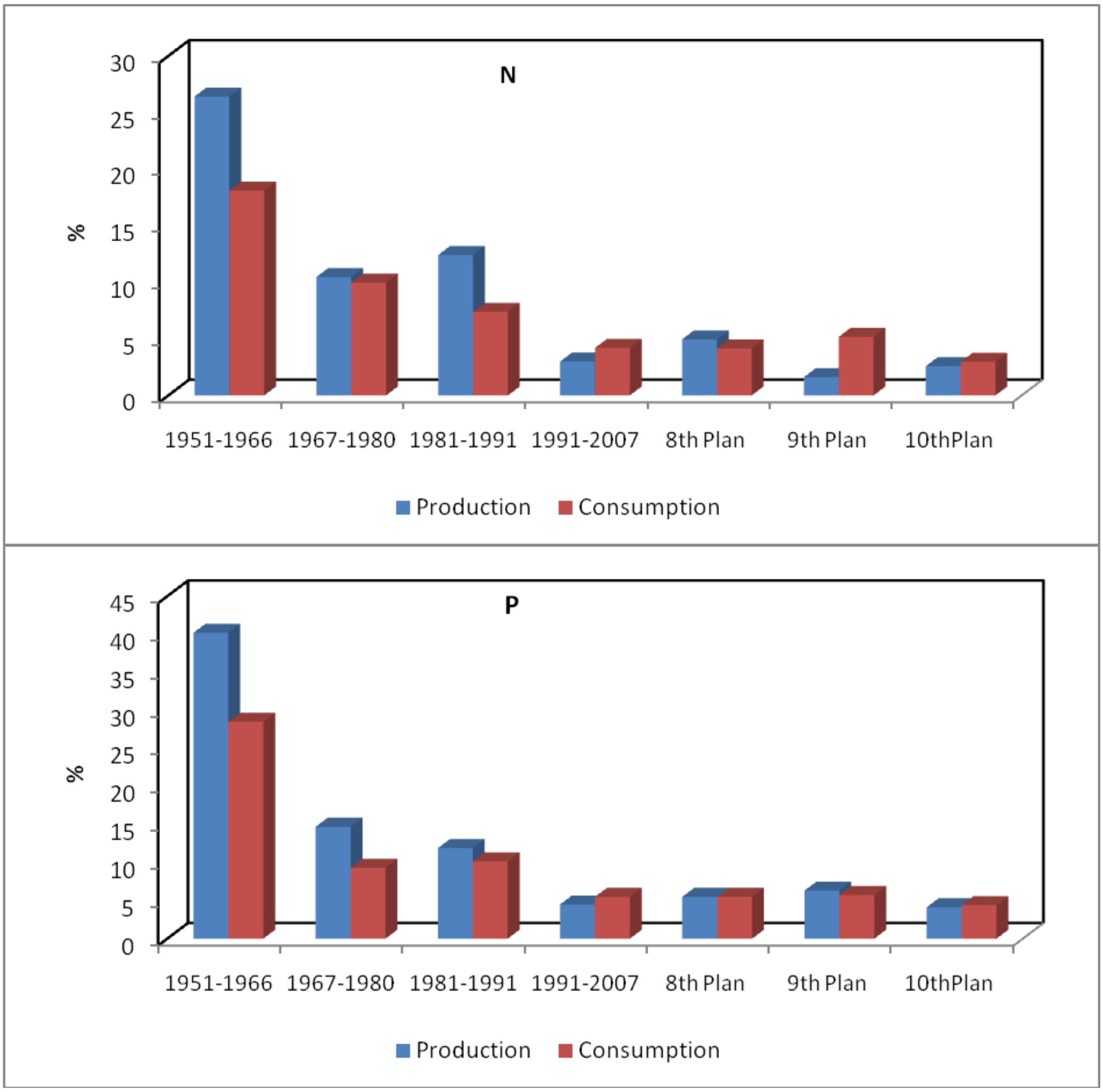
Table 2.9: Growth rate in fertilizer production (nutrient-wise)

Period	Growth rate (%)	
	N	P
Pre-green revolution period (1950-51 - 1966-67)	26.4	40.2
Post-green revolution period (1966-67 - 1991-92)	13.5	12.5
Phase I (1967-68 - 1980-81)	10.5	10.0
Phase II (1981-82 - 1991-92)	12.4	11.9
Post reforms Period (1991-92 - 2007-08)	3.0	4.5
8th Five Year Plan	5.0	5.5
9th Five Year Plan	1.6	6.3
10th Five Year Plan	2.6	4.1
1991-92 - 2000-01	5.5	5.8
2001-02 - 2007-08	1.1	1.1

Source: FAI (2008)

However, Indian fertilizer sector suffered a lot in the post-reforms period and performance was much lower compared to the decade of eighties. N fertilizer production increased at an annual growth rate of 3 per cent from 7.3 million tonnes in 1991-92 to 10.9 million tonnes in 2007-08. The P production increased at the rate of 4.5 per cent per annum. However, both N and P production remained almost stagnant during 2000-01 and 2007-08. Fertilizer production grew at a much faster rate compared to consumption in the pre-reforms period but in post-reforms period growth in fertilizer consumption was higher than production which increased dependency on imports (Figure 2.13).

Figure 2.13: Trends in growth rates of N and P production and consumption in India

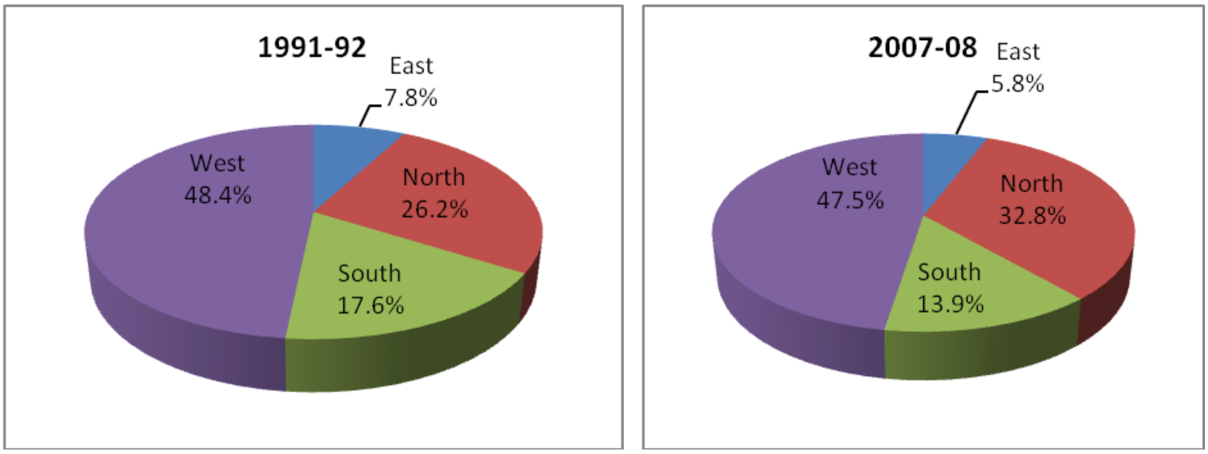


Source: FAI (2008)

Regional Imbalances

The share of different zones in total N production varied greatly. The western region had the highest share in N production accounting for 47.5 per cent in 2007-08, followed by northern region (32.8%). Eastern zone lags in N production and has also lost its share during the last one and half decade from 7.8 per cent in 1991-92 to 5.8 per cent during 2007-08. Similarly, southern region has also lost its share in total N production.

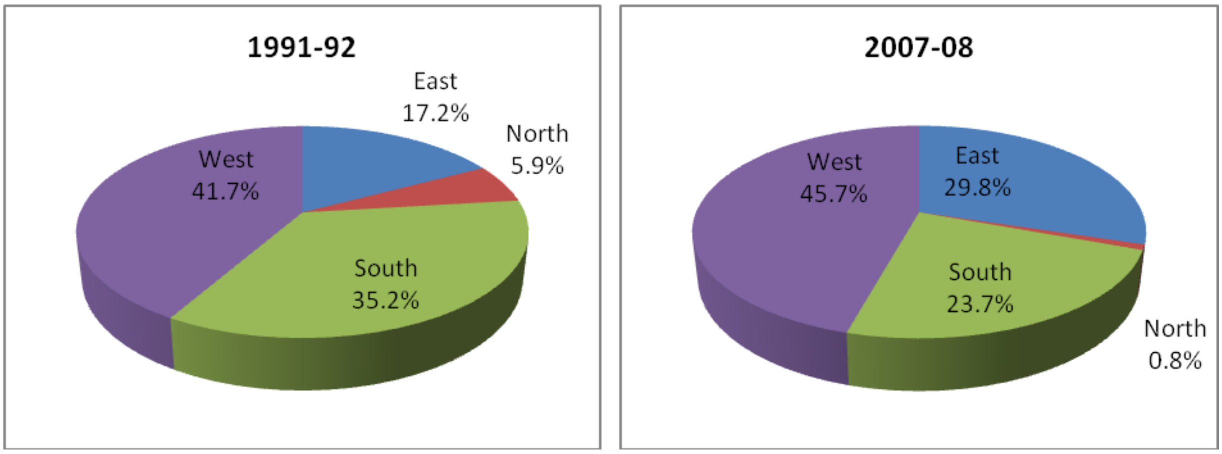
Figure 2.14: Trends in zone-wise production of N fertilizers in India



Source: FAI (2008)

In phosphate production also western region is the largest producer with 45.7 per cent share in 2007-08. Southern region, which ranked second in P production with a share of 35.2 per cent in 1991-92, lost its position and eastern zone became the second largest producer of P fertilizers in 2007-08 with a share of 29.8 per cent. The north zone is at the bottom with a share of less than one per cent during 2007-08, down from about 6 per cent in 1991-92. Between 1991-92 and 2007-08 eastern and western regions increased their share in P production while north and south zones lost their share. The reduction in share is higher in case of southern region compared with the north.

Figure 2.15: Trends in zone-wise production of P fertilizers in India

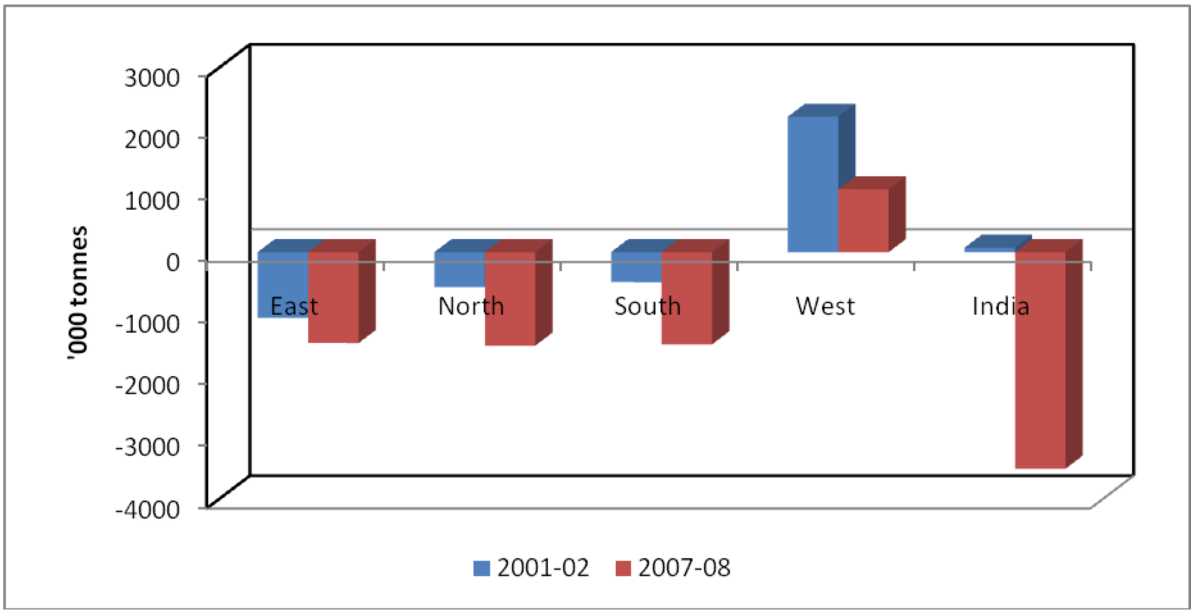


Source: FAI (2008)

Within zone also fertilizer production varied from state to state. For example, in 2007-08 Gujarat alone produced about 40 per cent of total N production in western region while in north region the share of Uttar Pradesh was over 80 per cent. Same was the case as regards the production of P fertilizers. Gujarat alone accounted for over 70 per cent of total P production in western region and about one-third of national production. Orissa, the second largest producer of P fertilizers accounted for over 70 of production in eastern region and about 22 per cent of national production.

Taking into account the regional production and consumption of nitrogenous fertilizers, all regions except the western region are in deficit and the extent of deficit is the highest in the northern region closely followed by the southern and eastern regions (Figure 2.16). Consumption requirements of deficit regions are met through transporting fertilizers from surplus regions and imports. The deficit has increased significantly between 2001-02 and 2007-08. In 2001-02, there was a small surplus balance but in 2007-08 there was a significant deficit (3.516 million tonnes) between production and consumption at the national level.

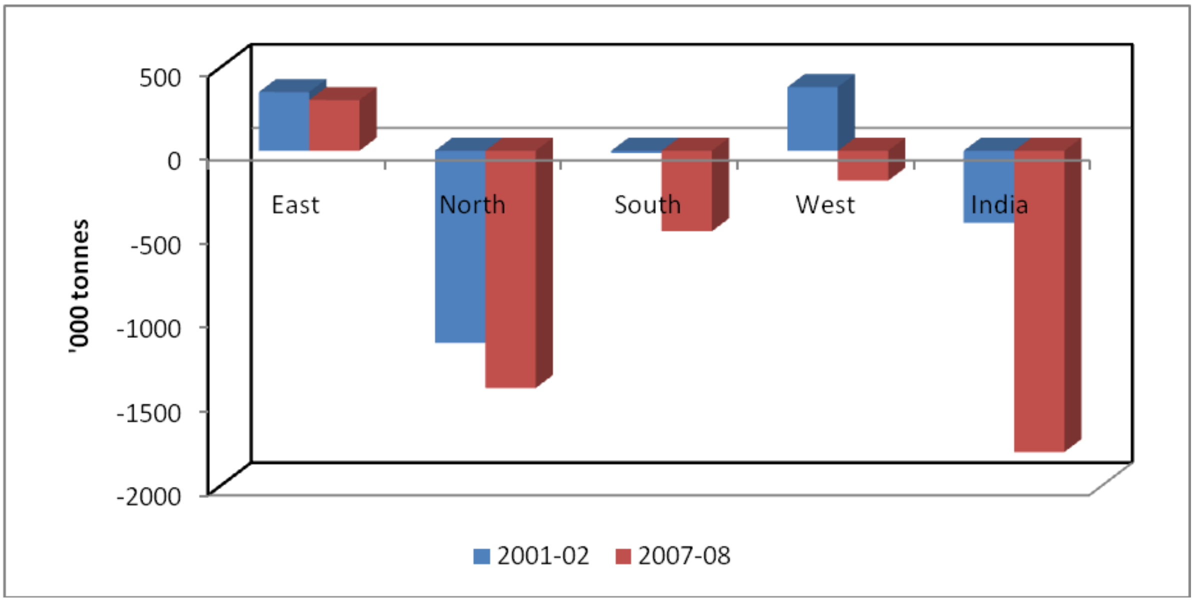
Figure 2.16: Regional pattern in gap between production and consumption of N fertilizers



Source: FAI (2008)

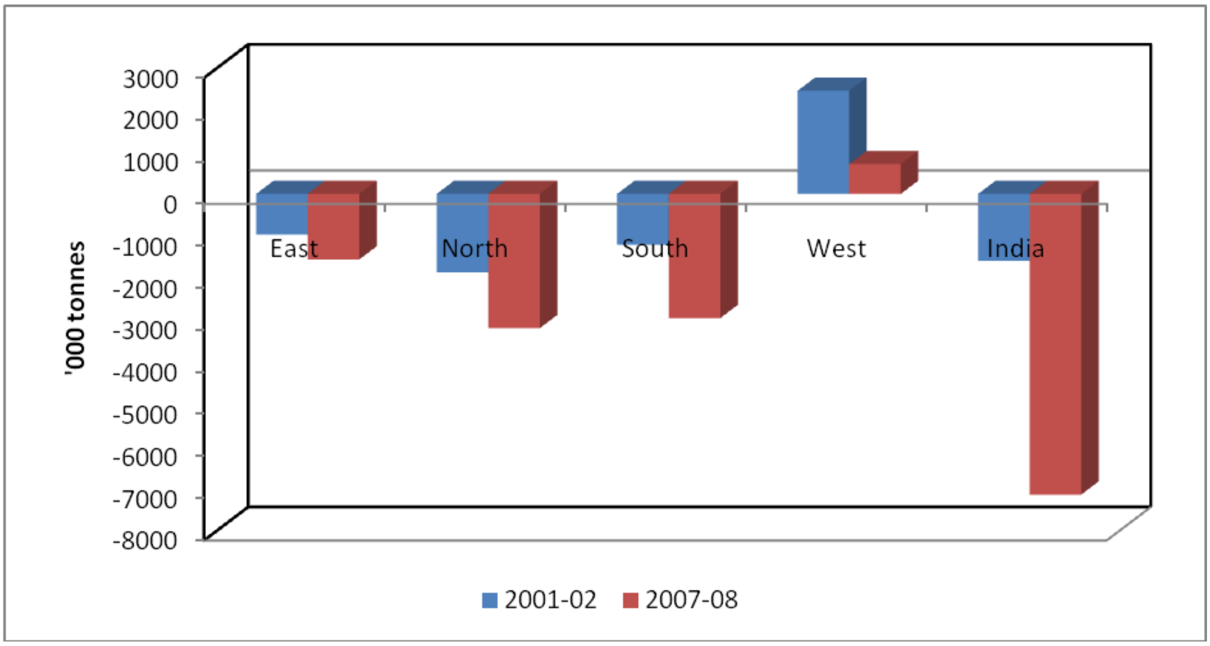
In case of the phosphatic fertilizers, there is a surplus in the eastern region and a significant deficit in northern region (Figure 2.17). Western region which was surplus in 2001-02 has become deficit in 2007-08. On an all India basis, there is a deficit in both nitrogenous and phosphatic fertilizers though the deficit is of much higher order in case of N fertilizers. The trend is almost similar in case of total fertilizer (N+P+K) production and consumption (Figure 2.18).

Figure 2.17: Regional pattern in gap between production and consumption of P fertilizers



Source: FAI (2008)

Figure 2.18: Regional pattern in gap between production and consumption of N+P+K fertilizers



Source: FAI (2008)

Feedstocks and Intermediates

N Fertilizers

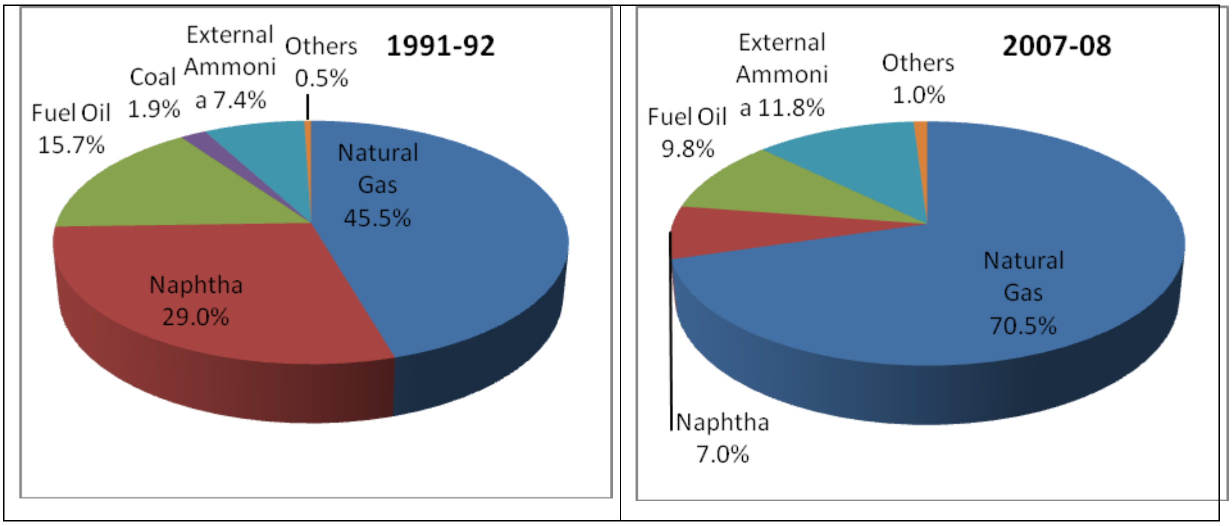
Domestic raw materials are available for nitrogenous fertilizers. For production of urea and other ammonia based fertilizers, natural gas, naphtha, fuel oil, low sulfur heavy stock (LSHS) and coal are major raw materials. In the early years, the N capacity was based almost entirely on coke oven gas. By 1970s, naphtha had become the most common feedstock, a position which was taken over by natural gas later on. The present fertilizer production scene represents a major departure from the past as regards the usage of various raw materials and imported intermediaries.

During the last one and half decade, N production has more and more shifted to the use of gas. The share of natural gas in total installed capacity of N fertilizers has increased from 14.4 per cent in 1971-72 to 41.5 per cent in 1991-92 which further increased to 61.5 per cent in 2007-08. This shift towards gas as feedstock was mainly due to new pricing scheme for urea which seeks to promote the use of natural gas, the efficient and comparatively cheaper feedstock, for urea production and encourage naphtha/fuel oil/LSHS based units to switch over to using gas as feedstock. The share of gas in urea production has increased from 45.5 per cent in 1991-92 to 70.5 in 2007-08. Naphtha, which used to be the most important feedstock in 1970s, has lost its share from 29 per cent to just 7 per cent in total production. Similarly share of coal has also declined significantly. Natural gas is the preferred feedstock for urea production as it is a clean fuel and energy source. However, its availability, even to 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, supply of gas to fertilizer sector has reduced (42% in 1995-96 to about 26% in 2007-08) despite initial allocation to meet the full requirements. Consequently, gas-based units have started facing a supply shortage and had to meet the shortfall using naphtha. Against the total requirement of 36.33 MMSCMD of gas for the existing gas based fertilizer units, the actual average supply was 27.29 MMSCMD, a shortfall of about 24.8 per cent.

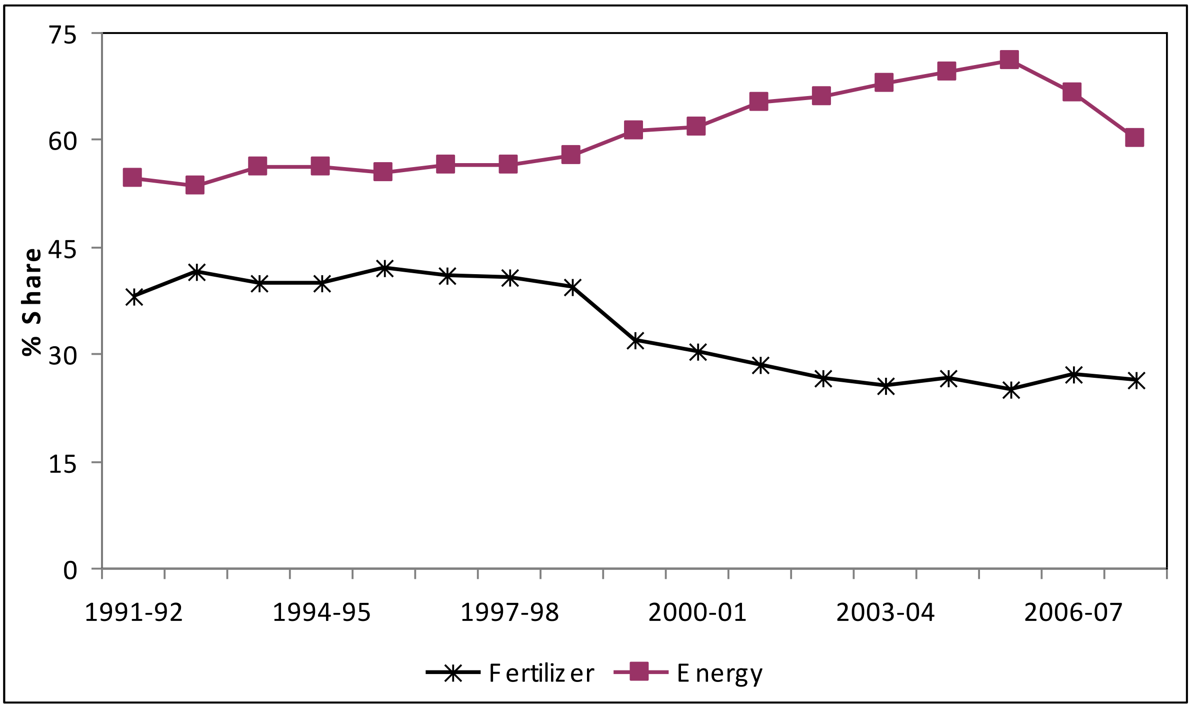
No major changes are expected in the product pattern. The share of urea is expected to remain high and dominate the N sector. However, with introduction of nutrient-based subsidy scheme in 2008, the share of other straight nitrogenous and NP/NPK complexes might increase in coming years.

Figure 2.19: Feedstock Share (%) in total production of N



Source: FAI (2008)

Figure 2.20: Natural gas allocation for fertilizer and energy sectors: 1991-92 – 2007-08



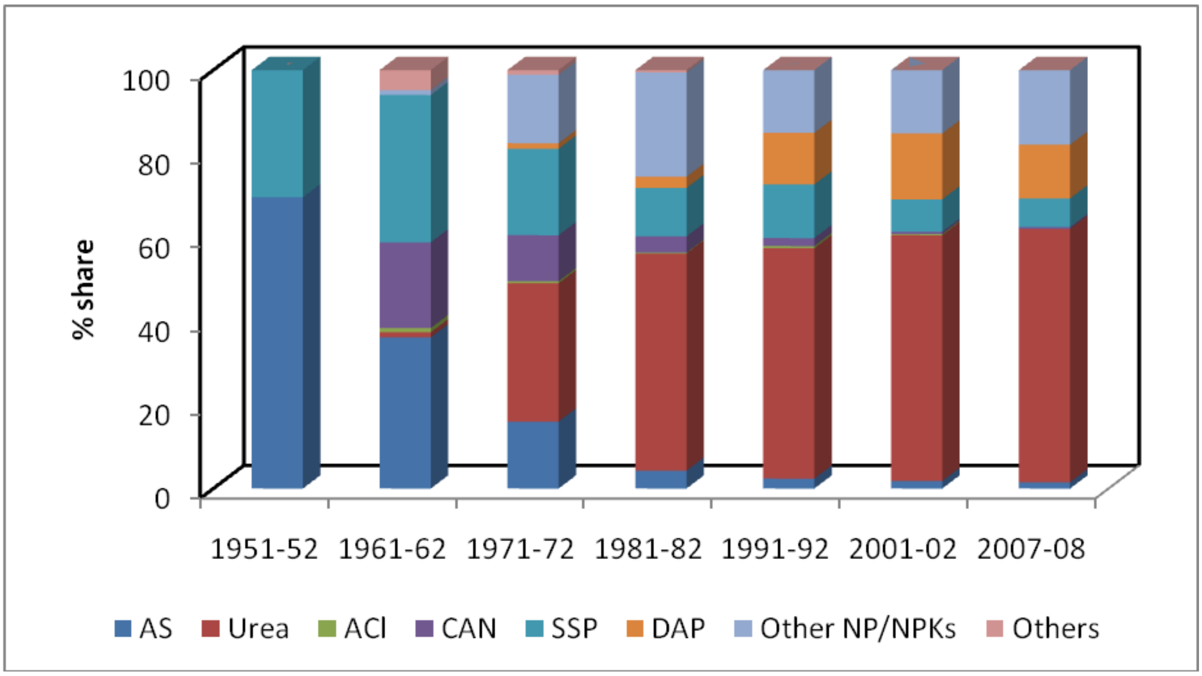
Source: FAI (2008)

__Product Shares__

Up to 1960s, ammonium sulphate and single superphosphate (SSP) dominated the product pattern and N and P fertilizers in the country (Figure 2.21). By 1970s, urea had emerged the single most important N fertilizer and further consolidated its position and its share increased to over 70 per cent in 2007-08.

Among P fertilizers, NP and NPK complexes mainly DAP emerged as important P fertilizer and took the leading share away from single super phosphate. By 2007-08, urea virtually dominated N sector accounting for 83.7 per cent of total N nutrient production, while DAP contributed more than half of P_2O_5 production. Single super phosphate lost its share significantly in the post-reforms period due to decontrol of SSP in 1992 and no concession for manufacturers of SSP. Subsequently, concession was introduced but the quantum of concession was much lower compared with DAP. Due to localized nature of the industry, different state governments fixed the selling prices and prices vary widely across states. The concession on SSP was increased in 2005-06 which was expected to increase its share but did not happen due to increase in input and other costs. With introduction of nutrient-based subsidy scheme, SSP and other complex fertilizer sectors are expected to gain some share.

Figure 2.21: Share of major fertilizer products in total fertilizer production in India

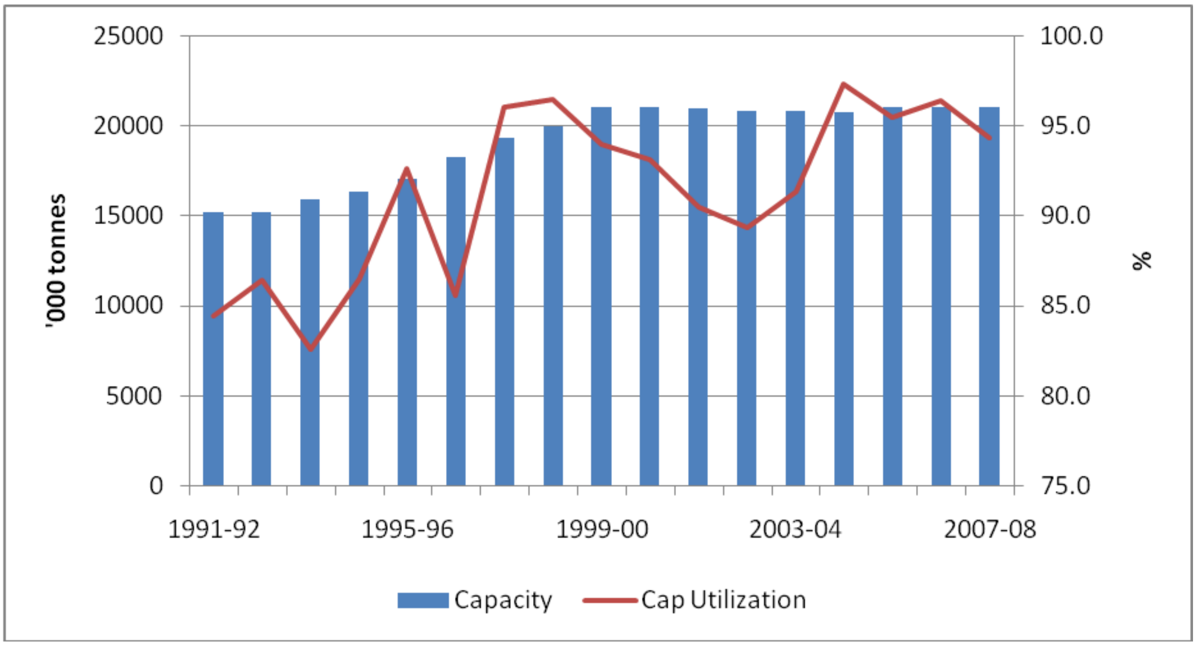


Source: FAI (2008)

Growth in Production and Capacity of Urea

The Figure 2.22 shows the growth in capacity and capacity utilization of urea in the post-reforms period. The installed capacity of urea increased significantly during the 1990s from 1.519 million tonnes in 1991-92 to 2.108 million tonnes in 2000-01 but no significant capacity addition took place during the last few years. Average capacity utilization of N sector is quite high. It has increased from about 85 per cent in early-1990s to about 97 per cent in the recent years with the exception of 2002-03 when it fell below 90 per cent due to poor monsoon.

Figure 2.22: Growth in capacity and capacity utilization of Urea

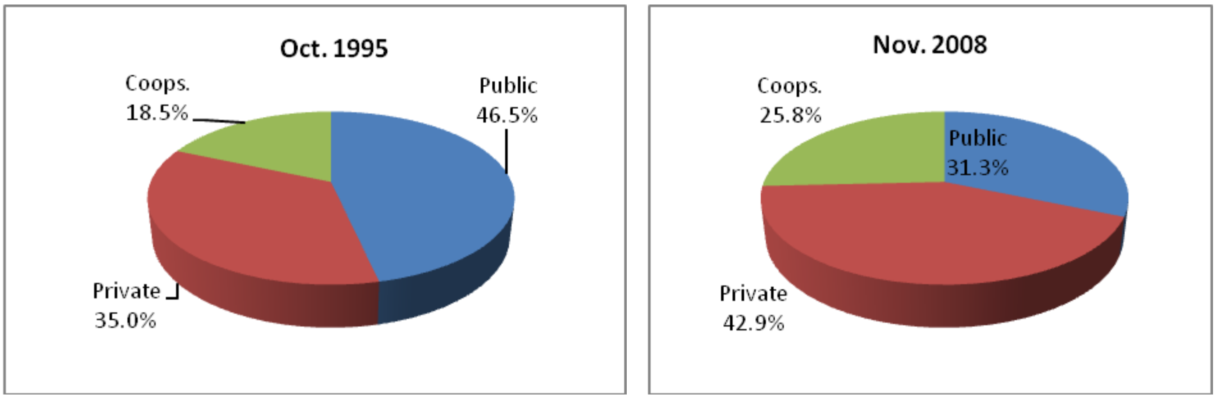


Source: FAI (2008)

Urea capacity is distributed among all three sectors; namely, private, public and cooperative (Figure 2.23). Private sector accounts for about 43 per cent of the capacity, followed by public sector (31.3%) and cooperatives (25.8%).

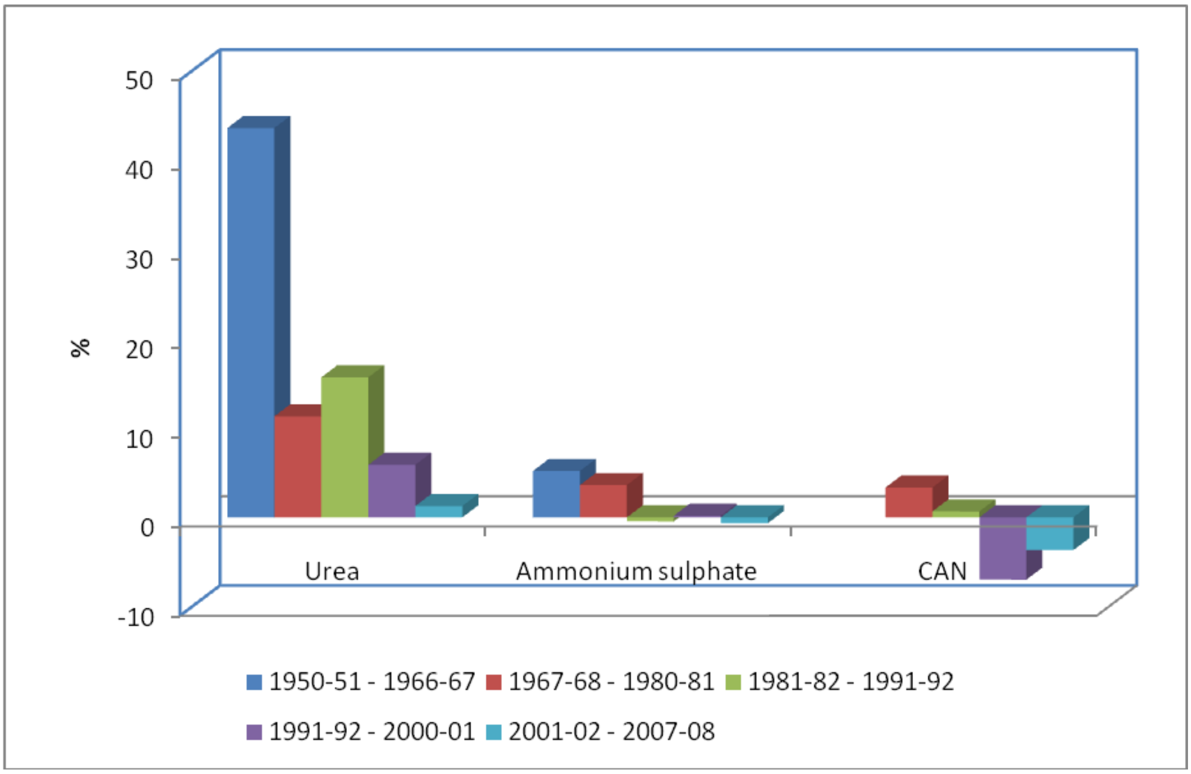
Trends in growth rate of production of urea, ammonium sulphate and calcium ammonium nitrate are given in Figure 2.24. Urea production grew at an annual growth rate of over 40 per cent in the pre-green revolution period (1951-52 to 1966-67) mainly due to low base year production. The production of urea grew at a growth rate of 11.3 per cent during the first phase of green revolution (1966-67 to 1980-81) which further accelerated to 15.7 per cent during the period 1981-82 to 1991-92. The growth in urea production decelerated during the nineties (5.9%) and remained almost stagnant during the 2000s. Other straight nitrogenous fertilizers, namely, ammonium sulphate and calcium ammonium nitrate, witnessed negative or stagnant growth during the last two and half decades.

Figure 2.23: Sector-wise distribution of urea capacity: October 1995 and November 2008



Source: FAI (2008)

Figure 2.24: Trends in growth rates of production of straight nitrogenous fertilizers, urea, AS and CAN



Source: FAI (2008)

Major Players in N Fertilizer Industry

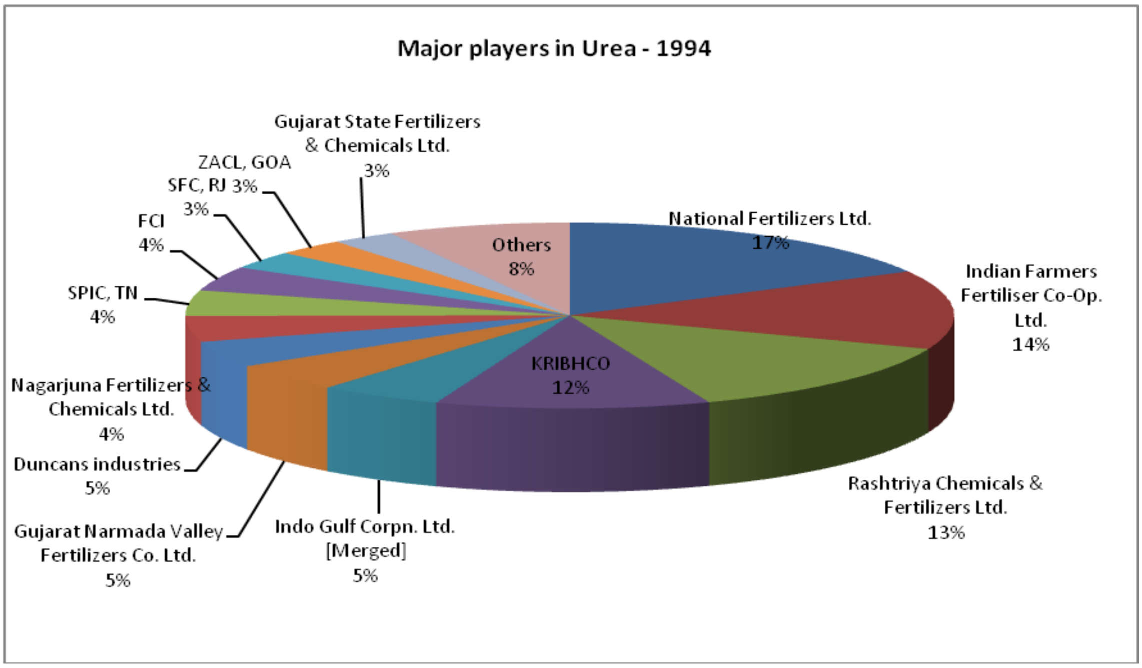
Major players in the urea industry are IFFCO, National Fertilizers Limited (NFL), Chambal Fertilizers and Chemical Ltd., KRIBHCO and Rashtriya Chemicals and Fertilizers (RCF), accounting for nearly two-third of total urea production in the country (Figure 2.25). In the top five producers, Chambal Fertilizers and Chemicals Limited is the only private sector player and its share is 9.3 per cent. There is no major change in production shares of major producers between 1994 and 2007 with the exception that IFFCO has increased its share while Rashtriya Chemicals and Fertilizers Limited lost its share.

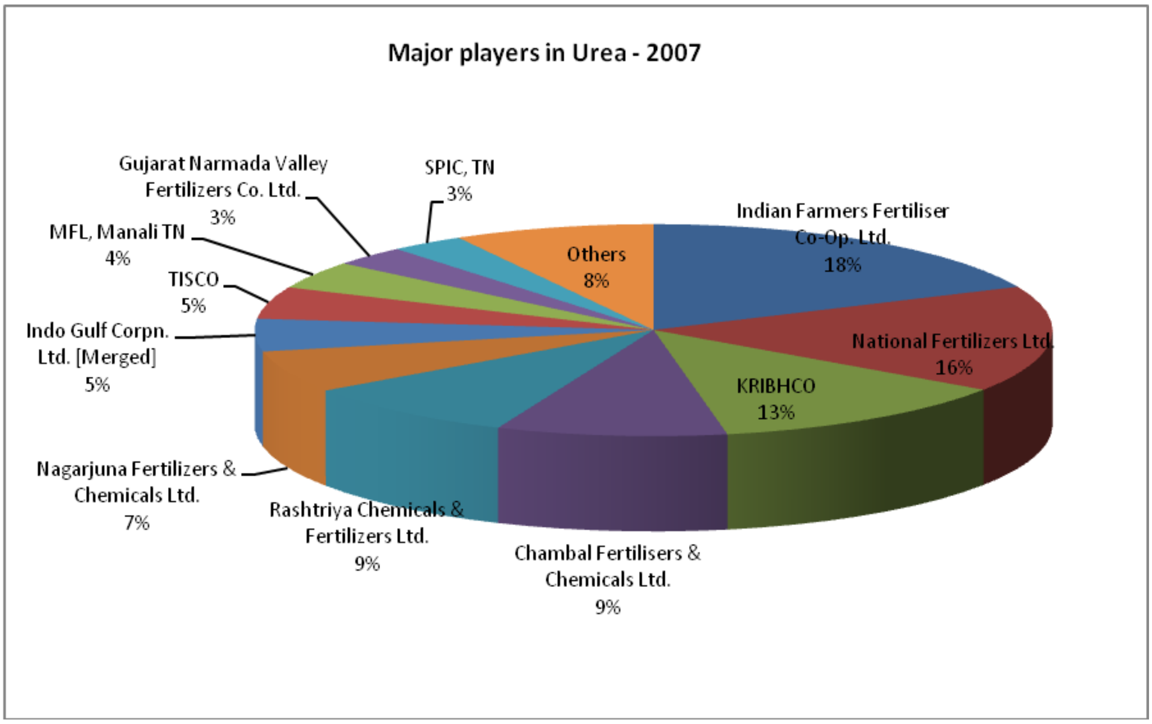
Growth in Production and Capacity of DAP and SSP

There has been a shift in the product pattern over the years. SSP dominated P fertilizer production before the 1960s whereas DAP dominates production at present. In 2007-08, di-ammonium phosphate (DAP) accounted for about 52 per cent of total P_2O_5 production. The growth in capacity and capacity utilization of DAP plants in the post-reforms period is given in Figure 2.26. There has been a significant increased in installed capacity of DAP during the decade of 1990s. It increased from 2.65 million tonnes in 1991-92 to about 7 million tonnes in 2001-02. However, no significant capacity addition has taken place during the last 6 years. Average capacity utilization which was over 100 per cent in the 1990s has declined sharply during the last 6-7 years and stood at 60.4 per cent during 2007-08, the lowest during the last 17 years.

SSP production is concentrated mainly in small and medium scale units and in 2007-08 there were 79 SSP plants in the country. The installed capacity of SSP sector has increased from 5.11 million tonnes in 1991-92 to 7.82 million tonnes in 2001-02 but then witnessed a declining trend during the next 4-5 years and reached a level of about 6 million tonnes in 2003 but again started picking up in 2005 and reached a level of 7.53 million tonnes in 2008. The capacity utilization of SSP plants has been low compared with urea and DAP plants. Capacity utilization declined from over 50 per cent in late 1990s to less than 30 per cent in 2007-08. The government provided adhoc concessions to SSP manufacturers which were less than other phosphatic fertilizers mainly DAP and it acted as major constraint for the SSP industry. With the introduction of nutrient based subsidy scheme, SSP sector is expected to revive and grow at a much faster rate.

Figure 2.25: Major players in urea

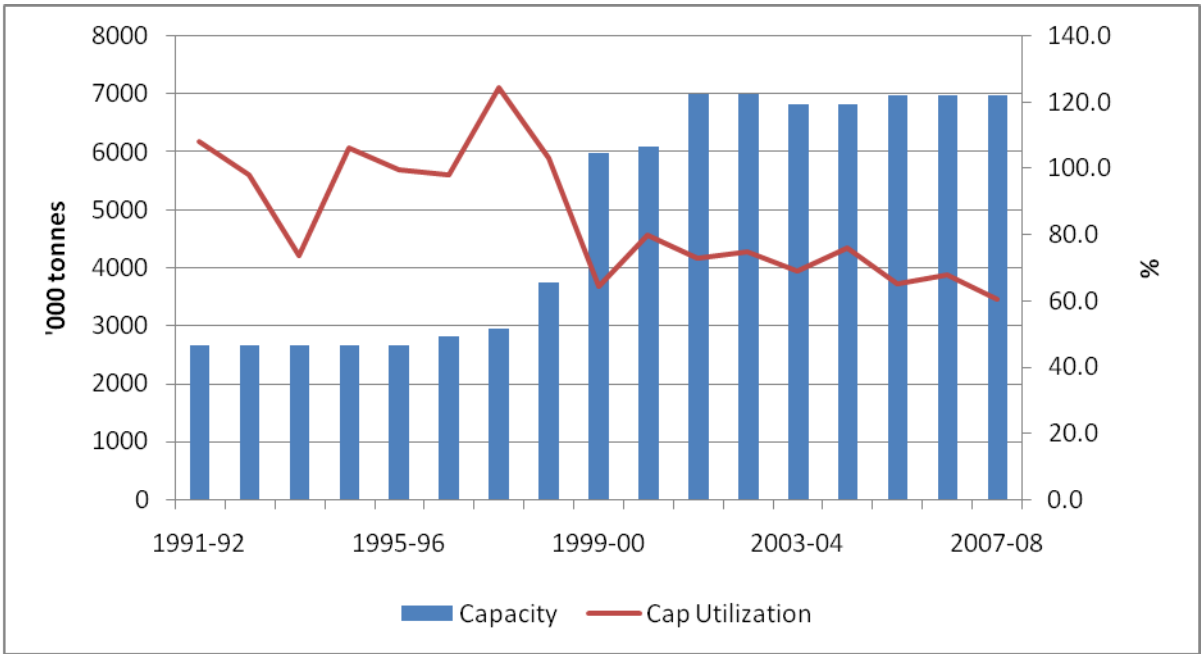




Source: FAI (2008)

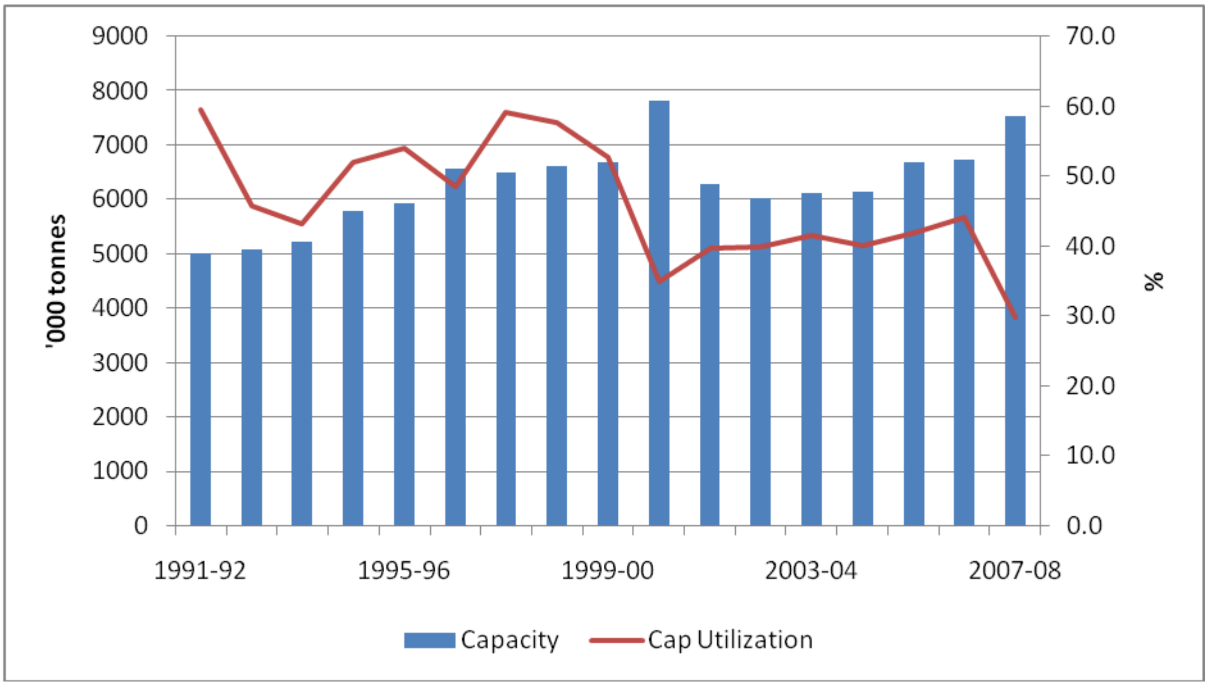
Trends in growth rate of DAP and SSP production are given in Figure 2.28. The DAP production grew at an annual compound growth rate of 23.2 per cent from 27.7 thousand tonnes in 1967-68 to 256.2 thousand tonnes in 1980-81 and 22.5 per cent from 277.9 thousand tonnes in 1967-68 to 1904.9 thousand tonnes in 1990-91. However, the growth in DAP production decelerated during the nineties (7.4%) and production growth rate became negative (-2.9%) in the 2000s. Almost similar trend was observed in case of SSP but the growth rates of SSP production were significantly lower than DAP growth rates during all periods except during 2000s when DAP growth rate was negative but SSP growth rate was positive but statistically non-significant.

Figure 2.26: Growth in capacity and capacity utilization of DAP



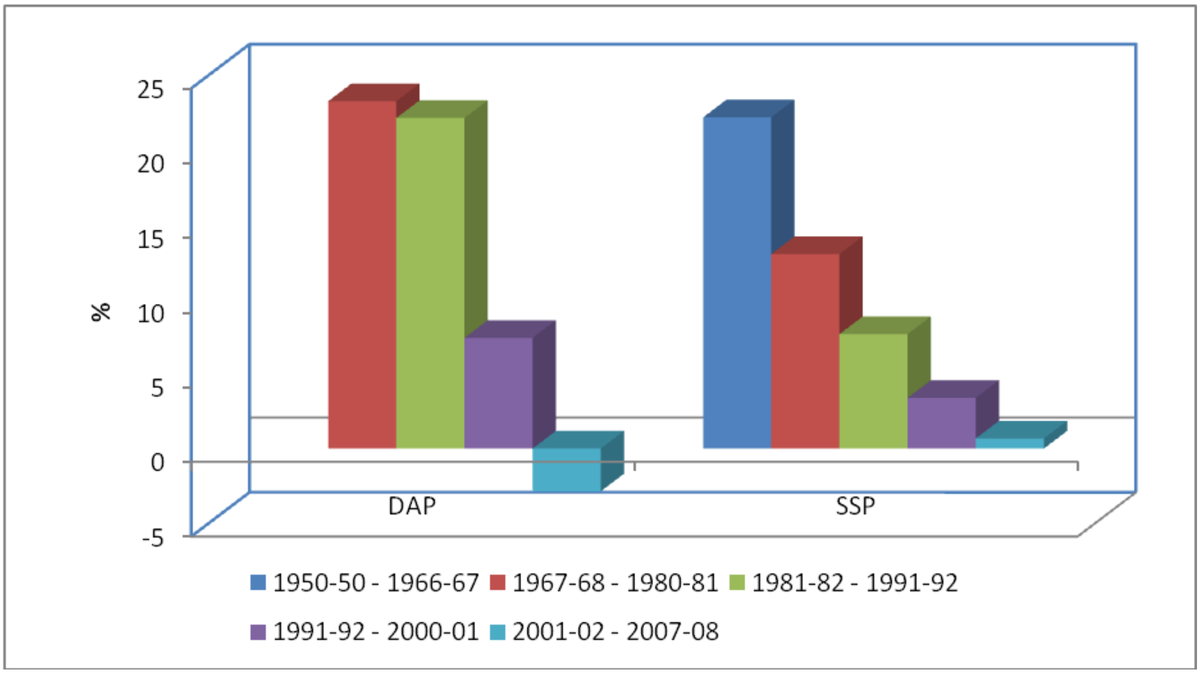
Source: FAI (2008)

Figure 2.27: Growth in capacity and capacity utilization of SSP



Source: FAI (2008)

Figure 2.28: Trends in growth rates of production of DAP and SSP



Source: FAI (2008)

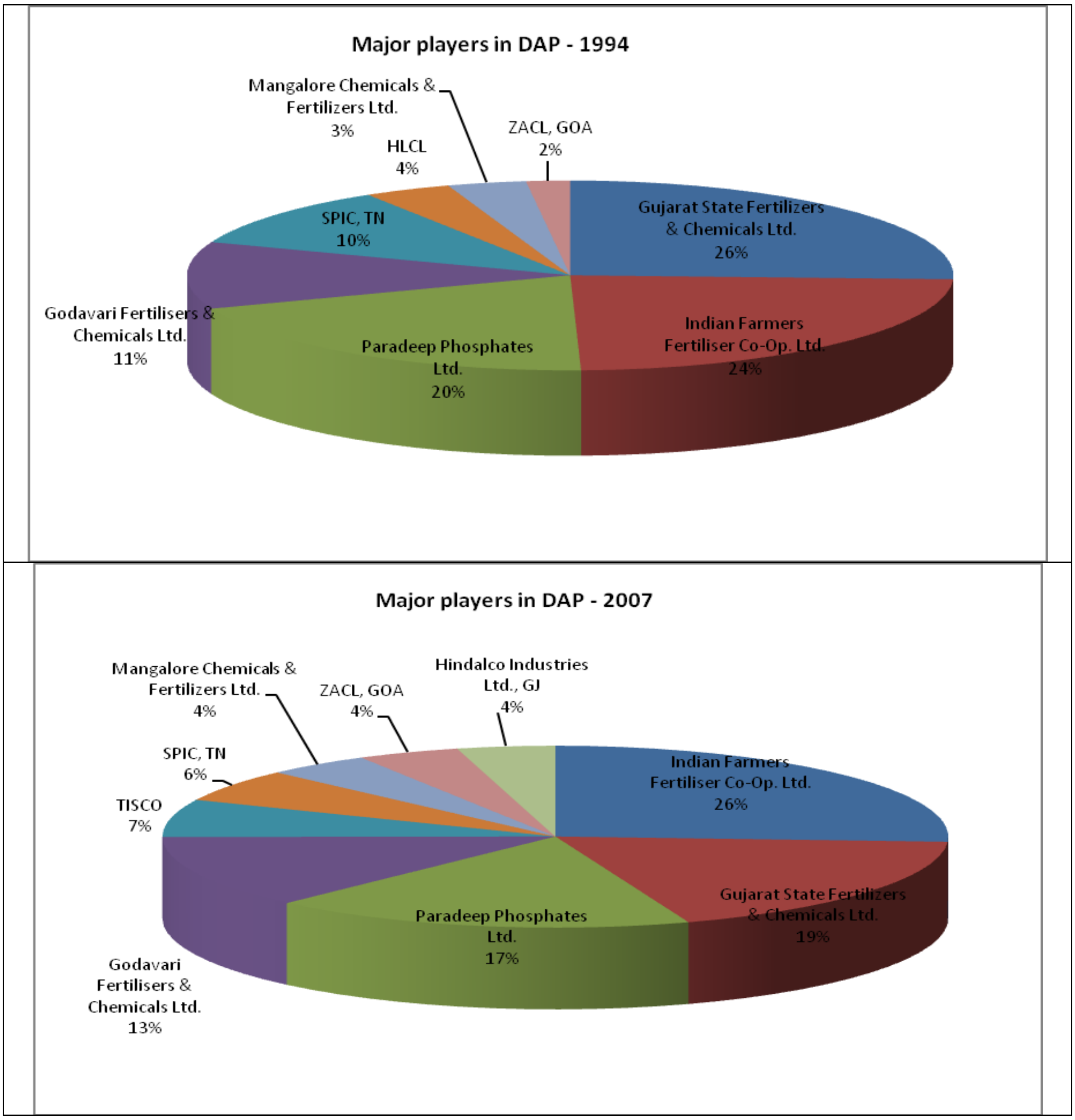
Major Players in P Fertilizer Industry

There are 9 major players in the domestic DAP industry using different sources of ammonia and phosphoric acid with a total installed capacity of about 6.97 million tonnes in 2007-08. Market shares in terms of production for the year 2007-08 of major producers of DAP are shown in Figure 2.29. Top three producers, namely, IFFCO, Gujarat State Fertilizers and Chemicals Limited and Paradeep Phosphates limited, control more than 60 per cent of total DAP production in the country. There has not been any major shift in production shares of major producers of DAP between 1994 and 2007. IFFCO, Godavari Fertilizers and Chemicals Limited and Zuari Agro Chemicals Limited have increased their share marginally.

Investment in Fertilizer Sector

The total investment in the fertilizer industry at the end of first plan was Rs. 64.9 crore and share of public sector was very high (93.1%). During the third and fourth five year plans significant investment took place in the sector in the public and private sector and also by cooperative sector from fifth plan onwards (Table 2.10). By the end of fourth plan, the investment had increased by more than four times (from Rs. 196.7 crore at the end of third plan to Rs. 783.1 crore at the end of fourth plan) due to a heavy thrust on agricultural development and green revolution. The investment growth was much faster during the fourth, fifth, sixth and seventh plan periods. The cooperative sector which entered fertilizer sector during the fifth plan witnessed a significant increase in its share (5.6% at the end of fifth plan to 16.1% at the end of tenth plan). The share of private sector also increased significantly from 31.5 per cent to 54.1 per cent during the corresponding period, while share of public sector declined.

Figure 2.29: Major players in phosphatic industry: DAP



Source: FAI (2008)

The total investment was Rs. 9,334 crore by the end of the 7th Plan for creating new capacities and expansion of the existing units, which increased to Rs. 15,477 crore by the end of the 8th Plan and jumped to Rs. 25,644 crore by the end of the 9th Plan. However, there was hardly any investment during the 10th Plan. The total investment in the fertilizer sector by the end of 2007-08 (as on November 1, 2008) was Rs.26,392 crore. The growth in investment and production capacity was almost stagnant during the 10th Five Year Plan. As a result gap between demand and supply increased significantly which led to increase in imports of fertilizers during the last few years.

Table 2.10: Investment in Fertilizer Industry in India

	Rs in crore			Share		
	Public	Coops	Pvt.	Public	Coops	Pvt.
Plan I (1951-56)	60.4	-	4.5	93.1	0.0	6.9
Plan II (1956-61)	64.9	-	9.8	86.9	0.0	13.1
Plan III (1961-66)	178.7	-	18	90.8	0.0	9.2
Plan IV (1969-74)	466.3	-	316.8	59.5	0.0	40.5
Plan V (1974-79)	1105.5	97.6	553.8	62.9	5.6	31.5
Plan VI (1980-85)	2550	331.1	1228.1	62.1	8.1	29.9
Plan VII (1985-90)	4855.8	1954.1	2524.2	52.0	20.9	27.0
Plan VIII (1992-97)	5170.8	1954.1	8352.2	33.4	12.6	54.0
Plan IX (1997-02)	7474.5	4231.5	13937.8	29.1	16.5	54.4
Plan X (2002-07)	7824.5	4231.5	14216.9	29.8	16.1	54.1

Source: FAI (2008)

Fertilizer Imports

The fertilizer consumption in India has generally exceeded the domestic production in both nitrogenous and phosphatic fertilizers except for few years. The entire requirement of potassic fertilizers is met through imports as India does not have commercially viable sources of potash. India mainly imports urea, DAP and MOP. Imports of nitrogenous fertilizers in the country are through state trading enterprises while imports of P and K fertilizers and raw materials/intermediates have been decontrolled. Imports of urea are done to bridge the gap between the indigenous availability and requirement through designated canalizing agencies like Metals and Minerals Trading Corporation Ltd. (MMTC), State Trading Corporation (STC) and Indian Potash Ltd. (IPL).

During 1950s and 1960s, about two-third of domestic requirement of N fertilizers was met through imports. Total imports of N fertilizers increased from 104.6 thousand tonnes in 1950s to 482.4 thousand tonnes in 1960s and 923.2 thousand tonnes in 1970s (Table 2.11). The level of P imports was very low in the fifties, which increased significantly during the sixties and seventies. With the introduction of the high yielding varieties of wheat and rice in mid-1960s, the fertilizer imports increased significantly in 1966-67 and thereafter (Figure 2.30). The fertilizer imports increased dramatically in 1977-78 and 1978-79, 1984-85 and again in 1988-89 and 1989-90. However, during the decade on 1990s imports were at low levels except in 1995-96 and 1997-98. There appears to be a cycle of about 8-9 years when imports jump significantly.

However, during the last 6-7 years due to low/no addition in domestic capacity coupled with rise in demand for fertilizers, imports have increased significantly in the 2000s. India imported 7.767 million tonnes of NPK fertilizer nutrients in 2007-08 as against 1.931 million tonnes in 2002-03. The growth of imports was rather slow in the eighties and nineties and accelerated in 2000s. The fertilizer imports increased significantly in 2005-06 and thereafter. Along with the quantity, the value of imported fertilizer nutrients also increased significantly during the last two years. The fertilizer price increase during 2007 and 2008 affected the cost of imported fertilizers adversely for India. The total value of imports increased from Rs. 7423.83 crore in 2005-06 to Rs. 18454.10 crore in 2007-08, an increase of 148.58 per cent, whereas the total quantity of imported fertilizers increased by about 46.6 per cent – from 5.3 million tonnes in 2005-06 to 7.7 million tonnes in 2007-08 and more than 10 million tones in 2008-09**.** Thus, the average cost of each tone of imported fertilizer was much higher in 2007-08 compared with what it was in 2005-06. For example the import parity price of urea more than doubled from Rs. 12,742.75 per tone for the quarter July-September 2007 to Rs. 25,717.08 per tone in the quarter April-June 2008 (GOI, 2007, 2008). Similarly, the rate of concession on phosphatic and potassic fertilizers also increased significantly during the last couple of years. The rate of concession for DAP increased from Rs. 6337 per tone for imported DAP (Rs. 6608 for indigenous DAP) for the quarter January-March 2007 to Rs. 49,790 per tone in July 2008, almost eight fold increase. The rate of concession for muriate of potash (MOP) increased from Rs. 6758 per tone to Rs. 24,327 per tone during the corresponding period.

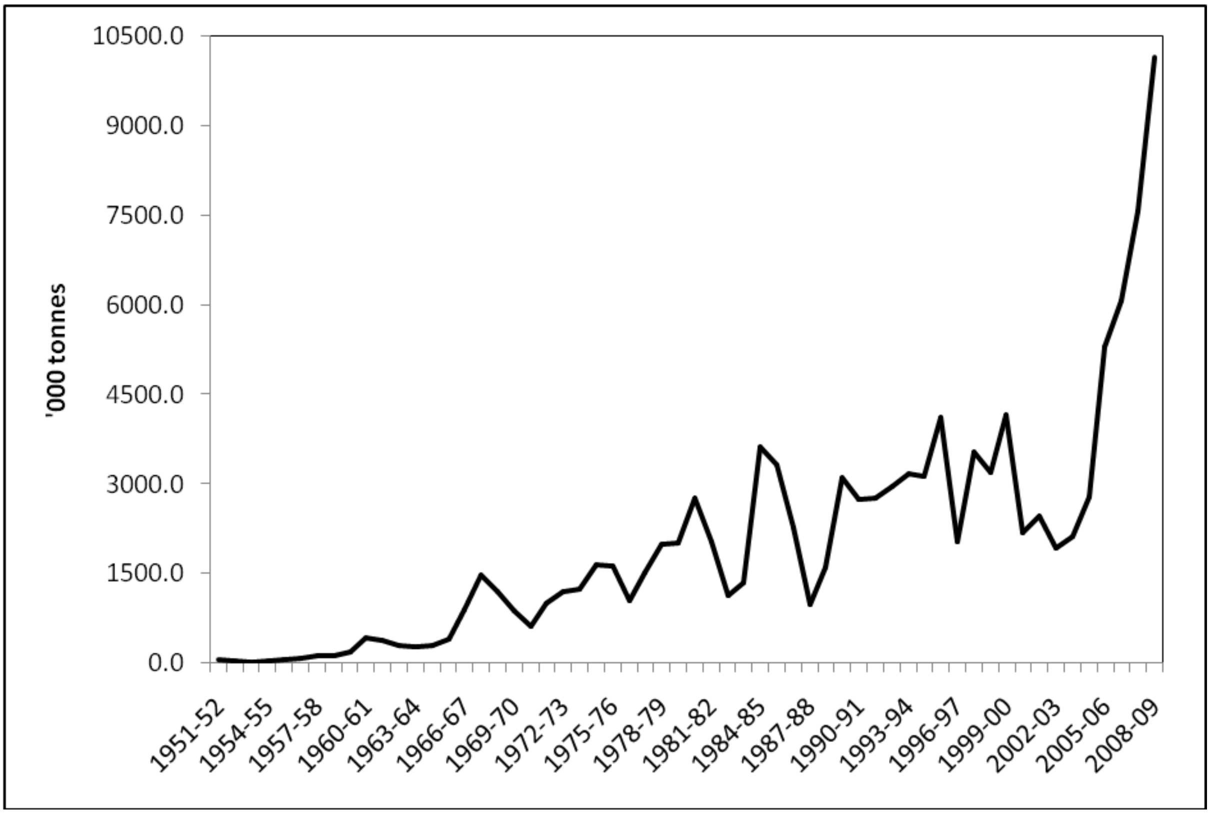
Table 2.11: Growth and Share of imports of fertilizers in total production and consumption in India: 1951-52 to 2007-08

Period	N	P_2O_5	K_2O	Total
Total Imports ('000 tonnes)				
1950s	104.6	4.0	14.9	119.9
1960s	482.4	81.0	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	1262.5	758.6	2055.0	4076.1
Share (%) of imports in total consumption				
1950s	66.1	0.8	100.6	59.8
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	9.3	14.9	100.2	20.4

Source: FAI (2008)

The share of imports in total consumption declined from 67.6 per cent in 1960s 36.6 per cent in 1970s, further to about 15 per cent in 1980s and reached a level of 9.3 per cent in 2000s. Almost similar trend was observed in case of phosphatic fertilizers. However, in terms of volume of imports, N fertilizer imports declined during the 1980s which marginally increased during the 1990s and further increased in the 2000s, while in case of phosphatic fertilizers imports have consistently increased over time.

Figure 2.30: Trends in imports of fertilizers (N+P+K) in India



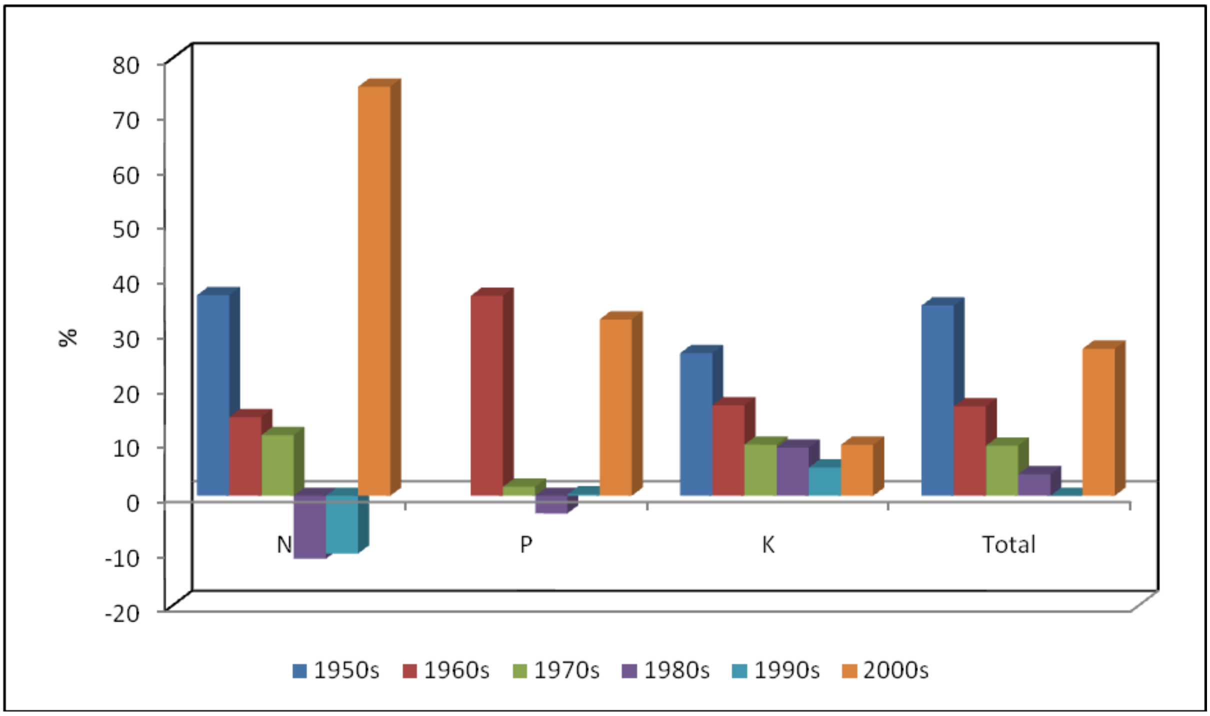
Source: FAI (2008)

Growth Rates in Fertilizer Imports

Growth rates in fertilizer imports during the period 1971-72 to 2007-08 are presented in Figure 2.31. Fertilizer imports grew at annual compound growth rate of 9.2 per cent during the 1970s and 3.9 per cent the following decade. During the 1990s, growth rate in fertilizer imports was almost zero due to negative growth rate in N fertilizer imports. However, fertilizer imports grew at annual compound growth rate of about 27 per cent during the period 2001-02 to 2007-08. Nutrient-wise import trends show a different pattern. In case of N fertilizers after the introduction of high yielding varieties in mid sixties, demand for N fertilizers increased and in order to meet rising demand India imported larger quantities of N fertilizers and grew at an annual compound growth rate of over 11 per cent. However, due to domestic capacity additions during the 1970s (because of introduction of RPS) domestic production increased significantly which reduced dependence on imports and N fertilizer imports recorded negative growth rates during the 1980s and 1990s. However, due to uncertainty in N fertilizer sector policy environment during the last decade, there was no capacity addition and therefore, imports grew at a growth rate of 74.7 per cent.

In case of P fertilizers, imports grew at an annual growth rate of 1.6 per cent in 1970s, which decelerated to -3.2 per cent in 1980s and 0.2 per cent in 1990s. However, in 2000s, P fertilizer imports increased at a growth rate of 32.2 per cent. In case of K fertilizers, since all demand is met through imports, imports have registered a growth rate of about 9 per cent during the last four decades with the exception of 1990s when imports increased at a growth rate of 5.2 per cent. This deceleration in 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 increase in prices.

Figure 2.31: Rate of growth (%) in imports of N, P and K fertilizers in India: 1971-72 to 2007-08



Source: FAI (2008)

The main fertilizer products imported in India are urea, calcium ammonium nitrate, ammonium sulphate, di-ammonium phosphate, muriate of potash and sulphate of potash. USA, CIS, China, Oman, Jordan, Canada, Israel and Qatar are the major exporters of fertilizer products to India.

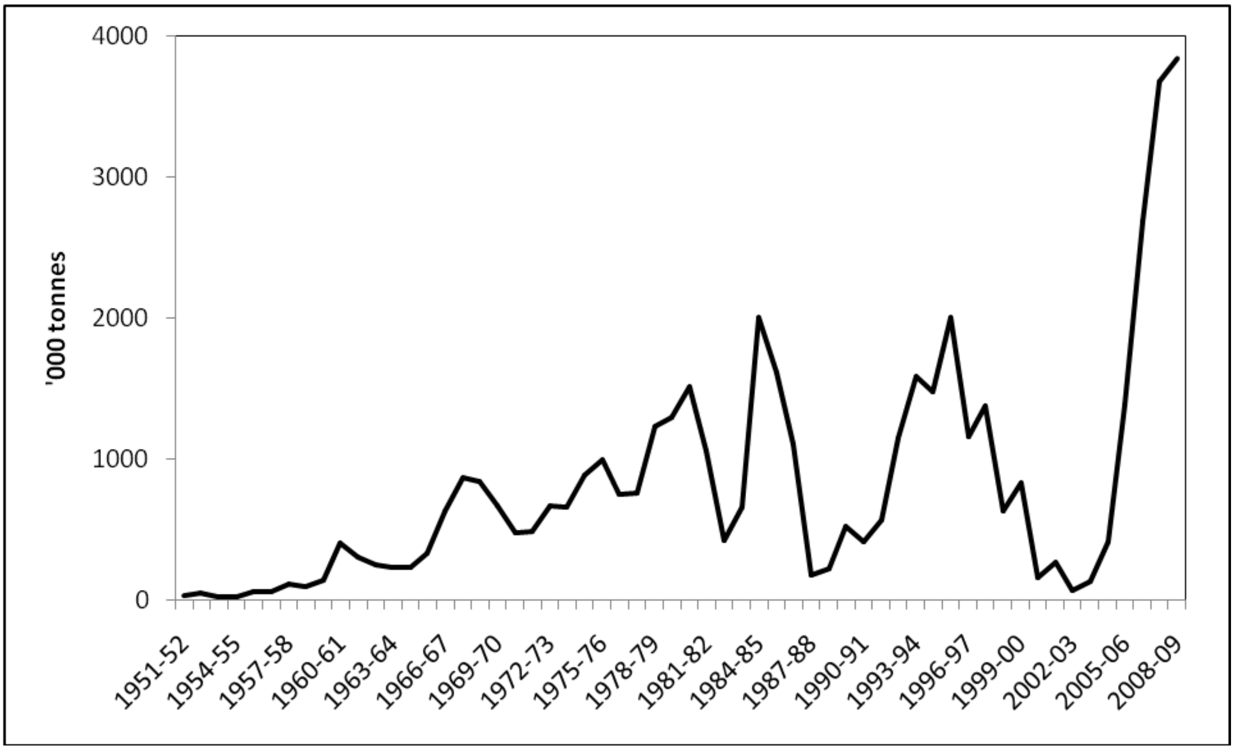
Imports of Nitrogenous Fertilizers

Consumption of nitrogenous fertilizers has always been higher than indigenous production despite significant growth in the domestic nitrogenous industry as consumption has increased at a higher rate compared with increase in production. The gap between demand and supply is met through imports and imports keep on varying depending upon the gap. Trends in imports of N fertilizers are presented in Figure 2.32. The figure shows that prior to 1960-61, Indian imported relatively small quantities of nitrogenous fertilizers. In absolute terms imports of nitrogenous fertilizers increased from 28.8 thousand tonnes in 1951-52 to 142 thousand tonnes in 1959-60. With a targeted consumption of one million tonnes of fertilizer nutrients during the Third Five Year Plan, fertilizer imports increased to 399 thousand tonnes in 1960-61 compared to 142 thousand tonnes in the previous year. The introduction of high-yielding varieties in 1966-67 further boosted the fertilizer imports to 632 thousand tonnes. Although there was a significant decline in the imports of nitrogenous fertilizers in 1970-71 and 1971-72, fertilizer imports increased by about 57 per cent between 1966-67 and 1975-76. N fertilizer imports more than doubled in the next ten years from 996 thousand tonnes in 1975-76 to over 2 million tonnes in 1984-85 and declining thereafter but again increased during 1994-95 to 1996-97. The gap between domestic supply and consumption reached a level of over one million tonnes in 1995-96. However, with the increase in domestic capacity, imports of nitrogenous fertilizers declined during the second half of 1990 and reached a low level of about 164 thousand tonnes during 2001-02. During 2002-03 and 2003-04 India did not import urea for direct consumption but small quantities for use in the manufacture of complex fertilizers. However, gap between consumption and production increased from less than half a million tonnes in 2004-05 to over 3.5 million tonnes in 2008-09 and imports increased from 413 thousand tonnes to about 3.8 million tonnes over the same period.

The contribution of imports to total fertilizer consumption has fluctuated between 21 per cent and 188 per cent in the pre-green revolution period (1951-52 to 1966-67) and between 3.1 per cent and 83.8 per cent in the post green revolution period (1967-68 to 1991-92) and from 1.3 per cent to 25.7 per cent thereafter. A ratio of current imports to current consumption might be useful only if the fertilizer market was in equilibrium, i.e., demand was equal to supply for every year. Otherwise, this ratio is misleading.

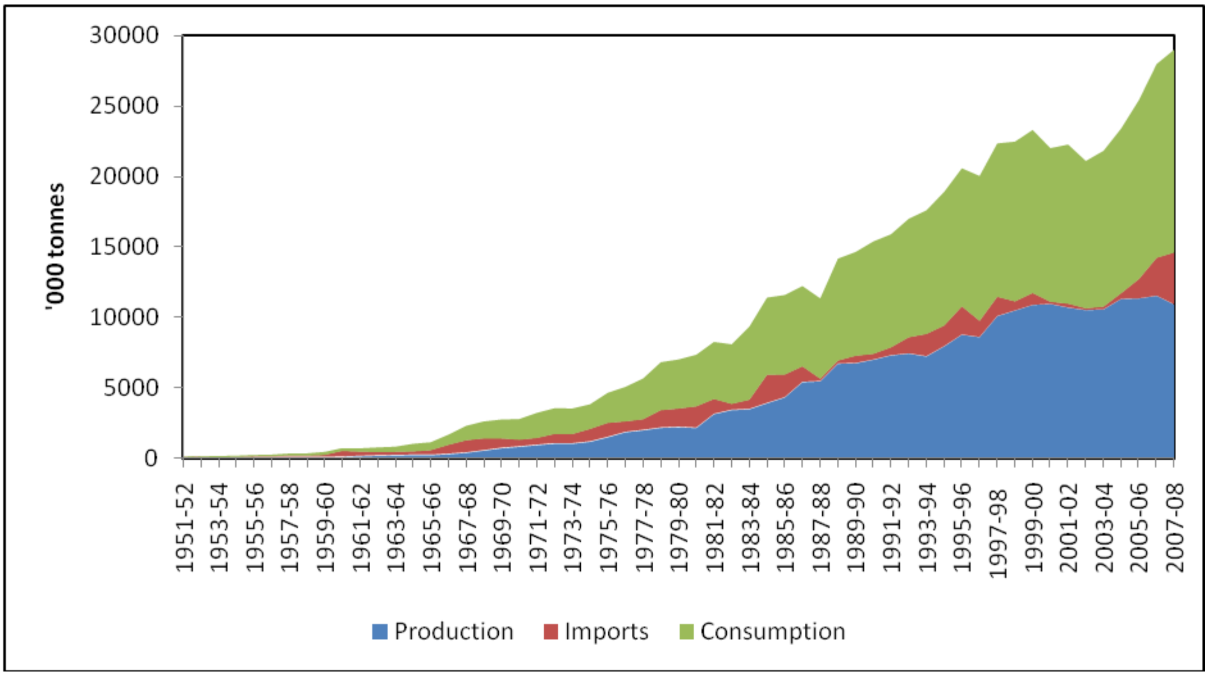
If there is excess supply in a given year, the aggregate supply in the following year will consist of three components: a) production, b) excess supply from the previous year, and c) imports. Assuming that the fertilizer market was in equilibrium in 1951-52, i.e., the quantity consumed was equal to the production plus imports, excess supply is calculated for every year from 1952-53 onwards and is given in Annexure Table 2.2. It is clear that total supply exceeded total consumption in all years except in 1983-84 when total supplies were marginally lower than consumption, and therefore, availabilities of N fertilizer nutrients can not be considered as a factor constraining N fertilizer consumption in the country. The total supplies, compared with consumption, exceeded by about 3 per cent (1991-92) and 242 per cent (1961-62).

Figure 2.32: Trends in imports of N fertilizers in India: 1951-52 to 2008-09



Source: FAI (2008)

Figure 2.33: Trends in production, consumption and imports of nitrogenous fertilizers in India; 1951-52 to 2007-08



Source: FAI (2008)

Nitrogenous Fertilizer Product Imports

Urea

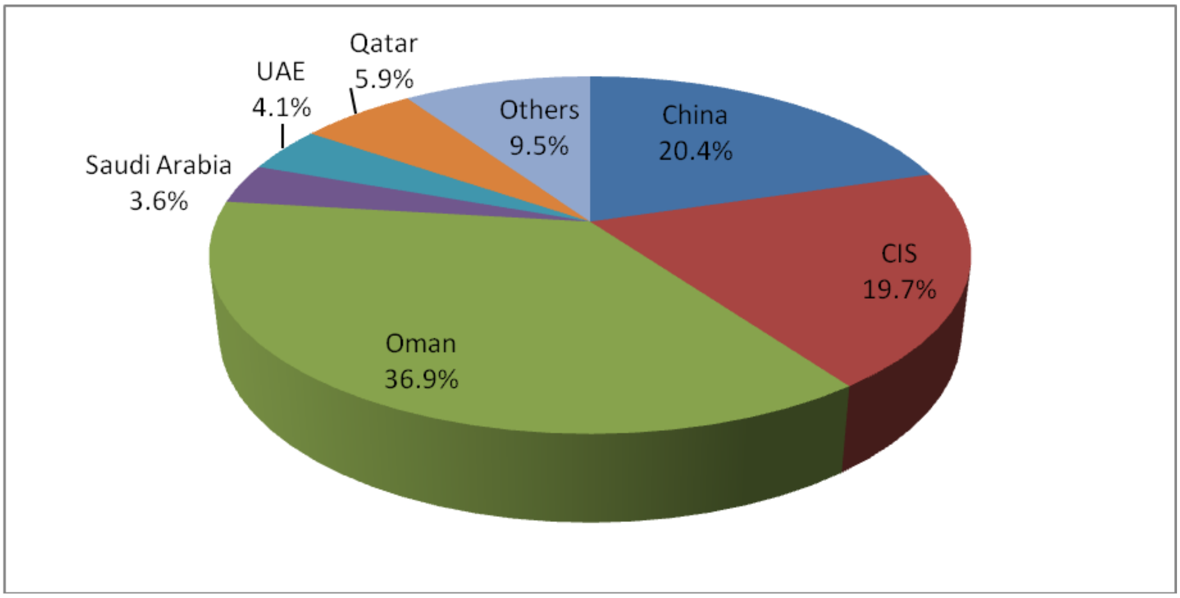
Urea is the main nitrogenous fertilizer product imported in the country. China, Oman, CIS, Qatar, Saudi Arabia and UAE are major exporters of urea to India (Figure 2.34). India also imports small quantities of urea from Egypt, Indonesia, and Malaysia.

Figure 2.35 shows the imports of urea in the country between 1981-82 and 2007-08. India imported about 2 million tonnes of urea in 1981-82 and increased to about 3.7 million tonnes in 1984-85 and declined thereafter. India did not import urea in 1989-90 and 1990-91. In 1991-92, about 391 thousand tonnes of urea were imported which increased to 2389 thousand tonnes in 1996-96 and reached the highest level of 6928 thousand tonnes in 2007-08. India, which earlier used to import ammonium sulphate and calcium ammonium nitrate in the sixties and seventies does not import these nitrogenous fertilizer products.

The contribution of urea imports to total supply (production + imports) has fluctuated between 0-45.7 per cent during the eighties (zero per cent in 1989-90 and 1990-91 and 45.7 per cent in 1980-81) and between 2.6 per cent and 19.3 per cent during the 1990s and 0.6

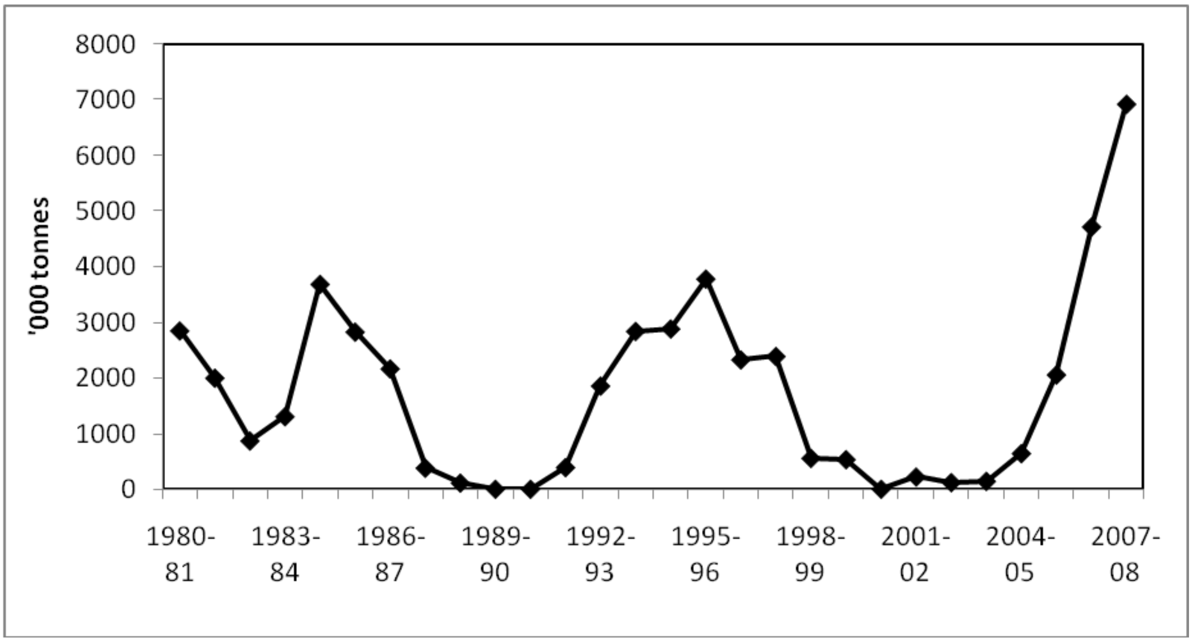
per cent in 2002-03 to 25.9 per cent in 2007-08. Urea imports have increased significantly after 2004-05. This increase in imports and rising international prices of urea and other fertilizer products have led to a substantial increase in fertilizer subsidies in the country.

Figure 2.34: Imports of urea from major importing countries during the triennium ending (TE) 2007-08



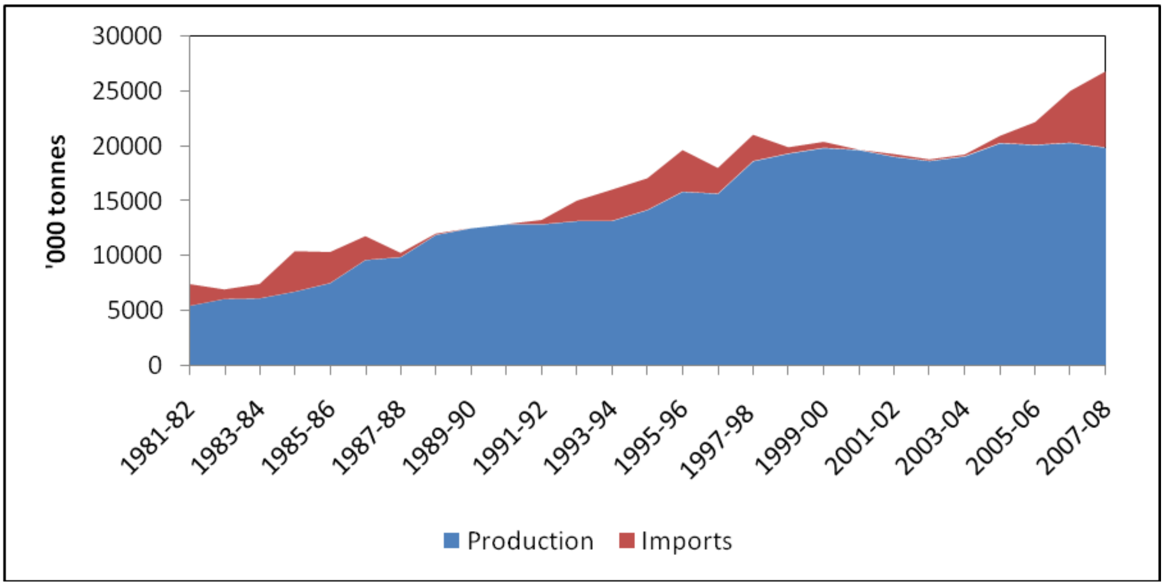
Source: FAI (2008)

Figure 2.35: Trends in imports of Urea in India



Source: FAI (2008)

Figure 2.36: Trends in production and imports of urea in India; 1981-82 to 2007-08



Source: FAI (2008)

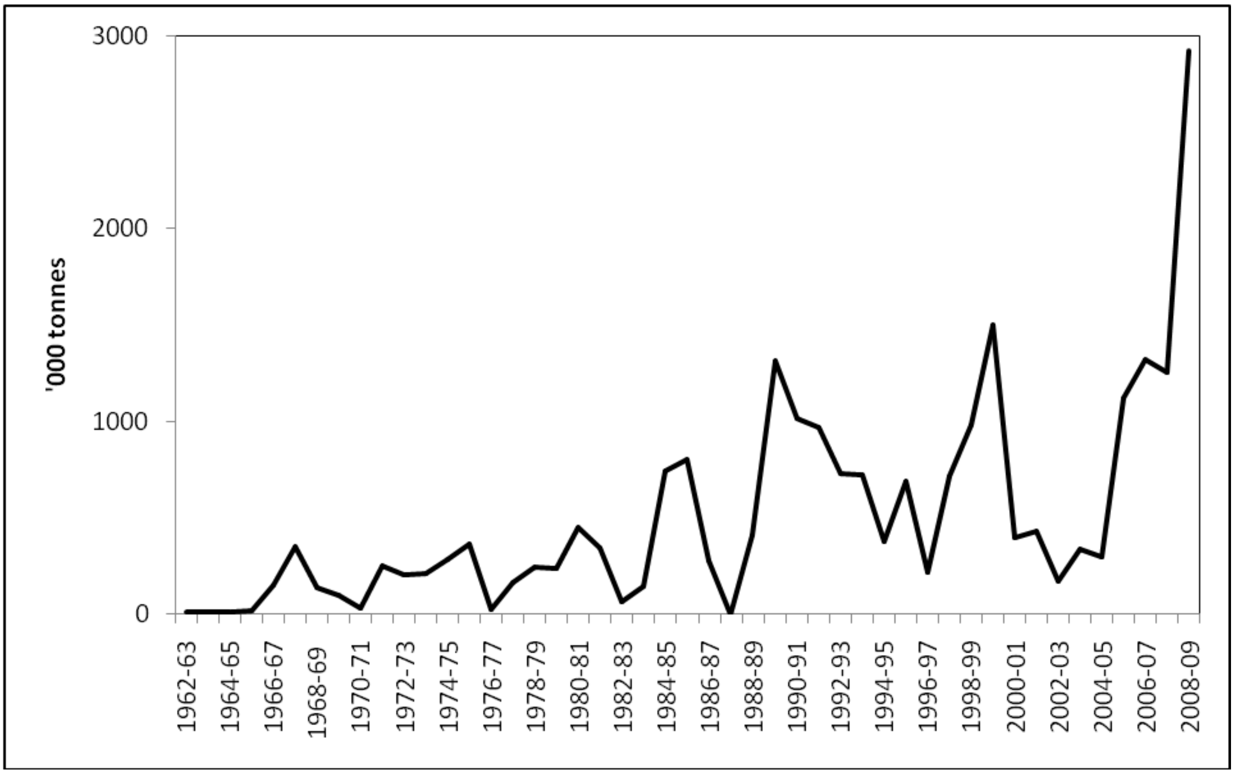
Imports of Phosphatic Fertilizers

Unlike the nitrogenous fertilizers, the imports constituted a small proportion of total supply of the phosphatic fertilizers in India till 1965-66. However, with the introduction of HYVs of wheat and rice in the mid-sixties, the imports of P_20_5 increased to 148 thousand tonnes in 1966-67 (compared to 14.0 thousand tonnes in 1965-66), and fluctuated between 22.8 thousand tonnes and about 1.3 million tonnes in the post-green revolution period (1967-68 to 1990-91) and from about 218 thousand tonnes in 1996-97 to about 1.54 million tonnes in 1999-00 (Figure 2.37). Imports of P fertilizers have increased substantially during the last 4-5 years and reached a record level of over 2.9 million tonnes in 2008-09.

The contribution of imports to total P fertilizer consumption has fluctuated between 3.6 per cent and 104.2 per cent between 1962-63 and 1980-81 and between zero and 43.5 per cent during the decade of 1980s (1981-82 to 1990-91) and from 5.7 per cent to 30 per cent thereafter.

The excess supply calculations for P_20_5 (Annexure Table 2.3) reveal some interesting results. Between 1952-53 and 1965-66, when imports were small, the excess supply fluctuated between 23.7 per cent and 100 per cent of the total consumption. The increased imports of P_20_5 in 1966-67 and thereafter, simply generated higher levels of surpluses, 90.2 per cent in 1967-68 and 70.9 per cent in 1968-69. The situation, however, changed drastically during the 1970s and 1980s. Instead of excess supply, the deficits of large quantities occurred in 9 out of 20 years from 1971-72 to 1990-91 and these deficits ranged from -1.9 per cent in 1990-91 to - 30.3 per cent in 1983-84. Therefore, availability of P fertilizer nutrients has been a major factor constraining P fertilizer consumption during these years. It's not however clear how these deficits were met during these years. However in the post-reforms period (1992-93 to 2007-08), total supplies exceeded total consumption, which indicates that availability was not a major constraint in fertilizer consumption.

Figure 2.37: Trends in imports of P fertilizers in India: 1962-63 to 2007-08



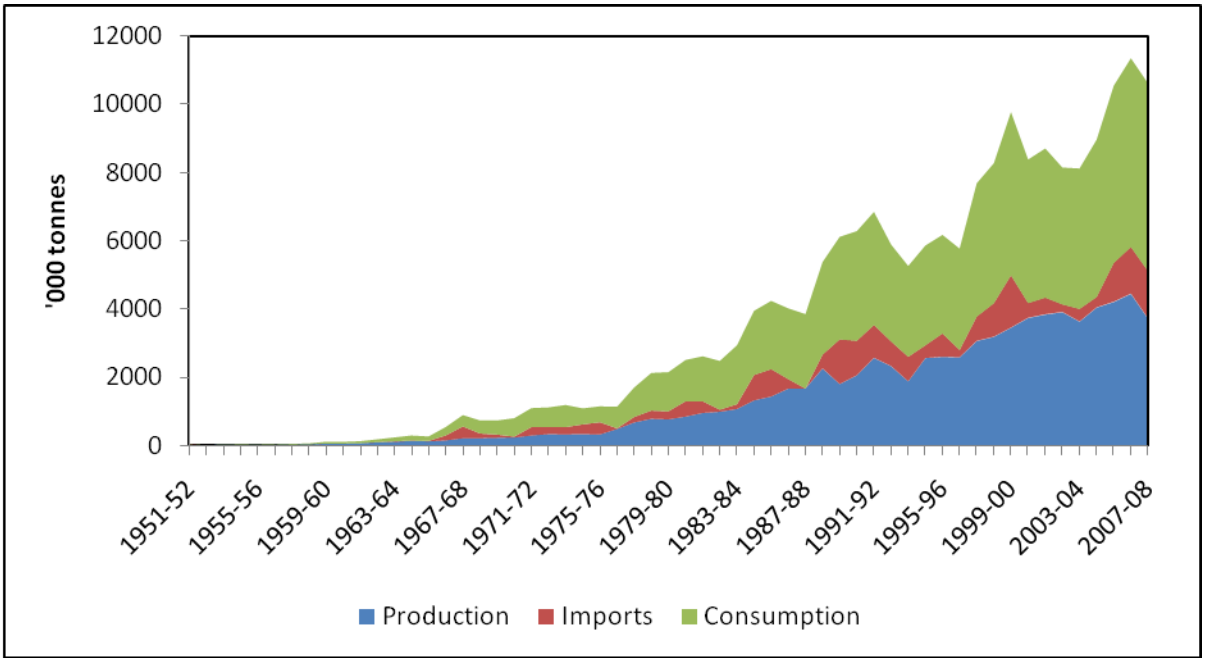
Source: FAI (2008)

Product Imports

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 NP and NPK complexes, di-ammonium phosphate (18-46-0) occupies an important place (about 95% of total P imports). Small quantities of mono-ammonium phosphate (11-52-10) are also imported.

During the 1980s, India imported about 5.1 lakh tonnes of phosphatic fertilizers and imports increased to 7.19 lakh tonnes during the 1990s and 7.312 lakh tonnes during the 2000s.

Figure 2.38: Trends in production, consumption and imports of phosphatic fertilizers in India; 1951-52 to 2007-08



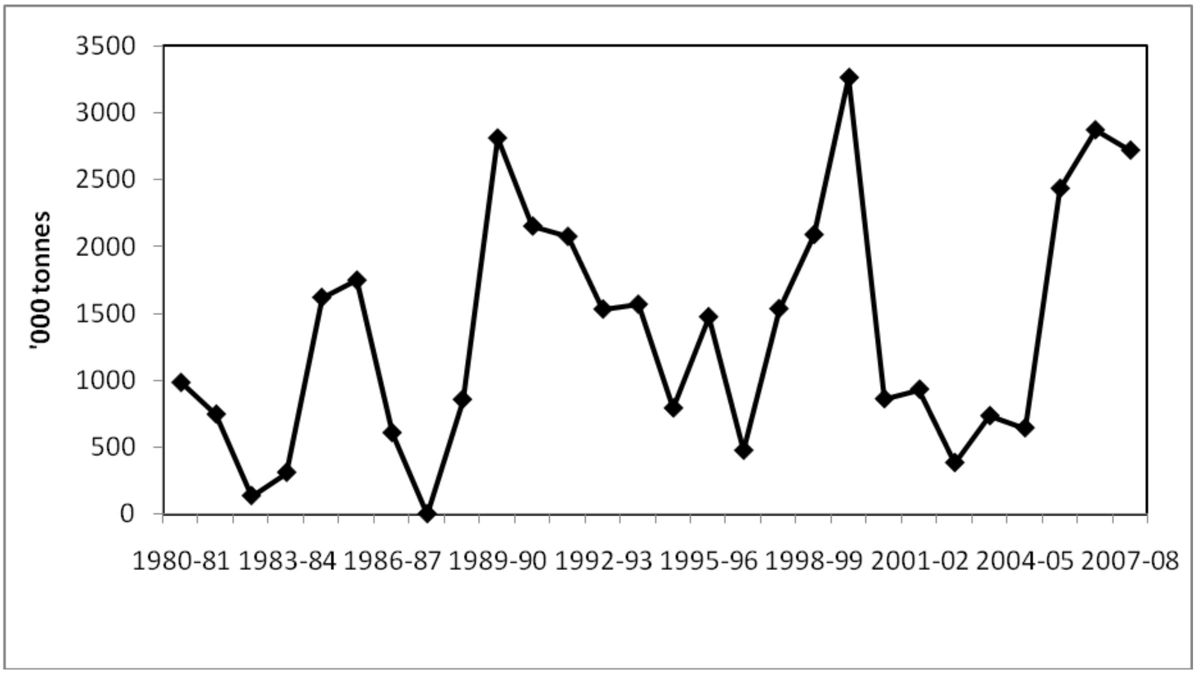
Source: FAI (2008)

DAP

Figure 2.39 shows the imports of DAP in the country between 1981-82 and 2007-08. India imported about 983 thousand tonnes of DAP in 1980-81 and increased to about 2.8 million tonnes in 1989-90 and declined in the first half of nineties. DAP imports again increased in 1997-98 and reached a record level of about 3.27 million tonnes in 1999-00 and started declining in the first half of the current decade but suddenly increased from about 644 thousand tonnes in 2004-05 to about 2.44 million tonnes in 2005-06 which further increased to 2.87 million tonnes in 2006-07. Total DAP imports in 2007-08 were about 2.72 million tonnes.

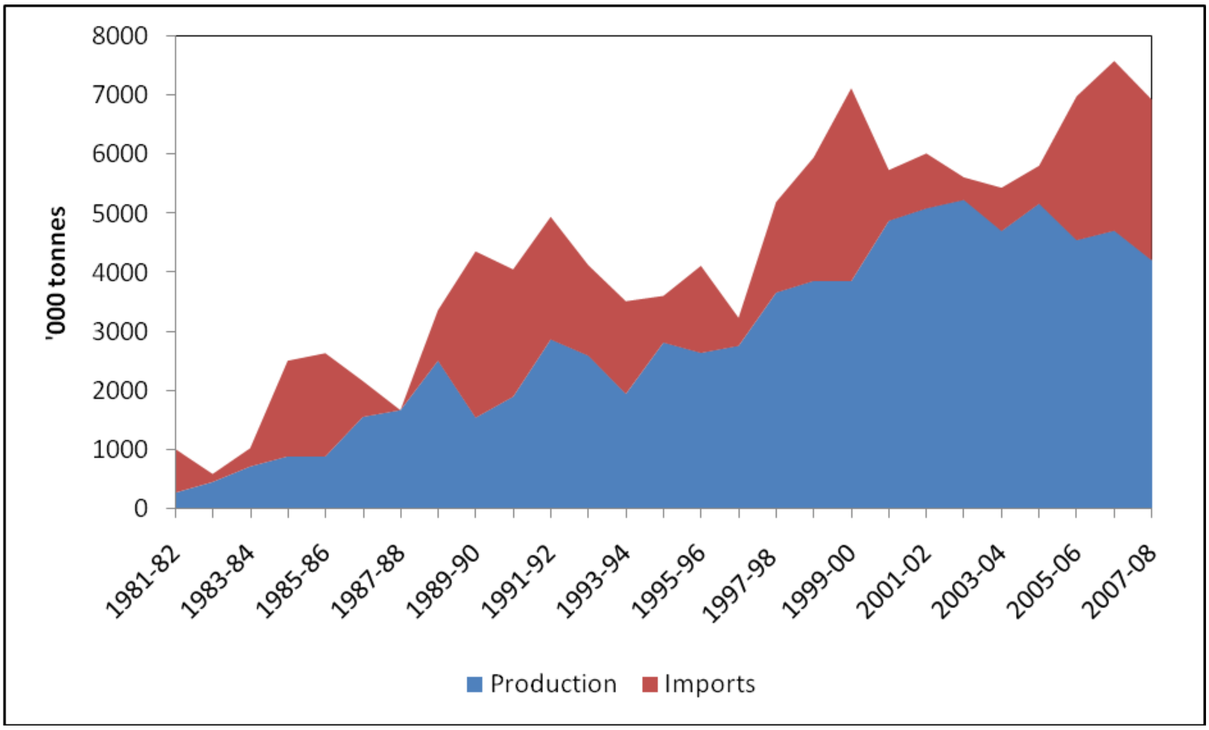
The contribution of imports to total DAP supplies (production + imports) has fluctuated between zero per cent and 79.3 per cent between 1980-81 and 1990-91 and between 14.7 and 45.8 per cent during the decade of 1980s (1981-82 to 1990-91) and from 6.8 per cent in 2002-03 to 39.3 per cent in 2007-08. The imports of DAP constitute nearly 15-20 per cent of the total consumption and dependence on imports would be quite high if imports of raw material like rock phosphate and phosphoric acid are taken into account.

Figure 2.39: Trends in imports of DAP in India



Source: FAI (2008)

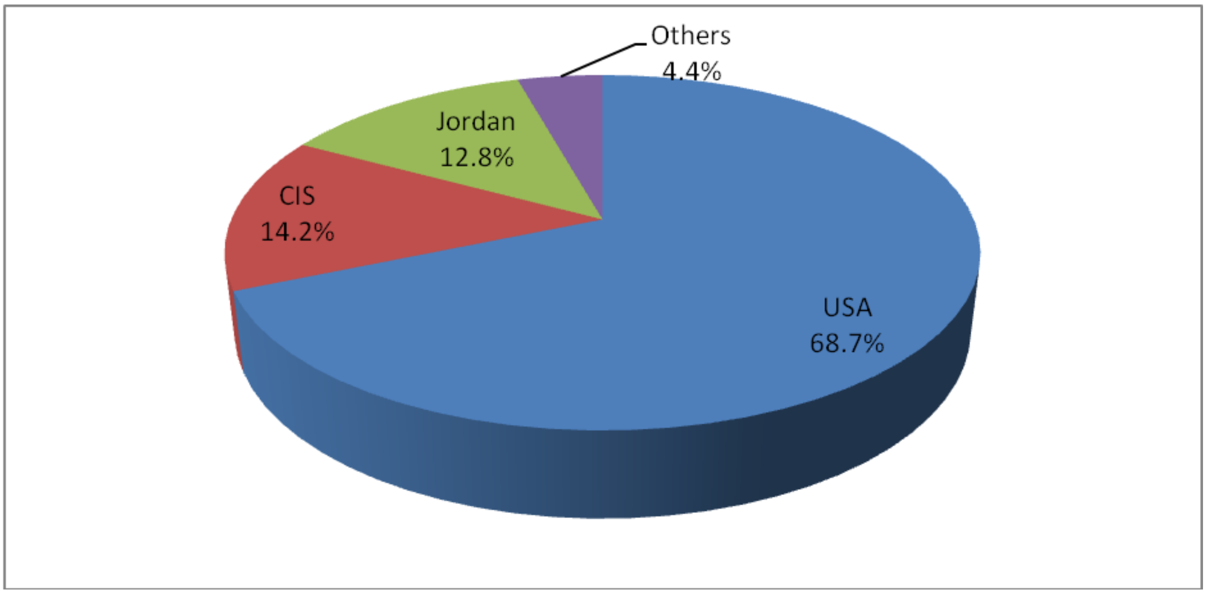
Figure 2.40: Trends in production and imports of DAP in India; 1981-82 to 2007-08



Source: FAI (2008)

Imports of phosphatic fertilizers mainly DAP are concentrated in small number of countries. USA, CIS and Jordan are the main exporters of P fertilizers to India accounting for over 95 per cent share in total imports (Figure 2.41).

Figure 2.41: Imports of DAP from major importing countries during the triennium ending (TE) 2007-08

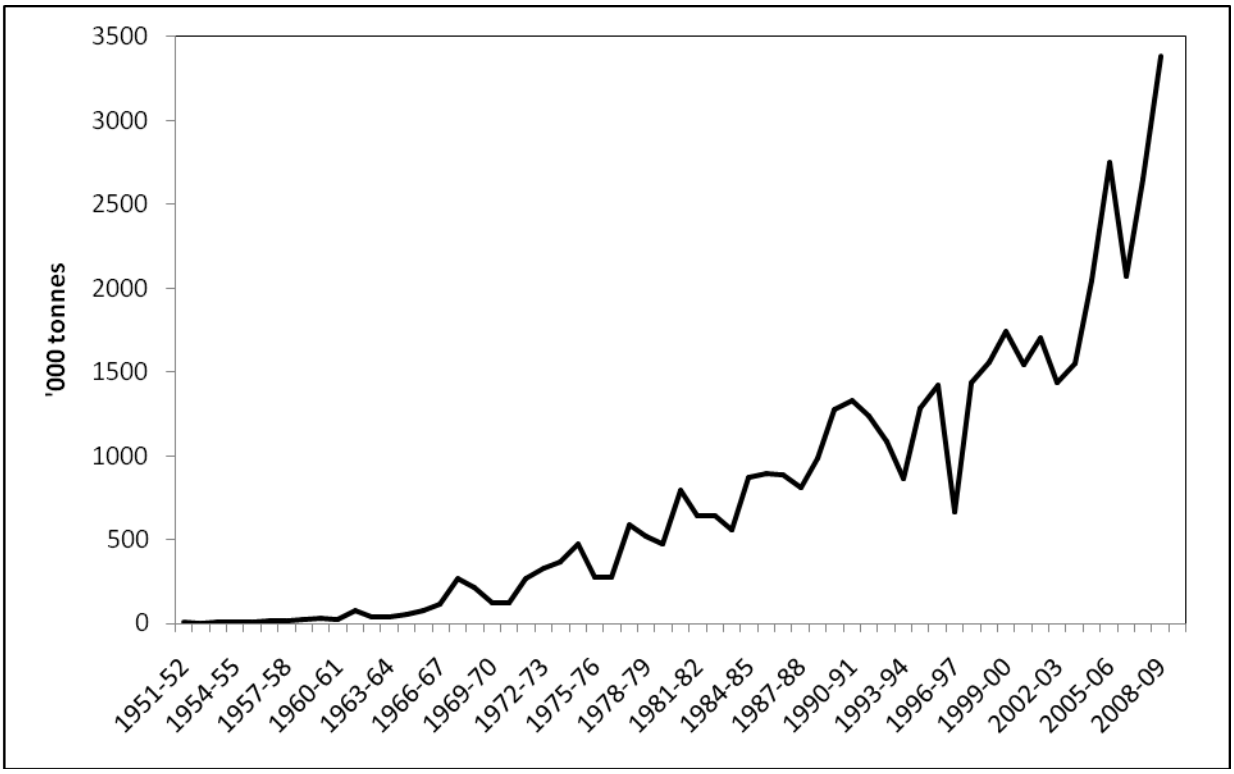


Source: FAI (2008)

Imports of Potassic Fertilizers

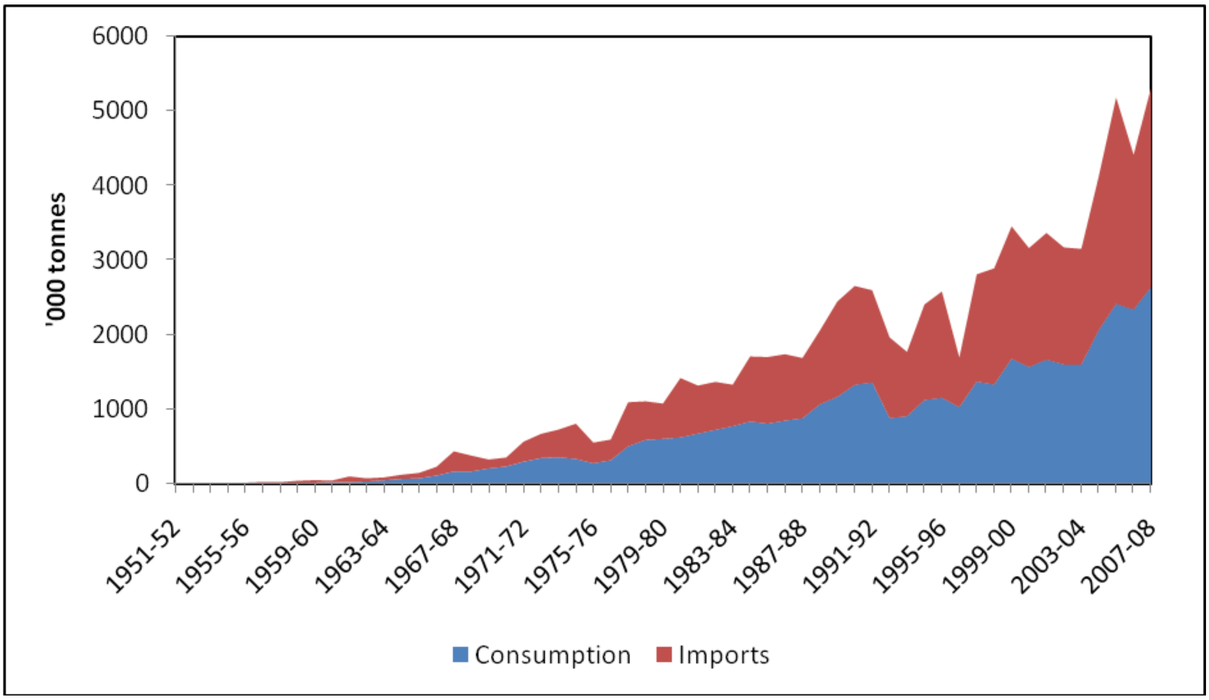
As India does not have any known reserves of potash ores, the potassic fertilizer requirements are met through imports. The trends in imports of K_2O in the country for the period 1951-52 to 2007-08 are presented in Figure 2.42. The quantity of K_2O imports was insignificant till mid-sixties but introduction of high-yielding varieties in 1966-67 increased the K_2O imports significantly. Between 1966-67 and 1981-82, the K_2O imports increased more than five times from 118 thousand tonnes to 6.44 lakh tonnes. The imports further increased during the decade of eighties (from 6.44 lakh tonnes in 1981-82 to 13.28 lakh tonnes in 1990-91). Imports of K_2O fluctuated between 6.13 lakh tonnes and 17.39 lakh tonnes during the 1990s due to certain policy changes like substantial increase in prices and decontrol of K_2O fertilizers. K_2O imports increased significantly during the last 6-7 years and reached a record level of 26.683 lakh tonnes during 2007-08.

Figure 2.42: Trends in imports of K_2O in India: 1951-52 to 2008-09



Source: FAI (2008)

Figure 2.43: Trends in consumption and imports of K2O in India: 1951-52 to 2007-08



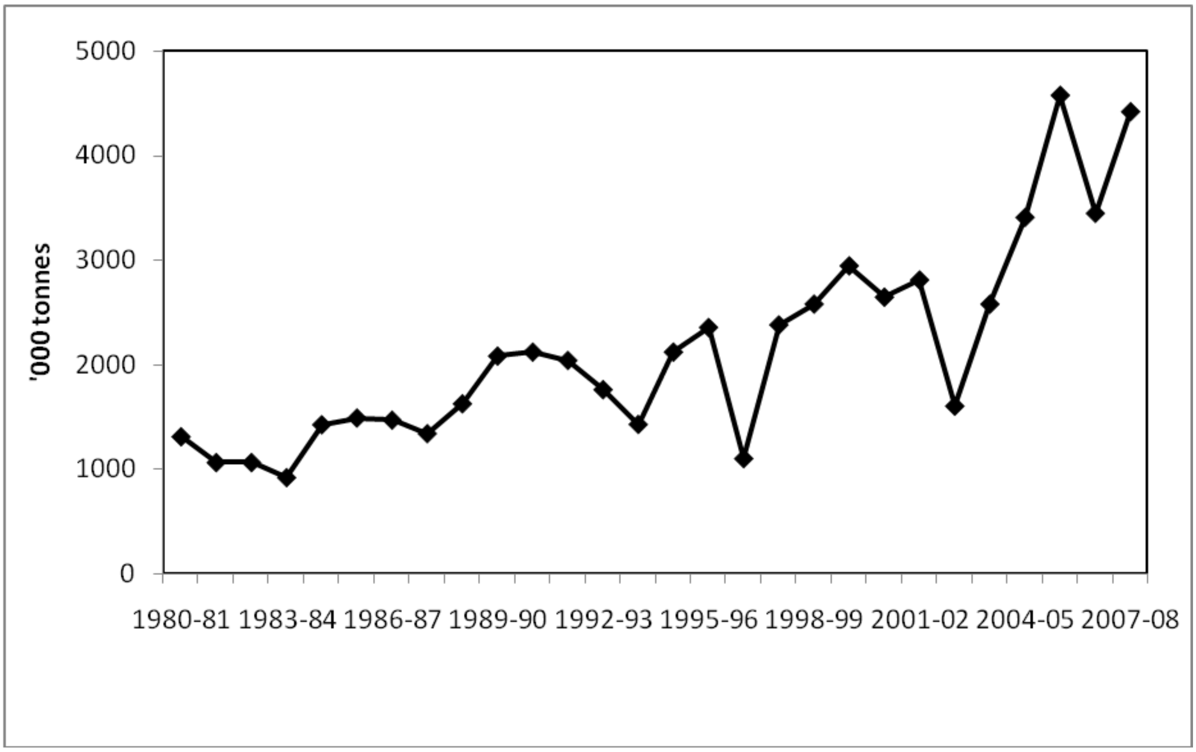
Source: FAI (2008)

Muriate of Potash (MOP)

MOP is the single largest potassic fertilizer imported in the country. A small quantity of Sulphate of Potash (SOP) is also imported for meeting the 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 top importers of potassic fertilizers. The trends in imports of MOP are presented in Figures 2.44 and 2.45.

Major sources of MOP supplies to India are CIS (35%), Canada (20.7%), Israel (18.5%), Jordan (13.9) and Germany (3.5%) and account for over 90 per cent of total imports. Muriate of potash is also imported from Belarus and Russia. A small quantity of sulphate of potash is also imported mainly from Germany.

Figure 2.44: Trends in imports of MOP

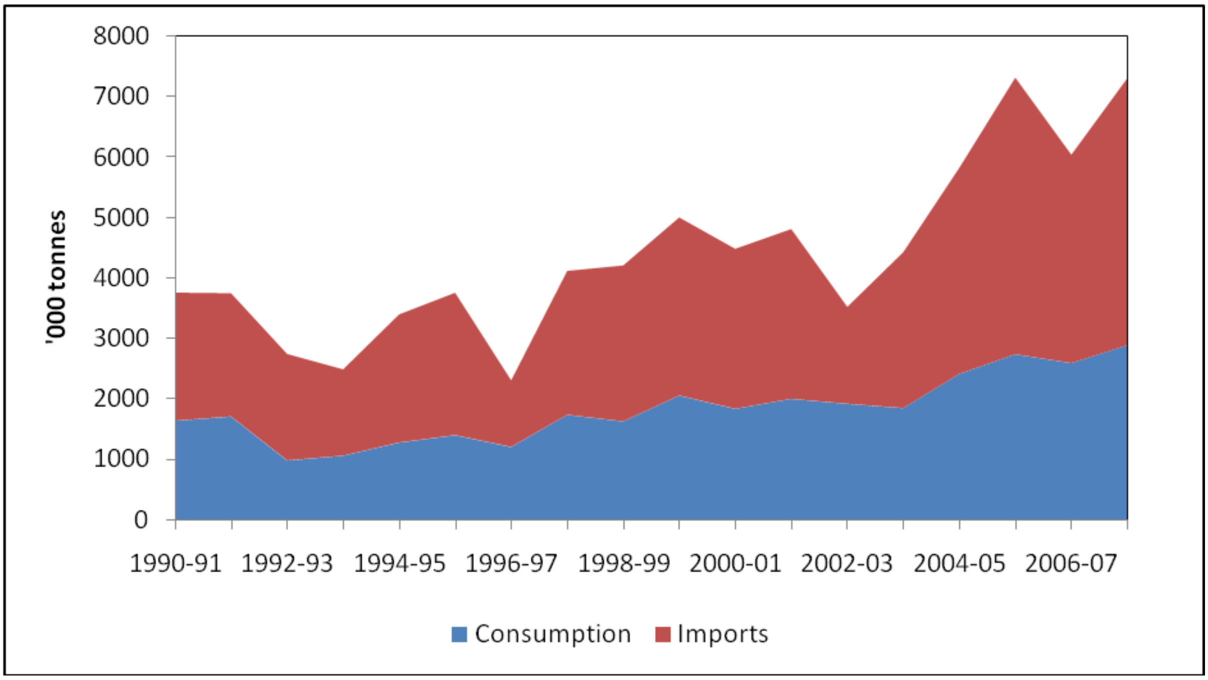


Source: FAI (2008)

Import of Raw Materials

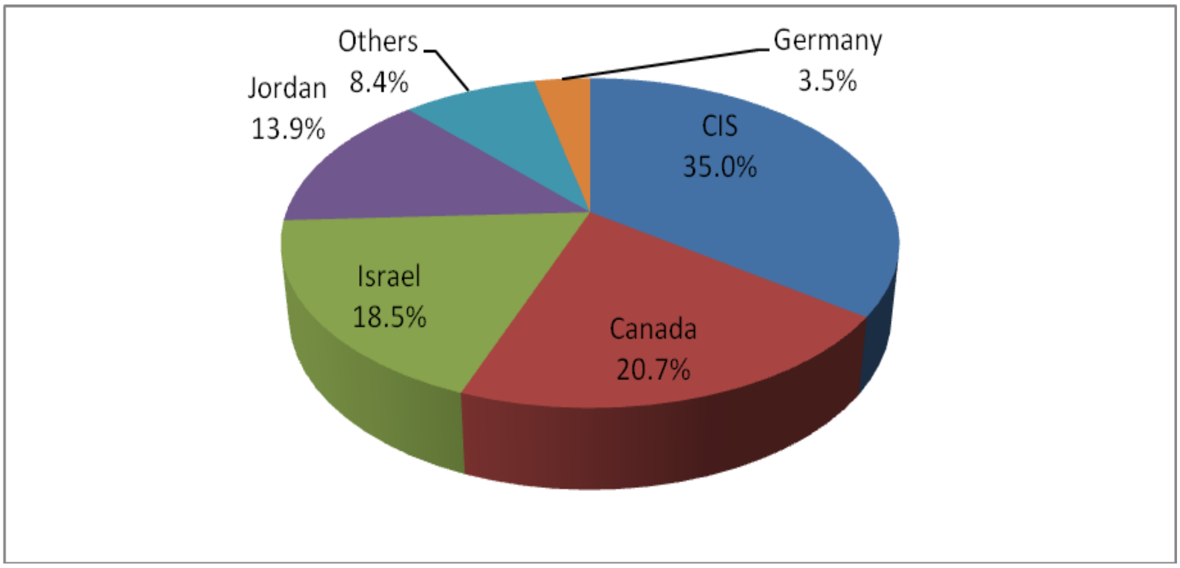
India is one of the largest importers of fertilizer raw materials and fertilizer intermediaries. India's share in world imports of rock phosphate was about 17.8 per cent making India number one in the world markets in 2006. India imported about 2.6 Mte of phosphoric acid against the total world trade of 4.8 Mte P_2O_5, accounting for 54.2 per cent of the world trade. India also imports about 10 per cent of world ammonia exports. India is also a major importer of ammonia and sulphur.

Figure 2.45: Trends in consumption and imports of MOP in India; 1991-92 to 2007-08



Source: FAI (2008)

Figure 2.46: Imports of MOP from major importing countries during the triennium ending (TE) 2007-08

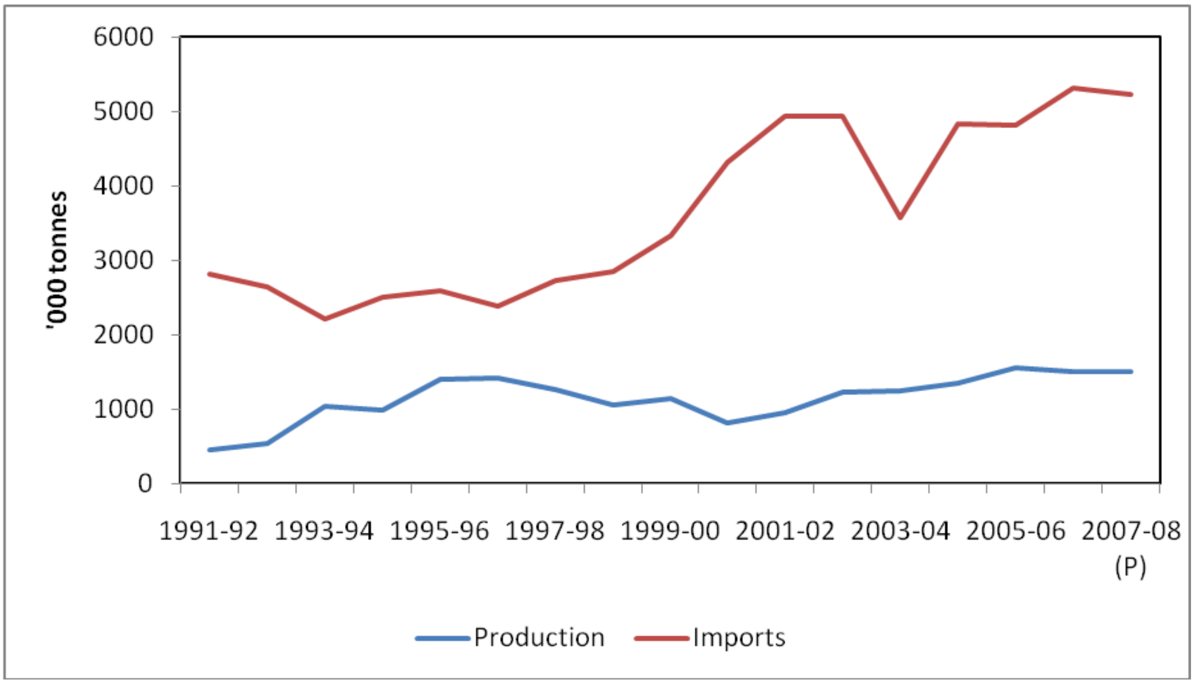


Source: FAI (2008)

Rock Phosphate

Trends in imports and indigenous production of rock phosphate are presented in Figure 2.47. The figure shows that rock phosphate imports have increased from 3.34 million tonnes in 1999 to 5.244 million tonnes in 2007. In contrast total production of rock phosphate in India during 2007-08 was about 1.5 million tonnes. The share of imports in total supply (production + imports) varied from about 63 per cent in 1996-97 to over 86 per cent in early 1990s. Indigenous production has increased during the last 6-7 years and dependence on imports has come down from about 84 per cent in 2000-01 to about 78 per cent in 2007-08.

Figure 2.47: Trends in imports of rock phosphate in India, 1991-92 to 2007-08



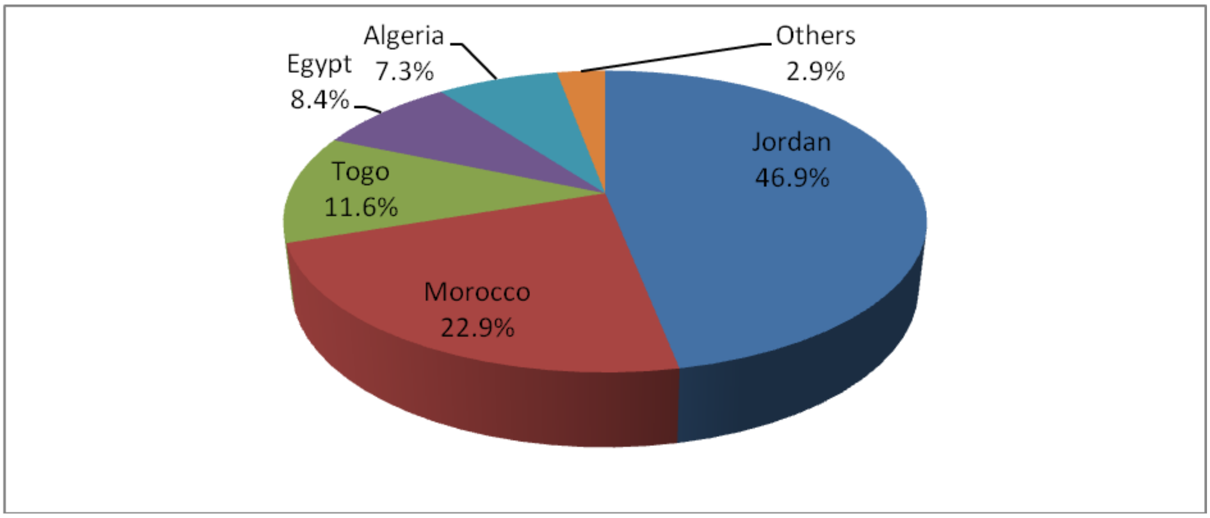
Source: FAI (2008)

About 70 per cent of total imports come form two countries, namely, Jordan and Morocco (Figure 2.48). Togo (11.6%), Egypt (8.4%) and Algeria (7.3%) are major exporters of rock phosphate to India.

Phosphoric Acid

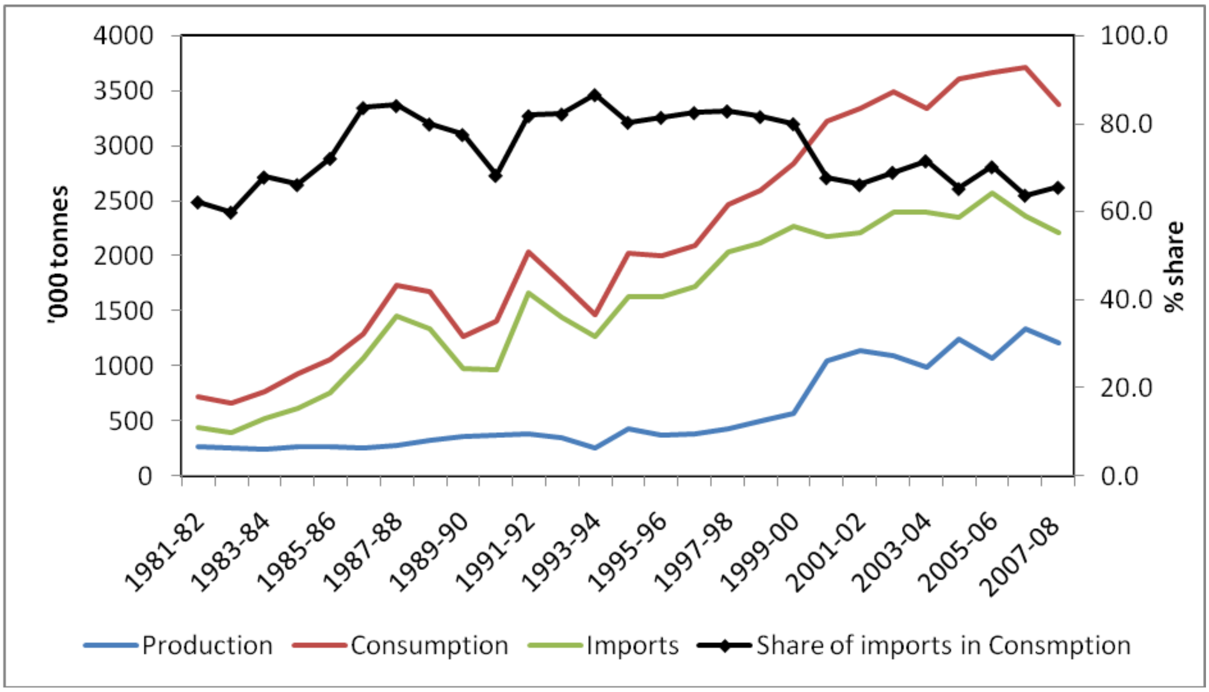
Trends in domestic production, consumption and imports of phosphoric acid are given in Figure 2.49. Domestic production of phosphoric acid was stagnant during the decade of 1980s while consumption rose significatly. The gap between doemstic production and consumption was met through imports and the share of imports in total cosnumption was over 70 per cent. However, production increased at an annual compound growth rate of nearly 10 per cent, from 386 thousand tonnes in 1991-92 to about 1.04 million tonnes in 2000-01. Imports have remained stable during the 2000s (about 2.3 million tonnes) and the share of imports in total consunmption has come down to about 66 per cent.

Figure 2.48: Imports of rock phosphate from major exporting countries during the TE 2007



Source: FAI (2008)

Figure 2.49: trends in production, consumption and imports of phosphoric acid in India



Source: FAI (2008)

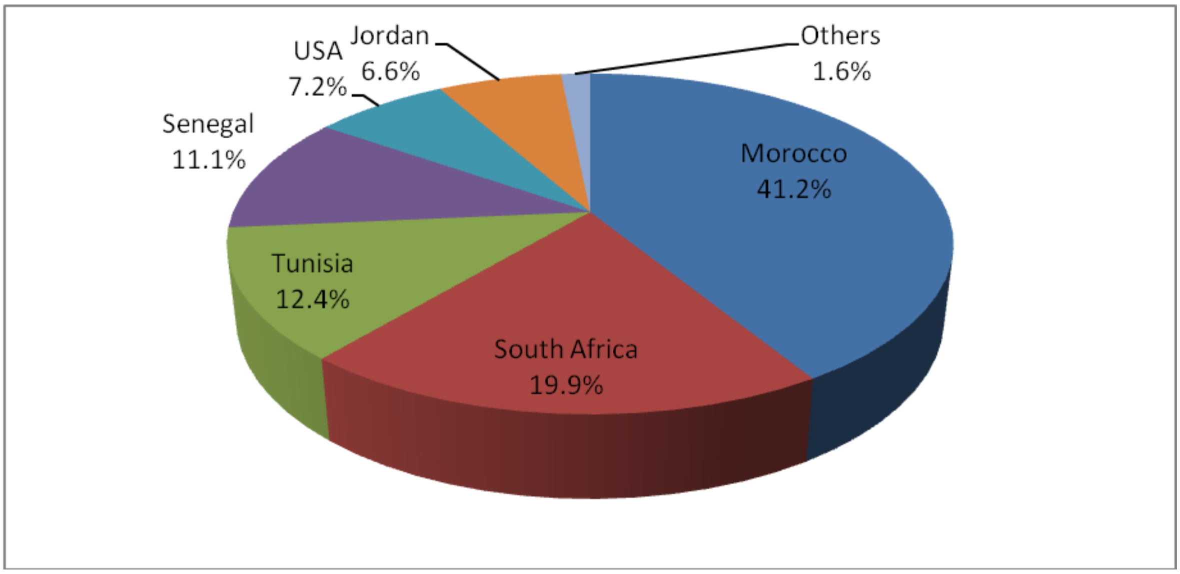
Morocco is the largest exports of phosphoric acid to India accounting for 41.2 per cent share in total imports, followed by South Africa (19.9%), Tunisia (12.4%), Senegal (11.1%), USA (7.2%) and Jordan (6.6%) during the TE 2007-08 (Figure 2.50).

Ammonia

The main raw material for nitrogen nutrient is ammonia which is either produced captively using different feedstocks like gas, naphtha or fuel oil or is imported. The cost of natural gas accounts for 70-90 per cent of the production cost of one ton of ammonia. The trends in production of ammonia and share of imports in total supply of ammonia are given in Figure 2.51. The production of ammonia in the country has increased at annual growth rate of about 2.6 per cent, from about 8.6 million tonnes in 1991-92 to about 12.3 million tonnes in 2007-08. While imports have increased at a faster rate (6.1%) from about 812 million tonnes in early 1990s to about 1.76 million tonnes in 2006-07. The share of imports to total supply has varied from about 7 per cent in 1993-94 to 14 per cent in 2006-07. India is one of the major importers of ammonia in the world.

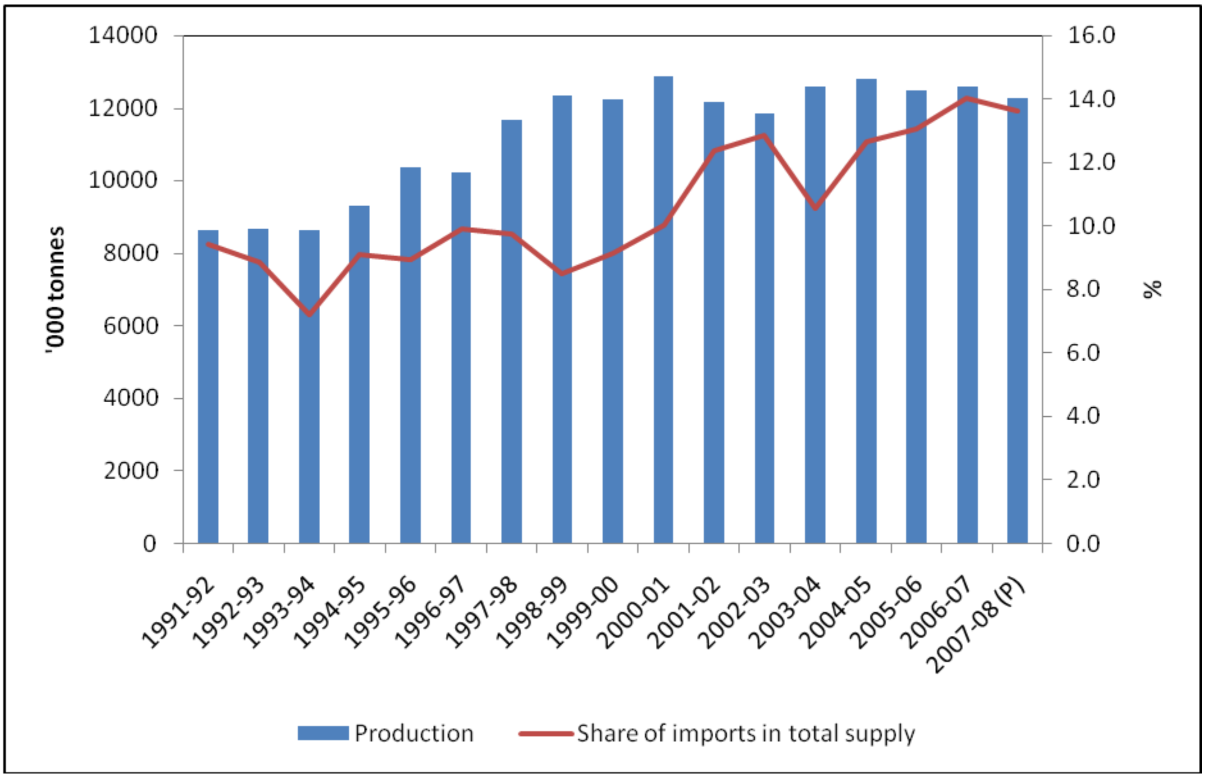
Nearly half of ammonia imports by India are from two countries, namely, Saudi Arabia (30.9%) and Qatar (16%). Other major suppliers of ammonia are Iran (11%), Malaysia (7.9%, Bangladesh (7.2%) and Indonesia (6.3%).

Figure 2.50: Imports of phosphoric acid from major exporting countries during the TE 2007-08



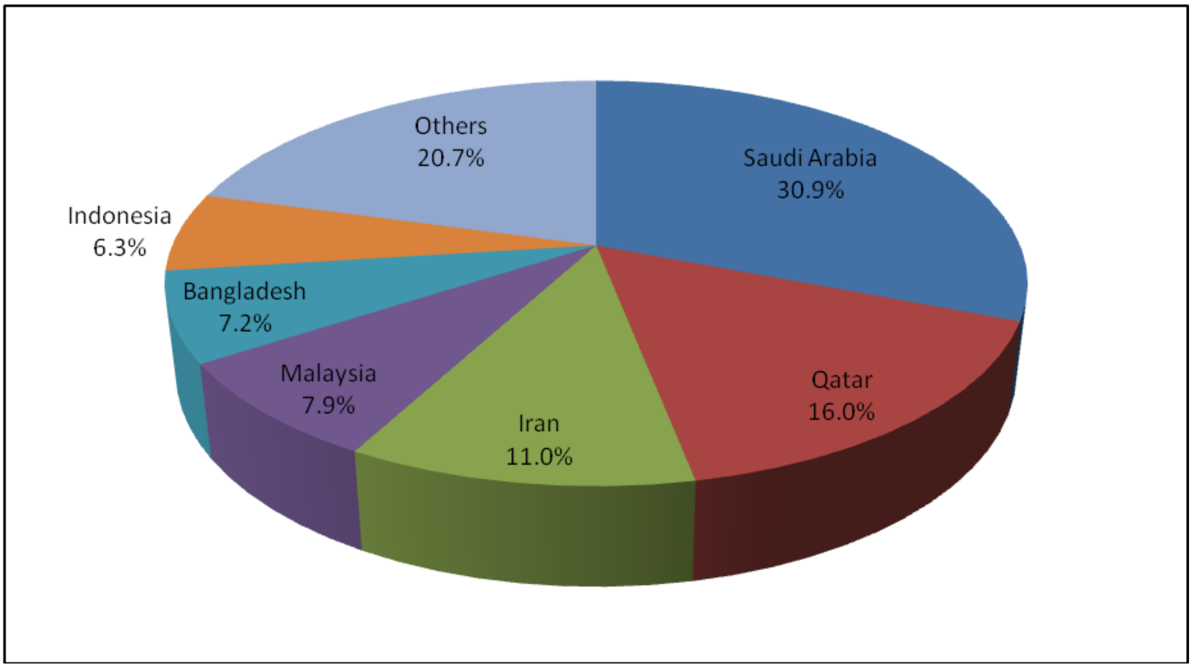
Source: FAI (2008)

Figure 2.51: Trends in imports of ammonia by India: 1991-92 to 2007-08



Source: FAI (2008)

Figure 2.52: Imports of ammonia by India from major countries: TE 2007-08



Source: FAI (2008)

It is evident that the Indian fertilizer industry with a capacity of about 12.28 million tonnes of nitrogen (N) and 5.86 million tonnes of phosphatic (P_2O_5) fertilizers is one of the largest in the world and has played an important role in development of agricultural sector. Fertilizer production, which grew at an impressive growth rate of over 10 per cent during the 1970s and 1980s, suffered a lot in the post-reforms period. Fertilizer production grew at a much faster rate compared to consumption in the pre-reforms period but in post-reforms period growth in fertilizer consumption was higher than production resulting in increased dependency on imports. The total investment in the fertilizer industry at the end of first plan was Rs. 64.9 crore and reached a level of Rs. 25,644 crore by the end of the 9th Plan. The growth in investment was much faster during the fourth, fifth, sixth and seventh plan periods. However, there was hardly any investment during the 10th Plan which led to a big gap between demand and supply. The unprecedented volatility and increase in world fertilizer prices mainly due to increased demand for fertilizers in cereal producing countries and rising crude oil prices, affected the cost of imported fertilizers adversely for India. The total value of imports in India increased from Rs. 7423.83 crore in 2005-06 to Rs. 18454.10 crore in 2007-08, an increase of nearly 150 per cent, whereas the total quantity of imported fertilizers increased by about 47 per cent – from 5.3 million tonnes in 2005-06 to 7.7 million tonnes in 2007-08.

Summary and Concluding Remarks

The Indian fertilizer industry is one of the largest in the world and has played an important role in development of Indian agriculture. The Green Revolution in the late sixties and introduction of RPS in the seventies gave an impetus to the growth of fertilizer industry in India and the 1970s and 1980s witnessed a significant addition to the fertilizer production capacity. However, there has not been any substantive capacity addition to fertilizer production during the last 10 years. Urea is the largest (78.8% of installed capacity) straight nitrogenous fertilizer in while share of other straight nitrogenous fertilizers such as Ammonium Sulphate, Calcium Ammonium Nitrate and Ammonium Chloride is about 3 per cent. The share of public sector in N capacity has declined over time while share of private and cooperative sector has increased. In case of phosphatic fertilizers, DAP constitutes about 55 per cent of total capacity and share of SSP is about 21 per cent and rest is constituted by NP/NPK complexes. The capacity of phosphatic fertilizers, which remained stagnant during the 1950s and 1960s, increased significantly during the seventies and eighties and has stagnated during the last few years. Over the years public sector has lost its share to private and cooperative sectors and today about two-third of the phosphatic fertilizer capacity is in the private sector.

Fertilizer production, which grew at an impressive growth rate of over 10 per cent during the 1970s and 1980s, suffered a lot in the post-reforms period. The production increased at an annual compound growth rate of about 5.5 per cent during the 1990s (1991-92 to 2000-01) and growth rate decelerated to one per cent between 2001-02 and 2007-08. Fertilizer production grew at a much faster rate compared to consumption in the pre-reforms period but in post-reforms period growth in fertilizer consumption was higher than production resulting in increased dependency on imports.

The total investment in the fertilizer industry at the end of first plan was Rs. 64.9 crore and reached a level of Rs. 25,644 crore by the end of the 9th Plan. The growth in investment was much faster during the fourth, fifth, sixth and seventh plan periods. However, there was hardly any investment during the 10th Plan which led to a big gap between demand and supply. The cooperative sector which entered fertilizer sector during the fifth plan witnessed a significant increase in its share. The share of private sector also increased significantly, while share of public sector declined.

During 1950s and 1960s, about two-third of domestic requirement of N fertilizers was met through imports. During the 1980s and 1990s imports were at low levels with few exceptions. However, during the last few years imports have increased significantly due to low addition in domestic capacity coupled with rise in demand for fertilizers. The unprecedented volatility and increase in world fertilizer prices mainly due to increased demand for fertilizers in cereal producing countries and rising crude oil prices, affected the cost of imported fertilizers adversely for India. The total value of imports in India increased from Rs. 7423.83 crore in 2005-06 to Rs. 18454.10 crore in 2007-08, an increase of nearly 150 per cent, whereas the total quantity of imported fertilizers increased by about 47 per cent – from 5.3 million tonnes in 2005-06 to 7.7 million tonnes in 2007-08.

Chapter 3

OVERVIEW OF INDIAN FERTILIZER INDUSTRY: CONSUMPTION TRENDS

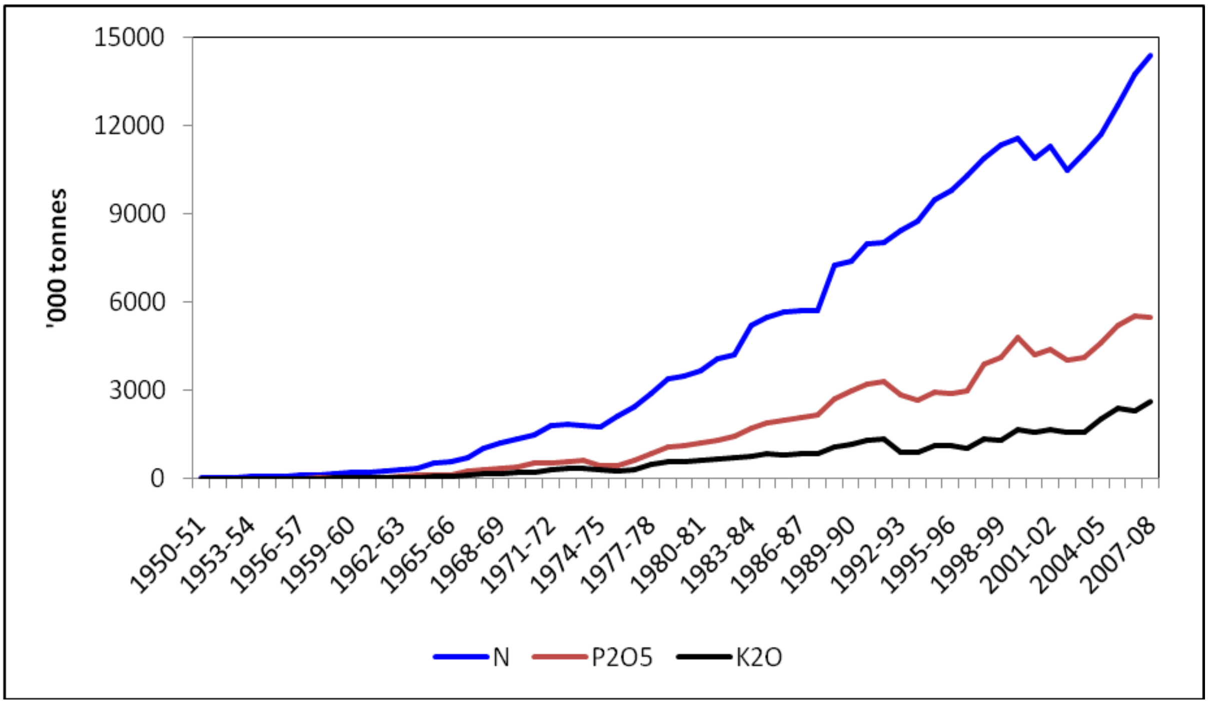
There is ample evidence that increased use of inorganic fertilizers has been responsible for an important share of agricultural productivity growth. Some argue that fertilizer was as important as seed in the Green Revolution (Tomich, Kilby and Johnson 1995), contributing nearly 50 per cent of the yield growth in Asia (Hopper 1993). Others have found that one-third of the cereal production world-wide is due to the use of fertilizer and related factors of production (Bumb 1995). Desai and Vaidyanathan (1995) reported that most of increase in foodgrains output during the first two decades of green revolution is attributable to chemical fertilizers. Therefore, growth in fertilizer consumption is of great importance to increase agricultural production and productivity and to meet future requirements.

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

Fertilizer Consumption Trends: All-India Analysis

India is the third largest consumer of fertilizers in the world, after China and USA. It accounted for 13.7 per cent of the world's N consumption, 14 per cent of phosphatic (P_2O_5) and 7.9 per cent of potassic (K_2O) nutrients in 2006-07 (FAI, 2008). Trends in fertilizer consumption in terms of total quantities and per hectare of cropped area in the country are presented in Figure 3.1 and 3.2. Fertilizer consumption was around 78 thousand tonnes in mid-1960s and it picked up very fast during the late 1960s and 1970s. At the time of onset of green revolution in 1966-67 consumption of fertilizers was about 1 million tonnes. In 1970-71, total fertilizer consumption increased to 2.26 million tonnes, which further increased to 12.73 million tonnes in 1991-92 (Figure 3.1). The rapid expansion of irrigation, spread of HYV seeds, introduction of Retention Price Scheme, distribution of fertilizers to farmers at affordable prices, expansion of dealer's network, improvement in fertilizer availability and virtually no change in farm gate fertilizer prices for 10 years (1981-1991) were major reasons for increase in fertilizer consumption during 1971 to 1990. During 1990s, total fertilizer consumption fluctuated between 12.15 and 16.8 million tonnes with the exception in 1999-00, when fertilizer consumption was over 18 million tonnes. Total fertilizer consumption reached a record level of 22.5 million tonnes during 2007-08.

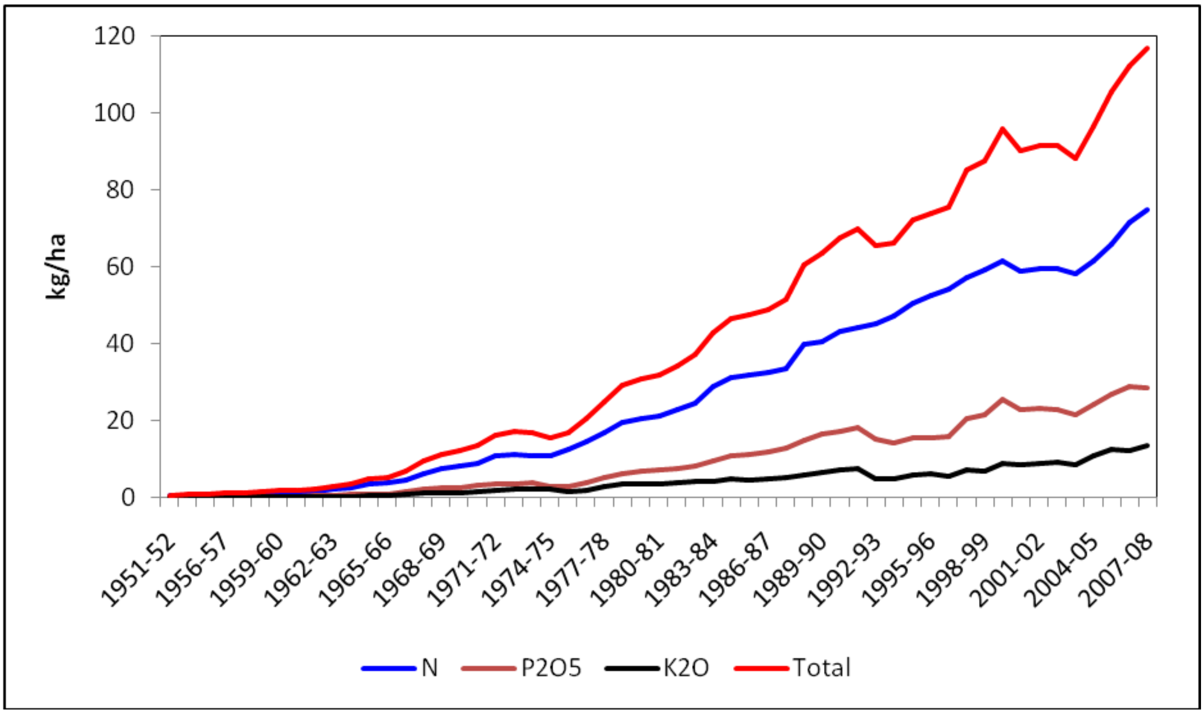
Figure 3.1: Trends in fertilizer consumption (N, P_2O_5 and K_2O) in India: 1950-51 to 2007-08



Source: FAI (2008)

On per hectare basis, fertilizer consumption was less than 2 kg during the 1950s and increased to about 5 kg in 1965-66. However, after introduction of green revolution in 1966-67, per hectare fertilizer consumption more than doubled in the next five years from about 7 kg in 1966-67 to about 16 kg in 1971-72, which further increased and reached a level of 50 kg in mid-1980s (Figure 3.2). Average fertilizer consumption on per hectare basis crossed 100 kg in 2005-06 and reached a record level of 117 kg in 2007-08. However, per hectare fertilizer consumption fell during 1973-74 and 1974-75 due to oil shock of 1973 when oil prices quadrupled almost overnight. The next reversal in intensity of fertilizer use came in 1992-93 when government decontrolled phosphatic and potassic fertilizers and increased fertilizer prices significantly. The decline in use of fertilizers was the highest (36.3%) in case of potassic and about 16 per cent in phosphatic fertilizers. The total fertilizer consumption (N+P+K) fell by about 6 per cent from 69.84 kg per hectare to 65.45 kg per hectare. Due to severe drought in many parts of the country, per hectare fertilizer consumption declined from 91.64 kg in 2002-0.3 to 88.32 kg per hectare in 2003.04. However, during the last five years, intensity of fertilizer use has increased substantially from about 88 kg to 117 kg per hectare (32.5% increase).

Figure 3.2: Trends in consumption of plant nutrients (N, P_2O_5 and K_2O) per hectare of gross cropped area in India: 1951-52 to 2007-08



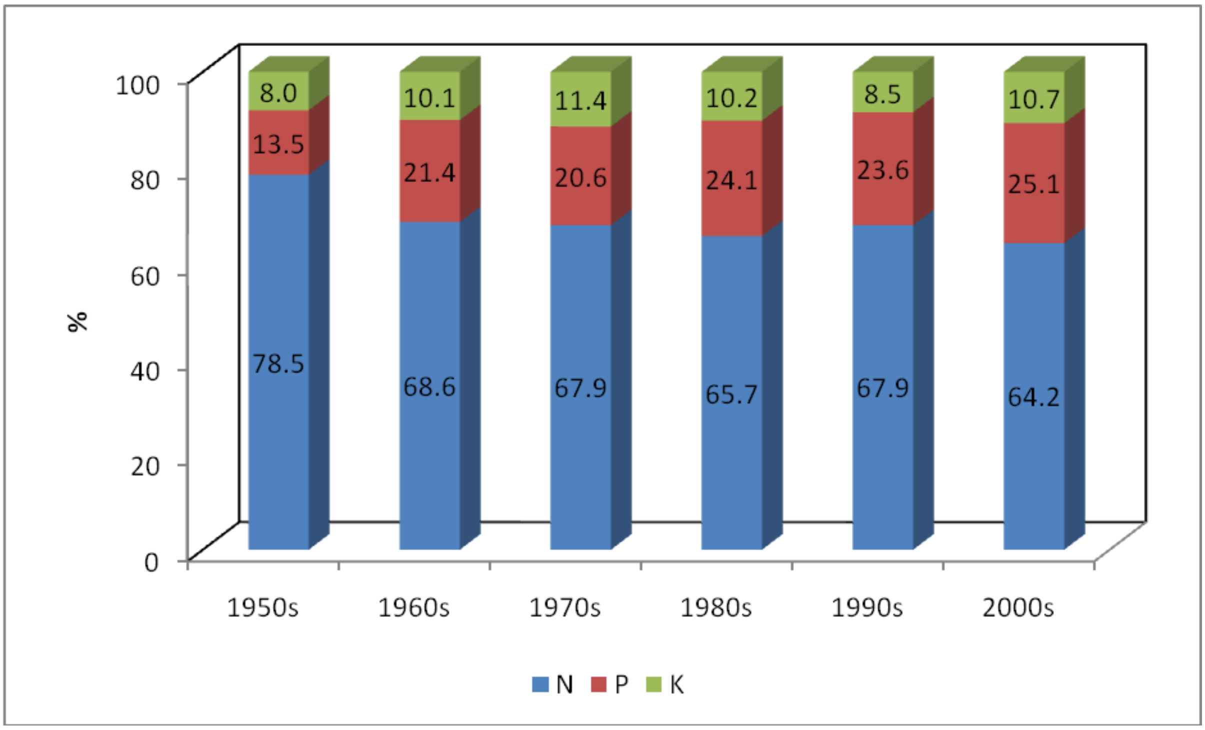
Source: FAI (2008)

Nutrient Share in Total fertilizer Consumption

Sixteen plant food nutrients are essential for proper crop development. Each is equally important to the plant, yet each is required in different amounts. These differences have led to the grouping of these essential elements into three categories; primary (macro) nutrients, secondary nutrients, and micronutrients. Primary (macro) nutrients are nitrogen (N), phosphorus (P), and potassium (K). They are the most frequently required in a crop fertilization program and are needed in larger quantity by plants as fertilizer. The secondary nutrients include calcium, magnesium, and sulphur. For most crops, these three are needed in lesser amounts than the primary nutrients. The micronutrients such as boron, chlorine, copper, iron, manganese, molybdenum, and zinc are used in small amounts, but they are as important to plant development and profitable crop production as the major nutrients. However, major focus of the Indian fertilizer sector policy has been on primary (macro) nutrients. In this section changing pattern of three primary nutrients is examined.

The share of primary nutrients in total fertilizer consumption is presented in Figure 3.3. Nitrogenous fertilizers account for nearly two-third of total nutrient consumption in the country. The share of N was 78.5 per cent in 1950s, which declined to 68.6 per cent in the sixties, 67.9 per cent in the seventies and further to 65.7 per cent in the eighties. However, the share of N increased to 67.9 per cent in the 1990s due to decontrol of P and K fertilizers, which fell to 64.2 per cent in the 2000s.

Figure 3.3: Share of primary nutrients (N, P and K) in total consumption of fertilizers



Source: FAI (2008)

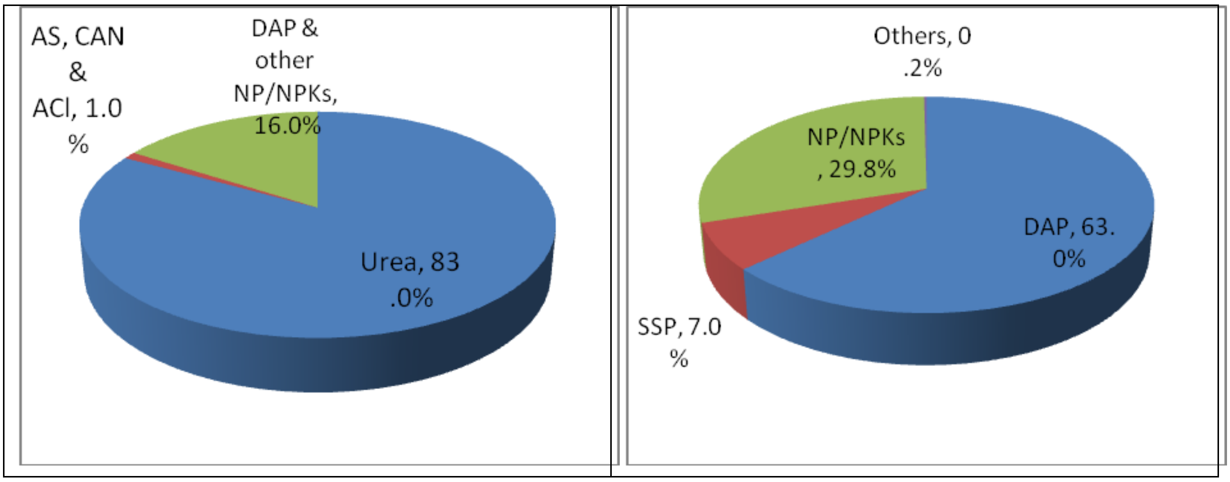
In case of P fertilizers, the share has increased from 13.5 per cent in 1950s to 21.4 per cent in the 1960s, which marginally declined during the 1970s and again picked up during the eighties (24.1%). During the 1990s the share of P in total consumption declined to 23.6 per cent and then increased during the 2000s (25.1%). Likewise the share of K increased from 8 per cent in 1950s to 11.4 per cent in 1970s, declined to 10.2 per cent in the eighties and further fell to 8.5 per cent in the 1990s. The share of K increased to 10.7 per cent in the 2000s. The rise in share of N and decline in the share of P and K fertilizers during the decade of nineties was mainly because of slow growth in consumption of P and K fertilizers compared with N fertilizers due to decontrol of P and K fertilizers and 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 use of primary nutrients, government introduced a concession scheme on the sale of decontrolled P and K fertilizers to the farmers in mid-1990s but still prices of these fertilizers were higher than nitrogenous fertilizers. In the late-1990s and early-2000s government hiked the concession rates for P and K fertilizers, which led to increase in their consumption and higher share in total fertilizer use during the 2000s. The scheme of concession for these fertilizers is still continuing.

Product Shares

Urea is major nitrogenous fertilizer and accounts for more than 80 per cent of India's total nitrogen consumption. The other major nitrogenous fertilizers being calcium ammonium nitrate (CAN), ammonium sulphate (AS) and ammonium chloride (ACl), which account for about one per cent of total N use. In case of phosphatic fertilizers, DAP accounts for 63 per cent of total phosphorus consumption in the country, the other important phosphorus delivering fertilizers include Single Superphosphate (7%), N:K and N:P:K complex fertilizers (Figure 3.4). The main reason for predominant share of these two products (urea and DAP) is that the subsidy/concession was available on these products. Under existing pricing regime, the price of nutrients in complex fertilizers and other decontrolled fertilizer products were higher than the price of same nutrient in other straight fertilizers like Urea, DAP, MOP and SSP. This led to comparatively higher usage of straight fertilizers vis-a-vis complex fertilizers. However, in order to promote balanced use of fertilizers and provide more choice to the farmers, government took a positive step and introduced nutrient-based subsidy scheme covering other products including complex fertilizers in June 2008. This policy intervention is expected to increase choice of products within three primary nutrients as well as more balanced use of fertilizers in terms of N:P:K ratio. Indigenous and imported TSP and indigenous ammonium sulphate were also brought under concession scheme.

Nutrient based pricing of fertilizers significantly reduced prices of complex and other fertilizers, which is expected to raise share of other products in nutrient consumption. It would also give boost to production of complex fertilizers.

Figure 3.4: Share of major fertilizers in nutrient consumption: 2007-08



Source: FAI (2008)

Growth Rates in Fertilizer Consumption

The growth rates in consumption of fertilizers and foodgrains during different time periods at all-India level are given in Table 3.1. The table shows that fertilizer consumption increased by more than 19 per cent in the pre-green revolution period (1950-51 to 1966-67) while foodgrains production increased by only 2.56 per cent. The reason for such a high growth in fertilizer consumption was that consumption in the base year (1950-51) was very low. This significant increase in total fertilizer consumption increased per hectare fertilizer use from less than one kg in 1951-52 to about 7 kg in 1966-67.

In the post-green revolution period, fertilizer use increased by 9.9 per cent per year during the first phase of green revolution (1967-68 to 1980-81) when spread of high yielding varieties was limited to mainly Punjab, Haryana, western part of Uttar Pradesh and some southern states. Per hectare fertilizer consumption increased from 9.4 kg in 1967-68 to 31.9 kg in 1980-81. Increase in fertilizer use along with increase in area under irrigation and high yielding varieties increased foodgrains production from 95.5 million tonnes in 1967-68 to about 130 million tonnes in 1980-81 at an annual compound growth rate of 2.27 per cent. However, foodgrains productivity increased at a faster rate (1.87%) in the first phase of green revolution compared with pre-green revolution period (1.45%). During the second phase of green revolution (1981-82 to 1990-91), when technology spread to other parts of the country, total fertilizer consumption increased an annual growth rate of 7.39 per cent. Per hectare fertilizer consumption more than doubled from 34.3 kg in 1981-82 to 69.8 kg in 1991-92. Total foodgrains production increased by about 2.8 per cent. The impressive growth of consumption of fertilizer in India in the post-green revolution period ensured increase in foodgrains production from 74.3 million tonnes in 1966-67 to 176.4 million tonnes during 1990-91.

Table 3.1: Growth rate in fertilizer consumption and foodgrains production

Period	Growth rate in fertilizer consumption (%)		Growth rate in foodgrains production (%)	Growth rate in foodgrains yield (%)
	Total	Per ha.		
Pre-green revolution period (1950-51 – 1966-67)	19.41	18.11	2.56	1.45
Post-green revolution period	8.75	8.49	2.65	2.53
Phase I (1967-68 – 1980-81)	9.90	9.29	2.27	1.87
Phase II (1981-82– 1991-92)	7.39	6.61	2.77	3.13
Post-reforms Period (1991-92 to 2007-08)	3.59	3.47	1.15	1.23
8th Five Year Plan	4.51	5.63	1.26	1.10
9th Five Year Plan	1.35	0.43	-2.87	-0.98
10th Five Year Plan	7.57	7.40	2.52	2.05

Source: FAI (2008)

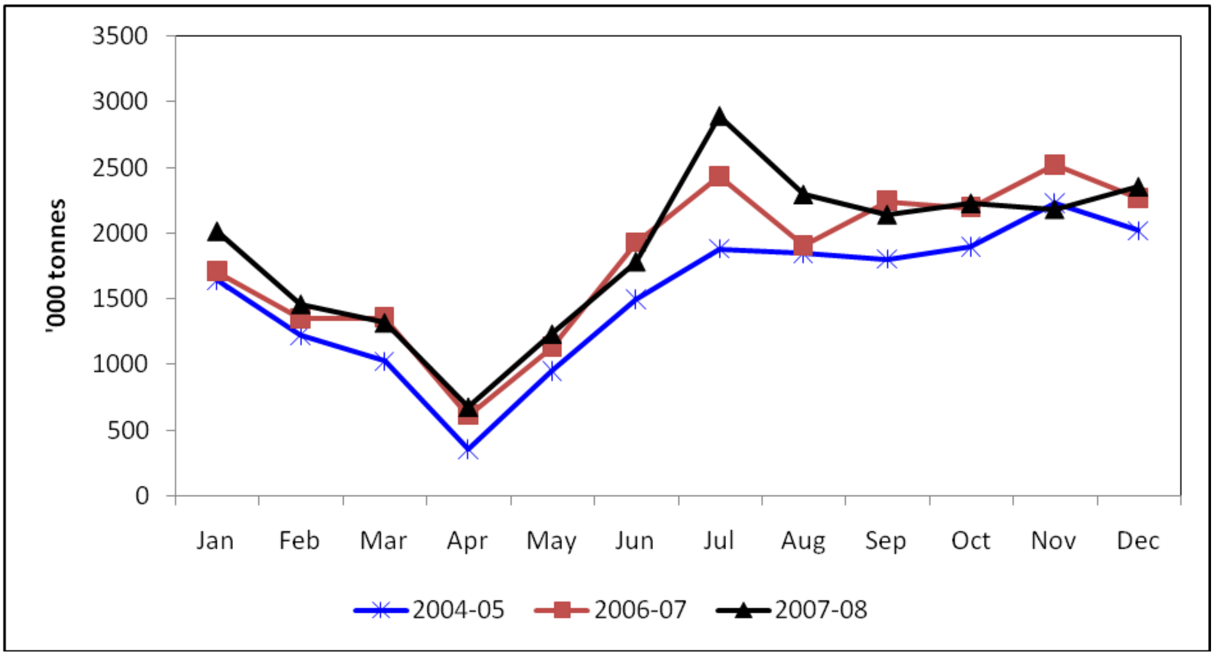
However, in 1991-92, certain policy reforms were initiated in fertilizer sector as part of macro-economic reforms. The potassic and phosphatic fertilizers were decontrolled w.e.f. August 25, 1992, the low analysis nitrogenous fertilizers viz. calcium ammonium nitrate, ammonium chloride and ammonium sulphate were decontrolled and brought under control several times in the past. These fertilizers were last decontrolled w.e.f. June 10, 1994. These policy interventions led to a serious slowdown in fertilizer consumption in the post-reforms period. Total fertilizer consumption declined from about 12.7 million tonnes in 1991-92 to 12.1 million tonnes in 1992-92. Similarly, per hectare fertilizer use also declined from 69.84 kg in 1991-92 to 65.45 kg in 1992-93. This reduction was more pronounced in case of phosphatic and potassic fertilizers. Total P_2O_5 consumption fell by about 14 per cent (from 3321.2 thousand tonnes in 1991-92 to 2843.8 thousand tonnes in 1992-93) and K_2O by 35 per cent (1360.6 thousand tonnes in 1991-92 to 883.9 thousand tonnes in 1992-93). Similar trend was observed in case of per hectare fertilizer consumption. Due to introduction of concession scheme on decontrolled phosphatic and potassic fertilizers in 1992-93, fertilizer consumption started picking up and reached a level of 18.069 million tonnes in 1999-00, declined to 16.702 million tonnes in 2000-01 and remained below this level up to 2003-04. Per hectare fertilizer consumption reached a level of 95.89 kg in 1999-00 but remained below this level during the next four years. Last four years viz., 2004-05 to 2007-08 have seen some recovery in fertilizer use in the country and total consumption reached a record level of 22.57 million tonnes and per hectare consumption at 117.07 kg in 2007-08.

The impact of slow growth of fertilizer consumption on growth of foodgrains production and crop output in the post-reforms period is quite evident from growth rates presented in Table 3.1. In post-reforms period (1991-92 to 2007-08) growth rate in fertilizer consumption was about 3.6 per cent compared with over 8.75 per cent during 1967-68 to 1991-92. Total fertilizer consumption recorded the lowest growth (1.35%) during the 9th five year plan compared with about 7.57 per cent during 10th plan. There seems to be a very high positive association between growth rates of fertilizer consumption and foodgrains production. During 8th plan period fertilizer consumption increased at an annual growth rate of about 4.51 per cent and foodgrains production increased by 1.26 per cent. Fertilizer consumption growth rate fell to 1.35 per cent during 9th plan and foodgrains production growth rate also declined to -2.87 per cent. During 10th five year plan, fertilizer consumption grew by 7.57 per cent and foodgrains production growth rate increased to about 2.52 per cent. In the post-reforms period (1991-92 to 2007-08) growth rate in fertilizer consumption (3.59%) turned out to be less than half of what was achieved (8.75%) during the post-green revolution period (1967-68 to 1991-92). Similar trend was observed in case of foodgrains production. Growth rate in foodgrains production declined to less than half (1.15%) during 1991-92 to 2007-08 compared with 1967-68 to 1991-92 period (2.65%)

Season-wise Consumption of Fertilizers

There is a high degree of seasonality in fertilizer consumption in the country due to seasonal crop production cycle. The fertilizer consumption is highest in July (*kharif* season) and December (*rabi* season), while it is lowest during the month of April and May (Figure 3.5).

Figure 3.5: Month-wise consumption of fertilizer nutrients (N+P+K) in India



Source: FAI (2008)

The season-wise consumption of fertilizers is given in Table 3.2. The results show that during the early-1980s kharif season accounted for less than 40 per cent of total fertilizer consumption, whereas rabi crops accounted for much larger share. This has now changed and consumption is more evenly spread between the two seasons. Growth rate in consumption of fertilizers was positive in both the seasons during the last three and half decades, with more pronounced growth in Kharif season. The fertilizer consumption during kharif season grew at an annual compound growth rate of 9.6, 5.0 and 6.6 per cent during the 1980s, 1990s and 2000s. In contrast, fertilizer consumption in rabi season increased by 6.8, 4.1, and 5.4 per cent during the same period, lower than kharif season growth rates. Accordingly, *kharif*:*rabi* ratio in total consumption changed from 38:62 during 1981-82 to 49:51 during 2007-08. This might be due to better irrigation facilities and diversification of crops from food to cash crops during kharif season.

Fertilizer Consumption Trends at Regional/State Level

Figure 3.6 shows the share of total fertilizer consumption by region. The eastern and southern regions have generally consumed less fertilizer while the northern and western regions consumed more. The share of northern zone was the highest (34.1%), followed by west and south accounting for nearly 25 per cent each and the lowest (15.5%) in eastern region. However, share of eastern region has increased from about 10 per cent in 1970s to 13.7 per cent in 1990s, which further increased to 15.5 per cent during the 2000s, which is an encouraging trend since fertilizer consumption in eastern region is quite low compared with national average as well as other regions. The share of western region has also increased during the last three and half decades. In contrast, south has lost its share from 30.7 per cent in seventies to 24.7 per cent in 2000s, while in case of northern region there is marginal decline in the share (from 36.9 per cent in 1970s to 34.1 per cent in 2000s).

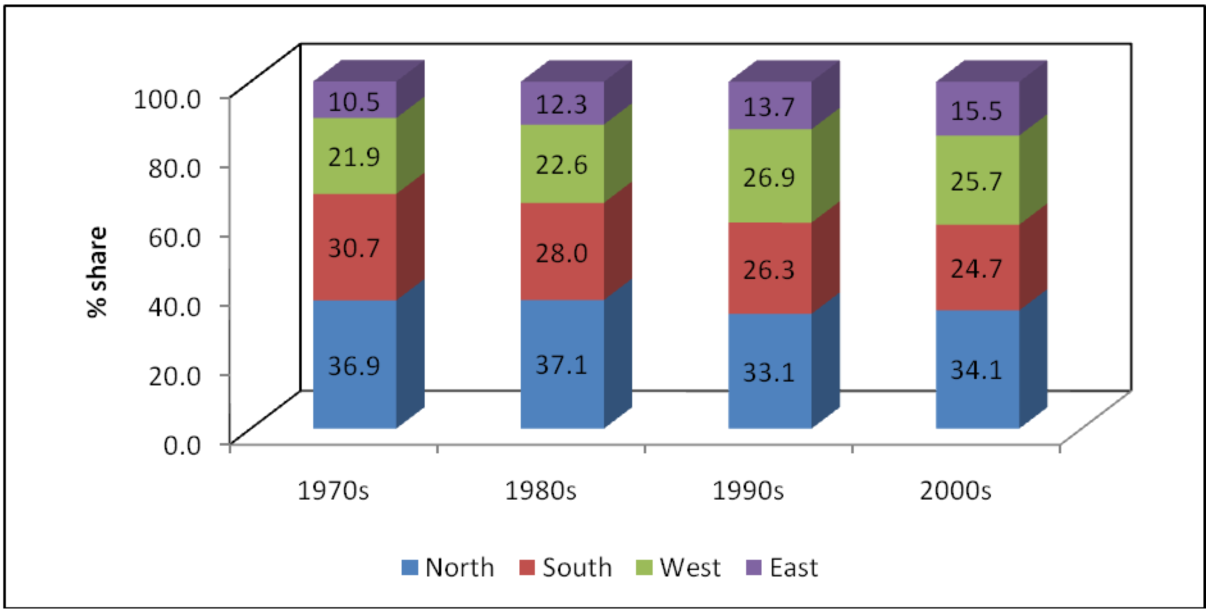
Table 3.2: Season wise consumption of N, P_2O_5 and K_2O ('000 tonnes) in India

Year	Kharif				Rabi				Kharif : Rabi Ratio
	N	P	K	Total	N	P	K	Total	
1981-82	1484.47	470.78	278.33	2310.17	2507.59	851.54	397.85	3756.98	38:62
1982-83	1911.37	556.36	338.04	2805.77	2331.10	876.31	388.26	3595.67	35:65
1983-84	2263.27	633.02	319.24	3215.52	2941.12	1097.26	456.18	4494.56	44:56
1984-85	2574.52	782.23	426.95	3783.70	2911.58	1104.18	411.53	4427.25	42:58
1985-86	2706.71	879.07	418.24	4004.02	2954.09	1126.14	389.82	4470.05	46:54
1986-87	2703.28	844.39	409.24	3956.91	3012.77	1234.46	440.76	4682.99	47:53
1987-88	2529.61	847.11	403.53	3780.25	3187.18	1339.96	476.95	5004.09	46:54
1988-89	3566.93	1121.52	514.29	5202.74	3684.08	1599.16	554.07	5837.31	43:57
1989-90	3450.06	1354.41	568.22	5372.69	3935.88	1659.83	599.77	6195.48	47:53
1990-91	3647.37	1421.14	672.55	5741.04	4349.79	1799.85	655.50	6805.15	46:54
1991-92	3687.03	1529.14	678.08	5894.25	4359.29	1792.02	682.48	6833.79	46:54
1992-93	3813.54	1454.89	579.34	5847.77	4613.29	1388.88	304.58	6306.76	46:54
1993-94	4026.16	1147.77	431.62	5605.55	4762.17	1521.55	477.06	6760.78	48:52
1994-95	4462.18	1427.28	534.71	6424.17	5044.93	1504.45	590.06	7139.44	45:55

1995-96	4863.07	1475.64	588.97	6927.68	4949.76	1421.90	566.84	6948.49	47:53
1996-97	4990.32	1395.93	533.56	6919.81	5311.43	1580.82	496.07	7388.32	50:50
1997-98	5348.43	2052.99	690.82	8092.24	5553.37	1860.56	681.64	8095.57	48:52
1998-99	5454.77	1920.79	458.05	7833.61	5899.01	2191.36	873.48	8963.85	50:50
1999-00	5755.25	2288.51	817.37	8861.13	5837.26	2509.42	861.06	9207.74	47:53
2000-01	5415.37	1884.93	733.64	8033.94	5504.79	2329.69	833.88	8668.36	49:51
2001-02	5397.39	1912.93	774.33	8084.65	5912.83	2469.47	892.76	9275.06	48:52
2002-03	4902.37	1715.72	714.60	7332.69	5571.75	2303.09	886.56	8761.40	47:53
2003-04	5142.81	1696.71	698.72	7538.24	5934.14	2427.57	899.19	9260.90	46:54
2004-05	5503.64	1920.96	923.64	8348.24	6210.27	2702.83	1137.02	10050.12	45:55
2005-06	6028.21	2150.97	1018.48	9197.66	6695.11	3052.71	1394.83	11142.65	45:55
2006-07	6575.95	2674.40	1004.15	10254.48	7196.92	2868.88	1330.67	11396.47	47:53
2007-08	6944.54	2731.08	1341.24	11016.86	7474.58	2783.66	1295.03	11553.27	49:51
Growth rate (%)									
1980s	9.15	12.36	8.70	**9.60**	6.27	8.70	5.65	**6.81**	-
1990s	5.24	5.39	2.51	**5.01**	3.19	5.65	7.81	**4.10**	-
2000s	5.51	8.15	10.14	**6.63**	4.89	3.74	8.82	**5.01**	-

Source: FAI (2008)

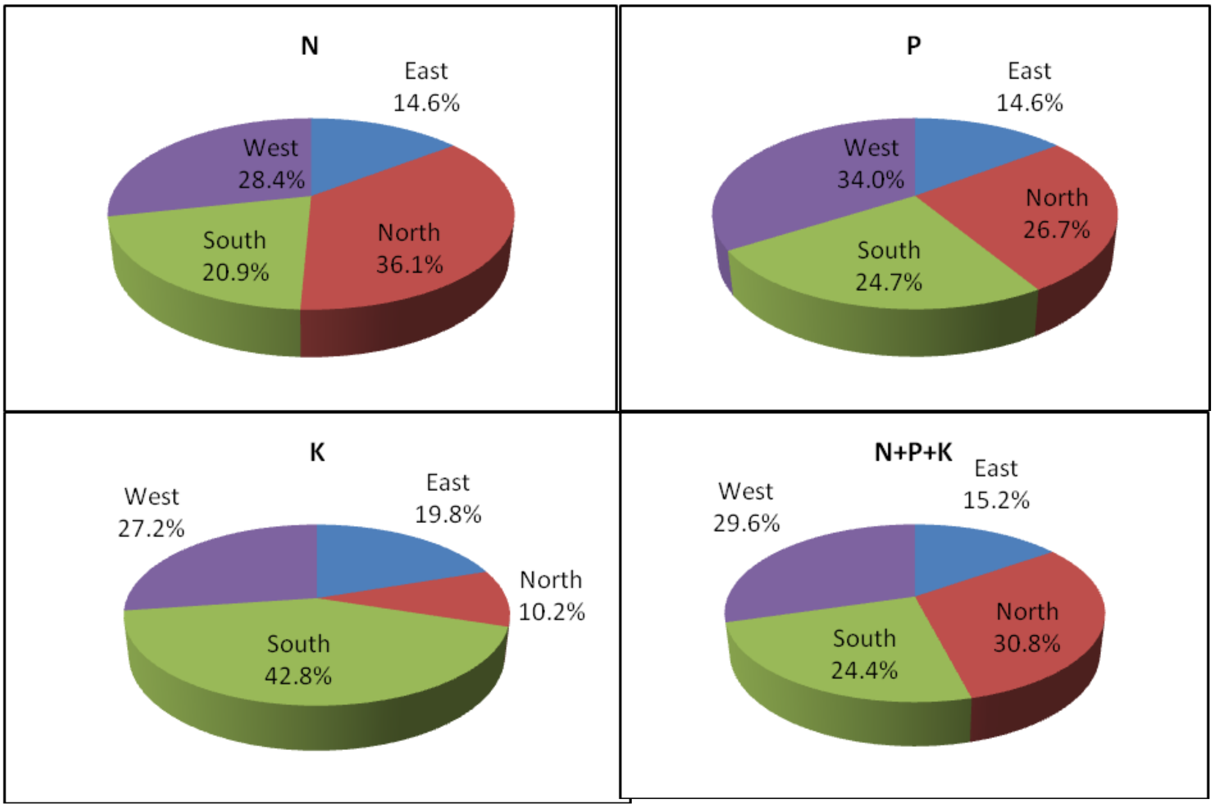
Figure 3.6: Distribution of fertilizer consumption trends by regions



Source: FAI (2008)

There are also regional differences in consumption of nutrients (Figure 3.7). Consumption of N is the highest in north region constituting 36.1 per cent, and the lowest in the eastern zone (14.6%). In case of phosphatic fertilizers, west zone has the highest share (34%), followed by north (26.7%) and southern region (24.7%). The southern region accounts for about 43 per cent of total K consumption in the country while share of north zone is the lowest (10.2%). These differences are due to variations in soil fertility status under different agro-ecological regions and cropping systems.

Figure 3.7: Region-wise share in N, P_2O_5 and K_2O consumption: 2007-08



Source: FAI (2008)

Table 3.3 presents region-wise share of gross cropped area and fertilizer consumption for the year 1981-82, 1991-92, 2001-02 and 2006-07. The northern region, which accounts for 22.3 per cent of gross cropped area, uses 30.8 per cent of total fertilizer in the country. The intensity of fertilizer consumption in terms of kg per hectare is also the highest (161.6 kg) in the northern region. Though the western region accounts for 42.2 per cent of gross cropped area, it accounts for 29.6 per cent of total fertilizer consumption. This is mainly due to large tracts of arid and semi-arid regions in Rajasthan, Gujarat and Madhya Pradesh and irrigation facilities are also low in the region. The cultivation of fertilizer-intensive crops like rice, wheat, sugarcane, etc. is also low in this region. However, the region has increased in its share from 23.5 per cent in 1981-82 to 29.6 per cent in 2007-08. Although share of eastern region is low but has increased from 10.2 per cent in 1981-82 to over 15 per cent in 2007-08. In contrast the share of southern region has declined from 27.1 per cent to 24.4 per cent during the corresponding period. The share of north zone has also declined sharply from 39.2 per cent in 1981-82 to 30.8 per cent in 2007-08.

Table 3.3: Regional share of Gross Cropped Area and fertilizer consumption in India

Zones	1981-82		1991-92		2001-02		2007-08	
	GCA	Fertilizer	GCA	Fertilizer	GCA	Fertilizer	GCA	Fertilizer
East	18.5	10.2	18.4	13.1	17.3	15.0	17.5	15.2
North	22.0	39.2	22.6	33.2	22.4	34.4	22.3	30.8
South	19.9	27.1	19.1	28.1	18.5	25.0	18.0	24.4
West	39.6	23.5	39.9	25.6	41.8	25.6	42.2	29.6
All India	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: FAI (2008)

These regional figures mask variability among states. Within each region there are also sharp differences in consumption (Annexure No. 3.1 State wise & region wise shares). Uttar Pradesh (54.0%), Punjab (24.4%) and Haryana (17.6%) accounted for about 96 per cent of north region's fertilizer consumption during 2007-08 while share of remaining three states (Uttrakhand, Jammu & Kashmir and Himachal Pradesh) was 4 per cent. Similarly in eastern region, West Bengal (40.1%) and Bihar (35.1%) used over three-fourth of total consumption in the region. In the southern region, about 96 per cent of the fertilizer consumption was in three states: Andhra Pradesh (48.5%), Karnataka (27.4%) and Tamil Nadu (19.6%). Maharashtra (34.8%), Gujarat (24.3%) and Madhya Pradesh (19.5%) consumed nearly 80 per cent of total fertilizer used in the western region.

Classification of States according to Growth Rates in Consumption

In order to analyze growth pattern in fertilizer consumption (N+P+K) in various states during different time periods, states have been classified on the basis of their consumption trends. The states have been classified into four categories:

i. States with positive and significant growth in consumption,
ii. States with positive but non-significant trend,
iii. States with significant negative growth rate, and
iv. States with negative but non-significant growth rate

The classification of states/UTs[1] according to growth rate in total fertilizer consumption during the last four decades is presented in Table 3.4. For the period 1971-72 to 2006-07, all states/UTs included in the present analysis recoded a significant positive growth rate in fertilizer consumption. Out of 20 states/UTs included in the present analysis, 12 had higher growth rate compared with national average (6.2 %). The growth rates were relatively higher in the North-eastern region because of low base in the 1970s. Among major foodgrains producing states, West Bengal, Haryana, Madhya Pradesh and Rajasthan recorded about 8 per cent growth rate during the period under study.

In order to examine fertilizer consumption trends during different sub-periods, total period from 1971-72 to 2007-08 was divided into four sub-periods: the 1970s (1971-72 to 1980-81), 1980s (1981-82 to 1990-91), 1990s (1991-92 to 2000-01) and 2000s (2001-02 to 2007-08), reflecting different phases of policy and technological interventions in the Indian agriculture. The green revolution involving use of modern high yielding varieties and other modern inputs and services like irrigation and rural credit, led to a shift in the cropping pattern and productivity levels which affected fertilizer consumption during the 1970s. There was a structural break in growth trends of fertilizer consumption during the late-1970s because retention pricing scheme (RPS) was introduced during this period, which affected fertilizer production and consumption. The green revolution also spread to other parts of the country (east and west zones) during the eighties. The 1990s witnessed significant changes in the policy environment (domestic and external), which had impact on fertilizer sector.

It is interesting to note that 19 out of 20 states/UTs had a significant positive growth rate during the 1970s, which increased to 20 out of 20 in 1980s. However, during 1990s, the

[1] Only those states/UTs, which have fertilizer consumption one an average more than 10,000 tonnes, have been included in the present analysis.

number of states having significant positive growth in fertilizer consumption declined to 18 and further declined to 17 during the 2000s. Fertilizer consumption which grew at an annual compound growth rate of over 10 per cent during the 1970s and 8 per cent in the 1980s, decelerated to 4.2 per cent in 1990s but picked up during the 2000s (5.8%).

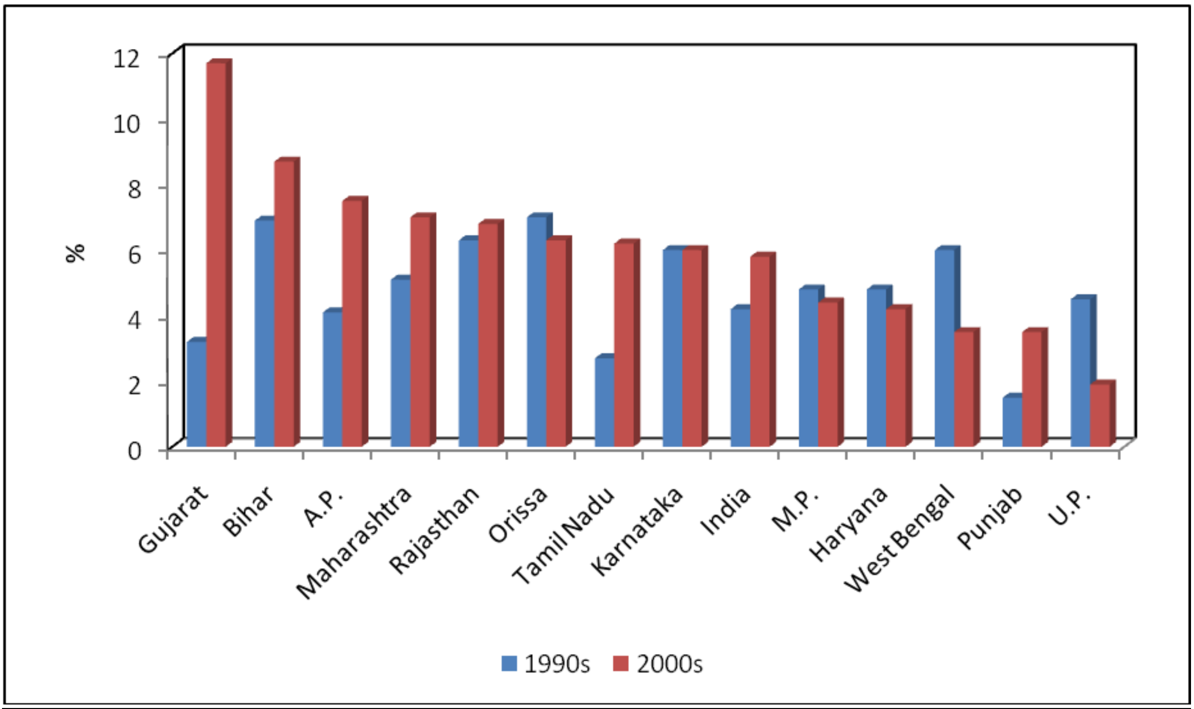
Table 3.4: Classification of states according to growth rate in total fertilizer (N+P+K) consumption

	1970s	1980s	1990s	2000s	All period
Significant +ve growth rate	Andhra Pradesh Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Manipur Orissa Pondicherry Punjab Rajasthan Tamil Nadu Tripura Uttar Pradesh West Bengal **19 (95.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Orissa Pondicherry Punjab Rajasthan Manipur Tamil Nadu Tripura Uttar Pradesh West Bengal **20 (100.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Jammu & Kashmir Karnataka Madhya Pradesh Maharashtra Manipur Orissa Pondicherry Punjab Rajasthan Himachal Pradesh Tamil Nadu Uttar Pradesh West Bengal **18 (90.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Maharashtra Orissa Pondicherry Punjab Rajasthan Tamil Nadu Uttar Pradesh West Bengal **17 (85.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Manipur Orissa Pondicherry Punjab Rajasthan Tamil Nadu Tripura Uttar Pradesh West Bengal **20 (100.0)**
Non-significant +ve growth rate			Tripura **1 (5.0)**	Madhya Pradesh Manipur Tripura **3 (15.0)**	
Significant -ve growth rate					
Non-significant -ve growth rate	Assam **1 (5.0)**		Kerala **1 (5.0)**		
India	10.2 20 (100.0)	8.0 20 (100.0)	4.2 20 (100.0)	5.8 20 (100.0)	6.2 20 (100.0)

Note: Figures in parentheses show percentage to total number of states included in the analysis
Source: FAI (2008)

Several factors such as low investment in agriculture research and development, irrigation, market infrastructure, poor extension services, decontrol of some of fertilizers, more emphasis on pricing policy, etc. seem to have contributed to deceleration in growth in fertilizer consumption during the decade of nineties. The states which experienced acceleration in growth rate during the 2000s included Gujarat, Bihar, Andhra Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Karnataka and Punjab. Among these states, Gujarat had the highest growth rate (11.7%) in fertilizer consumption, followed by Bihar (8.7%), Andhra Pradesh (7.5%), and Maharashtra (7.0%). Growth rates in fertilizer consumption decelerated in Madhya Pradesh, Haryana, West Bengal, Uttar Pradesh and Orissa (Figure 3.8).

Figure 3.8: Growth rate in total fertilizer consumption in selected states in India: 1990s and 2000s



Source: FAI (2008)

Distribution of states according to comparison between all-India growth rate and state-level growth in total fertilizer (N+P+K) consumption is presented in Table 3.5. The number of states/UTs having growth rate higher than national average was 9 in seventies which increased to 14 in 1980s and then declined to 12 in 1990s. During the 2000s, of 20 states, 10 had higher growth rate than all-India average. Growth rates in states like Gujarat, Bihar, Andhra Pradesh, Maharashtra, Rajasthan, Orissa, Tamil Nadu and Karnataka were higher than the national average during the 2000s. The number of states having significant positive growth rate higher than national average was the highest (60%) during the 1980s and the lowest (45%) in 1970s.

The above discussion gives an overall performance of the growth in total fertilizer consumption (N+P+K) in the states during the last three and half decades but it does not show trends in different nutrients, namely N, P and K. It is important to analyze growth trends in nutrient consumption as some policy distortions have led to an imbalance in fertilizer use (N:P:K ratio). In order to analyze growth pattern in N, P and K consumption in various states during different time periods, states have been classified on the basis of their consumption trends in N, P and K and results are presented in Tables 3.6, 3.8 and 3.10.

Table 3.5: Distribution of states according to comparison between all-India growth rate and state-level growth in total fertilizer (N+P+K) consumption

		1970s	1980s	1990s	2000s	1970-2008
> National average	Significant	9	14	12	9	12
	Non-significant	-	-	-	1	-
< National average	Significant +ve	10	6	6	8	8
	Significant –ve	-	-	-	-	-
	Non-significant + ve	-	-	1	2	-
	Non-significant - ve	1	-	1	-	-

Source: FAI (2008)

N Fertilizers

In 1970s, growth in N fertilizer consumption was the highest (10.3%), which declined to 7.4 per cent in 1980s, further declined to 4.1 per cent in 1990s however recovered marginally and grew at 6.7 per cent in 2000s. State-level analysis revealed that in 1970s, out of 20 states/UTs number of states showing positive significant growth in N consumption was 18. In following decade, all of the sates/UTs (20 out of 20) witnessed a significant positive growth rate. In 1990s, number of states/UTs showing positive significant growth decreased to 18 (90.0%) and the remaining states had stagnant consumption. In 2000s, number of states with significant increase in N consumption further declined to 16 (80.0%). None of the major states experienced significant decline in N consumption during 1970s, 1980s and 1990s but during 2000s, states like Uttar Pradesh, Madhya Pradesh and Pondicherry experienced positive but non-significant growth rates (stagnation in N consumption). Manipur had negative growth rate in N consumption during the 2000s.

Table-3.6: Classification of States according to growth rate in N fertilizer consumption

	1970s	**1980s**	**1990s**	**2000s**	**All period**
Significant +ve growth rate	Andhra Pradesh Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Manipur Orissa Pondicherry Punjab Rajasthan Tamil Nadu Uttar Pradesh West Bengal **18 (90.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Manipur Orissa Pondicherry Punjab Rajasthan Tamil Nadu Tripura Uttar Pradesh West Bengal **20 (100.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Madhya Pradesh Maharashtra Manipur Orissa Pondicherry Rajasthan Tamil Nadu Punjab Uttar Pradesh West Bengal **18 (90.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Maharashtra Orissa Punjab Rajasthan Tamil Nadu Tripura West Bengal **16 (80.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Manipur Orissa Pondicherry Punjab Rajasthan Tamil Nadu Tripura Uttar Pradesh West Bengal **20 (100.0)**
Non-significant +ve growth rate	Assam Tripura **2 (10.0)**		Kerala Tripura **2 (10.0)**	Madhya Pradesh Pondicherry Uttar Pradesh **3 (15.0)**	-
Significant -ve growth rate	-	-	-	Manipur **1 (5.0)**	-
Non-significant -ve growth rate	-	-	-		-
India	10.3 20 (100.0)	7.4 20 (100.0)	4.1 20 (100.0)	6.7 20 (100.0)	5.9 20 (100.0)

Note: Figures in parentheses show percentage to total number of states included in the analysis

Source: FAI (2008)

During 1970s, out of 20 states covered in the study, 10 reported higher growth rates in N consumption compared with the national average of 10.3 per cent. The number of states/UTs, which experienced higher than national average growth, was 15 in 1980s, 10 in 1990s and 6 in 2000s (Table 3.7).

Table 3.7: Distribution of states according to comparison between all-India growth rate and state-level growth in N consumption

		1970s	1980s	1990s	2000s	1970-2008
> National average	Significant	9	15	10	6	14
	Non-significant	1	-	-	-	-
< National average	Significant +ve	9	5	8	10	6
	Significant –ve	-	-	-	1	-
	Non-significant + ve	1	-	2	3	-
	Non-significant - ve	-	-	-	-	-

Source: FAI (2008)

P_2O_5 Fertilizers

Classification of states/UTs on the basis of growth rate in total P_2O_5 consumption is given in Table 3.8. Growth in total P_2O_5 consumption in India was 10.4 per cent in 1970s, 10 per cent in 1980s, 5.2 per cent in 1990s, 7.2 per cent in 2000s and 6.9 per cent for the period 1971-72 to 2007-08. The trends in P consumption were almost similar to what was observed in case of N fertilizers. However, trends in state wise consumption pattern were different from N fertilizer consumption. In 1970s, about three-fourth of states/UTs (14 out of 20) showed positive significant growth rate, whereas in 1980s, all the states/UTs reported positive significant growth. Situation changed significantly during 1990s and 70 per cent of the states reported positive significant growth rate while remaining 30 per cent showed positive but non-significant growth. In 2000s, three fourth of states witnessed significant positive growth rates and 20 per cent had positive but non-significant growth rate. During the last seven years (2001-02 to 2007-08), growth rate in P_2O_5 consumption was stagnant in some states like Madhya Pradesh and Rajasthan.

During 1970s, 7 out of 18 states covered in the study reported higher growth rate in P consumption compared with the national average (10.4%). The number of states/UTs, which experienced higher than national growth rate was 13 in 1980s, 9 in 1990s and 7 in 2000s (Table 3.9).

Table 3.8: Classification of States according to Growth in P fertilizer consumption

	1970s	1980s	1990s	2000s	All period
Significant +ve growth rate	Andhra Pradesh Bihar Gujarat Haryana Jammu & Kashmir Karnataka Madhya Pradesh Maharashtra Orissa Punjab Rajasthan Uttar Pradesh West Bengal **13 (72.2)**	Andhra Pradesh Assam Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Orissa Pondicherry Punjab Rajasthan Manipur Tamil Nadu Tripura Uttar Pradesh West Bengal **20 (100.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Jammu & Kashmir Karnataka Madhya Pradesh Maharashtra Orissa Pondicherry Rajasthan Tamil Nadu West Bengal **14 (70.0)**	Andhra Pradesh Bihar Gujarat Haryana Himachal Pradesh Karnataka Kerala Maharashtra Assam Orissa Punjab Tamil Nadu Tripura Uttar Pradesh West Bengal **15 (75.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Manipur Orissa Pondicherry Punjab Rajasthan Tamil Nadu Tripura Uttar Pradesh West Bengal **20 (100.0)**
Non-significant +ve growth rate	Himachal Pradesh Kerala Tamil Nadu **3 (16.7)**		Himachal Pradesh Manipur Punjab Uttar Pradesh **4 (20.0)**	Jammu & Kashmir Madhya Pradesh Manipur Pondicherry **4 (20.0)**	
Significant -ve growth rate	Assam **1 (5.6)**				
Non-significant -ve growth rate	Pondicherry **1 (5.6)**		Kerala Tripura **2 (10.0)**	Rajasthan **1 (5.0)**	
India	10.4 18 (100.0)	10.0 20 (100.0)	5.2 20 (100.0)	7.2 20 (100.0)	6.9 20 (100.0)

Note: Figures in parentheses show percentage to total number of states included in the analysis
Source: FAI (2008)

Table 3.9: Distribution of states according to comparison between all-India growth rate and state-level growth in P_2O_5 consumption

		1970s	1980s	1990s	2000s	1970-2008
> National average	Significant	7	13	8	7	11
	Non-significant	-	-	1	-	-
< National average	Significant +ve	6	7	6	8	7
	Significant –ve	1	-	-	-	-
	Non-significant + ve	3	-	3	4	-
	Non-significant - ve	1	-	2	1	-

Source: FAI (2008)

K_2O Fertilizers

Table 3.10 shows the distribution of states among four categories of the growth rates of K_2O consumption during the last four decades. In 1970s, total K consumption in India increased at an annual growth rate of 9.2 per cent. Growth rate in K consumption decelerated during the 1980s (7.0%) and 1990s (5.0%) but picked up in 2000s and potassic fertilizer consumption grew at an annual compound growth rate of 10.2 per cent. Of the 18 states/UTs, 13 (72.2%) witnessed a positive and significant growth rate in total K consumption during the seventies. The proportion of states/UTs with significant growth in K consumption increased to about 75 per cent in 1980s, and declined significantly during the 1990s and less than half of the states experienced significant positive growth rate and remaining states/UTs showed stagnant growth (non-significant positive/negative growth rate) in total K consumption. During the period 2001-02 to 2007-08, number of states with significant positive growth rate increased to 16 while about 20 per cent of the states had stagnant consumption.

Table 3.11 shows distribution of states according to comparison between all-India growth rate and state-level growth in K_2O consumption during different time periods. The number of states with significant positive growth rate varied from 6 in 1970s to 14 in 1980s. The most striking finding is that states like Punjab and Haryana experienced significant negative growth rate in K consumption during the 1980s. Generally consumption of potassic fertilizers is low in northern region which has led to imbalance in nutrient use.

The above analysis clearly shows that growth in total fertilizer consumption as well as in terms of nutrients (N, P, and K) which was high in the post green revolution period (1970s and 1980s) slowed down during the 1990s due to decontrol of certain fertilizers and uncertain policy environment. However, fertilizer consumption started picking up in the 2000s due to some positive policy changes in the sector and more emphasis on agricultural development during the decade. It is evident that in order to achieve sustainable growth in agricultural sector and promote use of fertilizers, there is a need to have a consistent and positive policy environment.

Table 3.10: Classification of States according to growth rate in K fertilizer consumption

	1970s	**1980s**	**1990s**	**2000s**	**All period**
Significant +ve growth rate	Andhra Pradesh Bihar Gujarat Karnataka Kerala Madhya Pradesh Maharashtra Orissa Pondicherry Punjab Tamil Nadu Uttar Pradesh West Bengal **13 (72.2)**	Andhra Pradesh Bihar Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Assam Manipur Orissa Tripura Pondicherry Tamil Nadu West Bengal **15 (75.0)**	Andhra Pradesh Assam Bihar Karnataka Manipur Orissa Punjab Uttar Pradesh West Bengal **9 (45.0)**	Andhra Pradesh Assam, Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Maharashtra Orissa Pondicherry Rajasthan Tamil Nadu Tripura Uttar Pradesh West Bengal **16 (80.0)**	Andhra Pradesh Assam, Bihar Gujarat, Haryana Himachal Pradesh Jammu & Kashmir Karnataka, Kerala Madhya Pradesh Maharashtra Manipur, Orissa Pondicherry Punjab, Rajasthan Tamil Nadu Tripura Uttar Pradesh West Bengal **20 (100.0)**
Non-significant +ve growth rate	Haryana Himachal Pradesh Rajasthan **3 (16.7)**	Gujarat **1 (5.0)**	Gujarat, Haryana Himachal Pradesh Jammu & Kashmir Madhya Pradesh Maharashtra Rajasthan Tamil Nadu **8 (40.0)**	Madhya Pradesh Punjab **2 (10.0)**	
Significant -ve growth rate	Assam **1 (5.6)**	Haryana, Punjab **2 (10.0)**	Tripura **1 (5.0)**		
Non-significant -ve growth rate	Jammu & Kashmir **1 (5.6)**	Rajasthan Uttar Pradesh **2 (10.0)**	Kerala Pondicherry **2 (10.0)**	Kerala Manipur **2 (10.0)**	
India	9.2 18 (100.0)	7.0 20 (100.0)	5.0 20 (100.0)	10.2 20 (100.0)	5.6 20 (100.0)

Note: Figures in parentheses show percentage to total number of states included in the analysis

Source: FAI (2008)

Table 3.11: Distribution of states according to comparison between all-India growth rate and state-level growth in K_2O consumption

		1970s	1980s	1990s	2000s	1970-2008
> National average	Significant	5	14	9	10	11
	Non-significant	1	-	3	-	-
< National average	Significant +ve	8	1	-	6	7
	Significant –ve	1	2	1	-	-
	Non-significant + ve	2	1	5	2	-
	Non-significant - ve	1	2	2	2	-

Source: FAI (2008)

Concentration of Fertilizer Use: District-level Analysis

A cursory examination of data on fertilizer use in various districts in 2007-08 revealed that the level of use varied among districts (Table 3.12). Total fertilizer consumption (N+P+K) varied from 29.3 thousand tonnes in Gopalganj (Bihar) to 256.5 thousand tonnes in Guntur (Andhra Pradesh). Per hectare fertilizer use (kg/ha) varied from about 23 kg in Jodhpur district of Rajasthan to about 636 kg in Tiruchirapalli in Tamil Nadu (FAI, 2008).

Wide variations in level of fertilizer use among districts suggest concentration of fertilizer use in some districts. To enquire into this aspect, districts were arranged in descending order of fertilizer use during different time periods. Table 3.13 shows the number of districts accounting for different percentages of fertilizers used in all the districts of the country. The table shows that nearly 18 per cent of the districts accounted for 50 per cent of total fertilizers used in the country in 2007-08. Eighty five per cent of total fertilizer use was accounted for by less than half of the districts in the country. It is also worth noting that at the other extreme more than half of the districts (53%) accounted for only 15 per cent of total fertilizer used in the country during 2007-08. As is evident from the Table 3.13, during all years included in the present analysis, the district-wise fertilizer consumption pattern with respect to concentration of fertilizer use is not unique. Thus bulk of the growth in fertilizer use is concentrated in few districts while a majority of districts have remained outside the mainstream of growth in fertilizer use. Therefore, real challenge is to increase fertilizer use in low-use districts.

Table 3.12: Distribution of districts (%) according to level of fertilizer consumption in 2007-08

Level of use (tonnes)	Nitrogen	Level of use (tonnes)	Phosphorus
>100,000	1.6	>40,000	2.0
80,000 – 100,000	2.9	30,000 – 40,000	3.9
60,000 – 80,000	7.9	20,000 – 30,000	7.6
40,000 – 60,000	11.8	10,000 – 20,000	21.8
20,000 – 40,000	20.5	5,000 – 10,000	21.3
10,000 – 20,000	18.0	<5,000	43.4
<10,000	37.3		

Source: FAI (2008)

Table 3.13: Concentration of fertilizer use in India: 1995-96 to 2007-08

Per cent of nutrients used	Number of districts				
	1995-96	1997-98	2005-06	2006-07	2007-08
10	11 (2.3)	12 (2.3)	12 (2.2)	12 (2.1)	12 (2.1)
20	14 (3.0)	16 (3.0)	15 (2.7)	17 (3.0)	17 (3.0)
30	18 (3.8)	20 (3.8)	20 (3.6)	20 (3.5)	20 (3.5)
40	22 (4.7)	23 (4.3)	24 (4.3)	24 (4.3)	24 (4.2)
50	26 (5.5)	27 (5.1)	29 (5.2)	29 (5.1)	28 (4.9)
60	27 (5.8)	30 (5.7)	34 (6.1)	35 (6.2)	34 (6.0)
70	34 (7.2)	37 (7.0)	41 (7.4)	41 (7.3)	42 (7.4)
80	42 (9.0)	45 (8.5)	51 (9.2)	54 (9.6)	54 (9.5)
85	27 (5.8)	28 (5.3)	34 (6.1)	34 (6.0)	35 (6.2)
100	248 (52.9)	291 (55.0)	297 (53.3)	298 (52.8)	300 (53.0)

Figures in parentheses indicate percentage to Total number of districts
Source: FAI (2008)

Classification of Districts according to Compound Growth Rates of Fertilizer Consumption

It is important to examine fertilizer consumption trends at micro-level. Since time series data on fertilizer consumption at farm level is not available, an analysis of growth in total fertilizer consumption at district level during the 1990s and 2000s was done. Table 3.14 shows the distribution of districts according to compound growth rates of fertilizer consumption between 1991-92 and 2000-01 (1990s) and 2001-02 to 2006-07 (2000s). Of the 355 districts covered in the study, 247 districts (69.6%) had significant positive growth rate in fertilizer consumption during the 1990s. Only 71 districts (20%) had significant negative growth rate in 1990s. In 2000s, there was acceleration in fertilizer consumption and 336 out of 458 districts (73%) showed significant growth rate while 78 districts (17%) showed significant negative growth, about 7 per cent reported positive but non-significant growth rate and only 3 per cent had non-significant negative growth rate. Almost similar trend was observed for entire period between 1991-92 and 2006-07.

Table 3.14: Classification of Districts according to compound growth rate of total fertilizer use during 1991-92 to 2006-07

	1990s	2000s	1990-2006
Significant +ve growth rate	Assam (20), Bihar (14) Orissa (05) West-Bengal (14) Haryana (08) Himachal Pradesh (07) Jammu & Kashmir (10) Punjab (05) Uttar Pradesh (42) Karnataka (12) Kerala (03) Tamil Nadu (06) Gujarat (14) Madhya Pradesh (30) Maharashtra (24) Rajasthan (22) Andhra Pradesh (11) **247 (69.6)**	Assam (17), Bihar (15) Orissa (19) West-Bengal (15) Haryana (14) Himachal Pradesh (10) Jammu & Kashmir (09) Punjab (16) Uttar Pradesh (55) Karnataka (19) Kerala (07) Tamil Nadu (12) Gujarat (19) Madhya Pradesh (40) Maharashtra (23) Rajasthan (27) Andhra Pradesh (19) **336 (73.4)**	Assam (17), Bihar (19) Orissa (06) West-Bengal (14) Haryana (13) Himachal Pradesh (11) Jammu & Kashmir (12) Punjab (09) Uttar Pradesh (46) Karnataka (14) Kerala (05) Tamil Nadu (06) Gujarat (13) Madhya Pradesh (29) Maharashtra (21) Rajasthan (21) Andhra Pradesh (16) **272 (77.9)**
Non-significant +ve growth rate	Assam (02) Bihar (03) West-Bengal (02) Haryana (04) Jammu & Kashmir (01) Uttar Pradesh (03) Karnataka (02)	Assam (02) Orissa (05) Haryana (04) Himachal Pradesh (01) Uttar Pradesh (10) Karnataka (01) Kerala (01)	Assam (01), Orissa (04) West-Bengal (02) Jammu & Kashmir (01) Punjab (01) Uttar Pradesh (01) Karnataka (04) Kerala (02)

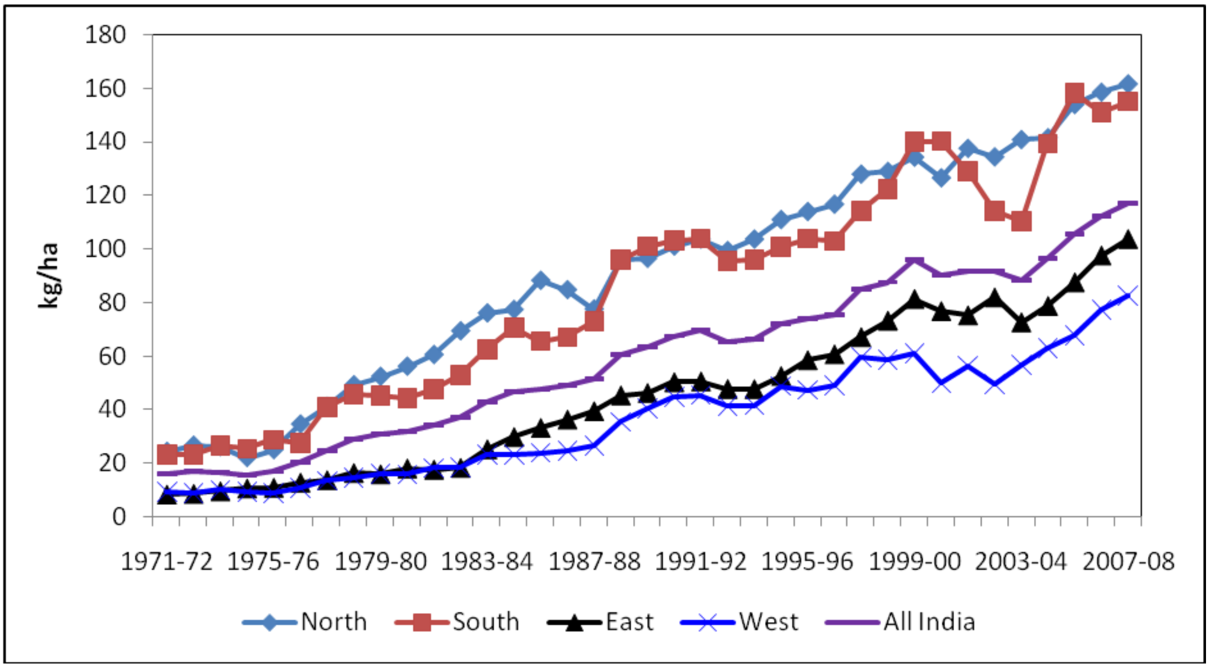
	Madhya Pradesh (07) Maharashtra (03) Rajasthan (01) Andhra Pradesh (02) **30 (8.5)**	Tamil Nadu (03) Gujarat (01) Madhya Pradesh (01) Maharashtra (01) Rajasthan (01) Andhra Pradesh (01) **32 (7.0)**	Tamil Nadu (02) Gujarat (01) Madhya Pradesh (04) Maharashtra (03) Rajasthan (02) Andhra Pradesh (02) **30 (8.6)**
Significant -ve growth rate	Assam (01), Bihar (06) Orissa (08) West-Bengal (01) Haryana (02) Himachal Pradesh (04) Jammu & Kashmir (02) Punjab (06) Uttar Pradesh (11) Karnataka (02) Kerala (10) Tamil Nadu (04) Madhya Pradesh (06) Maharashtra (02) Rajasthan (01) Andhra Pradesh (05) **71 (20.0)**	Assam (03) Bihar (16) Orissa (05) West-Bengal (02) Himachal Pradesh (01) Jammu & Kashmir (03) Uttar Pradesh (06) Karnataka (05) Kerala (04) Tamil Nadu (10) Gujarat (05) Madhya Pradesh (05) Maharashtra (09) Rajasthan (03) Andhra Pradesh (01) **78 (17.0)**	Assam (05) Bihar (05) Orissa (04) West-Bengal (01) Haryana (01) Himachal Pradesh (01) Punjab (01) Uttar Pradesh (07) Kerala (05) Tamil Nadu (03) Madhya Pradesh (03) Maharashtra (05) Rajasthan (01) **42 (12.0)**
Non-significant -ve growth rate	Bihar (01) Himachal Pradesh (01) Punjab (01) Uttar Pradesh (02) Karnataka (01) Kerala (01) **7 (2.0)**	Bihar (03) Jammu & Kashmir (01) Uttar Pradesh (01) Kerala (02) Tamil Nadu (02) Madhya Pradesh (02) Rajasthan (01) **12 (2.6)**	Punjab (01) Karnataka (01) Kerala (03) **5 (1.4)**

Figures in parentheses show number of districts in the state.
Source: FAI (2008)

Intensity of Fertilizer Use

Looking at total fertilizer consumption is not a good indicator as there are large differences in total cropped area across states. It would be more appropriate to examine trends in fertilizer consumption per hectare of cropped area. Figure 3.9 examines trends in the intensity of fertilizer consumption in terms of kg per hectare of total cropped area by region from 1971-72 to 2007-08. Overall, the average intensity of fertilizer use in the country increased from about 16 kg per hectare in 1971-72 to 117 kg per hectare in 2007-08. This level has been lower than that of north and south regions whose average intensity has been about 82 kg per hectare between 1971-72 and 2007-08 with a low of 23.1 kg in 1974-75 and a peak of 161.6 kg per hectare in 2007-08 in case of north regions and about 75 kg per hectare on an average with a low of 14.9 kg in 1973-74 and a peak of 168.5 kg in 2005-06 in case of south region.

Figure 3.9: Intensity of fertilizer use by region: 1971-72 to 2007-08

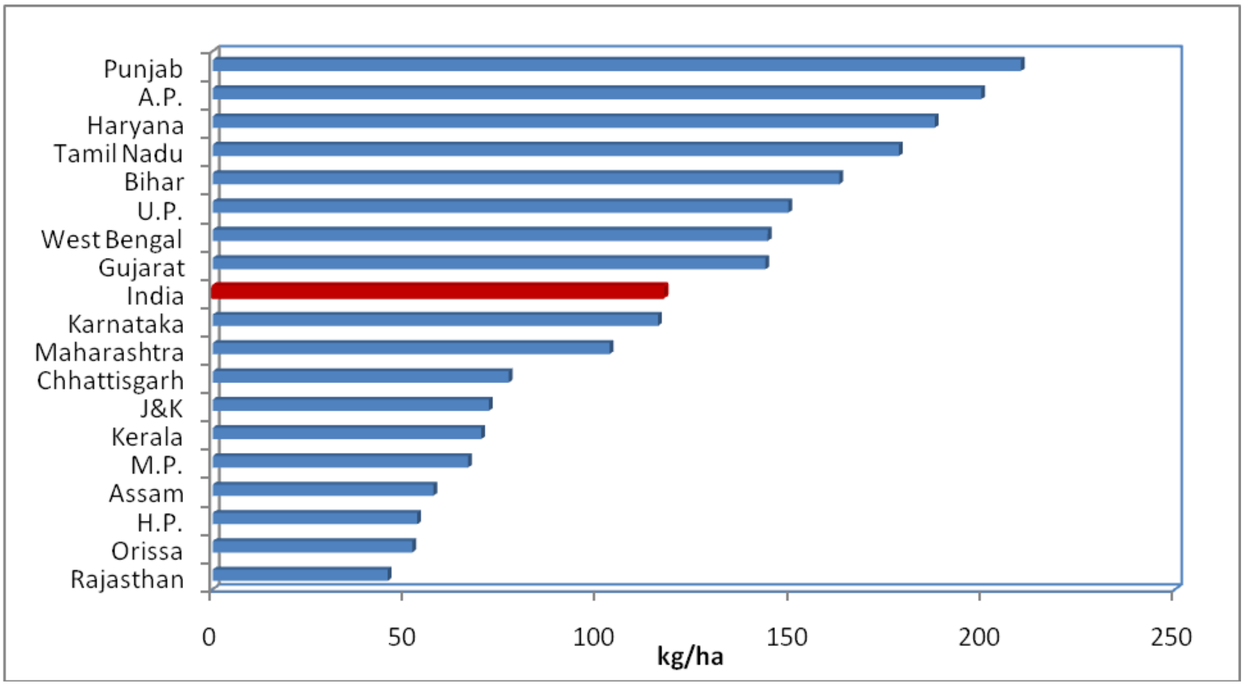


Source: FAI (2008)

Fertilizer consumption in India is highly skewed, with wide inter-regional, inter-state, inter-district and inter-crop variations. Intensity has generally been higher in northern (82 kg/ha average) and southern (75.1 kg/ha average) region and lower in the western (35.6 kg/ha) and eastern (38.3 kg/ha) regions. Sustained growth in intensity over the years is quite apparent in all the regions. However, some of these regional averages are heavily influenced by individual state observations (Figure 3.10). For example during the 2007-08, in western region Gujarat had a high rate of 143.6 kg per hectare while Rajasthan had a very low rate of 45.5 kg per hectare. Similarly, in northern region, Punjab had a very high level of 210 kg per hectare while Himachal Pradesh had a low rate of about 53 kg. Similar variations are quite apparent in other regions as well.

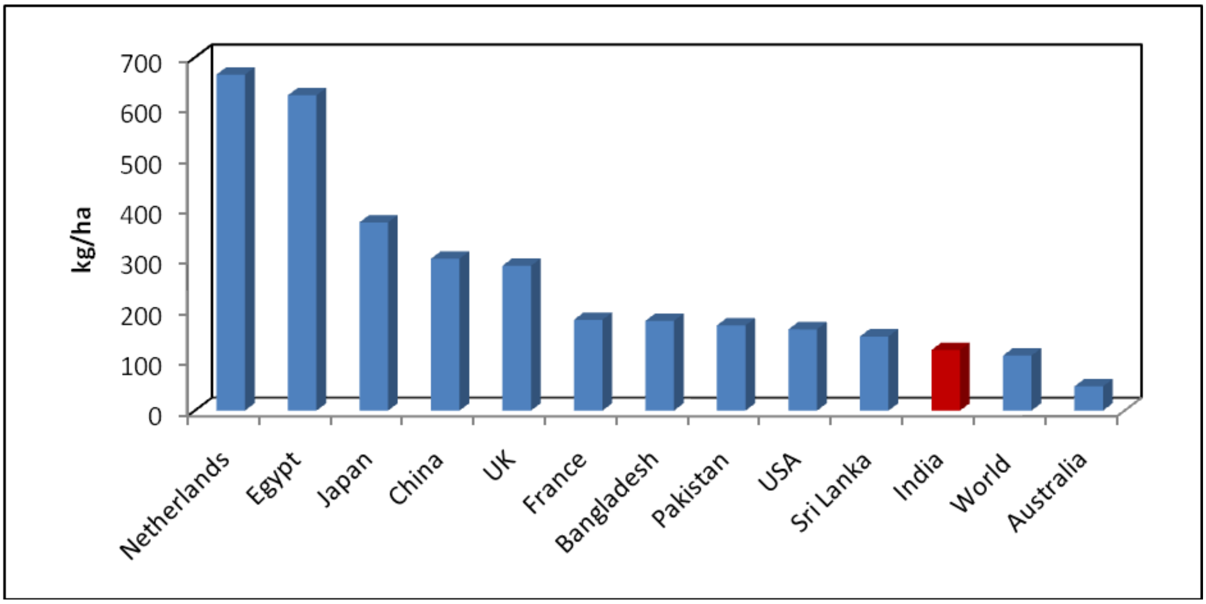
There are also wide differences across countries in fertilizer use intensity and rate of growth in fertilizer use intensity. The average intensity of fertilizer use in India remains much lower than many countries in the world (Figure 3.11). The average consumption of nutrients per hectare (120 kg/ha of arable land and land under permanent crops in 2005) was marginally above the world average of 109 kg/ha and lower than consumption of these nutrients by most of the developing countries, including neighboring countries like China (301 kg/ha), Bangladesh (178 kg/ha), Sri Lanka (147 kg/ha) and Pakistan (169 kg/ha).

Figure 3.10: Per hectare fertilizer use by States, 2007-08 (kg/ha)



Source: FAI (2008)

Figure 3.11: Consumption of plant nutrients (kg) per hectare of arable land and land under permanent crops in selected countries: 2005

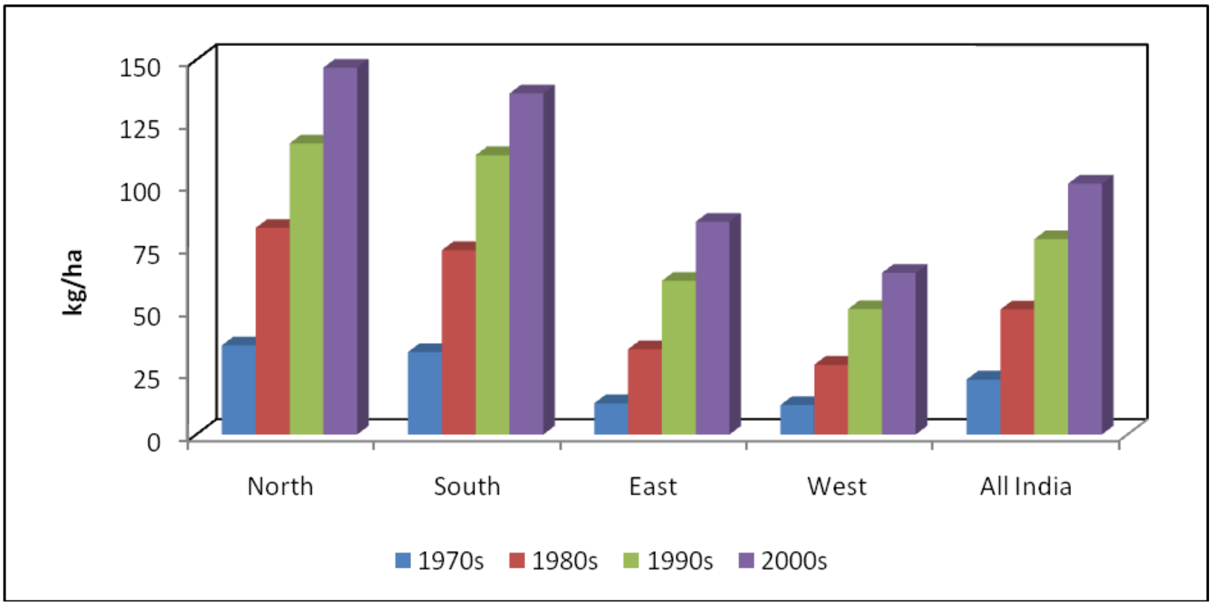


Source: FAI (2008)

Regional Trends

Trends in per hectare fertilizer consumption in different regions of the country are presented in Figure 3.12. Average fertilizer consumption per hectare of gross cropped area has increased significantly in all the regions. Per hectare fertilizer consumption which was 35.7 kg in the North, 33 kg in South, 12.5 kg in East and 11.8 kg in Western region during the 1970s more than doubled in all regions during the 1980s and reached a level of 82.7, 73.8, 34.2 and 27.9 kg, respectively. Intensity of fertilizer in the 2000s was the highest (146.9 kg/ha) in northern region, followed by south zone (136.5 kg) and the lowest in western region (64.7 kg). Intensity of fertilizer is relatively low in the east and west zone compared with north and south but has increased at a higher rate in east (7.3%) and west (6.5%) regions between 1971-72 and 2007-08 compared with 5.4 per cent in north and 5.5 per cent in south region.

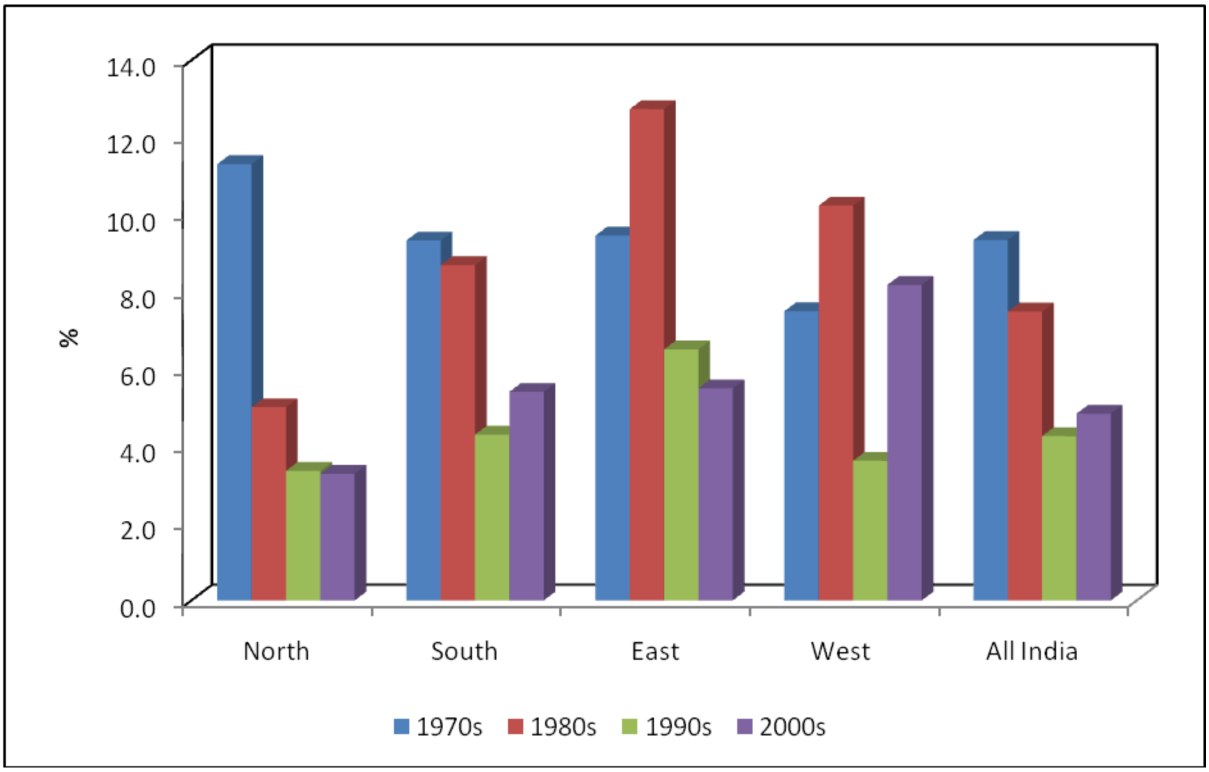
Figure 3.12: Regional trends in consumption of plant nutrients per unit of gross cropped area: 1971-72 to 2007-08



Source: FAI (2008)

Region-wise trends in growth rates of per hectare fertilizer use are given in Figure 3.13. The figure shows that during the 1970s, north zone registered the highest growth (11.3%), while western region had the lowest growth rate (7.5%). The high growth in consumption of fertilizer in northern region was due to spread of high yielding varieties and expansion of irrigation facilities in late 1960s and 1970s. During the decade of eighties, new technology spread to other regions of the country (east and western region) which led to increase in consumption of fertilizers in these regions. Eastern region experienced the highest growth (12.7%), followed by western region (10.2%). During the 1990s growth in intensity of fertilizer use decelerated in all regions and western region had the highest growth rate (8.2%). This growth in western region was driven by high rate of growth in states like Gujarat (9.6%) and Madhya Pradesh (8.9%). At all-India level growth rate in per hectare fertilizer consumption was the highest (9.3%) during the 1970s which declined to 7.5 per cent in the eighties and 4.3 per cent in the 1990s. However, the growth rate improved in the 2000s and reached a level of 4.8 per cent.

Figure 3.13: Region-wise decennial growth (CAGR) in intensity of consumption of fertilizer in India



Source: FAI (2008)

State-level Trends

The overall trends in data on fertilizer use mask considerable variability among states. Table 3.15 shows fertilizer use trends in different states in the country. The states are subdivided by row into those with lower versus higher fertilizer use intensity (defined as using less than national average of 96.6 kg per hectare of fertilizer nutrients during the 2001-02 to 2007-08 period versus using more than national average during that period), and they are subdivided by column into those with low versus high growth in fertilizer use intensity (defined as having recorded less than or more than national average of 14.3 per cent increase in mean levels of fertilizer use between 1995-96 to 2000-01 and 2001-02 to 2007-08).

Of the 11 states using higher than national average fertilizer use intensity during the 2000s, 10 of them displayed significant growth (>national average of 14.3%) in fertilizer consumption between 1995-2000 and 2001-2007 periods, while only one state (Andhra Pradesh) achieved less than national average. Per hectare fertilizer use in Pondicherry achieved the highest growth (96.3%), followed by Manipur (32.1%), Gujarat (27.6%) and Karnataka (27.6%). Of the 14 states having less than national average fertilizer intensity during the 2000s, 12 recorded moderate increase while two states recorded negative growth. Of the 12 states having positive growth, 9 performed well and average fertilizer use increased more than national average ranging from 19.7 per cent in Meghalaya to 120.4 per cent in Assam and remaining three states (Maharashtra, Kerala and Rajasthan) recorded lower than national growth. The fertilizer use declined in Sikkim and Nagaland.

At least one encouraging point emerges from this analysis. Even though fertilizer application levels throughout eastern and north-eastern regions generally remain low, almost all states in the region except Sikkim and Nagaland achieved impressive growth in fertilizer use over the past decade. This growth must be sustained, increased, and expanded to achieve levels of productivity growth needed to significantly reduce poverty in the region.

The average intensity of fertilizer use in India at national level is still much lower than in other developing countries but there are many disparities in fertilizer consumption patterns both between and within regions of India. Table 3.16 presents classification of districts according to range of fertilizer consumption per hectare of cropped area during the last three and half decades. 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 to 150 kg/ha of fertilizer. In contrast about 60 per cent of the districts were using less than 50 kg fertilizer (N+P+K) per hectare. However, the number of districts in high-fertilizer use category (>200kg/ha) has increased significantly during the second-half of nineties and 2000s. In the TE 1999-00, out of 470 districts, 31 districts (6.6%) were using more than 200 kg per hectare, while about one-third of the districts were consuming less than 50 kg. Between the TE 2002-03 and TE 2007-08, number of districts consuming higher than 200 kg/ha more than doubled from 36 in TE 2002-03 to 85 in TE 2007-08.

Table 3.15: Fertilizer use intensity and growth in fertilizer use intensity, by states

Intensity of fertilizer use (kg/ha)	% growth in fertilizer use intensity	
	≥ National average (14.3%)	< National average
≥ National average during 2001-02 to 2007-08 (≥96.6)	Pondicherry (980.8, 96.3) Punjab (194.1, 15.4) Haryana (169.3, 23.3) Tamil Nadu (160.2, 22.8) Uttar Pradesh (134.2, 18.3) West Bengal (130.9, 15.7) Bihar (110.3, 26.2) Karnataka (106.4, 27.6) Gujarat (106.2, 27.6) Manipur (100.6, 32.1)	Andhra Pradesh (166.9, 12.5)
<National average during 2001-02 to 2007-08 (96.6)	Jammu & Kashmir (71.3, 30.4) Madhya Pradesh (51.6, 22.9) Himachal Pradesh (48.2, 32.9) Assam (47.2, 120.4) Orissa (43.2, 32.2) Tripura (38.0, 85.0) Mizoram (24.4, 169.2) Meghalaya (17.5, 19.7) Arunachal Pradesh (2.8, 27.0)	Maharashtra (79.4, 7.9) Kerala (66.7, 2.5) Rajasthan (38.3, 9.0) Sikkim (5.8, -16.6) Nagaland (1.9, -31.6)

Note: Growth in fertilizer use is defined as the per cent increase in mean fertilizer use intensity between the 1995-96 to 2000-01 and the 2001-02 to 2007-28 period. Numbers in parentheses are the mean fertilizer use intensity for 2001-02 to 2007-08, and the per cent increase in fertilizer use intensity as defined above.

Source: FAI (2008)

In the TE 2007-08, 85 out of 526 districts (16.1%) consumed more than 200 kg/ha, 62 districts between 150-200 kg, 99 districts between 100-150 kg and 144 districts between 50-100 kg/ha. About one-fourth of the districts had less than 50 kg/ha fertilizer use much lower than recommended levels. Further less than 20 per cent of the districts accounted for about half of total fertilizer consumption in the country, indicating a high degree of concentration of fertilizer use. There are two extremes, one, districts/areas having consistently high levels of fertilizer use and two, areas using less than recommended levels of fertilizers. The low level of fertilizer use is because of lack of awareness, non-availability of credit for buying fertilizers, timely and easy availability of fertilizers and other complementary inputs like irrigation, better seed, etc. Increasing number of districts consuming consistently higher amounts of fertilizer (>200 kg/ha) is a cause of concern as it might lead to environmental degradation particularly land and water resources. On the other hand, still one-fourth of the districts use less than 50 kg/ha of fertilizers. Therefore, there is a need to have two-pronged strategy, one to monitor districts with high intensity of consumption and take corrective actions to reduce environmental degradation and on the other hand to promote fertilizer consumption in low-use districts to improve crop productivity.

Wide variation in fertilizer use intensity among states/districts shown in Table 3.16 suggests concentration of fertilizer in some states/districts. In order to investigate this aspect, high-use districts were classified state-wise and results are presented in Table 3.17.

Table 3.16: Classification of districts according to ranges of fertilizer consumption (N+P+K)

Consumption (kg/ha)	TE 1986-87	TE 1989-90	TE 1993-94	TE 1996-97	TE 1999-00	TE 2 002-03	TE 2007-08
Above 200	3 (0.95)	5 (1.44)	9 (2.22)	13 (3.13)	31 (6.60)	36 (7.51)	85 (16.10)
150-200	12 (3.32)	21 (5.77)	29 (7.44)	36 (8.55)	45 (9.65)	47 (9.71)	62 (11.79)
100-150	32 (9.21)	42 (11.44)	59 (15.21)	60 (14.46)	94 (20.00)	92 (19.08)	99 (18.82)
75-100	34 (9.69)	46 (12.52)	56 (14.44)	59 (14.10)	62 (13.26)	61 (12.60)	71 (13.43)
50-75	55 (15.67)	70 (19.01)	77 (19.83)	73 (17.47)	78 (16.67)	79 (16.32)	73 (13.81)
25-50	92 (26.31)	85 (22.88)	79 (20.34)	93 (22.29)	80 (16.95)	97 (20.11)	77 (14.70)
<25	121 (34.47)	99 (26.77)	81 (20.77)	84 (20.24)	79 (16.81)	71 (14.67)	59 (11.22)
Total	351 (100.0)	370 (100.0)	390 (100.0)	415 (100.0)	470 (100.0)	484 (100.0)	526 (100.0)

Figures in parentheses show per cent to total number of districts.

Source: FAI (2008)

In 1984-85, eight out of 15 districts in the category of high-use (above 150 kg) were located in Punjab, four in Andhra Pradesh, two in Tamil Nadu and one in West Bengal. These districts/states grow fertilizer intensive crops like rice, wheat, sugarcane, etc. In the next five years, the number of districts using 150 kg per hectare of fertilizer doubled. In Andhra Pradesh it increased from 4 to 8, Tamil Nadu from 2 to 6 and 2 districts in Haryana fell under this category. In 1992-93, about two-third of total districts with >150 kg per hectare fertilizer use were in two states, namely, Punjab (31.3%) and Andhra Pradesh (25.0%). During 2007-08, all 19 districts in Punjab, 16 out of 20 districts in Haryana, 15 of 22 districts in Andhra Pradesh, 40 out of 70 in Uttar Pradesh, 14 out of 29 in Tamil Nadu and 17 out of 37 in Bihar had fertilizer intensity more than 150 kg. About 70 per cent of districts with >150 kg fertilizer intensity are located in Punjab, Haryana, Uttar Pradesh, Andhra Pradesh, and Tamil Nadu, growing mostly fertilizer-intensive crops like rice, wheat and sugarcane.

Table 3.17: State-wise Distribution of fertilizer-intensive districts of major states according to ranges of fertilizer consumption in India: 1984-85 to 2007-08

	1984-85	1989-90	1992-93	1998-99	2002-03	2007-08
Fertilizer consumption intensity (>150 kg/ha)						
Uttar Pradesh	-	2	.	16	28	40
Punjab	8	7	10	12	14	19
Andhra Pradesh	4	8	8	12	8	15
Bihar	-	-	-	9	-	17
Haryana	-	2	4	8	9	16
Tamil Nadu	2	6	3	11	8	14
Karnataka	-	1	1	3	5	8
West Bengal	1	2	2	3	3	7
Gujarat	-	1	1	2	4	7
Maharashtra	-	1	1	-	1	4
Others	-	-	-	1	-	13
India	15	30	32	73	80	155

Source: FAI (2008)

Among four geographical regions, share of northern region with respect to high fertilizer intensity districts was the highest (50.6%), followed by southern region (23.1%), eastern region (16.3%) and the lowest in the west (10%). The consistent high-use of fertilizer coupled with imbalanced use has led to stagnation in crop yield in northern states like Punjab, Haryana and Uttar Pradesh.

Classification of States according to compound growth rates of fertilizer intensity

Classification of states on the basis of annual compound growth rates in per hectare total fertilizer consumption is presented in Table 3.18. It is evident from the table that per hectare consumption of total fertilizer, which was only 13.6 kg/ha in 1970-71 increased to about 117 kg/ha in 2007-08.

Table 3.18: Classification of states according to growth rate in per ha fertilizer consumption (N+P+K)

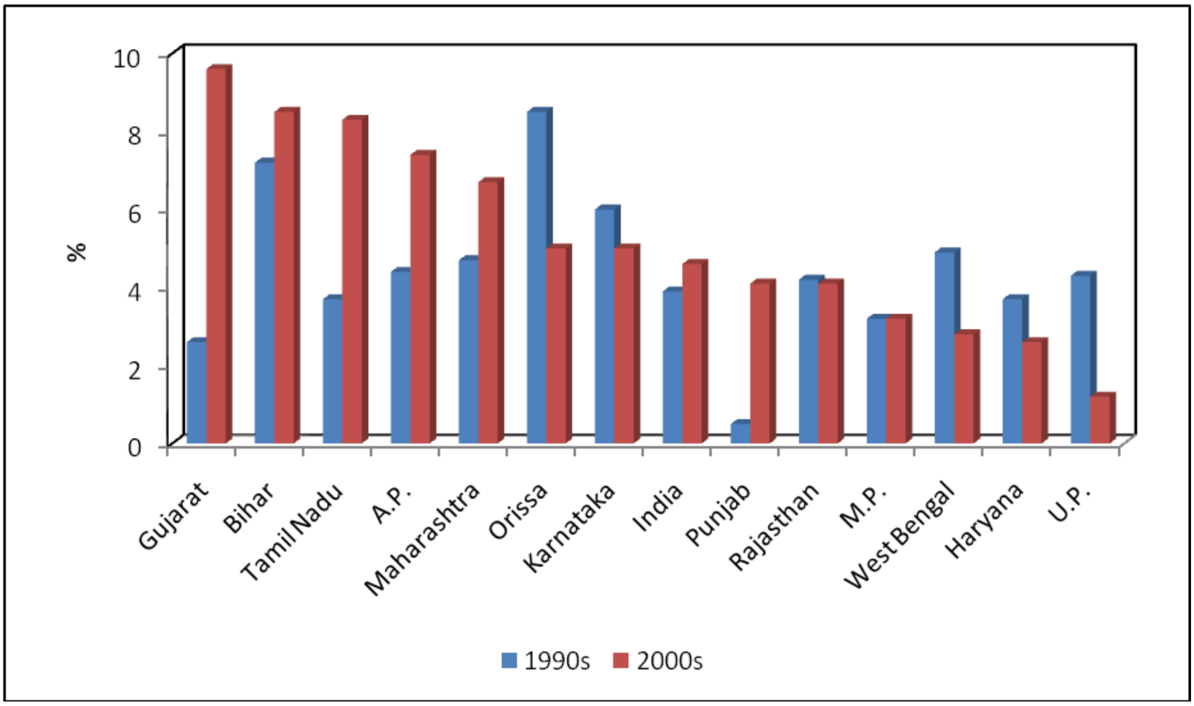
	1970s	1980s	1990s	2000s	All period
Significant +ve growth rate	Andhra Pradesh Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Manipur Orissa Pondicherry Punjab Rajasthan Tamil Nadu Uttar Pradesh West Bengal **18 (90.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Manipur Orissa Pondicherry Punjab Rajasthan Tamil Nadu Tripura Uttar Pradesh West Bengal **20 (100.0)**	Andhra Pradesh Assam Bihar Haryana Jammu & Kashmir Karnataka Madhya Pradesh Maharashtra Himachal Pradesh Manipur Orissa Pondicherry Rajasthan Uttar Pradesh West Bengal **15 (75.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Kerala Madhya Pradesh Orissa Pondicherry Punjab Tamil Nadu Tripura Uttar Pradesh West Bengal **16 (80.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Manipur Orissa Pondicherry Punjab Rajasthan Tamil Nadu Tripura Uttar Pradesh West Bengal **20 (100.0)**
Non-significant +ve growth rate	Tripura **1 (5.0)**		Gujarat Punjab Tamil Nadu Tripura **4 (20.0)**	Karnataka Maharashtra Rajasthan **3 (15.0)**	
Significant -ve growth rate				Manipur **1 (5.0)**	
Non-significant -ve growth rate	Assam **1 (5.0)**		Kerala **1 (5.0)**		
India	9.4 20 (100.0)	7.8 20(100.0)	3.9 20 (100.0)	4.8 20 (100.0)	5.8 20 (100.0)

Note: Figures in parentheses show percentage to total number of states included in the analysis
Source: FAI (2008)

During 1970s, 18 out of 20 states/UTs showed positive significant growth in per hectare consumption of total fertilizers. The number of states having positive significant growth increased to 20 in 1980s, accounting 100 per cent share of total states. However, in 1990s and 2000s the number of states having significant positive growth declined and nearly three-fourth of the states witnessed positive and significant growth in per hectare fertilizer consumption. Karnataka, Maharashtra and Rajasthan had positive but non-significant growth rate during the 2000s. Manipur was the only state which had significant negative growth rate during the 2000s.

The state-wise analysis of growth rates shows that during 2000s, Bihar had the highest growth rate (12.3%) in intensity of fertilizer use followed by Gujarat (9.6%) and Madhya Pradesh (8.9%). Out of 13 major states, 7 states had growth rate higher than national average (4.8%) during the 2000s while this number was 8 in nineties (Figure 3.14).

Figure 3.14: Growth rate in per hectare fertilizer use in selected states in India



Source: FAI (2008)

Growth rates in per hectare consumption of macro-nutrients (N, P and K) were also computed and the results are presented in Table 3.19, 3.20, and 3.21. It is evident from Table 3.19 that 90 per cent of states/UTs reported significant growth in N consumption during the 1970s and some north-eastern states had stagnation in per hectare N use.

However, number of states with significant positive growth rates increased to about 100 per cent in 1980s, decreased to 75 per cent in 1990s and further declined to 60 per cent in 2000s. About one-fourth of the states/UTs including major states like Punjab, Uttar Pradesh, Karnataka, Tamil Nadu, Maharashtra and Rajasthan showed positive but non-significant growth in N consumption during the 2000s.

Table 3.19: Classification of states according to growth rate in per ha fertilizer consumption (N)

	1970s	1980s	1990s	2000s	All period
Significant +ve growth rate	Andhra Pradesh Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Manipur Orissa Pondicherry Punjab Rajasthan Tamil Nadu Uttar Pradesh West Bengal **18 (90.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Manipur Orissa Pondicherry Punjab Rajasthan Tamil Nadu Tripura Uttar Pradesh West Bengal **20 (100.0)**	Andhra Pradesh Assam Bihar Haryana Jammu & Kashmir Karnataka Maharashtra Manipur Orissa Pondicherry Rajasthan Tamil Nadu Himachal Pradesh Uttar Pradesh West Bengal **15 (75.0)**	Andhra Pradesh Assam Bihar Haryana Himachal Pradesh Kerala Pondicherry Gujarat Madhya Pradesh Orissa Tripura West Bengal **12 (60.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Manipur Orissa Pondicherry Punjab Rajasthan Tamil Nadu Tripura Uttar Pradesh West Bengal **20 (100.0)**
Non-significant +ve growth rate	Tripura **1 (5.0)**		Gujarat Kerala Madhya Pradesh Punjab Tripura **5 (25.0)**	Jammu & Kashmir Karnataka Maharashtra Punjab Rajasthan Tamil Nadu Uttar Pradesh **7 (35.0)**	
Significant -ve growth rate				Manipur **1 (5.0)**	
Non-significant -ve growth rate	Assam **1 (5.0)**				
India	9.5 20 (100.0)	7.2 20 (100.0)	3.6 20 (100.0)	4.7 20 (100.0)	5.6 20 (100.0)

Note: Figures in parentheses show percentage to total number of states included in the analysis
Source: FAI (2008)

In case of P fertilizers, 70 per cent of the states/UTs witnessed significant growth during the 1970s while in 1980s all the states/UTs reported significant growth in P consumption. In 1990s, the share of states/UTs showing significant growth in P consumption fell significantly (75.0%) and further declined to 55 per cent in 2000s. About 40 per cent of the states reported stagnation (positive but non-significant growth rate) in P consumption during the 2000s.

Table 3.20: Classification of states according to growth rate in per ha fertilizer consumption (P)

	1970s	1980s	1990s	2000s	All period
Significant +ve growth rate	Andhra Pradesh Bihar Gujarat Haryana Jammu & Kashmir Karnataka Madhya Pradesh Maharashtra Manipur Orissa Punjab Rajasthan Uttar Pradesh West Bengal **14 (70.0)**	Andhra Pradesh Assam Bihar Haryana Himachal Pradesh Jammu & Kashmir Gujarat Karnataka Kerala Madhya Pradesh Maharashtra Manipur Orissa Pondicherry Punjab Rajasthan Tamil Nadu Tripura Uttar Pradesh West Bengal **20 (100.0)**	Andhra Pradesh Assam Bihar Haryana Himachal Pradesh Jammu & Kashmir Karnataka Madhya Pradesh Maharashtra Orissa Pondicherry Rajasthan Tamil Nadu Uttar Pradesh West Bengal **15 (75.0)**	Andhra Pradesh Assam Gujarat Himachal Pradesh Punjab Kerala Madhya Pradesh Orissa Pondicherry Tamil Nadu West Bengal **11 (55.0)**	Andhra Pradesh Assam Bihar Gujarat Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Manipur Orissa Tripura Pondicherry Punjab Rajasthan Tamil Nadu Uttar Pradesh West Bengal **20 (100.0)**
Non-significant +ve growth rate	Himachal Pradesh Kerala Tamil Nadu Tripura **4 (20.0)**		Gujarat Manipur Punjab **3 (15.0)**	Bihar Haryana Jammu & Kashmir Karnataka Maharashtra Rajasthan Tripura Uttar Pradesh **8 (40.0)**	
Significant -ve growth rate	Assam **1 (5.0)**		Tripura **1 (5.0)**		
Non-significant -ve growth rate	Pondicherry **1 (5.0)**		Kerala **1 (5.0)**	Manipur **1 (5.0)**	
India	9.6 20 (100.0)	10.0 20 (100.0)	4.9 20 (100.0)	4.9 20 (100.0)	6.5 20 (100.0)

Note: Figures in parentheses show percentage to total number of states included in the analysis
Source: FAI (2008)

In case of K fertilizers, 80 per cent of states/UTs reported significant growth in per hectare consumption during the seventies and the share remained same in 1980s. In 1990s, there was significant reduction in consumption of K fertilizers due to certain policy interventions and only 10 out 20 states witnessed significant growth in K consumption and half of the states reported stagnation (non-significant positive and negative growth rate) in K consumption. However, due to introduction of concession scheme for K fertilizers, the consumption increased during the 2000s and the number of states with significant positive growth rate increased to 15.

Table 3.21: Classification of states according to growth rate in per ha fertilizer consumption (K)

	1970s	1980s	1990s	2000s	All period
Significant +ve growth rate	Andhra Pradesh Bihar, Gujarat Haryana Himachal Pradesh Karnataka Kerala Madhya Pradesh Manipur Orissa Pondicherry Punjab Tamil Nadu Tripura Uttar Pradesh West Bengal **16 (80.0)**	Andhra Pradesh Gujarat Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Assam Bihar Maharashtra Manipur Orissa Pondicherry Tamil Nadu Tripura West Bengal **16 (80.0)**	Andhra Pradesh Assam Bihar Himachal Pradesh Karnataka Maharashtra Manipur Orissa Punjab West Bengal **10 (50.0)**	Andhra Pradesh Assam, Bihar Gujarat, Haryana Himachal Pradesh Jammu & Kashmir Karnataka Maharashtra Orissa Pondicherry Rajasthan Tamil Nadu Tripura West Bengal **15 (75.0)**	Andhra Pradesh Assam, Bihar Gujarat, Haryana Himachal Pradesh Jammu & Kashmir Karnataka Kerala Madhya Pradesh Maharashtra Manipur, Orissa Pondicherry Punjab, Rajasthan Tamil Nadu Tripura Uttar Pradesh West Bengal **20 (100.0)**
Non-significant +ve growth rate	Jammu & Kashmir Maharashtra Rajasthan **3 (15.0)**	Rajasthan **1 (5.0)**	Gujarat Haryana Jammu & Kashmir Madhya Pradesh Pondicherry Rajasthan Tamil Nadu Uttar Pradesh **8 (40.0)**	Kerala Madhya Pradesh Punjab Uttar Pradesh **4 (20.0)**	
Significant -ve growth rate	Assam **1 (5.0)**	Haryana, Punjab **2 (10.0)**			
Non-significant -ve growth rate		Uttar Pradesh **1 (5.0)**	Kerala, Tripura **2 (10.0)**	Manipur **1 (5.0)**	
India	8.5 20 (100.0)	6.8 20 (100.0)	4.4 20 (100.0)	8.5 20 (100.0)	5.1 20 (100.0)

Note: Figures in parentheses show percentage to total number of states included in the analysis
Source: FAI (2008)

The above results clearly show that growth in intensity of fertilizer use was the higher during the 1970s and 1980s. However, per hectare fertilizer use in general and P and K consumption in particular grew at a lower rate during the 1990s mainly due to partial decontrol of P and K fertilizers and discriminatory pricing policy towards P and K and complex fertilizers. Due to lower price of urea (N fertilizer), compared with P and K fertilizers farmers started using more of urea and less of P and K fertilizers without realizing the adverse consequences of this imbalance in use of primary nutrients.

Imbalance in Fertilizer Use

One of the major constraints to fertilizer use efficiency in India is an imbalance of applied nutrients. Nitrogen (N) applications tend to be too high in relation to the amount of potassium (K) and phosphate (P) used. This is partly the result of a difference in price of different nutrients, and partly due to the lack of knowledge among farmers about the need for balanced fertilizer applications. Consumption ratio of N and P_2O_5 in relation to K_2O and N in relation to P_2O_5 in India for the period 1972-73 to 2007-08 is given in Table 3.22.

The N:P:K ratio was little skewed towards N in 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 tight controls by the government on fertilizer prices and sales and distribution during the decade of 1980s. However, the fertilizer prices, which remained unchanged during the decade of 1980s, were raised by about 30 per cent in July 1991 but reduced in August 1991. Also the price, distribution and movement of phosphatic and potassic fertilizers were decontrolled w.e.f. August 25, 1992 while urea remained under statutory price control. This resulted in steep hike in the prices of P and K fertilizers. For example 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. 18.11 – 19.45 in rabi 1995-96. Similarly, price of MOP in terms of nutrient content (K_2O) increased from Rs. 2.83 per kg in July 1991 Rs. 7.50 in August 1992 and reached a level of Rs. 8.00 in rabi 1995-96.

In 1991-92, share of N, P and K in total consumption was 63.2, 26.1 and 10.7 per cent, respectively and N:P:K ratio was 5.9:2.4:1.0. Decontrol of P and K fertilizers and steep increase in prices resulted in decline in their consumption and consequent imbalance in the use of fertilizers. The share of N in total fertilizer consumption which was 63.2 per cent in

1991-92, increased to about 71 per cent in 1993-94 while share of P declined from 26.1 to 21.6 per cent and that of K from 10.7 to 7.3 per cent. The NPK ratio which was at 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.

Table 3.22: Consumption Ratio of N and P_2O_5 in relation to K_2O and N in relation to P_2O_5 in India: 1971-1972 to 2007-2008

Year	$N:P_2O_5:K_2O$			$N:P_2O_5:K_2O$	
	N	P_2O_5	K_2O	N	P_2O_5
1971-72	6.0	1.9	1	3.2	1
1972-73	5.3	1.7	1	3.2	1
1973-74	5.1	1.8	1	2.8	1
1974-75	5.3	1.4	1	3.7	1
1975-76	7.7	1.7	1	4.6	1
1976-77	7.7	2	1	3.9	1
1977-78	5.8	1.7	1	3.4	1
1978-79	5.8	1.9	1	3.1	1
1979-80	5.8	1.9	1	3	1
1980-81	5.9	1.9	1	3	1
1981-82	6.0	1.9	1	3.1	1
1982-83	5.8	2	1	3	1
1983-84	6.7	2.2	1	2.9	1
1984-85	6.5	2.2	1	2.9	1
1985-86	7.0	2.5	1	2.8	1
1986-87	6.7	2.5	1	2.7	1
1987-88	6.5	2.5	1	2.6	1
1988-89	6.8	2.5	1	2.7	1
1989-90	6.3	2.6	1	2.5	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
1995-96	8.5	2.5	1	3.4	1
1996-97	10.0	2.9	1	3.5	1
1997-98	7.9	2.9	1	2.8	1
1998-99	8.5	3.1	1	2.8	1
1999-00	6.9	2.9	1	2.4	1
2000-01	7.0	2.7	1	2.6	1
2001-02	6.8	2.6	1	2.6	1
2002-03	6.5	2.5	1	2.6	1
2003-04	6.9	2.6	1	2.7	1
2004-05	5.7	2.2	1	2.5	1
2005-06	5.3	2.2	1	2.4	1
2006-07	5.9	2.4	1	2.5	1
2007-08	5.5	2.1	1	2.6	1

Source: FAI (2008)

In order to correct the imbalance in use of N, P and K fertilizers, Government of India implemented a scheme of concession on sale of decontrolled fertilizers to the farmers. This scheme was initially implemented w.e.f. October 1, 1992 but still there was significant difference in prices of N, P and K fertilizers that led to more use of N and low use of P and K fertilizers leading to more imbalance in use of fertilizers (NPK ratio reached a level of 10.0:2.9:1.0 in 1996-97). Concerned with this deteriorating NPK ratio, Government of India announced a substantial increase in concession on P and K fertilizers with effect from July 6, 1996. The rate of concession on indigenous Di-Ammonium Phosphate (DAP) was raised by three times from Rs.1,000 per tonne to Rs.3,000 per tonne. A concession to the extent of Rs.1,500 per tonne was extended to imported DAP to bring its selling price at par with indigenous DAP. Similarly, the concession on Muriate of Potash (MOP) was increased from Rs.1,000 per tonne to Rs.1,500 per tonne. The rate of concession on Single Super Phosphate (SSP) was also enhanced from Rs.340 to Rs.500 per tonne. 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 NPK ratio and reached a level of 5.5:2.1:1.0 in 2007-08.

State-wise Consumption Ratios

State wise consumption of N, P and K per hectare of gross cropped area and consumption ratio of N and P_2O_5 in relation to K_2O for triennium ending (TE) 2007-08 is presented in Table 3.23. Punjab ranks number one in consumption of N (159.7 kg/ha) and second in P consumption (44 kg/ha) but use of K (5.8 kg/ha) is less than half of the national average (12.8 kg/ha). Haryana ranks second in per hectare use of N consumption (136.9 kg/ha) and use of K is very low (3.6 kg/ha). Tamil Nadu is at the top (48.2 kg/ha) in application of K, followed by West Bengal (30.9 kg/ha) and Andhra Pradesh (28.2 kg/ha). Per hectare use of N fertilizers is the highest (117.2 kg/ha) in north region and the lowest in western region (46.3 kg/ha). South region ranks first in P (40.9 kg/ha) and K (30.3 kg/ha) consumption. It is interesting to note that per hectare use of K in southern states is significantly higher than other states except for West Bengal. Per hectare fertilizer use is generally low in north-eastern states.

The NPK ratio, which is a measure of balanced use of fertilizer, shows wide inter-regional and inter-state disparity. While existing variation (TE 2007-08) from the ideal ratio (4:2:1) was nominal in the South (2.8:1.4:1.0) and the Eastern region (3.9:1.5:1.0), it was very wide in the North (26.4:7.9:1.0). State-Wise consumption ratio of N and P in relation to K for different periods is given in Annexure Table 3.2. Greatest degree of N:P:K imbalance was seen in case of Haryana (37.7:10.7:1.0) followed by Rajasthan (37.4:14.3:1.0) and Punjab (27.7:7.6:1.0) in 2007-08. However the ratio has improved over time. For example in 1993-94 (after decontrol of P and K fertilizers in 1992), the ratio was 70.4:15.7:1.0 in northern region and 11.4:4.1:1.0 in western region and improved to 21.3:7.0:1.0 in north and 6.5:2.7:1.0 in the western region in 2007-08 (Annexure Table 3.2).

Usage of Fertilizers by Crops

Understanding the contribution of the different crops to fertilizer use is a key component of fertilizer market analysis and a prerequisite to the development of sound fertilizer demand forecasts. Data on fertilizer use by crops in 2006-07 at global level is given in Figure 3.15. It is estimated that about half of world fertilizer was applied on cereals. Fertilizer application to three main cereals is of similar magnitude, 15.9 per cent for maize, 15.2 per cent for wheat and 14.6 per cent for rice. Fertilizer use on the other cereals represents a small share (4.6%)

of the world total. Oil crops account together for 9.3% of world fertilizer consumption and cotton receives 3.6 per cent of the fertilizer applied worldwide. Use on the other fibre crops is negligible. Sugar cane and sugar beet together account for 4.3 per cent of world fertilizer usage. Fruits and vegetables accounted for 17 per cent of world fertilizer consumption and other crops received the remaining 15.5 per cent.

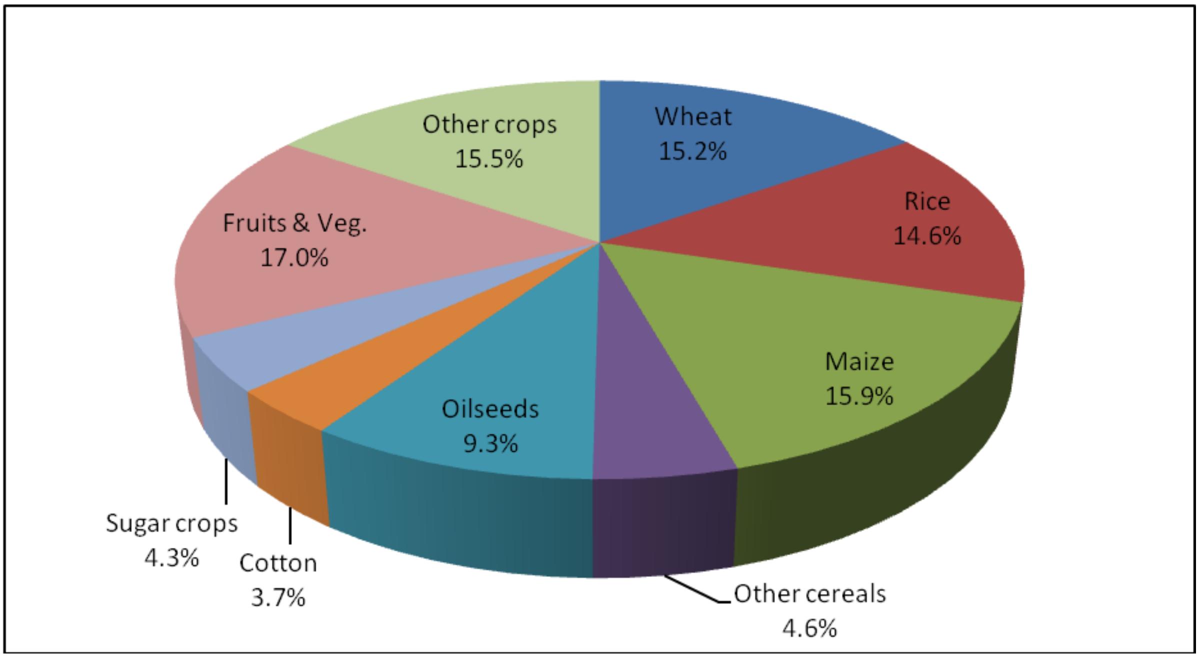
Table 3.23: State wise use of N, P and K per hectare of gross cropped area (TE 2007-08) and ratio of N, P and K

	Kg/ha				*N:P:K*		
	N	*P_2O_5*	*K_2O*	*Total*	*N*	*P_2O_5*	*K_2O*
East	**58.2**	**22.5**	**15.1**	**95.8**	**3.9**	**1.5**	**1.0**
Arunachal Pradesh	1.8	0.8	0.4	2.9	4.8	2.1	1.0
Assam	26.6	14.3	13.7	54.6	1.9	1.0	1.0
Bihar	105.8	21.9	11.6	139.3	9.1	1.9	1.0
Jharkhand	42.9	20.6	3.4	66.8	12.6	6.1	1.0
Manipur	58.2	12.0	4.8	75.0	12.1	2.5	1.0
Meghalaya	10.7	6.1	1.0	17.9	10.7	6.1	1.0
Mizoram	15.5	11.3	7.3	34.1	2.1	1.6	1.0
Nagaland	1.0	0.6	0.2	1.8	4.1	2.6	1.0
Orissa	29.5	11.5	6.8	47.8	4.4	1.7	1.0
Tripura	28.2	9.6	7.2	45.0	3.9	1.3	1.0
West Bengal	69.7	40.0	30.9	140.4	2.3	1.3	1.0
North	**117.2**	**35.0**	**4.4**	**158.6**	**26.4**	**7.9**	**1.0**
Haryana	136.9	39.0	3.6	179.5	37.7	10.7	1.0
Himachal Pradesh	32.2	9.9	8.5	50.6	3.8	1.2	1.0
Jammu & Kashmir	52.7	20.2	4.9	77.9	10.7	4.1	1.0
Punjab	159.7	44.0	5.8	209.6	27.7	7.6	1.0
Uttar Pradesh	106.4	33.5	7.4	147.3	14.4	4.6	1.0
Uttaranchal	81.3	19.3	7.3	107.8	11.2	2.7	1.0
South	**86.2**	**40.9**	**30.3**	**156.3**	**2.8**	**1.4**	**1.0**

Andhra Pradesh	118.5	54.0	28.2	200.6	4.2	1.9	1.0
Karnataka	59.5	32.6	24.8	116.9	2.4	1.3	1.0
Kerala	29.4	14.8	24.8	69.0	1.2	0.6	1.0
Tamil Nadu	94.9	42.4	48.2	185.4	2.0	0.9	1.0
Pondicherry	591.3	270.0	224.1	1085.4	2.6	1.2	1.0
West	**46.3**	**21.8**	**7.9**	**75.9**	**5.9**	**2.8**	**1.0**
Gujarat	84.0	33.3	11.4	128.8	7.4	2.9	1.0
Madhya Pradesh	34.8	19.4	3.3	57.6	10.4	5.8	1.0
Chhattisgarh	45.2	19.7	8.1	72.9	5.6	2.4	1.0
Maharashtra	52.5	28.2	16.7	97.4	3.2	1.7	1.0
Rajasthan	31.2	11.9	0.8	43.9	37.4	14.3	1.0
Goa	17.3	9.2	10.1	36.6	1.7	0.9	1.0
India	**62.2**	**28.3**	**12.8**	**112.3**	**4.8**	**2.2**	**1.0**

Source: FAI (2008)

Figure 3.15: Total fertilizer use by crops at the global level: 2006-07



Source: Haffer, P (2009)

It is generally expected that major benefit of fertilizer goes to the areas having access to better technology, irrigation facilities and market infrastructure and growing fertilizer-intensive crops like rice, wheat, sugarcane, fruits and vegetables. Trends in usage of fertilizers in India by various crops were analyzed and the results are presented in Table 3.24. It shows that rice was the largest user of fertilizer (36.8% of total consumption), followed by wheat (23.8%) in 2001-02. Paddy and wheat that accounted for around 55 per cent of total fertilizer consumption in the country in 1991-92, increased their share to over 60 per cent in 2001-02. The share of cereals was about 69 per cent, much higher than the world average of about 50 per cent. Fruits, vegetables, and sugarcane combined represent another 10 per cent of fertilizer use in the country. Cotton and pulses represent about 3 per cent each. In all the years rice was the dominant crop fertilized. Fruits and vegetables appear to be increasing in importance.

Fertilizer intensity measured as average kg per hectare does not follow exactly the same pattern across crops; intensity tends to be higher on sugarcane, cotton, fruits and vegetables and lower on coarse cereals and pulses (Table 3.25). It is quite evident that farmers growing input-intensive crops are the main beneficiary of fertilizer use.

Table 3.24: Share of usage of fertilizer nutrients (N+P+K) by various crop groups (% share)

Crop	1991-92	1996-97	2001-02
Rice	35.1	36.5	36.8
Wheat	19.3	24.2	23.8
Pulses	-	1.4	3.0
Total foodgrains	-	69.8	71.9
Oilseeds	5.9	7.9	8.6
Cotton	5.5	5.4	2.9
Sugarcane	-	4.9	5.1
Fruits	-	0.6	1.9
Vegetables	-	1.2	3.5
Spices & condiments	-	0.7	1.4

Source: All India Report on Input Survey, 1991-92, 1996-97 and 2001-02

Table 3.25: Usage of fertilizer nutrients (N+P+K) by various crop groups (kg/ha of GCA)

Crop	1991-92	1996-97	2001-02
Rice	79.8	100.0	125.5
Wheat	85.3	119.3	132.4
Pulses	-	21.6	27.6
Total foodgrains	-	86.3	94.7
Oilseeds	-	52.5	64.8
Cotton	88.8	143.0	146.8
Sugarcane	160.9	185.4	202.0
Fruits	-	94.5	145.5
Vegetables	-	165.3	169.9
Spices & condiments	-	162.2	124.9

Source: All India Report on Input Survey, 1991-92, 1996-97 and 2001-02

Given the importance of foodgrains, as a share of total cropped area, and recent efforts of the government to bring more area under foodgrains mainly wheat and rice under National Food Security Mission (NFSM) and Rashtriya Krishi Vikas Yojna (RKVY), they will be particularly important crops for stimulating the use of fertilizer in the country. However rising demand for high-value crops mainly fruits and vegetables, due to increasing income level, urbanization, changing lifestyle, etc. demand for fertilizer is also expected to increase as these crops are fertilizer-intensive crops.

Pattern of Fertilizer Consumption by Farm Size

It was found that there is a high degree of inequality in fertilizer consumption among crops and rice, wheat and sugarcane are the prime beneficiaries. However, it would be more appropriate to study pattern of fertilizer use across different farm sizes as these crops are grown by all categories of farms. In this section we have examined the issue of inter-farm size consumption of fertilizer.

Table 3.26 shows farm size-wise consumption of fertilizers in India in 1991-92, 1996-97 and 2001-02. As is evident from the table, with a share of less than 7 per cent in total holdings, medium and large farmers consumed 25.9 per cent of total fertilizers used in the country in 2001-02. Semi-medium farmers accounted for 11 per cent of holdings, but consumed 22.1 per cent of total fertilizers. On the other hand, small and marginal farmers which constitute over 82 per cent of total holdings consumed 52 per cent 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 2001-02, share of small and marginal farmers in gross cropped area was 42.6 per cent and they consumed 52 per cent of total fertilizer used in the country. On the other hand, share of medium and large farmers in gross cropped area was nearly one-third and consumed over one-fourth of total fertilizers. Significantly over 77 per cent of gross cropped area was fertilizer on marginal farmers in 2001-02 while less than half of the cropped area was fertilizer on large holdings.

Table 3.26: Pattern of fertilizer consumption by farm size

	Marginal (<1 ha)	Small (1.0-2.0 ha)	Semi-medium (2.0-4.0 ha)	Medium (4.0-10.0ha)	Large (>10ha)	All households
Distribution of holdings (%)						
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
Share in gross cropped area (%)						
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
Proportion of fertilizer area to gross cropped area (%)						
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
Share in total fertilizer consumption (%)						
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

Source: FAI (2008)

Moreover, small and marginal farmers were using fertilizers more intensively as compared to medium and large farmers (Table 3.27). The average fertilizer consumption per hectare of gross cropped area was the highest (126.4 kg) on marginal holdings and the lowest on large farms (56.6 kg) in 2001-02. Similar trend was observed during 1991-92 and 1995-96. Moreover there has been a significant increase in fertilizer intensity on all farm size holdings during the period 1991-92 and 2001-02. However, the increase was the largest (74.8%) on marginal farms (from 72.2 kg/ha in 1991-92 to 126.4 kg/ha in 2001-02), followed by small holdings (53.7%) and the lowest (21.4%) on large farms. Average fertilizer consumption was the highest in Punjab, followed by Haryana and Tamil Nadu. At state-level almost a similar trend of inverse relationship between farm size and intensity of fertilizer use was observed (Table 3.28). The only exception was the state of Punjab, where large farms showed higher fertilizer use intensity (169.9 kg/ha) compared with small (164.3 kg/ha) and marginal farms (163.3 kg/ha) in 2001-02.

Table 3.27: Pattern of fertilizer use intensity by farm size

	Marginal	Small	Semi-medium	Medium	Large	All households
	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
	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

Source: FAI (2008)

Table 3.28: State-wise fertilizer use per hectare of gross cropped area by size of holding, 2001-02

States	Marginal	Small	Semi-medium	Medium	Large	All households
Andhra Pradesh	171.1	149.0	139.0	128.1	109.6	146.7
Assam	50.4	29.9	24.4	16.1	3.8	30.7
Gujarat	104.1	83.0	72.8	59.0	40.4	70.0
Haryana	145.1	126.0	132.6	132.1	118.5	130.7
Himachal Pradesh	61.6	55.9	52.3	47.3	38.9	55.4
Jammu & Kashmir	159.4	71.6	62.4	39.2	30.4	107.9
Karnataka	172.0	122.5	98.5	79.9	62.2	105.1
Kerala	180.8	104.6	108.3	121.2	131.5	152.0
Madhya Pradesh	44.1	33.5	29.3	27.0	24.4	30.0
Maharashtra	143.2	109.8	92.6	82.8	63.8	101.1
Orissa	65.0	56.4	55.8	60.2	63.8	59.1
Punjab	163.3	164.3	166.7	169.5	169.9	168.6
Rajasthan	69.3	46.9	41.9	33.4	16.3	32.6
Tamil Nadu	173.8	140.6	137.4	128.6	90.2	148.6
Uttar Pradesh	120.4	109.3	104.5	95.0	83.5	109.9
West Bengal	130.2	137.5	139.2	107.5	112.3	133.0
All India	126.2	100.6	88.8	75.8	55.9	92.6

Source: All India Report of Input Survey, 2001-02, Agriculture Census Division, Department of Agriculture & Cooperation, Ministry of Agriculture, New Delhi, 2008

Table 3.29 shows category-wise use of fertilizers by paddy and wheat cultivators during 2001-02 and 1996-97. We find that marginal and small farms used about 60 per cent of total fertilizer on paddy farms and fertilizer consumption per hectare of gross cropped area was also higher on marginal and small farms and declined with size of holding. In case of wheat, marginal and small farms consumed 45.7 per cent of total fertilizer used in wheat crop in

2001-02. The share of marginal and small farms in total consumption has increased between 1996-97 and 2001-02 from 56.9 per cent to 60 per cent in paddy and from 39.2 to 45.7 per cent in wheat.

Table 3.29: Fertilizer use by size of holding of paddy and wheat cultivators, 1996-97 and 2001-02

	Paddy			Wheat		
Size group	Total Fertilizer used	Per cent of total fertilizer used	Per ha. Fertilizer used (kg)	Total Fertilizer used	Per cent of total fertilizer used	Per ha. Fertilizer used (kg)
2001-02						
Below 1.0	1811.8	35.8	136.7	875.3	27.4	144.0
1.00 – 1.99	1226.5	24.2	118.6	582.2	18.3	123.3
2.00 – 3.99	1043.6	20.6	109.6	679.8	21.3	123.9
4.00 – 9.99	747.4	14.8	105.8	733.7	23.0	129.0
>10	232.6	4.6	104.8	318.6	10.0	132.3
All groups	5061.7	100.0	119.4	3189.7	100.0	130.8
1996-97						
Below 1.0	1479.7	34.3	118.9	653.7	22.9	128.6
1.00 – 1.99	975.5	22.6	95.3	464.7	16.3	106.0
2.00 – 3.99	907.8	21.1	88.4	609.4	21.4	111.1
4.00 – 9.99	705.6	16.4	90.8	753.3	26.4	122.5
>10	241.9	5.6	101.8	371.6	13.0	132.3
All groups	4310.5	100.0	100.0	2852.6	100.0	119.3

Source: All India Report of Input Survey, 2001-02, Agriculture Census Division, Department of Agriculture & Cooperation, Ministry of Agriculture, New Delhi, 2008

Looking at class-wise proportion of area treated with fertilizers, we find that share of area treated with fertilizers was the highest on marginal farms (84.5% in paddy and 93.5% in wheat) and it goes down with the size of holding (Table 3.30). The share of area treated with fertilizers has increased from 72 per cent in 1996-97 to 80.7 per cent in 2001-02 in case of paddy and from 77.6 per cent to 90.7 per cent in wheat during the same period. This increase was significantly higher on small and marginal farms as compared to large farms. For example, in case of paddy the share increased from 75.3 per cent in 1996-97 to 84.5 per cent in 2001-02 on marginal farms in case of paddy and from 76 per cent to 93.5 per cent in wheat. Generally, the share of area treated with fertilizers was higher in wheat than paddy.

Table 3.30: Share of paddy and wheat area treated with fertilizers in India

(% to gross cropped area under the crop)

Size group (ha)	Paddy		Wheat	
	1996-97	2001-02	1996-97	2001-02
Below 1.0	75.3	84.5	76.0	93.5
1.00 – 1.99	72.3	81.4	75.8	91.1
2.00 – 3.99	69.6	78.1	77.6	90.2
4.00 – 9.99	69.8	77.2	79.0	89.2
>10	71.8	75.9	80.1	87.3
All groups	72.0	80.7	77.6	90.7

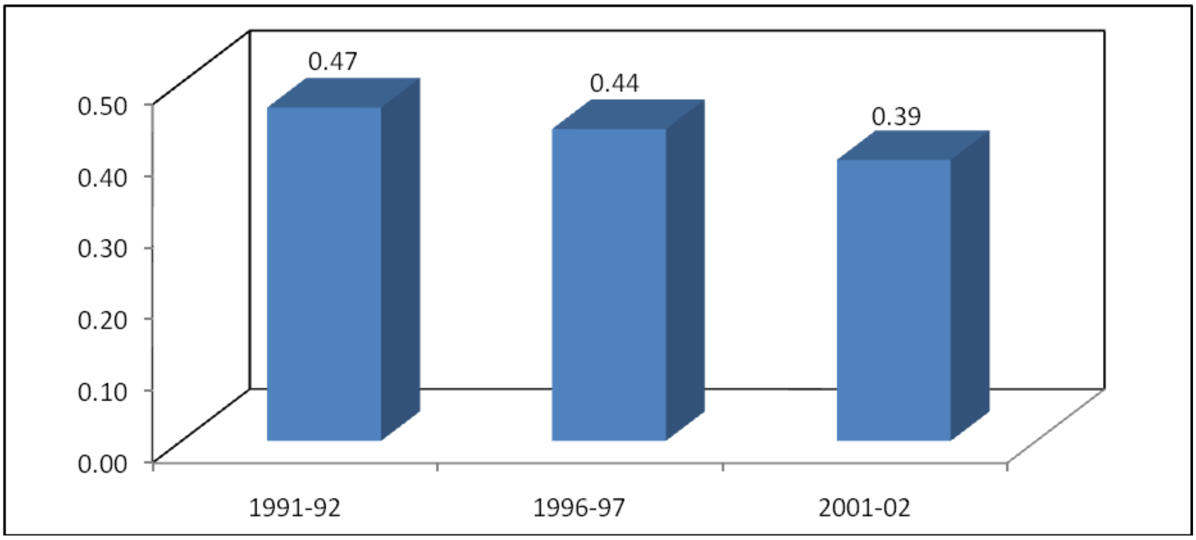
Source: FAI (2008)

It may be concluded form the above discussion that there is a fair degree of inter-farm equity in distribution of fertilizer consumption. However, it would be useful to examine changes in equity in fertilizer consumption over time. In order to investigate this issue, gini coefficients were computed for the period 1991-92, 1996-97 and 2001-02 and are given in Figure 3.16. The gini coefficient is a measure of statistical dispersion most prominently used as a measure of inequality of income distribution. It is defined as a ratio with values between 0 and 1. A low gini coefficient indicates more equal distribution, while a high Gini coefficient indicates more unequal distribution. As Figure makes clear, between 1991-92 and 2001-02, inequality in fertilizer consumption across different farm size groups went down from 0.47 to 0.42, which is a positive development.

Summary and Concluding Remarks

Total Fertilizer consumption in India is among the top in the world with total consumption (in nutrient terms) of about 22.57 million tonnes in 2007-08. However, India ranks low in terms of intensity of fertilizers use (kg/ha) in comparison to most of the developing and developed countries in the world. The overall consumption of fertilizers has increased significantly from 65.6 thousand tonnes in 1951-52 to 22.57 million tonnes in 2007-08. Accordingly, per hectare consumption of fertilizers, which was less than one kg in 1951-52, has gone up to the level of 117 kg in 2007-08.

Figure 3.16: Gini coefficient in 1991-92 and 2001-02 (Input survey)



Note: Calculations based on distribution of holdings ranked by their fertilizer consumption shares

Nitrogenous fertilizers account for nearly two-third of total nutrient consumption in the country while share of P fertilizers is about 25 per cent and K about 11 per cent. Urea accounts for more than 80 per cent of India's total nitrogen consumption and in case of phosphatic fertilizers, DAP accounts for 63 per cent of total phosphorus consumption in the country. The main reason for predominant share of these two products (urea and DAP) is concentration of subsidy/concession on these products.

Fertilizer consumption in India is highly skewed, with wide inter-regional, inter-state, inter-district and inter-crop variations. The eastern region has generally consumed less fertilizer while the northern region consumed more. The share of northern and southern region has declined while the shares of eastern and western regions have increased during the last four decades. There are also regional differences in consumption of nutrients. Consumption of N is the highest in north region constituting 36.4 per cent, and the lowest in the eastern zone (14.6%). In case of phosphatic fertilizers, west zone has the highest share (34%), followed by north (26.7%) and southern region (24.7%). The southern region accounts for about 43 per cent of total K consumption in the country while share of north zone is the lowest (10.2%). These differences are due to variations in soil fertility status under different agro-ecological regions and cropping systems. The growth in total fertilizer consumption as well as in terms of nutrients (N, P, and K) was high in the post-green revolution period (1970s and 1980s) slowed down during the 1990s due to decontrol of certain fertilizers and uncertain policy environment. However, fertilizer consumption started picking up in the 2000s due to some positive policy changes in the sector and more emphasis on agricultural development during the decade.

The results show that there is a high degree of concentration of fertilizer consumption at disaggregated level. About 18 per cent of the districts in the country accounted for half of total fertilizer use while bottom 53 per cent of the districts accounted for only 15 per cent of total fertilizer used in the country. The intensity of fertilizer use varied greatly from 45 kg per hectare in Rajasthan to 210 kg per hectare in Punjab. Intensity of fertilizer use has generally been higher in northern (82 kg/ha average) and southern (75.1 kg/ha average) region and lower in the western (35.6 kg/ha) and eastern (38.3 kg/ha) regions. 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. For example in the TE 2007-08, 85 out of 526 districts (16.1%) consumed more than 200 kg per hectare, 62 districts between 150-200 kg, 99 districts between 100-150 kg and 144 districts between 50-100 kg per hectare. On the other hand about one-fourth of the districts had less than 50 kg per hectare fertilizer use much lower than recommended levels. Therefore, there is a need to monitor districts/areas with high intensity of consumption and take corrective actions to check environmental degradation as well as make efforts to promote fertilizer consumption in low-use districts to improve crop productivity

One of the major constraints to fertilizer use efficiency in India is imbalance of applied nutrients partly as the result of a difference in price of nutrients, and partly due to the lack of knowledge among farmers about the need for balanced fertilizer applications. The N:P:K ratio was little skewed towards N in 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 steep increase in prices in the early 1990s resulted in decline in their consumption and consequent imbalance in the use of fertilizers. The NPK ratio which was at 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 concerted efforts of the government like increase in concessions on phosphatic and potassic fertilizers and an increase in price of urea in 1997 led to improvement in NPK ratio and reached a level of 5.5:2.1:1.0 in 2007-08. There are wide inter-regional and inter-state disparities in N:P:K ratios. Greatest degree of N:P:K imbalance was seen in case of Haryana (37.7:10.7:1.0) followed by Rajasthan (37.4:14.3:1.0) and Punjab (27.7:7.6:1.0) in 2007-08 but the ratio has improved over time.

There is a high degree of inequality in fertilizer consumption among crops. Rice is the largest user of fertilizer (36.8% of total consumption), followed by wheat (23.8%). Fruits, vegetables, and sugarcane combined represented another 10 per cent of fertilizer use. Given the importance of foodgrains and recent efforts of the government to bring more area under foodgrains will stimulate demand for fertilizer in the country. In addition rising demand for high-value crops (fruits and vegetables) is also expected to increase demand for fertilizer as these crops are fertilizer-intensive crops. 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 42.6 per cent in 2001-02 and they consumed 52 per cent of total fertilizer used in the country. On the other hand, share of medium and large farmers in gross cropped area was nearly one-third and consumed over one-fourth of total fertilizers. Significantly over 77 per cent of gross cropped area was fertilizer on marginal farmers while less than half of the cropped area was fertilizer on large holdings. Moreover, intensity of fertilizer use was higher on small and marginal farms as compared to medium and large farmers. The inequity in fertilizer consumption across different farm size groups has declined during the last decade.

Chapter 4

FERTILIZER POLICIES, PRICES AND SUBSIDIES

Both the intensity of fertilizer usage in terms of nutrients per hectare area and the extent of fertilization as measured by the ratio of fertilized area to total cropped area in many developing countries are lower than developed countries. However, fertilizer use has been and will continue to be a major factor in the increasing agricultural production. Typically, very few countries, even advanced ones, have relied entirely on the free market system to set fertilizer prices. It is, therefore, not surprising that governments in developing countries are interested in promoting the use of fertilizers. The fertilizer prices at both producer and farmer levels are determined directly or indirectly by the government in most of the developing countries including India. Such government interventions generally have two basic objectives: (i) to provide fertilizers to farmers at stable and affordable prices in order to increase agricultural production through higher fertilizer use, and (ii) to encourage domestic production by allowing fertilizer producers a reasonable return on their investments. This chapter provides a brief overview of fertilizer sector policies and discusses the issue of fertilizer subsidies in India. The review of policies is based on different publications/documents such as various committee reports, Fertilizer Statistics, notifications from the Department of Fertilizers, Ministry of Chemicals and Fertilizers, Government of India, etc.

Fertilizer Policies

The fertilizer policy environment in the country can be broadly classified into three periods, (ii) Pre-RPS Regime (up to mid-1970s); (ii) Post-RPS Era (mid-1970s to 1980s), and (iii) Post-reforms Period (1991- onwards).

Pre-Retention Price Scheme (RPS) Era (1950s – mid-1970s):

In the late 1930s, fertilizer imports constituted over 80 per cent of the nutrients used, and these were mainly used in plantation sector. Due to World War II world exports fell sharply and the International Emergency Food Council allocated those exports to various Governments. To import the fertilizers allocated to India and to ensure equitable distribution of all fertilizers at fair prices all over the country and to all sectors, the Government of India established the Central Fertilizer Pool in 1944. Both domestic and imported fertilizers were pooled together under Central Fertilizer Pool and distributed through state agencies and boards representing different commodities like tea, coffee, rubber, etc. Prices were fixed on a no-profit, no-loss basis and this was the beginning of price controls on fertilizers. It originated from supply side constraints and an effort to ensure that some supplies are allocated to the non-plantation sector to promote a rapid increase in food production. In 1943 the Government launched the Grow More Food Campaign to increase food production rapidly and limited availability of fertilizers was one of the most severe constraints.

Until 1953, the prices the Central Fertilizer Pool set for fertilizers did not include railway freight, which resulted into different prices at different locations and led to inequality in fertilizer consumption across regions/states. The Government decided to charge uniform prices by including equated railway freight in the prices. For a brief period between 1948 and 1952, this policy of pooling supplies was also applied to phosphatic fertilizers. Although the pooling arrangements were discontinued for phosphatic nutrients after 1952, the Government continued to fix ex-factory prices until 1966. Potassic fertilizers were imported by the State Trading Corporation through the Indian Potash Supply Agency but there was no control over the retail selling prices. This price and distribution policy continued until the mid-1960s. This policy of pooling supplies and regulating distribution led to some increase in fertilizer consumption in the country. However, it was realized that supply side and distribution constraints are more important than prices in increasing fertilizer consumption.

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

During the 1950s fertilizer production and consumption remained at a very low level. In 1960-61, total production was about 65 thousand tonnes and consumption 338 thousand tonnes. In view of low levels of production and consumption of fertilizers in the country, the Government of India constituted a Committee on Fertilizers in 1964 (Sivaraman committee) to examine the problems connected with the distribution of all chemical fertilizers, pricing of fertilizers, role of cooperatives in their marketing, and the role of extension services in the promotion and popularization of the use of fertilizers. The committee submitted its report in 1965 and made a number of recommendations. The committee identified five major constraints on achieving the desired growth in consumption, (i) availability of fertilizers; (ii) arrangements for procurement and delivery fertilizers; (iii) fertilizer distribution system; (iv) availability of adequate credit for distributors as well as for farmers; and (v) fertilizer promotion. Most of the committee's major recommendations were accepted by the government and a comprehensive fertilizer policy was announced by the Government in December 1965 as a part of the New Agricultural Strategy. Main recommendations of the committee included increased domestic production over imports to increase the availability of fertilizers and recommended a major expansion in the domestic production capacity. To fix the prices of nitrogenous fertilizers, the committee recommended the continuation of the practice of pooled prices because of the disparities between indigenous and import prices and because of the variation in the cost of production among domestic factories. For the same reasons and because of regional imbalances in production and consumption, it recommended that the distribution arrangements be continued through the Central Fertilizer Pool in the short run. An important recommendation of the committee was elimination of the monopoly of the cooperatives in fertilizer distribution system, increasing the number of retail outlets and raising the distribution margins. In 1966, fertilizer marketing was liberalized as per the recommendations of the Sivaraman Committee Report and manufacturers were given freedom to market up to 50 per cent of their production. In 1969-70 the pooling was terminated and domestic manufactures were given complete freedom in marketing their own products. Producers of complex fertilizers were also allowed to fix their prices. However, the prices of ammonium sulphate, calcium ammonium nitrate and urea remained statutorily fixed under the Fertilizer Control Order. The monopoly of the cooperatives in fertilizer distribution was also abolished.

The stagnation in the growth of fertilizer consumption in the early 1970s caused by the tight availability of fertilizers due to decline in imports and dismal growth in domestic production concerned the government. Consequently, the government started regulating the distribution of fertilizers under the Essential Commodities Act (ECA) and the concept of half-yearly zonal conferences was introduced in 1972. All the fertilizers were distributed by the manufacturers according to their ECA allocation during kharif and rabi seasons, as per the supply plan fixed at the zonal conferences. Due to fertilizer shortages in the early 1970's, government passed the Fertilizer Movement Control Order in 1973, which brought fertilizer distribution and its inter-state movement under government control.

Between 1966-67 and 1973-74, the farm gate prices of fertilizers increased by about 60 per cent. First, in 1967-68, fertilizer prices rose because of a 57 per cent due to devaluation of the rupee in June 1966. Second, the oil price shock in 1973 led to substantial price increases for imported fertilizers as well as import prices for raw materials like oil and naphtha also increased leading to higher costs of indigenous fertilizer production. Consequently, the retail prices for all fertilizers went up in 1974-75, irrespective of whether they were statutorily controlled by the government. The price rise was greater than the increased cost of domestic production, but lower than the increased cost of imported fertilizers. To prevent any gain to domestic producers and to reduce the burden of the subsidy on imported fertilizers, the government of India introduced the Fertilizer Pool Equalization Charge (FPEC) in 1974. Indigenous manufacturers were required to contribute a specific amount, Rs. 610 per tonne of urea, into this pool which was used to subsidize the cost of imported fertilizers.

Post-Retention Price Scheme (RPS) Era (Mid-1970s – 1980s):

The fertilizer industry suffered following the oil price shock in the early 1970s. Cost increases in the production and import of fertilizer led to a slowing of investment into new capacity. In order to ensure sufficient use of fertilizer at reasonable prices and to stimulate investment, the government set up a committee (Marathe Committee) in January 1976 to study the basis of existing pricing of fertilizers, establish norms for determining the production costs for individual units which would ensure a fair return on investment on a sustained manner, the rationalization of prices of feedstocks and other inputs, the revision of ex-factory realization from time to time due to any change in cost of inputs, and the development of a pricing policy of imported fertilizers.

The committee submitted Part I of its Report in May 1977 and recommended a 12 per cent post tax return on net worth regardless of the location, age, technology and cost of production and fixed a retention price for each unit according to the costs of production.

The computation of cost was based on the assumption of 80 per cent capacity utilization for ammonia-urea plants coupled with consumption norms of raw materials, energy etc. These norms were fixed with the view of enhancing capacity utilization, promoting efficiency of existing plants as well as stimulating investment into new capacity. Based on the recommendations of the Committee, the Retention Price Scheme (RPS) was introduced for various fertilizers. The RPS for nitrogenous fertilizers (except ammonium chloride) was introduced in November 1977.

The Part II of the report was submitted in 1978 which covered pricing of complex fertilizers, equated freight, and distribution of fertilizers. The committee recommended RPS for complex fertilizers and the scheme was introduced in February 1979. However, prices of ammonium sulphate and calcium ammonium nitrate were decontrolled from 8th June, 1980 but again brought under price controls w. e. f 21st August, 1984 and 7th September, 1984, respectively. The single superphosphate was brought under RPS in May 1982. In 1985 Ammonium chloride was brought under RPS.

The committee recommended the continuation of ECA allocations introduced in July 1972 and introduction of an equated freight system for each unit to ensure supply of fertilizer at uniform prices throughout the country. Further subsidies to the fertilizer industry were given to support fertilizer use in backward, hilly, inaccessible and tribal areas and by small and marginal farmers in dry areas. In view of these subsidies retail prices could be reduced between 1974 and 1979 and remained stable thereafter during decade of the 1980s.

The retention price scheme encouraged fertilizer consumption through subsidized farm gate fertilizer prices and on the other hand encouraged production of fertilizer through ensuring adequate returns to producers. The system was originally thought to be self financing. However, low farm gate prices, rising input costs, increased output and high capital costs of production resulted in higher subsidies

Due to mounting subsidies, the government tightened the norms on capacity utilization and depreciation to reduce retention prices and thus subsidies. In January 1989 with retrospect to April 1988, capacity utilization norms were increased to 90 per cent for gas-based urea plants and 85 per cent for naphtha and fuel oil based plants. Depreciation was based on 20 year lifetime instead of 10. Capacity utilization norms were set slightly lower from the 11th

year of plant lifetime onwards: 85 per cent for gas-based urea plants and 80 per cent for naphtha and fuel oil based plants. Coal based plants were subject to a norm of 60 per cent capacity utilization for the first 10 years and 55 per cent thereafter, phosphoric acid plants' norms were 75 and 70 per cent, respectively.

In addition, substantially increasing stocks of fertilizer in the 1980s gave way to consider abandoning the distribution control system under ECA and introducing a system of free distribution under the retention price scheme and a normative transport allowance. The goal of exempting large quantities of fertilizer from allocation control was to increase competitiveness among producers and bring down prices as well as to reduce subsidies on transportation. The government partially eased distribution of fertilizers in 1987 and 1988. Specific quotas not covered by ECA were allowed to be freely distributed. However, for these quantities the system of freight equalization would not apply with the effect that extra freight cost involved above the normal freight under ECA allocation would not be reimbursed. In April 1983, the Department of Fertilizers, Ministry of Chemicals and Fertilizers constituted a High Powered Committee of Secretaries to study the Retention Prices Scheme, covering the cost of production, the capital cost of fertilizer plants, the cost of inputs, and analysis of the factors contributing to the increase in the cost of production and subsidy in order to suggest measures to contain the subsidies. The Committee suggested a group retention price for each of the different feedstocks for existing units and recommended a shift to uniform price later so as to allow plants time to adjust. The committee favored a tariff adjusted import parity price for new gas based units but none of the major recommendations of the Committee were accepted by the government

In 1987, a High powered Committee was set up by Ministry of Agriculture and Rural Development to examine fertilizer consumer prices. The committee submitted its report in 1987. The committee recognized fertilizer as a key input for agricultural production and recommended systematic development of the dry lands, improvement in soil testing laboratories, creation of more soil testing capacities, future product pattern in the form of urea, DAP and MOP, with the continuance of existing NPK fertilizer capacity, incentives for fertilizer promotion, monitoring fertilizer use efficiency, strengthening of credit, abolition of sales tax, etc. The committee also suggested increase in the prices of fertilizers by 5 to 7 per cent, provided the country has achieved a cumulative increase of 30 per cent in the consumption of fertilizers during the preceding three years.

Post-Reforms Period (1991- onwards):

In order to reduce subsidies the government increased fertilizer prices for farmers by 40 per cent in July 1991. However, as a result of immense pressure from various quarters, the government reduced the price increase to 30 per cent for large farmers and withdrew it for small and marginal farmers in August 1991. This dual price scheme was operational for a brief period, from 14th August 1991 to 31st March 1992 and was discontinued after that due to operational difficulties. Following this and the devaluation of the rupee in 1991 fertilizer subsidies increased significantly and accounted for about 40 per cent of total subsidies. The prices of Ammonium Sulphate, CAN and Ammonium Chloride were decontrolled in July, 1991.

A Joint Committee on Fertilizer Pricing was constituted in 1991 to review the method of computation of Retention Prices for different manufacturers of fertilizers in order to contain subsidies. The Committee submitted its report on the 20th August, 1992. The Committee concluded that increase in subsidy was mainly due to rise in the prices of inputs, increase in the cost of imported fertilizers, devaluation of the rupee and the stagnant farm gate prices during the 1980s. The Committee recommended decontrol of phosphatic and potassic fertilizers. However, to promote dispersed use of nitrogenous fertilizers, urea continued to remain under price control and urea price was reduced by 10 per cent. Low analysis nitrogenous fertilizers which had been decontrolled in July 1991 were brought back under control. The committee recommended a detailed study of the RPS as well as the working of the FICC by a Committee of Experts due to lack of incentives in RPS for fertilizer units to optimize capital costs of plants.

Based on the recommendations of the Joint (Parliamentary) Committee on Fertilizer Pricing, the prices, movement and distribution of all phosphatic and potassic fertilizers were decontrolled in August 1992.

The import of feedstocks such as rock phosphate and sulphur was decanalised in March 1992 and ammonia and phosphoric acid from April 1992. Imports of DAP were decanalised in September 1992 and MOP from June 1993. The prices of Ammonium Sulphate, CAN and Ammonium Chloride were decontrolled from 10th June, 1994. In keeping with the policy of economic reforms, all types of fertilizers except urea were freed from price, movement and distribution control in early-1990s.

Immediately following the decontrol of phosphatic and potassic, fertilizers prices went up sharply (70-100%) and temporary shortages occurred. As a neutralization measure the government announced some measure such as exemption of phosphoric acid from custom duty when imported for use in fertilizer production, exemption of basic duty on import of fertilizer projects under a specific import scheme and permission to import raw materials at official exchange rates etc. However, these measures did not result in sufficient reduction of decontrolled fertilizer (particularly DAP) prices. Moreover it led to significant reduction in consumption of P and K fertilizers and created imbalance in use of fertilizer nutrients (N:P:K).

The government focused on output pricing policy through high procurement prices. The procurement prices increased significantly in the 1990s but did not lead to higher fertilizer consumption as well as agricultural production. It became evident that higher fertilizer prices resulted in reduced consumption and lower production.

In order to cushion the impact of increase in the prices of these fertilizers and to check decline in their consumption and, to prevent adverse NPK ratio, the Government of India introduced a concession (subsidy) scheme from 1992-93 and an adhoc concession of Rs.1000 per tonne each for DAP and MOP, Rs.435-999 per tonne for NP/NPK fertilizers was announced from Rabi 1992-93**.** The scope and coverage of concession scheme was significantly enhanced in the subsequent years.

High Powered Fertilizer Pricing Policy Review Committee (1997)

To review the existing system of subsidization of urea and suggest an alternative broad-based scientific and transparent methodology, the Government of India constituted a High Powered Fertilizer Pricing Policy Review Committee (HPC) under the chairmanship of Prof. C. H. Hanumantha Rao to:

- Review the working of the Retention Price Scheme (RPS) for fertilizers and to make suggestions for correcting the deficiencies of the system, keeping in view the broad objectives of economic reform.
- Review the adequacy or otherwise of incentives to the industry and issues relating to return on net worth, norms of capacity utilization, depreciation etc.
- Suggest appropriate capital norms and debt equity ratio in respect of new fertilizer projects.
- Review the input pricing policy and its impact on the RPS
- Review system of equated freight and recommend measures to rationalize it, including minimization of cross country movement to reduce leads
- Suggest measures to improve the cohesiveness of the policies in respect of the controlled and decontrolled segments of fertilizer industry, especially policies impinging on the availability of fertilizers and the relative pricing of controlled and decontrolled fertilizers with a view to achieving an agronomically desirable NPK consumption ratio, while keeping the fertilizer subsidy at a reasonable level.

The HPC submitted its report in April 1998 and recommended discontinuation of unit-wise RPS for urea and a uniform Normative Referral Price (NRP) be fixed for existing gas based urea units and also for DAP. The committee recommended that a Feedstock Differential Cost Reimbursement (FDCR) could be given for a period of five years for non-gas urea units. However no decision was taken on the report.

The government had instead set up an Expert Committee in April 1999 to reassess existing urea plant capacity. This Committee recommended five different methods to reassess the capacity. Another committee under the Chairmanship of Y.K. Alagh was set up in May 2000 which submitted its report in March 2001. A downward revision was made on a provisional basis on retention prices of 11 urea manufacturing units, as a result of interim reassessment of capacity.

Expenditure Reforms Commission (2000)

The last major attempt to suggest a viable alternative to the RPS for urea was made in September 2000 in the report of the Expenditure Reforms Commission (ERC), headed by Sh.

K P Geethakrishanan. The ERC report recommended dismantling of the control system in a phased manner, which can compete with imports with a small level of protection and a feedstock cost differential compensation to naphtha/LNG based units to ensure self-sufficiency. The commission also emphasized the suggested scheme should retain the objective of self-sufficiency, preserve viability of existing units, protects small and marginal farmers, and reduces subsidy outlay. The ERC suggested four phases over a period of six years in the proposed new pricing policy for urea units, beginning with the discontinuance of the RPS from February 1, 2001, along with the introduction of the group based concession scheme. The scheme of ERC was as follows:

a. Stage I (1.2.2001 to 31.3.2002): The existing urea manufacturing units will be grouped into 5 categories; (i) pre-1992 gas based units, (ii) post 1992 gas based units, (iii) naphtha based units, (iv) FO/LSHS based units and (v) mixed feedstock units. The individual retention prices to be replaced by a fixed concession for units in each of these groups. Distribution control will be done away with. The system of the determination of maximum retail price by the government to be continued.

b. Stage II (1.4.2002 to 31.3.2005): The concession to be further reduced on naphtha fuel oil/LSHS and mixed feed plant based on reduction in energy consumption and lowering of capital related charges (CRC)

c. Stage III (1.4.2005 to 31.3.2006): Feasibility of all non-gas based plants of modernizing and switching over to LNG. For plants which will not be able to switch over to LNG as feedstock, only the level of concession that the unit would have been entitled to if it had switched over to LNG would be allowed.

d. Stage IV (from 1.4.2006) - The fourth stage, to commence from 1st April, 2006 when the industry was to be decontrolled. The commission recommended a 7 per cent increase in the price of urea every year from 1.4.2001. No concession will be necessary from April 2006 onwards for gas based plants. The fuel oil/LSHS and mixed feed stock plants, existing naphtha plants converting to LNG, as also new plants and substantial additions to existing plants will be entitled to a feed stock differential with that for LNG plants serving as a ceiling.

The ERC recommended that the farm-gate prices of nitrogenous, phosphatic and potassic fertilizers should be fixed so as to promote balanced fertilizer use. It was suggested that once the price of urea is determined every six months, the prices of potassic and phosphatic fertilizers should be suitably adjusted to ensure the desired NPK balance. The ERC, in addition to recommending a group concession scheme for urea manufacturing units, had also envisaged improvement in the energy efficiency.

On the request of the Ministry of Agriculture, the Tariff Commission undertook a Cost Price Study of Complex Fertilizers to decide the rates of concession on decontrolled complex fertilizers covered under the Concession Scheme. The commission recommended the delivered prices of various complex fertilizers for (a) Group I comprising units with gas as feedstock, (b) Group II comprising of the units using predominantly naphtha.

Group of Ministers (GoM)

A Group of Ministers (GoM) under the Chairmanship of Shri. K.C. Pant, the then Deputy Chairman, Planning Commission was constituted to examine and make recommendations on urea pricing policy keeping in view the recommendations of ERC. The recommendations of GoM broadly constituted a group concession scheme.

New Pricing Scheme

Based on the recommendations of various committees (HPC, ERC, GoM), a new pricing policy for urea units was approved by the Government on December 19, 2002 and New Pricing Scheme (NPS) came into force from April 1, 2003.The scheme was implemented in three stages**.**

a) Stage-I: From 1.4.2003 to 31.3.2004
b) Stage-II: From 1.4.2004 to 31.3.2006
c) Stage- III: From 1.4.2006 onwards. The modalities were to be decided by the Department of Fertilizers (DoF) after review of the implementation of Stage-I and Stage-II.

The scheme introduced a group based concession, which replaced unit-wise RPS. The NPS envisaged phased decontrol of movement, distribution and sale of urea which was under the ECA allocations. For the Kharif 2003 season, 75 per cent of the production of each manufacturer was covered under ECA allocation and the balance 25 per cent could be sold freely anywhere in India. For the rabi 2003-04 seasons this ratio was changed to 50:50. However, total decontrol of urea distribution was deferred initially for a period of six months from April 1, 2004 up to kharif 2004, which was subsequently deferred up to rabi 2005-06 (up to March 31, 2006). The existing system of 50 per cent ECA allocation and 50 per cent outside ECA allocation has now been extended to Stage-III of NPS.

For quantities sold under the ECA, units are allowed equated freight in the same manner as for the 8th pricing period. For urea sold under the free category (urea outside the ECA allocation), the equated freight was reduced by Rs.100 per tonne. Under Stage II of NPS, the capital related charges and consumption norms were tightened.

Under the New Pricing Scheme (NPS), policy for Stage-III commencing from the 1st April, 2006 was to be formulated and announced based on the experience of Stages I and II. Accordingly, a Working Group was set up to Review Stage I and II of New Pricing Scheme (NPS) and formulate Policy for Stage III for urea units' under the chairmanship of Dr. Y.K. Alagh in December, 2004.The Working Group submitted its report in December 2005.

Based on the recommendations of Alagh committee, the Government notified the New Pricing Scheme (NPS) Stage III for urea units on the on the 8th March, 2007. The NPS Stage II scheduled to be expired by the 31st March, 2006 was extended up to 30th September, 2006. The NPS Stage III came into force from 1st October 2006 and will be effective up to 31st March 2010.

The Stage-III Policy, which seeks to promote further investment in the urea sector, aims to maximize urea production from the existing urea units including through conversion of non-gas based units to gas, providing incentives for additional urea production and encourage investment in Joint Venture (JV) projects abroad. The Stage-III policy seeks to promote usage of most efficient and comparatively cheaper feed stock Natural Gas/LNG for production of urea in the country. The policy lays down a definite plan for conversion of all non-gas based urea units to gas.

The policy seeks to rationalize distribution and movement of urea and the system of freight reimbursement with the objective of ensuring availability of urea in all parts of the country.

The Government will continue to regulate movement of urea up to 50 per cent of production depending upon the situation. The State Government will be required to allocate the entire quantity of planned urea arrivals both regulated and de-regulated urea in district-wise, month-wise and supplier-wise format. The monitoring of movement and distribution of urea throughout the country up to the district level will be done by an on-line web based monitoring system. To facilitate movement of fertilizers to far flung area, the reimbursement of freight will be based on actual leads for rail and road movement.

Expert Group on Phosphatic Fertilizer Policy

An Expert Group on Phosphatic Fertilizer Policy under the chairmanship of Prof. Abhijit Sen, Member, Planning Commission was constituted to review the current phosphatic fertilizer environment, examine international and Indian phospahtic fertilizer scenario and alternatives to the existing methodology of phosphatic fertilizer pricing and costing. The Expert Group submitted its report in October 2005. The committee suggested the subsidy on DAP to form the basis for subsidy on other phosphatic and complex fertilizers. The subsidy on DAP would have 3 components, (i) difference in the landed price of imported DAP (including customs duty) and the MRP, (ii) cost of marketing including the selling and distribution expenses and dealers' margin (Rs.350 per tonne) and (iii) to offset disadvantage to the domestic manufacturers of vis-à-vis abroad. Floor and ceiling for the disadvantage was recommended as 5 and 20 per cent of CFR price of DAP. The committee suggested the government may review the competitiveness achieved by the industry in future and accordingly consider downward revision of the two limits. The cost of domestic production would be arrived at taking into account the normated cost of phosphoric acid, international ammonia prices, cost of conversion, and capital cost based on norms given by the Tariff Commission. The marketing cost of Rs.1350 would be escalated on annual basis linked to WPI (General) index. The adjustment in subsidy of the first two components would be made quarterly after taking into account the prevalent international prices and foreign exchange rates. The expert group did not recommend any immediate change in the MRP but suggested that changes in MRP may be considered in case the MRP goes below 65 per cent of the landed price of imported DAP. The committee also recommended that the government may, however, consider revision in the MRP of DAP in case any revision is brought in the MRPs of other nutrients.

An Inter-Departmental Group under the chairmanship of Secretary (Agriculture) was set up to look into the recommendations of the Task Force and comment on its relevance, suitability and implementability by Department of Fertilizers, Department of Agriculture & Cooperation and other concerned Ministries/Departments of Government of India. The recommendations of the Task Force were accepted in principle by the government.

Imported MAP (11-52-0), including powdered MAP was brought under concession scheme for decontrolled phosphatic and potassic fertilizers from April 1, 2007. The concession payable on the fertilizers was capped to that payable on imported DAP and no additional concession/cost would be reimbursed for processing powdered MAP to granulated MAP.

The concession scheme on decontrolled P and K fertilizers was further continued from April 1, 2008 with some changes. For example, for Phosphatic and Potassic fertilizers there has been a departure from cost plus approach and subsidy has been benchmarked to Import Parity Price (IPP) of DAP and there will be uniform subsidy for imported and indigenous DAP based on IPP concept. In case of complex fertilizers, the price of P_2O_5 will be determined on the basis of imported DAP and imported Ammonia. The price of K will be determined on the basis of imported MOP. Cost of S in sulphur containing complex fertilizers will be recognized based on the price of imported sulphur.

A revised concession scheme for SSP was implemented from 1st May, 2008 for the year 2008-09. The new policy has made provision for fixation of uniform MRP throughout the country by the Central Government unlike the earlier practice of MRP being fixed by the State Governments, which varied from state to state. The policy also provides for monthly revision in the concession rates to reflect the variation in prices of raw-materials vis-à-vis indigenous and imported rock phosphate and imported Sulphur. The policy recognizes Sulphur content in SSP while fixing MRP.

In order to promote use of secondary and micro nutrients and to improve fertilizer use efficiency, the government allowed the fortification/coating of fertilizers specified in Fertilizer Control Order (FCO), up to 20 per cent of their total production from June 1, 2008.

Task Force on the Balanced use of Fertilizers

A Task Force on the Balanced use of Fertilizers was constituted by Department of Agriculture and Cooperation, which submitted its report in 2005-06. The task force recommended nutrient-based subsidy instead of the present product-based subsidy. In addition, the Task Force recommended encouragement for the usage of organic manure, bio-fertilizers and NPK mixture fertilizers and their judicious use with chemical fertilizers. The Task force recommended that the basket of the fertilizers subsidy may be extended to other fertilizers such as those covering secondary and micronutrients to ensure its optimal use by the farmers for mitigating the deficiencies and sustaining balanced fertilization. It also recommended for strengthening the soil testing laboratories, fertilizers quality control laboratories and to prepare soil fertility maps in the country. The committee further recommended fortification of the major fertilizers with the appropriate grade of secondary/micro nutrients, customized and value added fertilizers.

Nutrient-based Pricing

Based on the recommendations of the Task Force on the Balanced use of Fertilizers, government introduced nutrient based pricing of subsidized fertilizers to promote balanced use of fertilizers. As per the scheme, the per unit price of nutrients N, P, K and S will be the same in all complex grade fertilizers. Under existing pricing regime, the prices of nutrients in complex fertilizers were higher than the price of same nutrient in other straight fertilizers like Urea, DAP, MOP and SSP. This led to comparatively higher usage of straight fertilizers vis-a-vis complex fertilizers. The nutrient based pricing will lead to parity in price of complex fertilizers with other straight fertilizers and, thus, is expected to promote balanced use of nutrients by encouraging usage of complex fertilizers.

With the introduction of nutrient-based pricing, MRPs of complex fertilizers have reduced significantly ranging from about 5 per cent to 28.3 per cent (Table 4.1). The nutrient prices of urea, DAP and MOP is the benchmark for determining the prices for nutrient prices of N, P and K. For the first time, sulphur has been recognized as a primary nutrient to be covered under the Concession Scheme.

The TSP was included under the concession scheme from 1st April 2008 and indigenous Ammonium Sulphate (20.6:0:0:23) from July 1, 2008.

Table 4.1: Changes in prices of fertilizers due to introduction of nutrient-based pricing

Product	Price before June 18, 2008	Price on June 18, 2008	Change (%)
Urea	4830	4830	0
DAP/MAP	9350	9350	0
MOP	4455	4455	0
SSP	3400	3400	0
Complex fertilizers			
16:20:00:13	7100	5875	-17.3
20:20:00:13	7280	6295	-13.5
20:20:00:00	7280	5343	-26.6
23:23:00:00	8000	6145	-23.2
28:28:00:00	9080	7481	-17.6
10:26:26:00	8360	7197	-13.9
12:32:16:00	8480	7637	-9.9
14:28:14:00	8300	7050	-15.1
14:35:14:00	8660	8185	-5.5
15:15:15:00	6980	5121	-26.6
17:17:17:00	8100	5804	-28.3
19:19:19:00	8300	6487	-21.8

Source: GOI (2008)

Policy for New Investment in Urea

The government approved and implemented the policy for new investments in urea sector, both indigenous and abroad in September, 2008. In this policy some changes have been made from cost based approach to benchmarking with imports. Main features of the policy are (i) the additional urea from (a) revamp of existing units (within four years of notification) will be recognized at 85 per cent of Import Parity Price (IPP), (b) expansion of existing units (within five years of notification) at 90 per cent of IPP, and (c) revived units of HFC and FCI (within five years of notification) at 95 per cent of IPP, with the floor and ceiling prices of US$ 250 per tonne and US$ 425 per tonne, respectively in each category; (ii) the price of urea from the Greenfield projects will be derived through a bidding route, with percentage discount over IPP, with an appropriate floor and ceiling price, and (iii) the coal gasification based urea projects will be treated at par with Brownfield or Greenfield project as the case may be. In addition, these projects will also get incentives or tax benefits.

Joint Venture Projects

The joint venture projects abroad will be encouraged through committed off-take contracts with pricing decided on the basis of prevailing market conditions and in mutual consultation with the joint venture partners. The principle for deciding upon the maximum price will be the price achieved under the green field projects or 95 per cent of IPP subject to a floor of US$ 225 per tonne CIF India and a cap of US $405 per tonne CIF India inclusive of handling and bagging cost.

Fertilizer Prices

International prices

When studying prices and price determination in any industry, one usually looks to a body of economic theory called industrial organization and relevant empirical studies to help provide answers. In perfect markets, prices will be determined by the forces of supply and demand, but the international fertilizer market is not perfect market. Table 4.2 indicates the level of concentration in the industry. The world fertilizer markets have always been dominated by a small number of buyers and sellers. There have been some changes in shares of different players but still few players control the market.

The question arises as to the degree of competitive pricing in the industry, or if there is some monopoly profit in the system. In other words, to what extent are prices (and profits) above what they would be in a competitive market characterized by many buyers and sellers, where prices are determined by forces of supply and demand, and industry profits are "normal". Apart from the level of prices in the industry, there is also the question of spatial prices, which is important in the fertilizer industry because farmers constitute a geographically dispersed market. Fertilizer prices can be extremely variable, and this raises the question of what price dynamics are at work that results in such price variability. Fertilizer demand is a derived demand, which in the developed countries is price inelastic while in developing country markets, demand is price elastic, such as in major markets like China and India. This section deals with trends in world fertilizer prices.

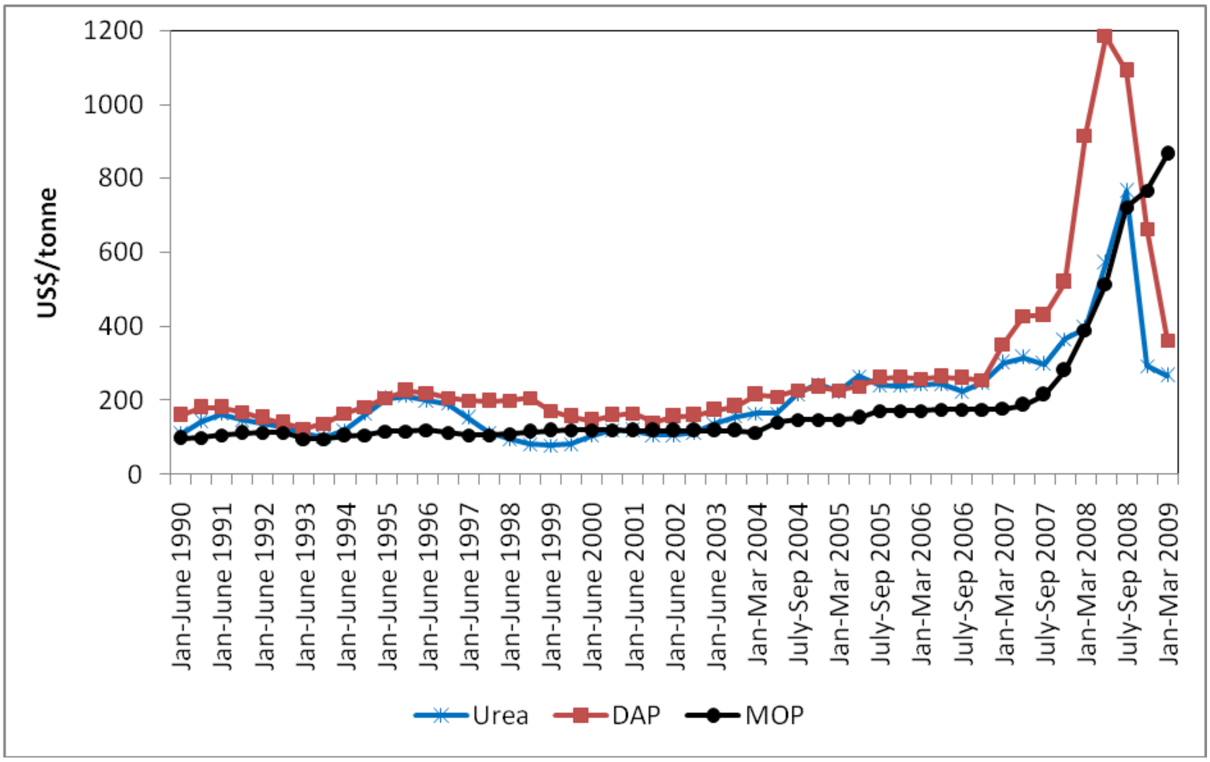
Table 4.2: Concentration of world fertilizer production, consumption and trade: 2006

Product	Countries	% Share to world
Production		
DAP/MAP	USA (35.1%), China (19.0%), India (17.6%), Russia (5%), Tunisia (4.3%)	81
MOP	Canada (31.3%), Russia (19.6%), Belarus (15.0%), Germany (11.6%), Israel (6.9%)	84.4
Rock Phosphate	China (34%), USA (18%), Morocco (16%), Russia (6%), Tunisia (5%)	79
Sulphur	China (13%), USA (13%), Canada (13%), Russia (10%), Japan (5%)	54
Ammonia	China (31%), Russia (9%), India (8%), USA (6%)	54
Phosphoric Acid	USA (27%), China (24%), Morocco (10%), Russia (6%)	67
Consumption		
Rock Phosphate	India (17.8%), USA (8.1%), Poland (5.4%), Spain (5.1%)	36.4
Sulphur	China (31.1%), Morocco (13.2%), USA (10.4%), Tunisia (7.1%)	61.8
Ammonia	USA (38.4%), India (9.4%), Korea Republic (5.0%), France (4.4%)	57.2
Phosphoric Acid	India (54.2%), France (4.2%)	58.4
Imports		
DAP	India (24%), China (10%), Pakistan (7%), Vietnam (6%), Argentina (4%)	51%

Source: FAI (2009); IFA (2009)

While world fertilizer prices have been rising gradually since 2004 and in 2007 and 2008 the world witnessed an escalating phenomenon with prices reaching four digit figures. As seen in Figure 4.1, fertilizer prices have also fluctuated widely over the last two decades. Attempts have been made to relate these fluctuations in prices to many factors such as demand-supply balance, agricultural prices, energy prices, climatic factors, etc. but it is difficult to find single parameter which can explain these wide variations.

Figure 4.1: Trends in international prices of urea (FOB Middle East), DAP (FOB US Gulf) and MOP (FOB Vancouver): (US$/tonne product bulk)



Source: FAI (2009)

Nitrogen Fertilizer Prices

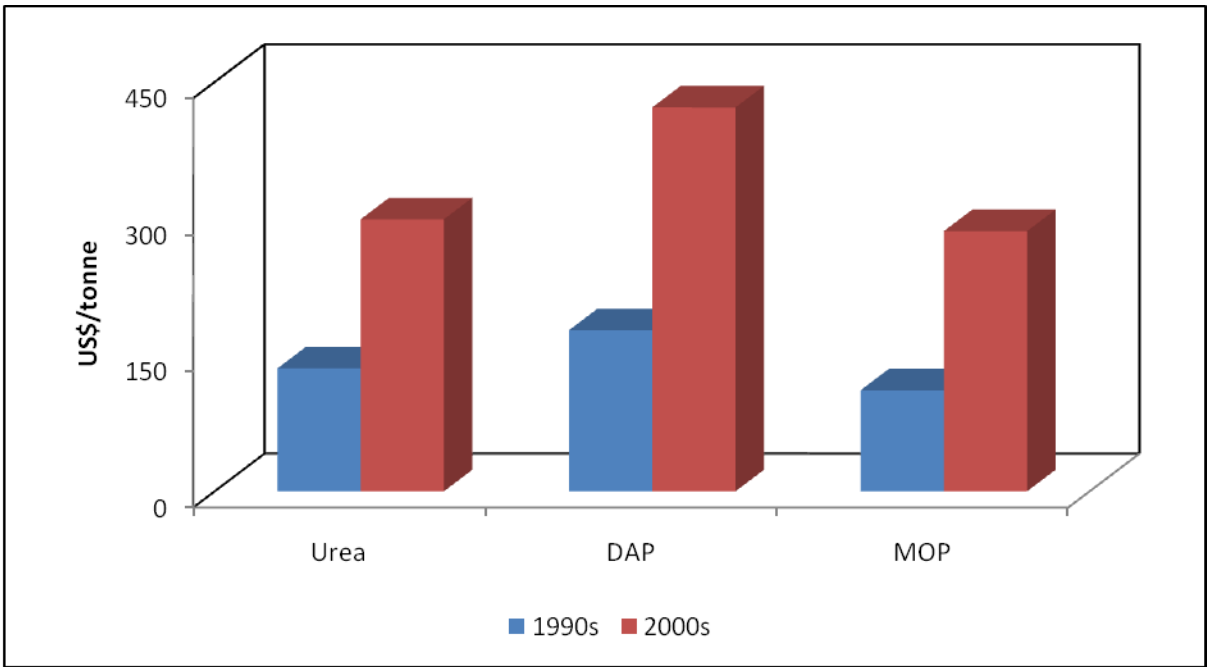
The prices of urea, the main nitrogen product traded and consumed, have varied widely both in absolute and in relative terms over the last two decades. The price of urea varied from about US$70 in July-December 1998 to US$865 per tonne in July-September 2008 (Table 4.3). The coefficient of variation was quite high (63.5%) between 1990 and 2008. The average FOB price during the decade of 1990s was US$135 and increased significantly (US$260/tonne) during the 2000s. Urea prices have increased steadily since the end of 2002 but this increase became more marked during 2007 and 2008 (Figure 4.3). The price of urea rose from about US$ 270 to US$ 410 in 2007 and reached about US$ 450 in April 2008. The price then soared to US$865 per tonne in August 2008 and then started declining and reached a level of about US$250 in April 2009. This increase in urea prices was partly due to high commodity and energy prices.

Table 4.3: Trends in international prices of urea, DAP and MOP (US$/tonne product bulk): January 1990 – September 2008

Product	Minimum	Maximum	Average	Coefficient of Variation (%)	CAGR (%/annum)
Urea (FOB Middle East)	70 (July-Dec. 1998)	865 (July-Sep. 2008)	200	63.5	2.64
DAP (FOB US Gulf)	110 (Jan.-June 1993)	1230 (April-June 2008)	270	83.6	2.77
MOP (FOB Vancouver)	80 (Jan.-June 1993)	945 (July-Sep. 2008)	160	70.7	2.46

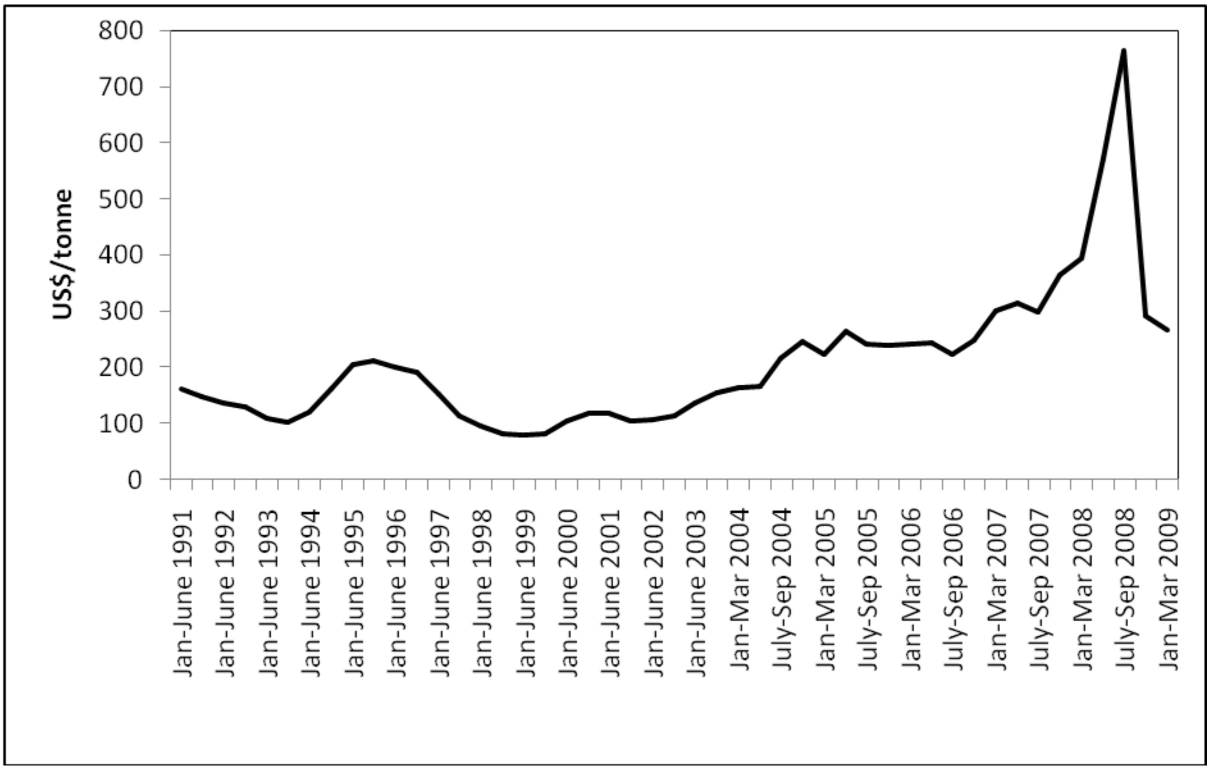
Source: FAI (2009)

Figure 4.2: Trends in international prices of urea, DAP and MOP during the 1990s and 2000s



Source: FAI (2008)

Figure 4.3: Trends in international prices of urea (US$/tonne product bulk): FOB Middle East



Source: FAI (2008)

Phosphate Prices

The prices of DAP started going up in 2002 and have increased significantly in recent period, rising from US$ 259 per tonne in 2006 to US$ 432 per tonne in 2007 and about US$963 per tonne in 2008, an increase of about 272 per cent. Prices have recorded a continuous increase between January 2007 and September 2008 (Figure 4.4).

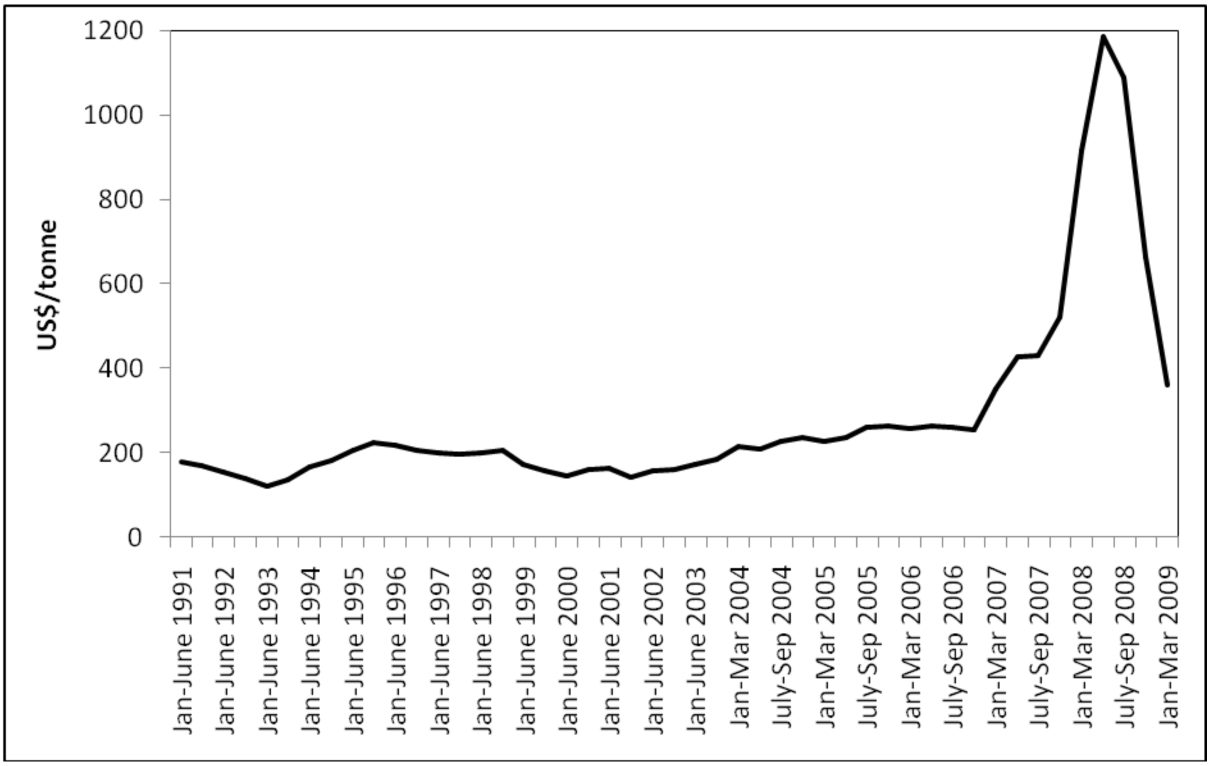
The price of DAP varied from about US$110 in January-June 1993 to US$1230 per tonne in April-June 2008 (Table 4.3). The prices of DAP are the most volatile among three major products, namely urea, DAP and MOP. The coefficient of variation was the highest (83.6%) between 1990 and 2008. The average FOB price during the decade of 1990s was US$177 and increased significantly (US$422/tonne) during the 2000s, an increase of 238 per cent. The prices started falling during the last quarter of 2008 and this decline is still continuing but current prices are still higher than 2005 and 2006 prices.

Potassic Fertilizer Prices

Trends in prices of MOP since 1991 are shown in Figure 4.5. The price of muriate of potash (MOP), the most common source of potassium, rose from about US$175 per tonne in 2006 to US$280 per tonne in 2007. By December 2008, MOP was sold for US$870 per tonne, an increase of about 400 per cent. Potash is the only fertilizer whose price continued to rise in early 2009 and reached a level of about US$870 per tonne. The price of MOP started declining from April 2009 and reached a level of US$745 per tonne in April 2009. The prices of MOP varied from US$80 per tonne to US$975 per tonne between 1991 and 2008.

The average FOB price during the decade of 1990s was US$111 and increased significantly (US$286/tonne) during the 2000s, an increase of 258 per cent.

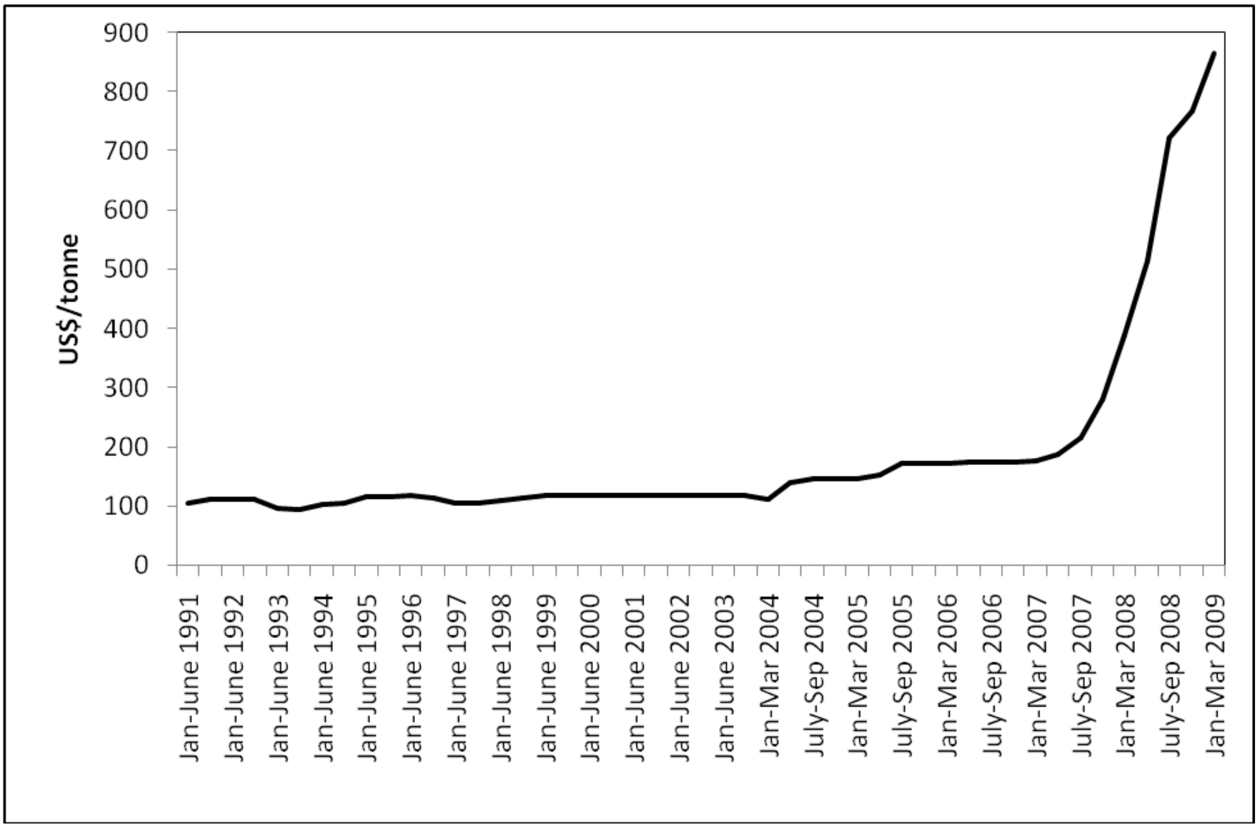
Figure 4.4: Trends in international prices of DAP (US$/tonne product bulk): FOB US Gulf



Source: FAI (2009)

As is evident from the earlier discussion that fertilizer prices started rising rapidly in late 2007 and price rise lasted for almost one year. Numerous factors converged simultaneously to cause fertilizer prices to rise and then suddenly fall. Prices were mainly driven up by an imbalance between supply and rapidly increasing demand mainly in Asia. Demand was particularly strong in China and India. Another factor was increased demand for fertilizers to produce biofuels in the United States, Brazil and Europe. The rise in prices of grains due to low stocks was another reason was soaring prices. In addition, China imposed high tariffs on fertilizer exports which led to increase in international prices. Energy prices peaked, causing an increase in the price of natural gas (main raw material for nitrogenous fertilizer production), and sulphur and phosphoric acid (used for production of phosphatic fertilizers) also caused the fertilizer prices to rise.

Figure 4.5: Trends in international prices of MOP (US$/tonne product bulk): FOB Vancouver



Source: FAI (2009)

World fertilizer prices started falling significantly in late 2008 after reaching all time highs in 2008 mainly due to low demand because of slow down in world economic growth and declining energy prices. Demand for fertilizers fell and stock started accumulating. High prices also led to demand contraction as farmers were unable/unwilling to pay such a high price. Therefore, fertilizer manufacturers cut back on production and this might lead to another rise in international prices. Price movements are expected to be volatile in the coming years.

Relationship between Fertilizer Prices and Feedstock Prices

Table 4.4 shows the correlation coefficient between prices of fertilizers and fertilizer raw materials/intermediates. Strong positive correlation coefficient exist between the price of natural gas and urea (0.86), DAP and phosphoric acid (0.80) and DAP and rock phosphate (0.89), and MOP and rock phosphate (0.84). Positive and high correlations were also found between the prices of natural gas and P and K fertilizers, e.g. 0.74 for DAP and 0.84 for MOP. On the other hand, correlation coefficients between price of agricultural commodities and fertilizers were also positive and high. Positive and very high correlation coefficients were found between prices of fertilizers and wheat, 0.81 for urea, 0.91 for DAP and 0.87 for MOP. The correlation coefficients between DAP prices and price of soybeans and rice were also high. The above results clearly indicate that fertilizer prices are driven by agricultural commodity prices as well as feedstock prices.

Table 4.4: Correlation coefficient between the prices of fertilizers, feedstocks and agricultural commodities

	Urea	DAP	MOP	Rock phos.	Phos. acid	Natural Gas	Rice	Soybean	Wheat	Maize
Urea	1.00									
DAP	0.82	1.00								
MOP	0.84	0.96	1.00							
Rock phos.	0.53	0.89	0.84	1.00						
Phos. acid	0.80	0.80	0.80	0.52	1.00					
Natural Gas	0.86	0.74	0.84	0.52	0.76	1.00				
Rice	0.70	0.78	0.70	0.61	0.75	0.53	1.00			
Soybean	0.63	0.80	0.70	0.68	0.58	0.45	0.71	1.00		
Wheat	0.81	0.91	0.87	0.73	0.73	0.69	0.79	0.84	1.00	
Maize	0.74	0.58	0.56	0.27	0.69	0.72	0.50	0.37	0.60	1.00

Trends in Domestic Prices

Whereas large fertilizer subsidies are relatively recent, the Government has always controlled the prices of fertilizers either directly or indirectly since pre-independence. Why these controls were introduced? How did they change over time, and why? How did it affect the growth of consumption and production of fertilizers? Which factors have led to the growing burden of fertilizer subsidies? These are important issues but difficult to answer for various reasons. For example, historically, fertilizer price policy in the country has been inseparable from fertilizer supply and distribution policy. The supply and distribution policies have been governed on the one hand by the objective of raising agricultural production rapidly, and on the other by the constraints inherent in the strategy adopted to pursue economic development and industrialization after independence. In this section fertilizer price trends in the post-green revolution period have been discussed.

With respect to fertilizer prices and pricing policy, the post-green revolution period can be divided into three different sub-periods:

i. Pre-RPS Era (1966 - 1977)

ii. Post-RPS Period (1977 – 1991), and

iii. Post-Reforms Period (1991 – onwards)

Prior to 1965, the government followed a basic policy of pooling fertilizers supplies and regulating their distribution. Domestic industry was in infancy stage and imports were the main source of domestic supplies. A Central Fertilizer Pool (CFP) procured all domestic and imported fertilizers and a uniform retail price was established by pooling indigenous and imported fertilizer prices. There was very little use of fertilizer subsidy and CFP made profits in 18 out of 20 years between 1944-45 and 1963-64.

After 1965, the government introduced new policy measures such as abolishing of domestic procurement by the CPFP to promote domestic production of fertilizers. The period from 1964-65 to 1974-75 witnessed two large increases in fertilizer farmgate prices. The first came in 1967-68 because of devaluation of the rupee in mid-1966 and the second and larger increase occurred in 1974-75 following the 1973-74 oil price hike. The prices of both imported fertilizers and domestic cost of fertilizer production increased significantly.

Concerned over the sizable decline in consumption due to rise in prices, the Government reduced the prices for fertilizers in 1975, 1976, 1977 and 1979. Due to difference in cost of domestic production and imported fertilizers, a Fertilizer Pool Equalization Charge (FPEC) was introduced in 1974 under which domestic producers were required to pay a charge per tonne into the FPEC to subsidize the high cost of imported fertilizers. This was the beginning of fertilizer subsidy regime in the Indian agriculture.

In 1977, a Retention Prices Scheme (RPS) was introduced to encourage domestic production and reduce dependence on widely fluctuating international fertilizer markets. After introduction of RPS, the share of domestic production in meeting total domestic demand increased significantly. However, the country was still heavily dependent on imports of raw materials required for production of phosphatic fertilizers. The cost of production of domestic fertilizers was higher than the landed costs of imported fertilizers most of the time. As such substantial subsidies have to be given on domestic production. In order to contain subsidy, prices of all fertilizers were increased in June 1980 and ammonium sulphate and CAN were decontrolled, which led to substantial increase in their prices and then brought back under statutory controls in August 1984 . In June 1983 prices of urea, DAP and MOP were reduced. Fertilizer prices were again increased in January 1986 and brought to the levels prevailing in 1981-82. Fertilizer prices had remained almost unchanged from July 1981 to July 1991 except for the period June 1983 to January 1986.

Despite the increases in the retail prices of fertilizers in 1980-81, the total amount of the subsidy paid on domestic fertilizers did not go down in 1981-82 (Annexure Table 4.1). Even more significant, the share of subsidy on domestic fertilizers in the total subsidy grew rapidly after 1980-81, reaching as high as about 95 per cent in 1987-88. Part of the explanation lies in the rising relative importance of domestic fertilizers in total consumption. However, the increased domestic supply was possible because of new fertilizer plants, which in general had higher unit costs of production. Thus, the question of the relative importance of domestic and imported fertilizers in the total fertilizer subsidy is tied up with the fertilizer pricing policy. This point is stressed because the relative importance of domestic production and imports in total fertilizer supply is decided not by competitive market forces but by the macro policy about global fertilizer market structure.

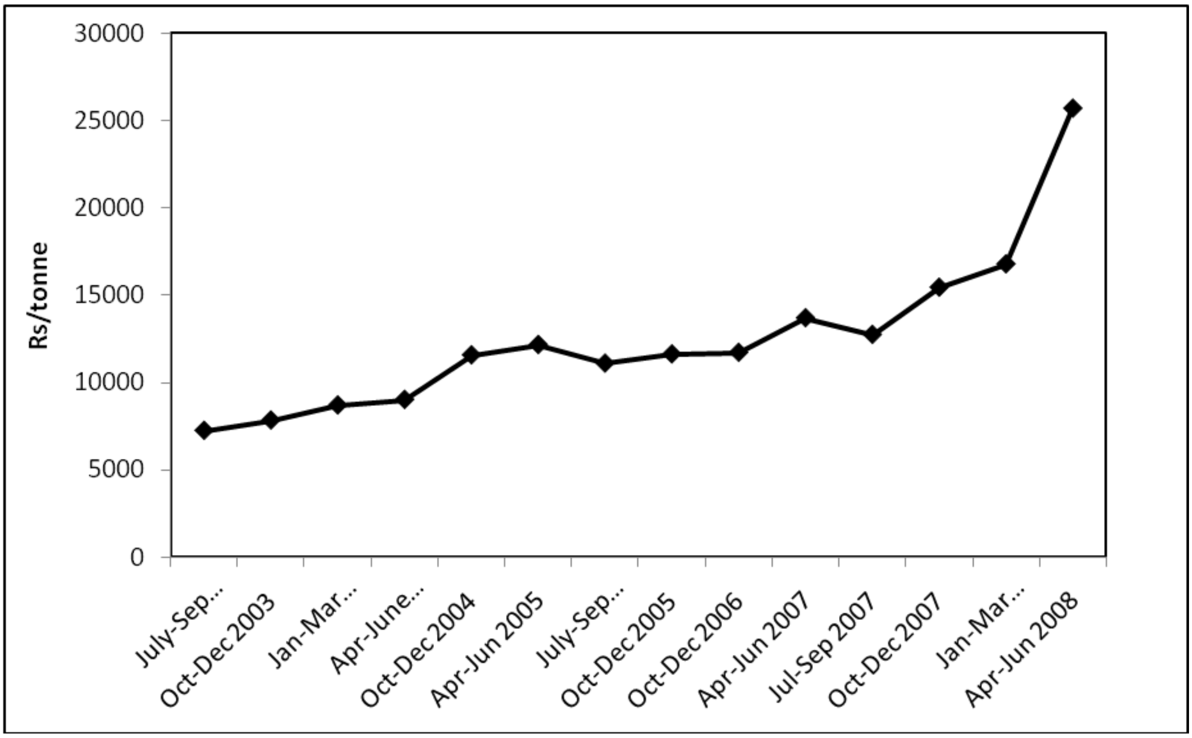
As a part of macro-economic reforms, fertilizer prices were increased by 40 per cent in July 1991 and low analysis fertilizers such as CAN, ammonium chloride, ammonium sulphate and sulphate of potash were decontrolled. In addition, a ceiling on the subsidy per tonne payable to single superphosphate producers was also announced with a view to moving towards total deregulation. However, due to pressures from all quarters the average price increase on fertilizers was reduced by to 30 per cent and small and marginal farmers were exempted from price increase. In August 1992, phosphatic and potassic fertilizers (including DAP, MOP and complex grade fertilizers) were also decontrolled. Consequently, prices of these fertilizers rose sharply compared with urea prices. The price of DAP increased from Rs. 4680 per tonne in 1992-93 to Rs. 6650 per tonne in 1993-94 and price of MOP increased from Rs. 1700 to Rs. 4500 per tonne. The price disparity between urea and phosphatic and potassic fertilizers led to imbalance in use of nutrients (N, P and K). In order to cushion the price increase and promote balanced use of fertilizers, the government introduced a scheme of concession on decontrolled P and K fertilizers in 1992-93 on adhoc basis. The scale and coverage of this scheme was extended in July 1996 and again in 1997-98, the concession on these fertilizers was increased from April 1997 and a uniform indicative price was announced. Based on recommendation of the Tariff Commission (Cost Plus Approach) and the Inter Ministerial group revised methodology for calculating concession rates for DAP (imported and indigenous) and MOP was implemented from April 2003. The Cost Plus approach took into account raw material and input cost including utilities, handling and distribution cost, dealers margin, interest and return on capital employed, etc., in case of indigenous finished products. In case of imported finished products, it considered the import price including custom applicable, handling and distribution cost, dealer’s margin, interest and return. Based on this methodology, normative delivered cost of P and K fertilizers (DAP, MAP, MOP and NPK Complexes excluding SSP) was computed. The difference between the normative delivered cost and the MRP was provided as concession/subsidy. From April 2008, final concession rates were worked out on monthly basis and concession for imported DAP was based on the average of low and high prices of DAP published in FMB and Ferticon from US Gulf FOB plus freight rate from Tampa to Mundra for the previous month or the actual weighted average of the landed price for the current month, whichever is lower. Concession for indigenous DAP and imported DAP was the same.

Urea prices were increased by 20 per cent in June 1994 followed by another increase of 10 per cent in February 1997 and 5 per cent in February 2002. The prices of urea have remained unchanged since 2002. Similarly, prices of DAP and MOP have also remained unchanged from 2002-03 till date. However, due to continuous increase in price of inputs and raw materials, total delivered cost of fertilizers covered under subsidy/concession scheme has increased significantly in general and in the last two years particularly. The import parity price of urea has also increased significantly during the last 5 years due to rising international prices of raw materials (Figure 4.6). For example, import parity price of urea was Rs. 7240 per tonne in July-September 2003, which increased to about Rs. 25717 per tonne in the quarter April-June 2008. The international prices of urea have started declining from later part of 2008. However, current world prices are still higher than normal prices. Since world urea markets are highly volatile, it is not advisable to depend on imports. This suggests that there is a need to increase domestic production, which requires long-term consistent and favorable policy.

The concession on decontrolled phosphatic and potassic fertilizers has increased significantly during the last few years. The average concession on domestic DAP which was about Rs. 2500 per tonne in 2002 rose to Rs. 10436 per tonne in September 2007 and reached a level of Rs. 50081 per tonne in June 2008. Likewise the average concession on imported DAP increased from about Rs. 1600 per tonne in early-2003 to Rs. 15795 per tonne in March 2008 and Rs. 50081 per tonne in June 2008 (monthly concession on indigenous and imported DAP was the same from April 2008).

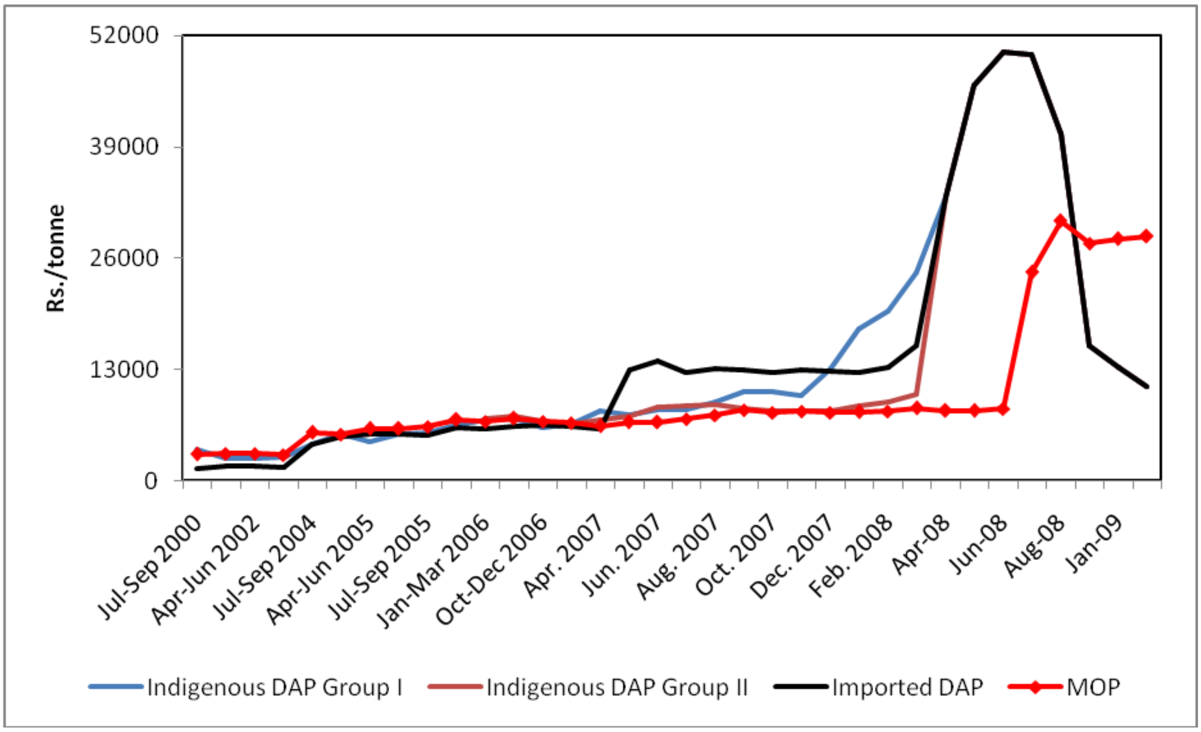
The scenario was not different for the MOP. The concession on MOP increased from about Rs. 3000 per tonne in early 2003 to Rs. 24,327 per tonne in July 2008 and further increased to Rs. 28549 in February 2009. These trends are in line with international price trends. The prices of nitrogenous and phosphatic fertilizers have stared declining since the second half of 2008 but prices of potassic fertilizers are still rising in the world markets.

Figure 4.6: Trends in import parity price of urea: 2003 – 2008



Source: GoI (2008)

Figure 4.7: Trends in concession rates for decontrolled phosphatic and potassic fertilizers: 2000 - 2009



Source: GoI (2008)

Economics of Fertilizer Use

To understand the economics of fertilizer use resulting from the changes in fertilizer and agricultural commodity prices over the years, the parity ratio between fertilizer and wheat and rice support prices was worked out for the period 1971-72 to 2007-08 (Annexure Tables 4.3 and 4.4). The ratio of prices paid for fertilizers and received for wheat is presented in Figures 4.8 and 4.9.

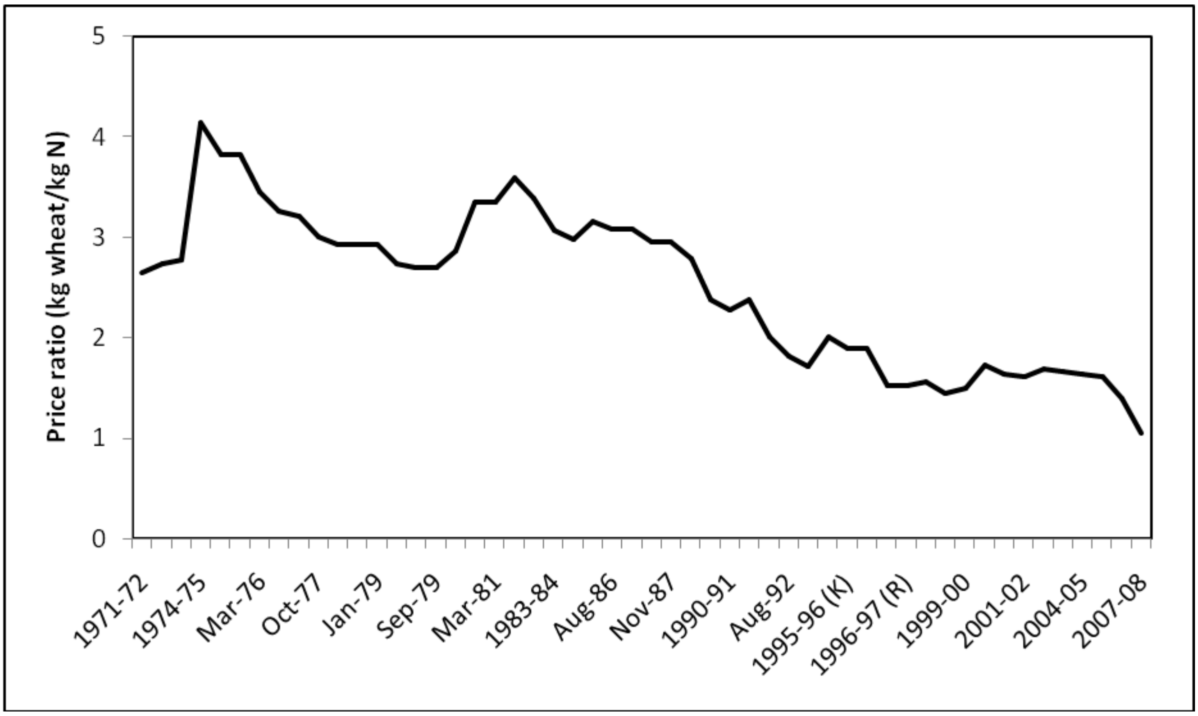
During 1971-72 and 1974-75, 1980-81, 1981-82, 1986-87 and 1991-92, the parity ratio between wheat and N fertilizers increased. As a result, during these years there was either decline in consumption of N fertilizers or consumption almost remained stagnant. In the post reforms period (1991-92 to 2007-08) the parity ratio between wheat and fertilizer prices favored wheat (1.0-2.4 units of wheat were needed to buy one unit of nitrogen) and became more favorable overtime. Consequently, these years witnessed significant increase in consumption of N fertilizers. The pattern is almost the same when consumption of N is related to the price of N in terms of kg of paddy required to buy N. Sharp rise in the price of N in 1974-75 when about 5.8 kg of paddy was required to buy 1 kg of N resulted in significant decline (about 3.5%) in consumption of N and sharp decline in the price of N in terms of paddy during 1988-89 to 1990-91 and subsequent years led to increase in consumption of N fertilizers. Thus, wheat and paddy prices increased faster than did those of N fertilizers since early 1990s.

In case of P_2O_5 whenever there was a sharp increase in its price in terms of per kg of wheat and paddy required to buy 1 kg of P_2O_5, the growth in consumption slowed down or even declined as in 1974-75, 1992-93 and 1995-96. A sharp decline in P_2O_5 price in terms of wheat and paddy in 1977-78, 1988-89 to 1990-91, 1994-95, 1997-98 and 2004-05 accelerated consumption of P fertilizers.

In case of K_2O whenever the price parity ratio between wheat/paddy and fertilizer prices favored the agricultural commodities, the consumption of K fertilizers increased significantly. However, when it became less favorable as fertilizer prices rose sharply (e.g. in 1974-75, 1975-76, 1985-86, 1992-93, 1996-97 and 2002-03), consumption of K fertilizers either slowed down or declined. For example when in 1992-93 the parity ratio between wheat/paddy and fertilizer prices became unfavorable (increased from 1.03 in 1991-92 to

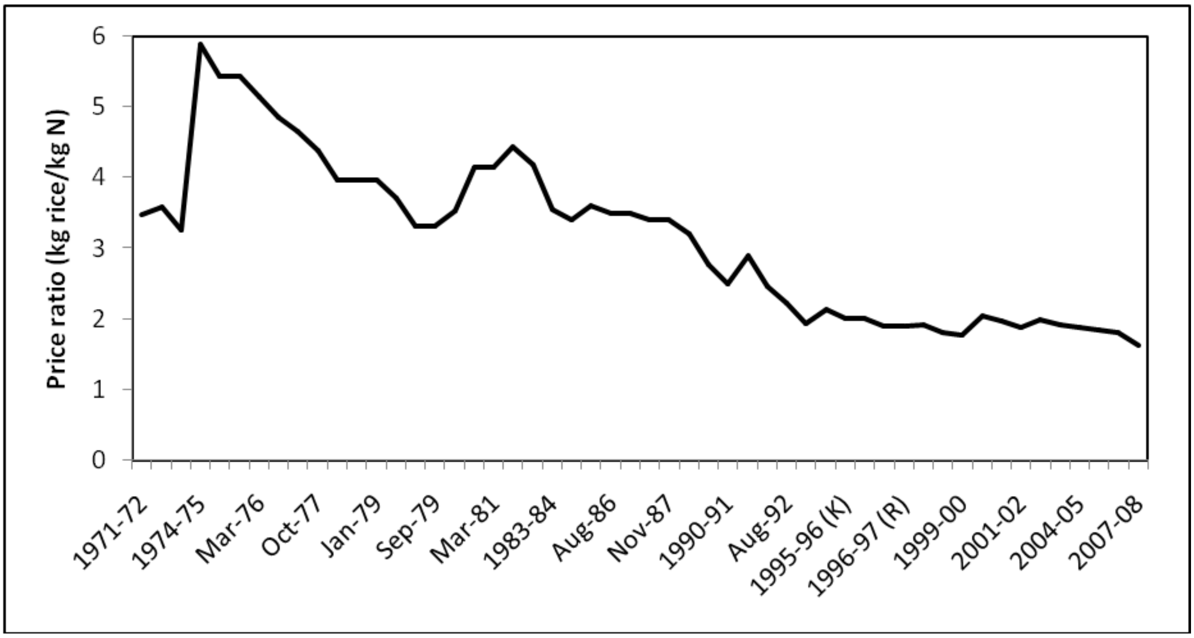
2.73 in 1992-93 in case of wheat and 1.05 to 2.78 in case of paddy) K fertilizer consumption fell by about 35 per cent. Again during rabi season of 1996-97 when K prices increased more than output prices, fertilizer consumption declined by about 10.9 per cent.

Figure 4.8: Trends in price ratios of wheat and N fertilizers



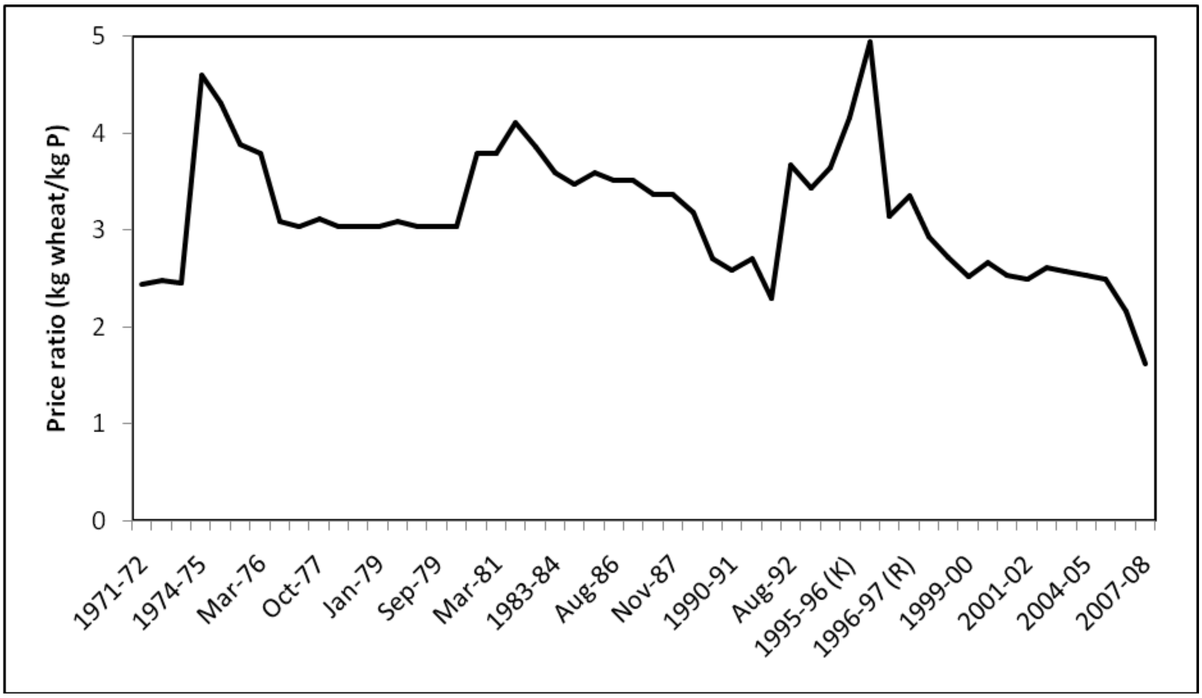
Source: FAI (2008)

Figure 4.9: Trends in price ratios of rice and N fertilizers



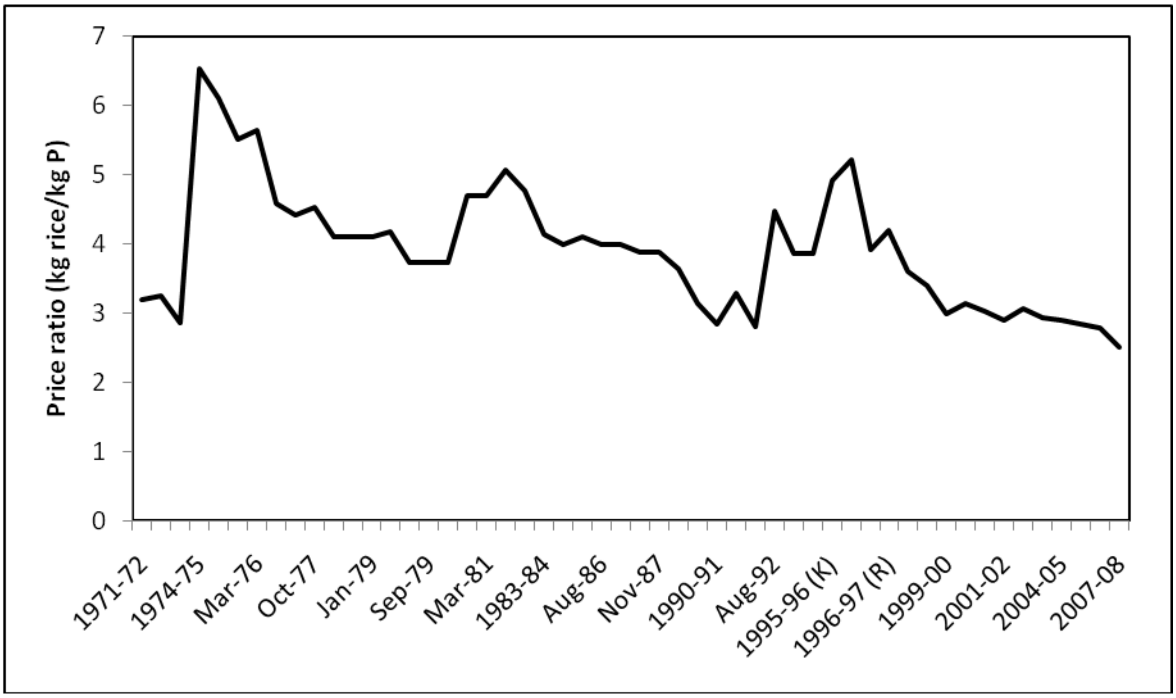
Source: FAI (2008)

Figure 4.10: Trends in price ratios of wheat and P fertilizers



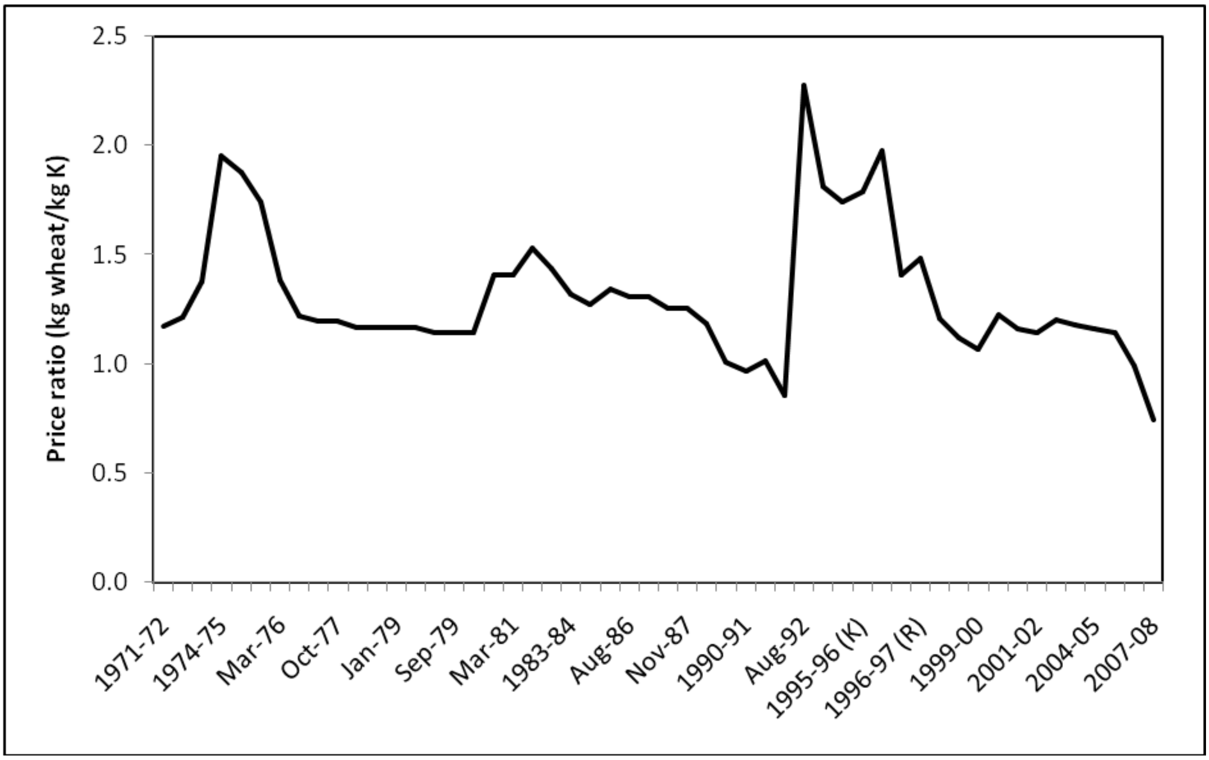
Source: FAI (2008)

Figure 4.11: Trends in price ratios of rice and P fertilizers



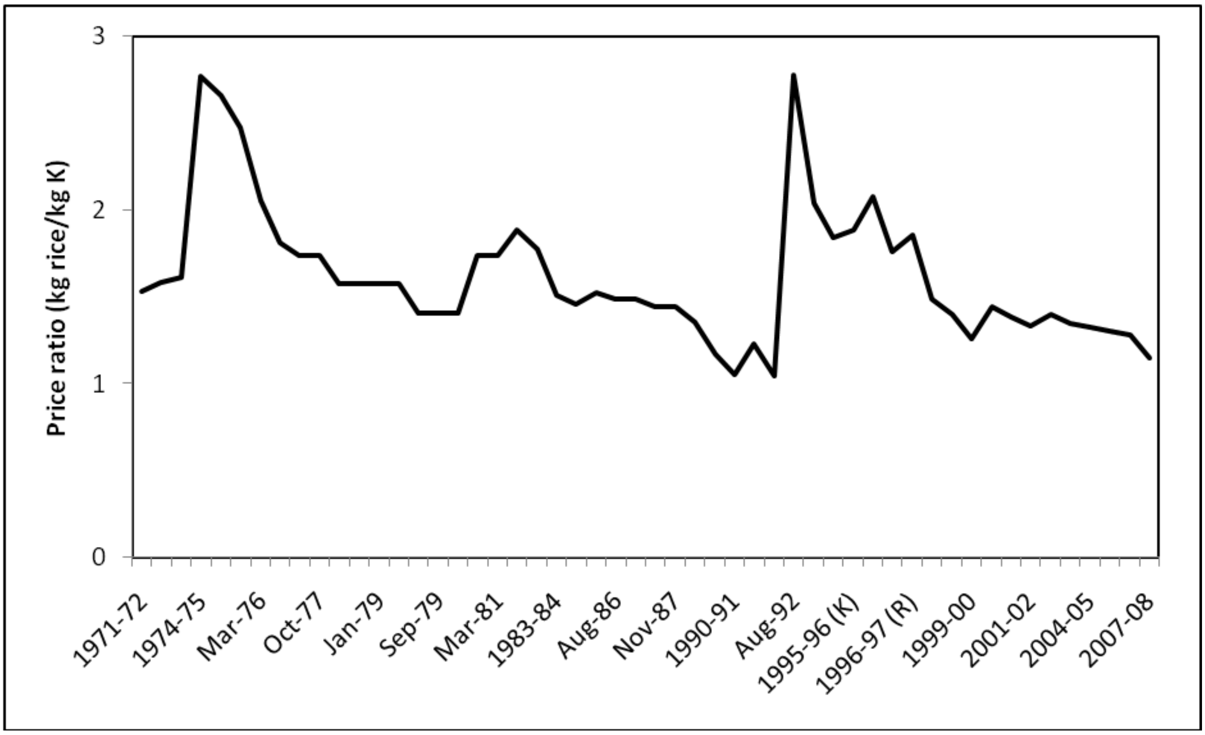
Source: FAI (2008)

Figure 4.12: Trends in price ratios of wheat and K fertilizers



Source: FAI (2008)

Figure 4.13: Trends in price ratios of rice and K fertilizers



Source: FAI (2008)

Fertilizer Subsidies

Magnitude of Subsidies

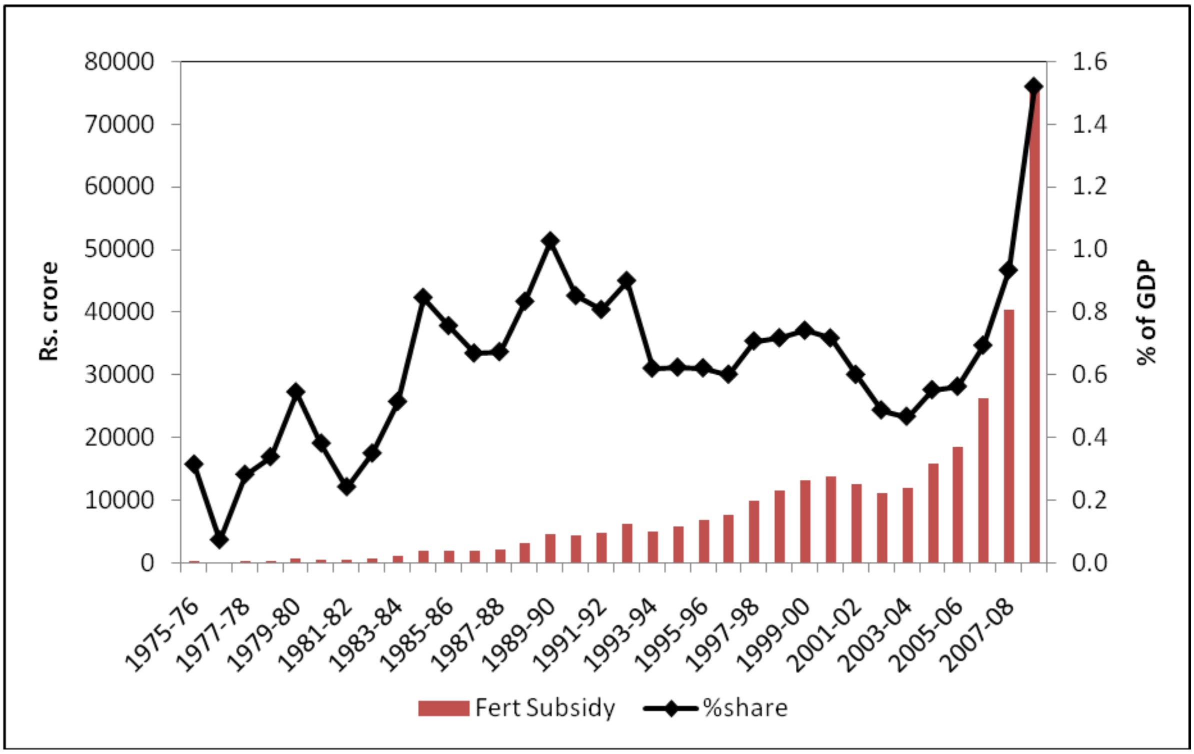
The Indian fertilizer industry has come a long way since its early days of post independence era. India today is one of the largest producer and consumer of fertilizers in the world. India's production in terms of nutrients (N and P) reached a level of 15.96 million tonnes in 2006-07 from 38.7 thousand tonnes in 1951-52. Similarly, consumption of fertilizers in terms of nutrients (NPK) has also grown from about 65.6 thousand tonnes in 1951-52 to nearly 22.57 million tonnes in 2007-08. The Indian Fertilizer industry, given its strategic importance in achieving self-sufficiency of food grain production in the country, has for decades, been under government control.

With the objective of providing fertilizers to farmers at an affordable price and ensuring adequate returns on investments to entrepreneurs, a fertilizer policy was envisaged of providing fertilizers to farmers at subsidized prices to induce farmers to use fertilizer. In order to achieve this objective, government introduced the RPS, a cost-plus approach, for nitrogenous fertilizers in November 1977 and extended to complex fertilizers in February 1979. Under RPS the retail price of fertilizers was fixed and was uniform throughout the country and 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. The RPS did achieve its objective of development of large domestic industry and near self-sufficiency in fertilizer production and increased consumption of chemical fertilizers but it had not been free from criticism of fostering inefficiency leading to huge burden of subsidies.

The burden of fertilizer subsidies on the budget of central government has grown dramatically over the years, from Rs.505 crore in 1980-81 to a historical high of about Rs.75849 crore in 2007-08. The budget estimate for the year 2009-10 is Rs.49980 crore. As is evident from the statements (Annexure Tables 4.1 and 4.2) and the figure given below, as a proportion of GDP at current prices, fertilizer subsidy, after expanding from 0.24 per cent in the 1981-82 to a peak of 1.03 per cent in 1989-90, started to decline. It was 0.85 per cent in 1990-91, and 0.62 per cent in 1993-94. In a subsequent reversal of trend, it reached almost 0.74 per cent in 1999-2000, but has declined since and was estimated at 0.47 per cent in

2003-04. However, it started increasing from 2004-05 onwards and reached a record level of 1.52 per cent in 2008-09 as per revised budget estimates for 2008-09 (Figure 4.14).

Figure 4.14: Trends in fertilizer subsidies in India: 1975-76 – 2007-08



Source: FAI (2008)

State-wise Distribution of Fertilizer Subsidies

Since data on state-wise fertilizer subsidies is not available, an indirect method was used to compute state level subsidies. In order to calculate subsidy on fertilizers in major states, we multiplied the actual use of urea in the state with the national subsidy rate by taking weighted average of domestically produced and imported urea usage and subsidies (Rs./tonne). While in case of P and K fertilizers we could not compute state-wise subsidies using the same methodology as concession rates varied quite frequently and the amount of subsidy calculated by this method was significantly different from the total concession on P and K fertilizers reported in the budget. Hence, we first computed per unit fertilizer subsidy on decontrolled P and K fertilizers by dividing total concession paid on these fertilizers by total consumption of P and K fertilizers in the concerned year and multiplying it with total P and K consumption in the concerned state. In this case our assumption is that fertilizer subsidy is distributed in proportion to fertilizer used. The results are presented in Table 4.5.

As table shows, a large share of total fertilizer (54.5%) subsidy is cornered by top five states, namely, Uttar Pradesh, Andhra Pradesh, Maharashtra, Madhya Pradesh and Punjab. Most of these states mainly grow fertilizer-intensive crops such as rice, wheat, and sugarcane. The share of these five states in 1992-93 was about 60 per cent, which declined to 55.8 per cent in 1999-00 and further to 54.5 per cent in 2007-08. The share of these states in urea subsidy was almost the same but in case of P and K fertilizers these top five states accounted for less than 50 per cent of total subsidy (Annexure Table 4.5 and 4.6). Their share in subsidy on P and K fertilizer increased marginally to 51.7 per cent in 1999-00 and 52.2 per cent in 2007-08. Other major beneficiary states are Gujarat, Karnataka, West Bengal, Bihar Haryana and Tamil Nadu. Their share in total subsidy has increased from 31.7 per cent in 1992-93 to 36.4 per cent in 2007-08. The share of resource-poor states like Rajasthan, Orissa, Assam, Jammu and Kashmir and Himachal Pradesh is low and they accounted for 6.7 per cent of total subsidy in 1992-93. However, their share increased to about 7.9 per cent in 1999-00 and was the same in 2007-08. The share of major fertilizer consuming states like Uttar Pradesh, Punjab, Haryana and Tamil Nadu has declined during the last one and half decade. While the share of agriculturally less developed states like Madhya Pradesh, Gujarat, Bihar, Rajasthan and Orissa has increased.

Looking at the absolute shares of states in total subsidy in not a good indicator because there are large variations in total cropped area among states. It would be appropriate to examine inter-state equity in terms of per hectare of cropped area. In terms of per hectare subsidy on fertilizers, Punjab, Andhra Pradesh, Haryana, Tamil Nadu, West Bengal and Uttar Pradesh are the main beneficiaries. In these states, fertilizer consumption per hectare is significantly higher than the national average. Out of 17 states included in the present analysis, 10 states had less than national average during 1992-93 and 1999-00 and this number fell to 8 in 2007-08. States like Maharashtra, Jammu & Kashmir, Kerala, Madhya Pradesh, Assam, Himachal Pradesh, Orissa and Rajasthan had less than national level average subsidy (Rs. 2083/ha) in 2007-08. In case of these states, fertilizer consumption is substantially lower than the national average. The per hectare subsidy in Punjab (Rs. 3924) is more than four times compared with states like Orissa (Rs. 824) and Rajasthan (Rs. 894). The average subsidy on per hectare basis more than doubled between 1992-93 and 1999-00 (from Rs. 331/ha to Rs. 703/ha) and almost tripled between 1999-00 and 2007-08.

Table 4.5: Share major states in total fertilizer subsidy in India: 1992-93 to 2007-08

	1992-93	1999-00	2007-08
Uttar Pradesh	23.2	19.5	17.5
Andhra Pradesh	10.6	10.8	11.3
Maharashtra	8.5	10.3	10.2
Madhya Pradesh	6.2	6.6	7.8
Punjab	11.6	8.6	7.7
Gujarat	5.5	5.2	7.0
Karnataka	4.2	6.2	6.5
West Bengal	5.2	6.7	6.4
Bihar	6.0	5.8	6.2
Haryana	5.8	5.3	5.5
Tamil Nadu	5.0	5.4	4.8
Rajasthan	4.2	4.7	4.4
Orissa	1.6	2.0	1.9
Assam	0.2	0.6	1.0
Kerala	0.7	1.0	0.9
Others	0.9	0.5	0.4
Jammu & Kashmir	0.4	0.4	0.4
Himachal Pradesh	0.3	0.2	0.2
Coefficient of variation (%)	96.5	82.1	76.7

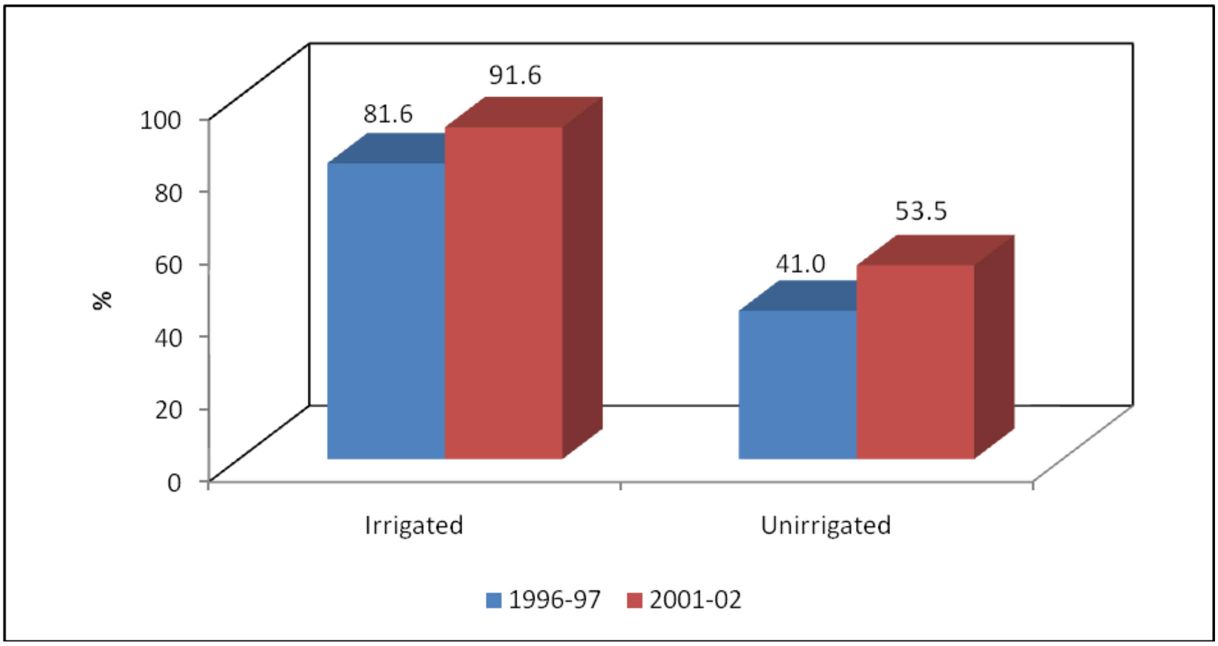
Overtime, however, the inequalities in fertilizer subsidy among states have declined sharply. The coefficient of variation in the share of states in total fertilizer subsidy has declined from 96.5 per cent in 1992-93 to 82.1 per cent in 1999-00 and further to 76.7 per cent in 2007-08. The coefficient of variation in per hectare fertilizer subsidy at state level is substantially lower and has declined more sharply from 79.3 per cent in 1992-93 to 51.9 per cent in 2007-08. This has happened due to improvement in infrastructure, irrigation facilities, coverage of area under high yielding variety seeds, shift in crop pattern towards fertilizer intensive crops in some of these less developed states during the last decade. The benefits of fertilizer subsidy are not restricted to only resource-rich states but have spread to other states.

Table 4.6: State-wise trends in intensity of fertilizer subsidy (Rs./ha. of gross cropped area)

States	1992-93	1999-00	2007-08
Punjab	946	1454	3924
Andhra Pradesh	512	1096	3561
Haryana	607	1164	3476
Tamil Nadu	430	1104	3307
West Bengal	373	931	2660
Uttar Pradesh	553	981	2617
Bihar	394	774	2432
Gujarat	304	651	2301
Karnataka	207	682	2107
Maharashtra	247	637	1829
Jammu & Kashmir	242	457	1264
Kerala	150	455	1235
Madhya Pradesh	159	334	1213
Assam	35	206	1143
Himachal Pradesh	170	277	958
Orissa	102	314	894
Rajasthan	129	322	824
India	331	703	2083
Coefficient of Variation (%)	79.3	57.1	51.9

It also needs to be mentioned that benefits of fertilizer subsidy have spread to unirrigated areas as the share of area treated with fertilizers has increased from 41 per cent in 1996-97 to 53.5 per cent in 2001-02 on unirrigated lands(Figure 4.15), while this share is substantially higher in irrigated areas (91.6% in 2001-02). Likewise, the share of unrrigated areas in total fertilizer use has also increased from 26 per cent in 1996-97 to 30.7 per cent in 2001-02 (Figure 4.16). Per hectare fertilizer use on unirrigated lands has increased by about 42 per cent between 1996-97 and 2001-02 (35.8 kg/ha to 50.9 kg/ha). In case of irrigated areas, intensity of fertilizer use is significantly higher compared with unirrigated area but has increased at a lower rate (13.1%) between 1996-97 and 2001-02 (Figure 4.17).

Figure 4.15: Percentage area treated with fertilizers on irrigated and unirrigated land: 1996-97 and 2001-02



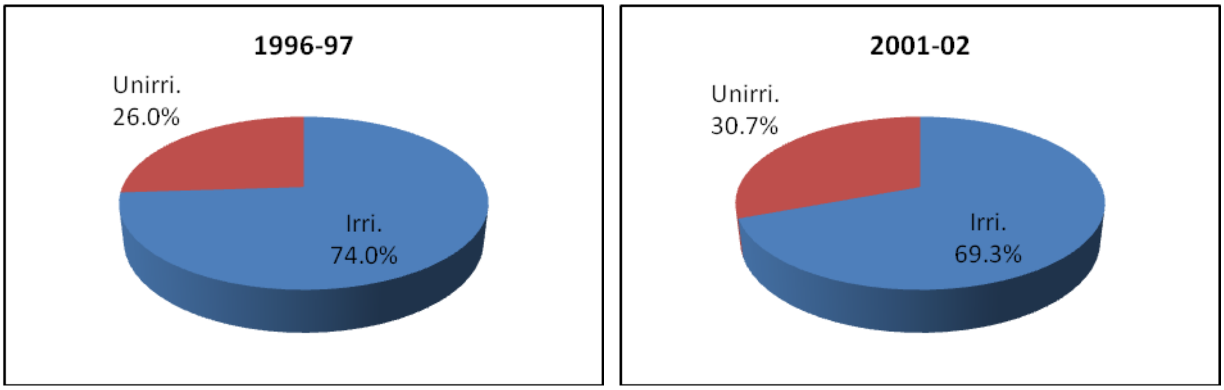
Source: GOI (2008)

It is quite evident from the above discussion that benefits of fertilizer subsidy are not restricted to only resource-rich areas but have spread to other areas as well. The inequity in distribution of fertilizer subsidy among states is still large but has declined over time.

Crop-wise Fertilizer Subsidy

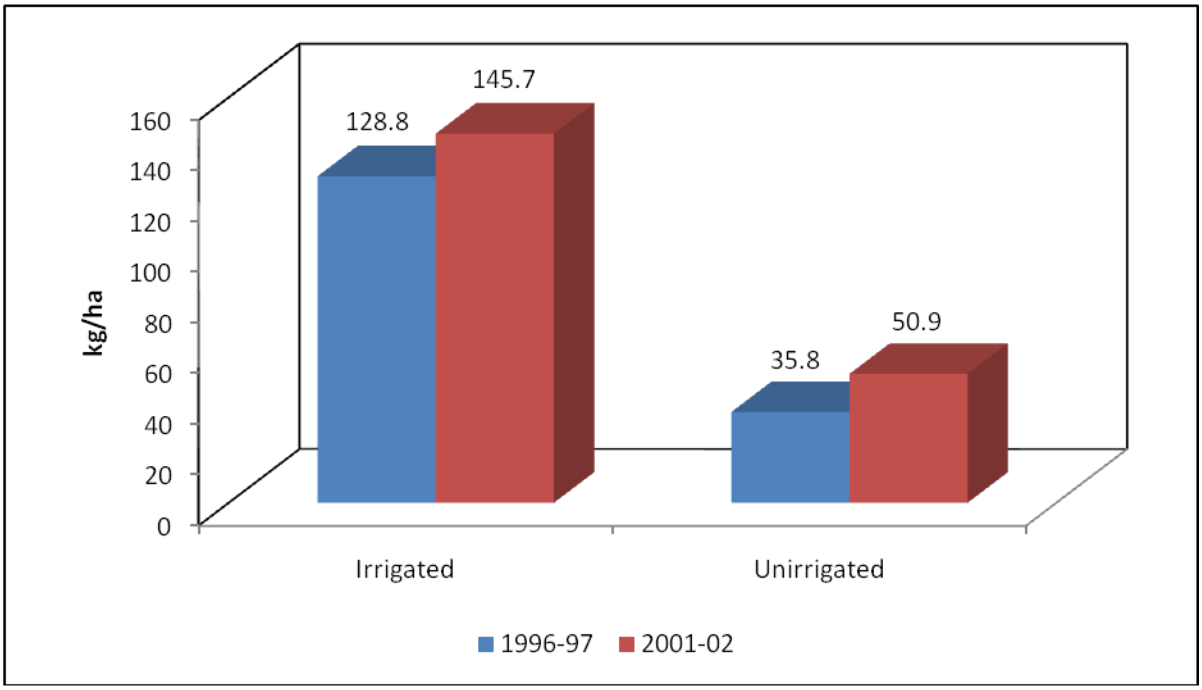
Crop-wise fertilizer use and subsidy shares during 2001-02 are given in Table 4.7. It is evident from the table that paddy and wheat are the major users of fertilizer subsidy accounting for over half of the total subsidy. The share of paddy was the highest (32.2%), followed by wheat (20.3%) and sugarcane (6.3%). Cotton is another fertilizer intensive crop which accounted for 5.9 per cent of total fertilizer subsidy. Coarse cereals receive a small share of fertilizers subsidy. The farmers growing fertilizer-intensive crops like paddy, wheat, sugarcane and cotton are the major beneficiaries of subsidy. So there is a high degree of concentration of fertilizer subsidies in terms of crops as four crops consume nearly two-third of total fertilizer subsidy.

Figure 4.16: Changes (%) in share of irrigated and unirrigated areas in consumption of fertilizer between 1996-97 and 2001-02



Source: GOI (2008)

Figure 4.17: Trends in consumption of fertilizers (N+P+K) on irrigated and unirrigated land



Source: GOI (2008)

Table 4.7: fertilizer subsidy on major crops in India: 2001-02

Crop	Total Fertilizer used ('000 tonnes)	Total subsidy (Rs. Lakh)	% share in total subsidy	Per ha fertilizer use (Kg)
Paddy	5061.7	367.5	32.2	119.4
Wheat	3189.7	231.6	20.3	130.8
Sugarcane	989.6	71.8	6.3	240.6
Cotton	921.0	66.9	5.9	110.8
Groundnut	465.9	33.8	3.0	74.6
Jowar	443.8	32.2	2.8	60.0
Bajra	304.3	22.1	1.9	29.0
Maize	258.4	18.8	1.6	55.8
Others	4073.4	295.7	25.9	66.1
All crops	15707.8	1140.4	100.0	92.6

However, it is more important to look at inter-farm size distribution of subsidy as all categories of farmers grow these fertilizer-intensive crops. We have calculated fertilizer subsidy on per hectare basis as well as share of different farm size groups and the results are presented in Table 4.8. it can be seen from the table that there is an inverse relationship between farm size and average subsidy per hectare. Per hectare subsidy on marginal farms was more than double compared with large farms. The average subsidy was the highest (Rs. 916.2/ha) on marginal farms and the lowest on large farms (Rs. 405.8/ha). The share of marginal farmers in total fertilizer subsidy in 2001-02 was the highest (28.3 per cent), followed by small farms (23.0%) and the lowest on large farms (6.3%). The share of small, marginal and semi-medium farms has increased between 1996-97 and 2001-02 while the share of medium and large farms has declined. The results clearly show that fertilizer subsidy is distributed more equitably among different farm sizes compared with crop-wise and state-wise distribution of fertilizer subsidy.

Table 4.8: Fertilizer subsidy on different farm size holdings in India: 1996-97 and 2001-02

Farm size (ha)	Per hectare fertilizer use (kg)		Ratio of subsidy to all households		Share in total fertilizer subsidy (%)	
Marginal (<1.00)	550.7	916.2	134.8	224.2	25.6	28.3
Small (1.00-1.99)	437.8	730.4	107.1	178.7	20.4	23.0
Semi-medium (2.00-3.99)	399.1	644.7	97.7	157.8	23.0	23.3
Medium (4.00-9.99)	360.9	550.3	88.3	134.7	22.2	19.1
Large (≥10.00)	271.4	405.8	66.4	99.3	8.8	6.3
All households	408.6	672.3	100.0	164.5	100	100

Source: GOI (2008)

Reasons for Rising Subsidies

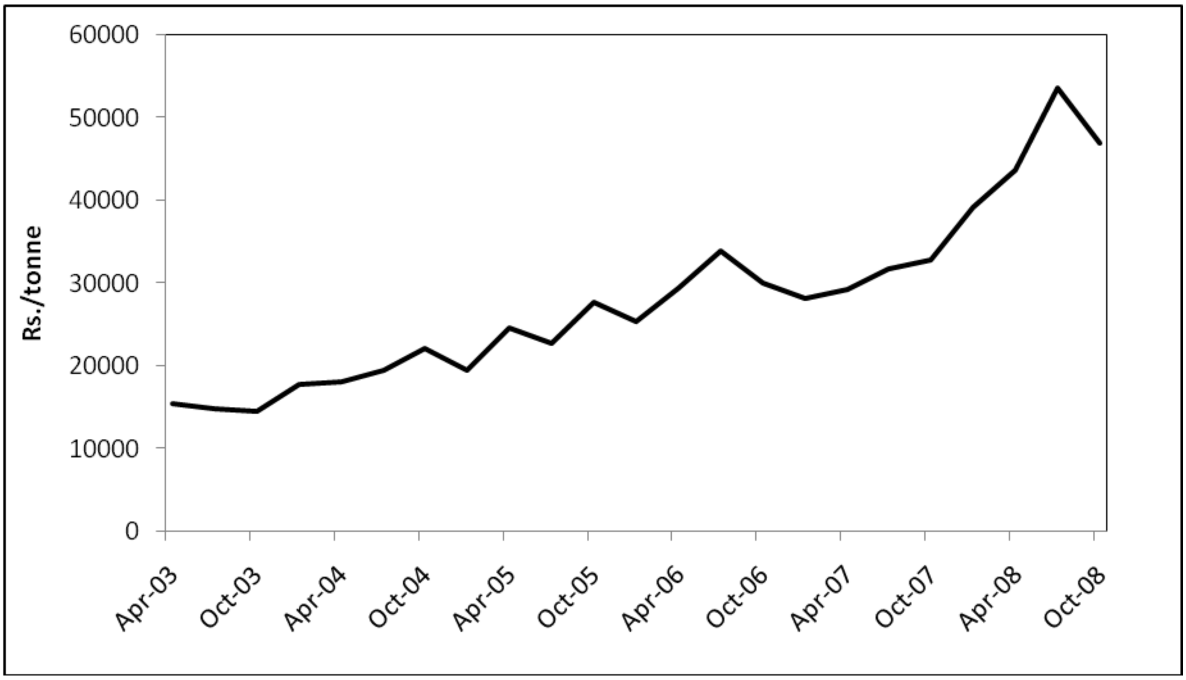
This rise in prices of fertilizers is a consequence of both demand and supply trends. On the demand side, food prices increased on a mix of strong consumption growth, which in turn has been powered by impressive income growth. At the same time, a series of supply-side disruptions in key markets have also led to rising prices. Some of these reasons are discussed in the following section:

Rising Prices of feedstock but Stagnant Prices of Fertilizers

The major reason for rising fertilizer subsidies in India is sharp increase in the prices of feedstock, fuels and other inputs but almost stagnant prices of fertilizers. The delivered price of naphtha for fertilizer companies has increased significantly during the last 5-6 years. For example, average price of naphtha has increased from about Rs. 15,000 per tonne in 2003 to Rs. 53,640 per tonne in July 2008 (Figure 4.18). Similarly the spot price of RLNG for fertilizer companies has increased from less than Rs. 8000 per thousand cubic meter in 2005 to Rs. 13395 per thousand cubic meter in October 2008 (Figure 4.19).

Trade of phosphoric acid is very thin as only 15 per cent of total production enters the world market and is also not a free trade as more than half of the global trade is through long-term supply arrangements between the producers and consumers. Moreover about 85 per cent of world production of phosphoric acid is for captive consumption and rest is traded in the international markets. India being a major importer of phosphoric acid in the world accounting for over 55 per cent of global trade and meeting about two-third of fertilizer sector requirement through imports, is vulnerable to volatile world markets.

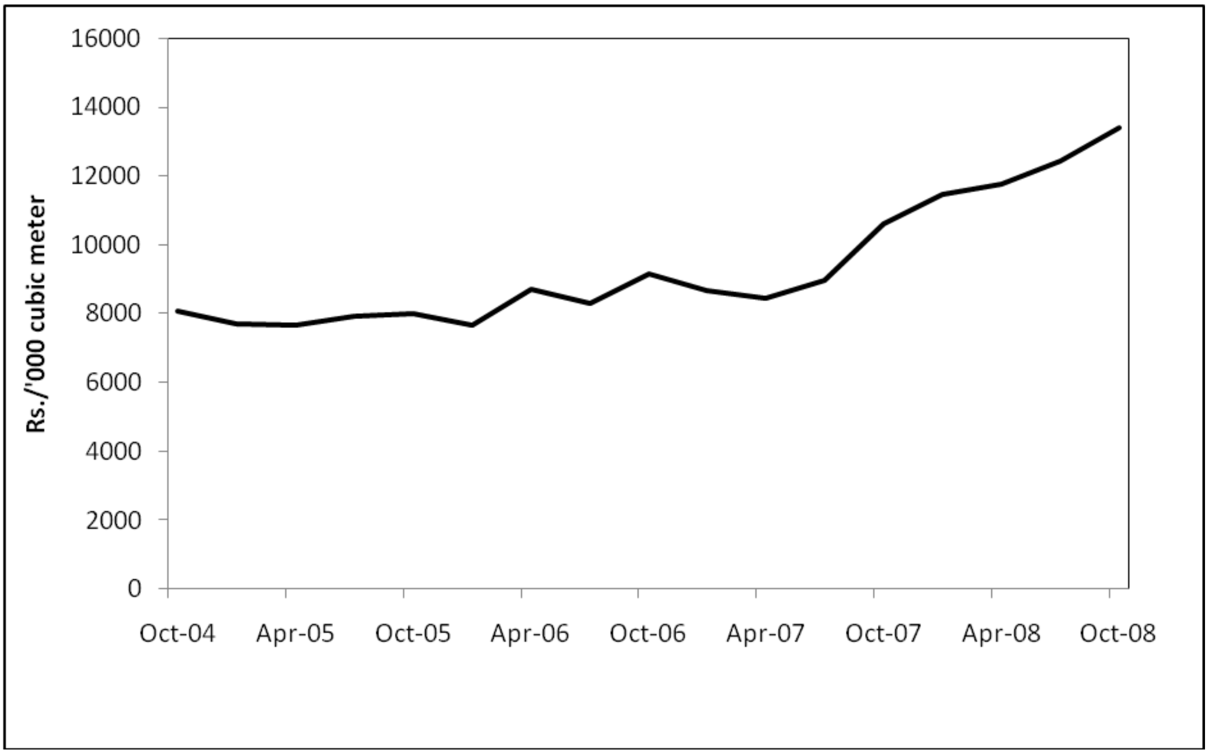
Figure 4.18: Trends in delivered prices of naphtha for fertilizer companies: 2003 - 2008



Source: FAI (2008)

India is the largest importer of rock phosphate and second largest importer of ammonia in the world. Therefore, domestic cost of production is very much related to international price trends of these raw materials and intermediates. The prices of most of the raw materials/intermediates have increased significantly during the last few years and price trends are shown in Figure 4.20 and 4.21. For instance, international price of ammonia has increased from less than US$200 per tonne in 2003 to about US$ 430 per tonne in early 2008 whereas price of phosphoric acid has increased from US$ 356 per tonne in 2003 to US$566 per tonne in January-March 2008. Similarly prices of sulphur and rock phosphate have also increased dramatically during the last couple of years. For example, international price of rock phosphate which was in the range of US$41-45 per tonne in January 2007, reached US$350-450 per tonne during July-September 2008. In contrast the farmgate prices of fertilizers in the country have remained almost stagnant during the last few years. This widening gap between cost of production/imports due to rising prices of raw materials and stagnant retail prices has led to substantial increase in fertilizer subsidies.

Figure 4.19: Estimated delivered price of BPCL/GSPC RLNG for fertilizer companies: 2004-2008

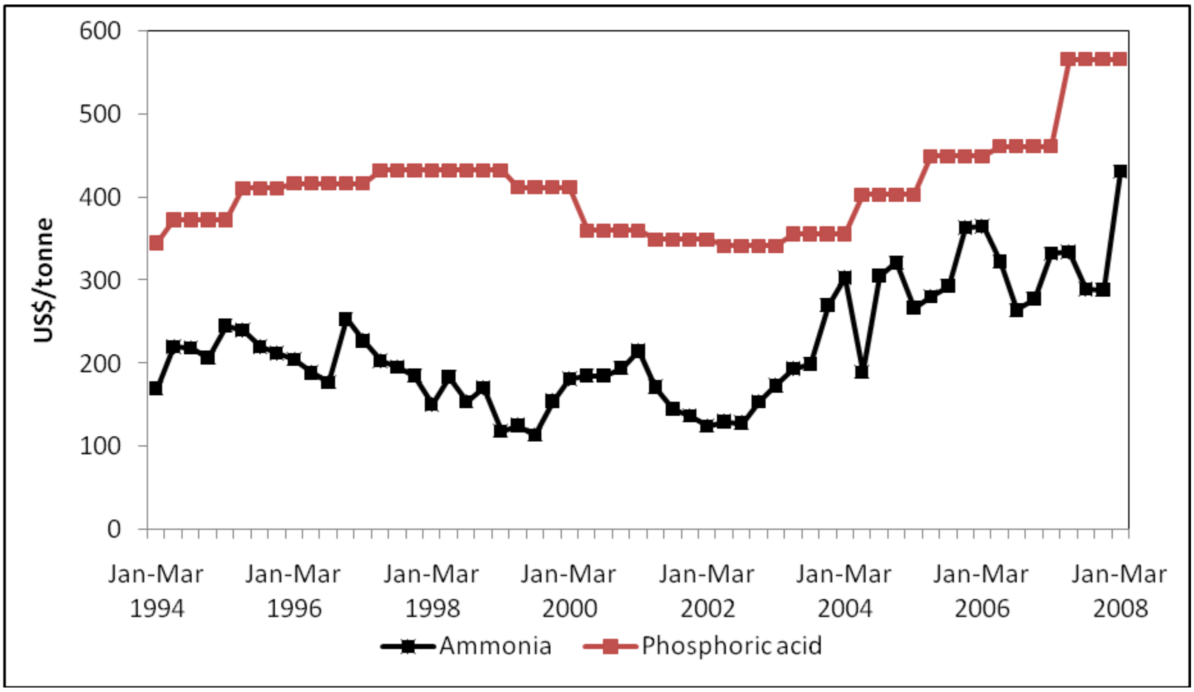


Source: FAI (2008)

Input vs. Output Prices

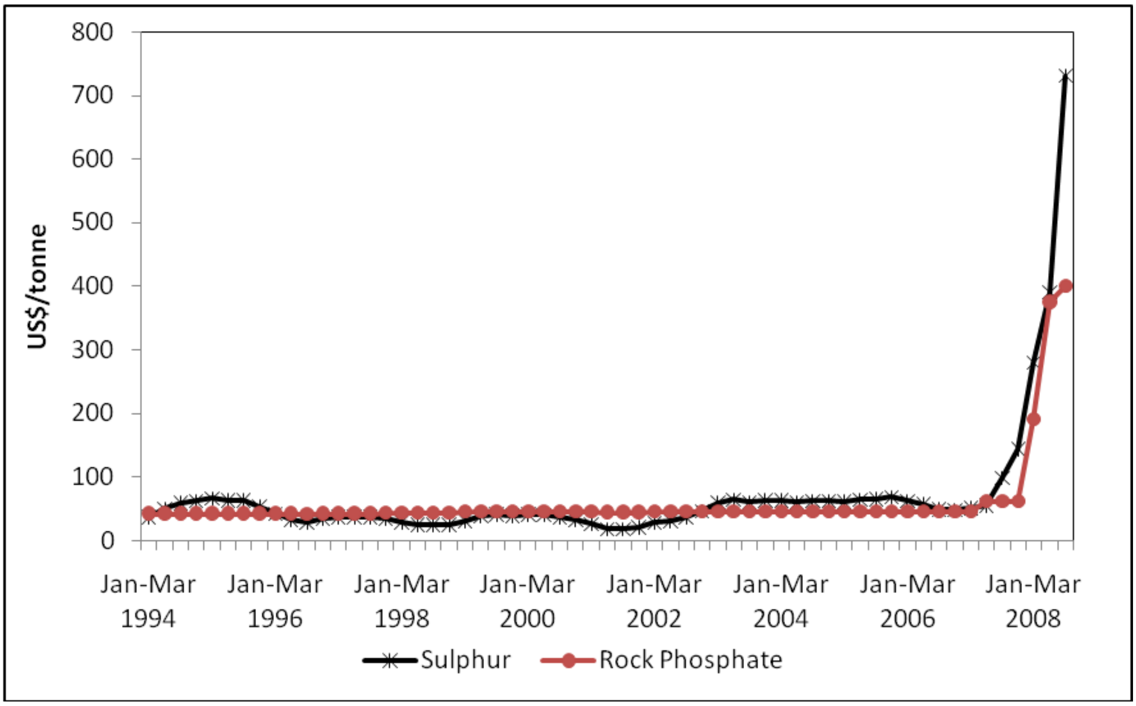
There was shift in the policy focus after introduction of macro-economic reforms in 1991 and pricing policy was over-emphasized as a tool to stimulate growth in agriculture while non-price factors such as technology, inputs and services, infrastructure, etc. were neglected. Over the years, the output prices have increased substantially but the prices for fertilizers have not increased. As is evident from Figure 4.22, by 2008-09, procurement prices of wheat and rice increased by about 260 per cent over 1991-92 whereas farm-gate price of urea increased by less than 60 per cent during the same period. More interestingly, between 2001-02 and 2008-09, prices of wheat and rice increased by over 60 per cent while price of urea, a major fertilizer product being used by a large proportion of farmers, remained unchanged at Rs. 4830 per tonne due to political compulsion.

Figure 4.20: Trends in world prices (US$/tonne) of ammonia and phosphoric acid (CFR India): 1994 - 2008



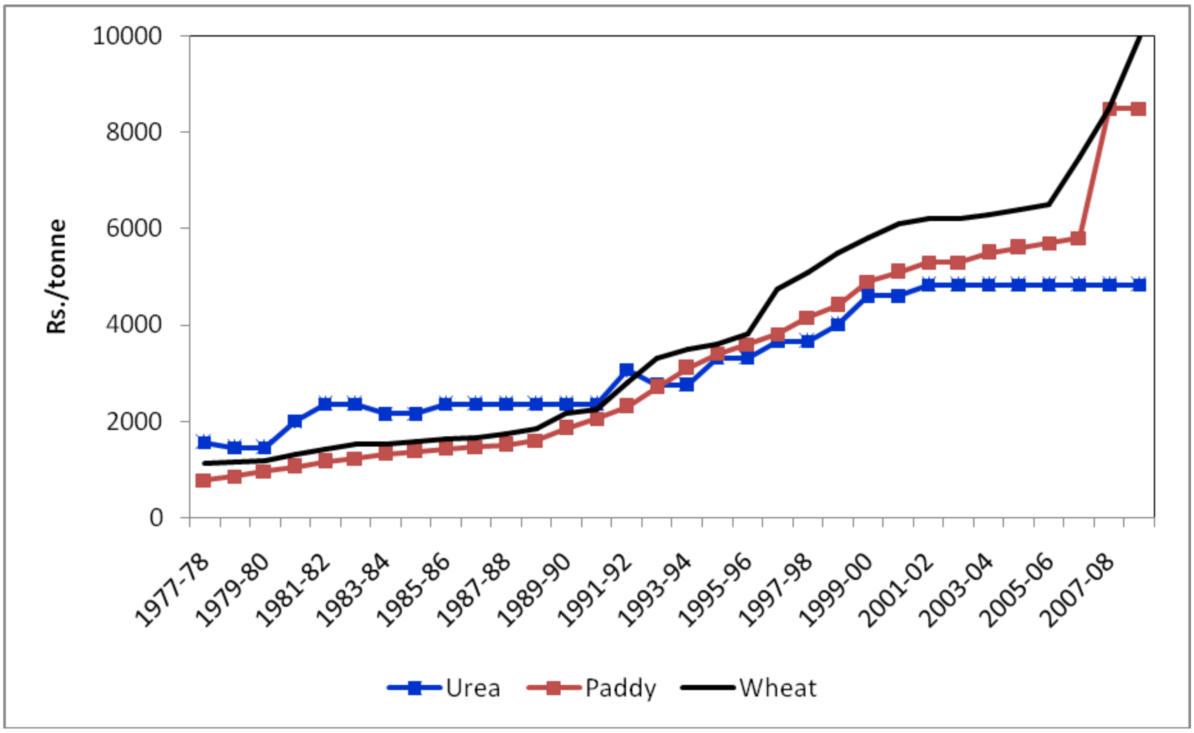
Source: FAI (2008)

Figure 4.21: Trends in world prices (US$/tonne) of sulphur (FOB Vancouver) and rock phosphate (FOB Casablanca): 1994 - 2008



Source: FAI (2008)

Figure 4.22: Trends in urea prices and minimum support prices of wheat and paddy: 1977-78 - 2008-09



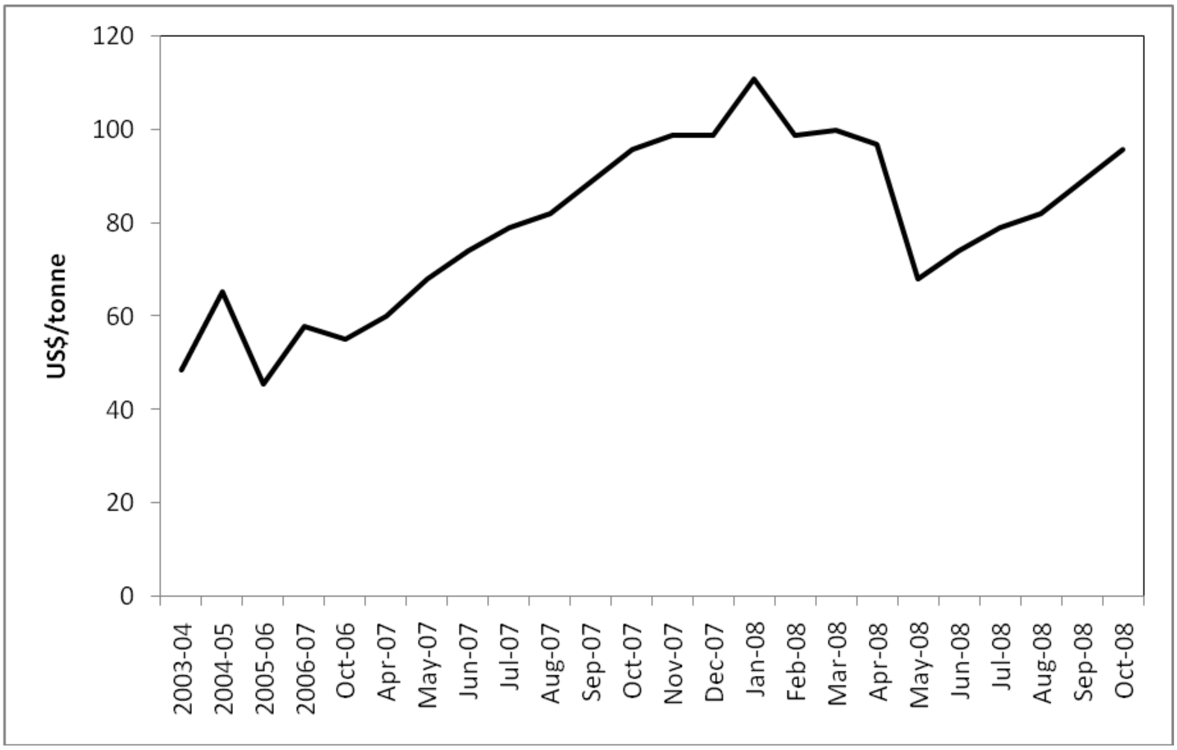
Source: GOI (2009)

High Energy Prices

In addition, the most important driver of fertilizer price increases over the few past years are developments in world energy markets. High oil prices have led to shortages and uneconomically high prices of feedstocks for fertilizer sector. It has also encouraged a policy focus on biofuels, including significant subsidies for the development of the biofuels industry in developed countries such as the US and the EU. Production has responded quickly to these incentives which led to increased demand for fertilizers and creating imbalance in fertilizer demand and supply.

Freight has become increasingly important in fertilizer trade, particularly in the case of potash, for which about 80 per cent production enters world trade. The freight cost has increased from less than US$50 per tonne in 2003-04 to US$111 per tonne in January 2008 (Figure 4.23). Since freight costs have increased sharply due to rising fuel prices, it has significantly affected fertilizer prices.

Figure 4.23: Ocean freight rates for grains (US$/tonne): US Gulf Port to Bangladesh



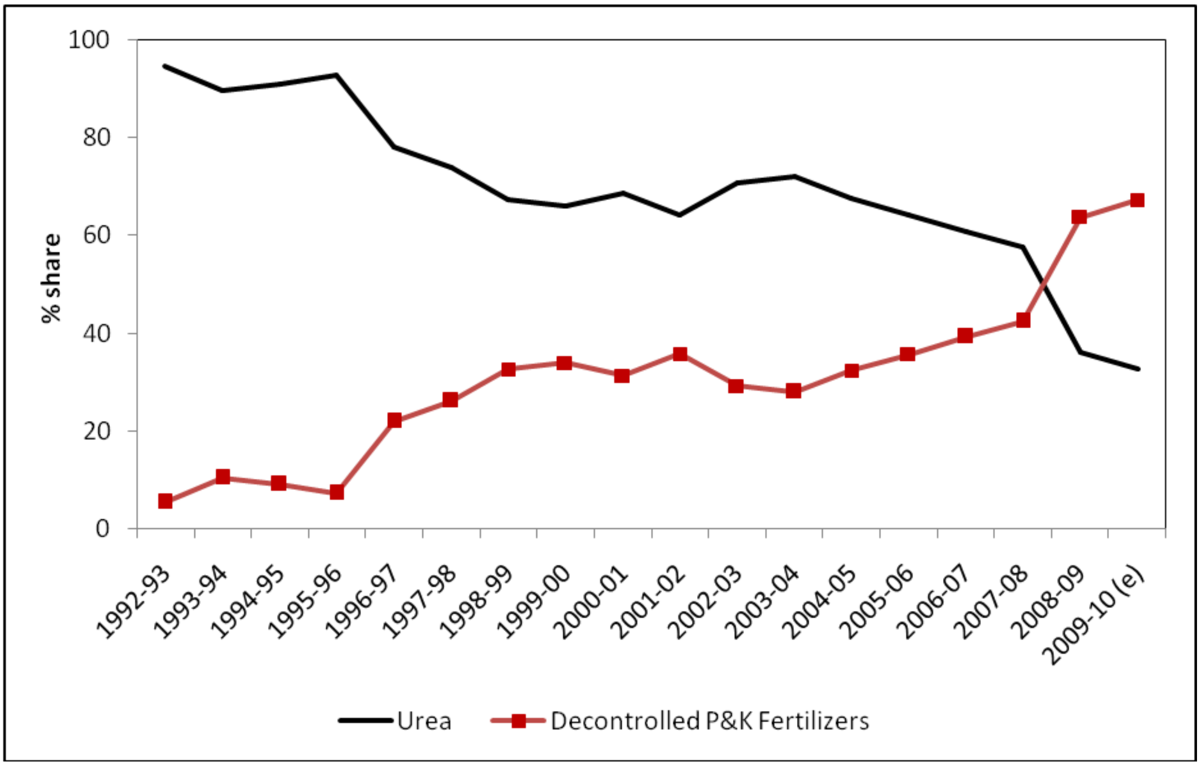
Source: FAO (2009)

Efforts to Reduce/Contain Fertilizer Subsidies

It was only in the aftermath of the economic crisis of 1991 that a serious attempt was made to reform fertilizer sector policy to rationalize the subsidies. Government decontrolled the phosphatic and potassic fertilizers such as di-ammonium phosphate (DAP) and muriate of potash (MOP) in 1992, and extended a flat-rate concession on these fertilizers. But, urea imports continued to be restricted and canalized. However, introduction of concession scheme for phosphatic and potassic fertilizers in 1992-93 and subsequent increase in concession rates along with subsidies on domestic and imported urea have led to rise in subsidies.

Decontrol of phosphatic and potassic fertilizers has not been able to achieve the stated objective of reducing fertilizer subsidies. The share of subsidy on urea and decontrolled P and K fertilizers is given in Figure 4.24. It is evident from the figure that the share of subsidy on urea has declined from over 90 per cent in early nineties to about 70 per cent in early 2000s and reached a level of about 36 per cent in 2008-09. Whereas the share of decontrolled P and K fertilizers has risen from less than 10 per cent in early 1990s to about 30 per cent in early 2000s and reached 63.7 per cent in 2008-09. It is estimated that share of subsidy on decontrolled fertilizers would be about 67 per cent in 2009-10 compared with about 33 per cent for urea (indigenous and imported).

Figure 4.24: Share of urea (under statutory controls) and decontrolled P and K fertilizers in total fertilizer subsidy: 1992-93 – 2009-10 (BE)



Source: AFI (2008)

The Retention Price Scheme (RPS), which is at the root of the growing subsidy, and how much of the benefit of the subsidy is going to farmers rather than the producers of fertilizer have been matters of some debate in the country (Gulati, 1990, GoI, 2004). However, this debate is mostly based on simple comparison of farmgate prices, domestic cost of production and import parity prices assuming that international prices of fertilizers are determined by the market forces of demand and supply. As discussed in the earlier section the international fertilizer market is not perfect market as the markets have always been dominated by a small number of buyers and sellers. Moreover, whenever major consumers like India and China enter the world market, international prices rise dramatically (Figure

4.25). Strong positive correlation exists between the world price of urea and imports of urea by India (0.74). This supports the argument for achieving self-sufficiency in fertilizer production in the country.

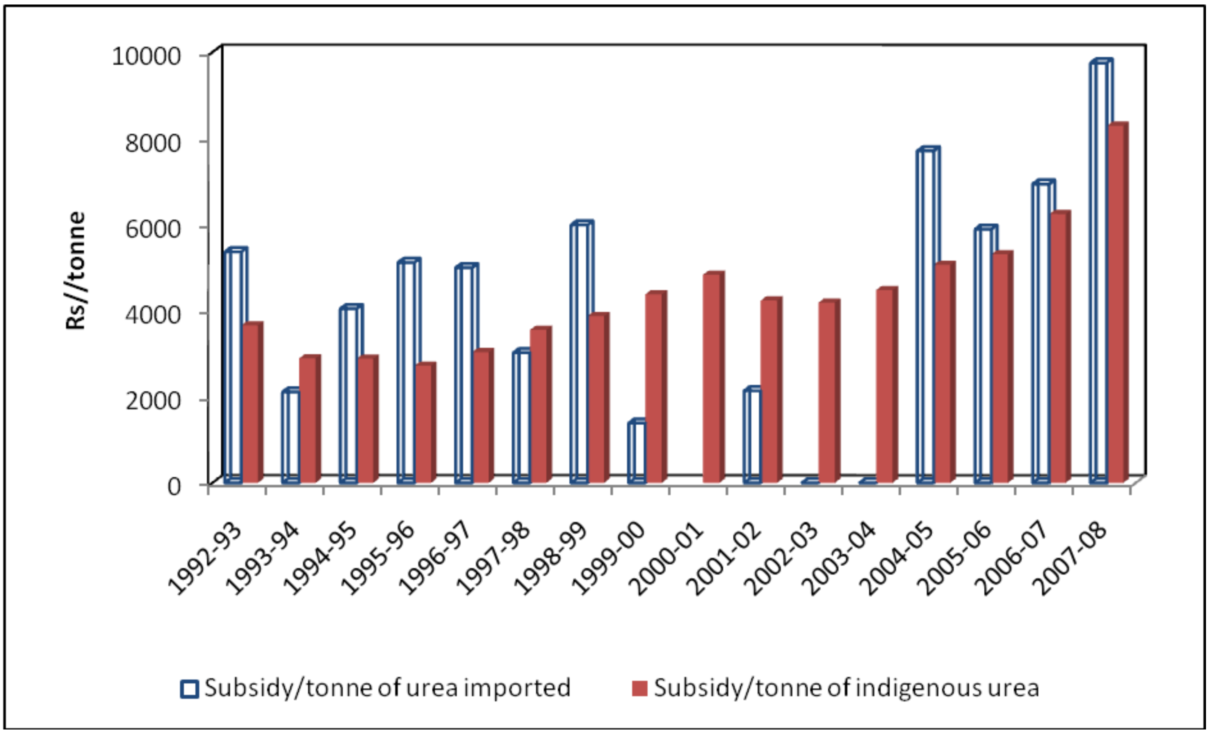
Figure 4.25: Trends in urea imports by India and international prices of urea: 1993-94 – 2007-08

Source: FAI (2008)

It has also been argued several times that domestic urea industry is a high-cost producing industry, therefore, import substitution strategy could be thought about. However, we need to keep in mind the nature, structure and conduct of urea industry. In order to look at the cost structure of imported urea vs. domestically produced urea, we computed per unit subsidy on imported and indigenously produced product (by dividing the total subsidy on indigenous urea by total production and total subsidy on imported urea by total imports) and the results are presented in Figure 4.26. As will be seen from the figure that out of 13 years between 1992-93 and 2007-08 when urea was imported, nine years average subsidy on imported urea was higher than indigenously produced urea. Likewise, share of subsidy on imported urea has also increased significantly during the past few years (Figure 4.27). For example the share of subsidy on imported urea was 4.6 per cent in 2003-04 and it increased to about 40 per cent in 2008-09 and is estimated to further increase to 47.6 per cent during

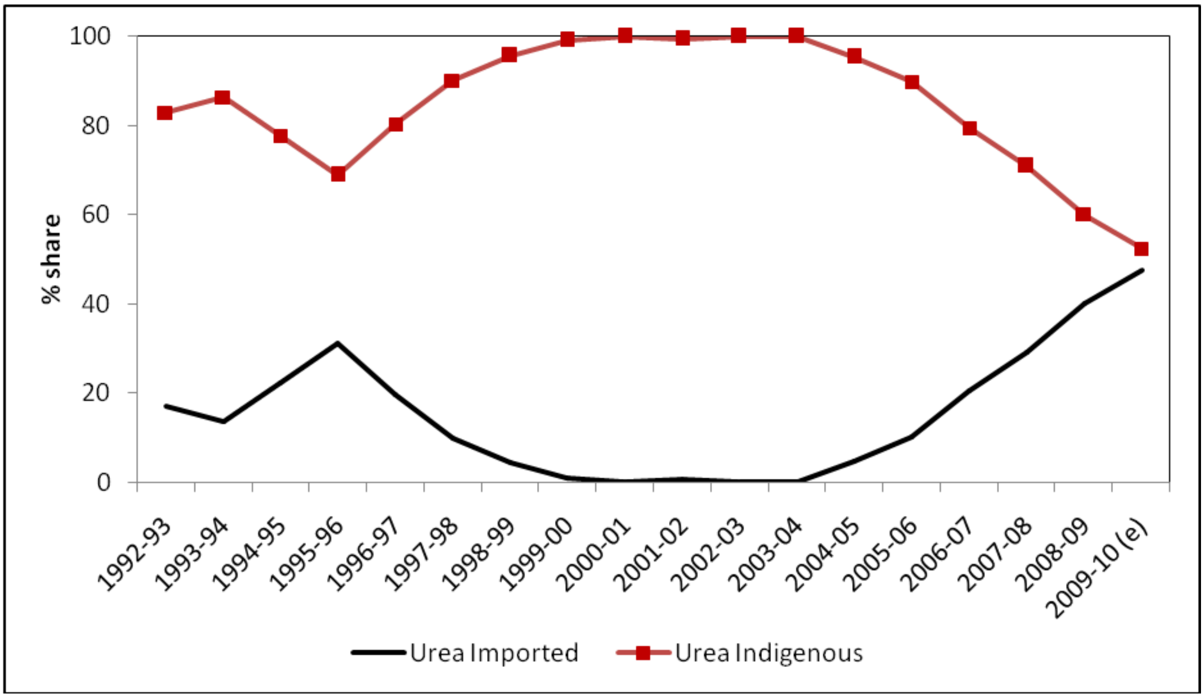
2009-10. These trends show that international prices of urea are not always lower than domestic cost of production. However, this argument does not justify existence of high-cost producing units. The total weighted average cost of production of urea was Rs. 9444 per tonne, the weighted average cost of production of gas based units was Rs. 6280 per tonne, Rs. 15,679 per tonne for naphtha based plants and Rs. 11430 per tonne for FO/LSHS based units in 2007 (GoI, 2007). The import parity price (IPP) of urea have ranged from about Rs. 11096 per tonne in July-September 2005 to Rs. 25717 per tonne during April-June 2008 and showed an increasing trend during the past 5-6 years. Since the average cost of production of urea in general and gas based units in particular has been low compared with IPP, it is therefore advisable to strengthen domestic production capacity. It would help in attaining self-sufficiency in urea production and cushion against highly volatile world urea market. The government has encouraged production of urea based on gas as feedstock because of its efficiency over other feedstocks but there is need to ensure availability of gas for fertilizer sector due to competing uses of gas. It may be desirable to have an option of mix of feedstocks if availability and pricing of gas is an issue.

Figure 4.26: Imputed subsidy per tonne of urea imported and indigenously produced: 1992-93 – 2007-08



Source: FAI (2008)

Figure 4.27: Share of imported and indigenous urea in total subsidy on urea: 1992-93 – 2009-10 (BE)



Source: FAI (2008)

Summary and Concluding Remarks

The Indian Fertilizer industry has been under strict government control for most of the period since independence. Major controls on prices and distribution of fertilizers were introduced in 1973 (Fertilizer Movement Control Order) and movement of fertilizer was brought under the Essential Commodity Act. In 1977, the Retention Price cum Subsidy Scheme (RPS) was implemented, which encouraged investment in the sector by assuring a 12 per cent post-tax return over net worth to the fertilizer producers. Though the government interventions helped in meeting the objective of ensuring capacity creation and achieving self-sufficiency in foodgrains production, it did not encourage improving efficiencies in the sector.

With the burgeoning subsidy bill and the need to focus on fiscal prudence, government polices in the post-reforms period were aimed at improving efficiencies in the sector. The economic reforms initiated in 1991 marked the first major attempt at fertilizer sector reforms in India and set the stage for major policy changes in the sector. In August 1992, government decontrolled prices, distribution and movement for phosphatic and potassic fertilizers, while the low analysis nitrogenous fertilizers were also decontrolled in June 1994. However, urea, the main nitrogenous fertilizer continued to remain under government controls. The government's efforts at initiating reforms in fertilizer sector in general and urea in particular has involved the appointment of a number of committees including High Powered Fertilizer Pricing Policy Review Committee (1997-98), Expenditure Reforms Commission (2000), and Group of Ministers (GoM, 2002). The recommendations of the GoM formed the basis for the New Pricing Scheme (NPS) announced in 2003, which aims at inducing urea units to achieve efficiency besides bringing transparency and simplification in subsidy administration. The NPS is being implemented in stages (3 stages) and phased decontrol of urea has been undertaken under the NPS. In the case of phosphatic fertilizers, based on the recommendations of the Expert Group on Phosphatic Fertilizer Policy the pricing of the phosphatic fertilizers were linked to price in the international market and future scenario and the pricing of indigenous DAP to the price of imported DAP in the international market. The partial decontrol/deregulation of phosphatic and potassic fertilizers, complete decontrol of complex fertilizers and controls on urea have led to imbalanced use of fertilizers. However, in order to promote balanced use of fertilizers and improve soil health, government introduced nutrient-based pricing of subsidized fertilizers including complex fertilizers in June 2008, which is expected to increase use of complex fertilizers, thereby promote balanced use of nutrients.

While world fertilizer prices have been rising gradually since 2004 and in 2007 and 2008 the world witnessed an escalating phenomenon with prices reaching four digit figures. Prices were mainly driven up by an imbalance between supply and rapidly increasing demand mainly in Asia. Another factor was increased demand for fertilizers to produce biofuels in the United States, Brazil and Europe. High energy prices led to an increase in the price of natural gas (main raw material for nitrogenous fertilizer production), and sulphur and phosphoric acid (used for production of phosphatic fertilizers) which also caused the fertilizer prices to rise. World fertilizer prices started falling significantly in late-2008 after reaching all time highs in 2008 mainly due to low demand because of slow down in world economic growth and declining energy prices. The results clearly showed that fertilizer prices are driven by agricultural commodity prices as well as feedstock prices

As against high volatility in world prices of fertilizers, domestic prices have remained stable in the country. Prices of major fertilizers like urea, DAP and MOP remained constant during the decade of 1980s. During the decade of 1990s prices of all fertilizers witnessed large increases but have remained at the same level since 2002-03. Relative prices of N, P and K are important as they affect the consumption pattern. The relative prices of fertilizers to foodgrains (wheat and paddy) revealed that whenever the parity ratio between wheat/paddy and fertilizer increased, there was either decline in consumption of fertilizers or consumption almost remained stagnant. In the post reforms period the parity ratio between crop and fertilizer prices favored crop and became more favorable overtime. Consequently, these years witnessed significant increase in consumption of fertilizers

The burden of fertilizer subsidies on the budget of central government has grown dramatically over the years, from Rs. 505 crore in 1980-81 to a historical high of about Rs.75849 crore in 2007-08. The distribution of fertilizer subsidy among states showed that a large share of total fertilizer subsidy is cornered by top five states, namely, Uttar Pradesh, Andhra Pradesh, Maharashtra, Madhya Pradesh and Punjab. The per hectare subsidy in Punjab (Rs. 3924) was more than four times compared with states like Orissa (Rs. 824) and Rajasthan (Rs. 894). The average subsidy on per hectare basis more than doubled between 1992-93 and 1999-00 and almost tripled between 1999-00 and 2007-08. Overtime, however, the inequalities in fertilizer subsidy among states have declined sharply. The benefits of fertilizer subsidy have spread to unirrigated areas as the share of area treated with fertilizers has increased from 41 per cent in 1996-97 to 53.5 per cent in 2001-02 on unirrigated lands. It is evident that benefits of fertilizer subsidy are not restricted to only resource-rich areas but have spread to other areas as well. Among crops, paddy and wheat are the major users of fertilizer subsidy accounting for over half of the total subsidy. The inter-farm size distribution of fertilizer subsidy showed that subsidy is distributed more equitably among different farm sizes compared with crop-wise and state-wise distribution of fertilizer subsidy. The average subsidy as well as share in total subsidy was the highest on marginal farms and the lowest on large farms. Moreover, the share of small, marginal and semi-medium farms has increased between 1996-97 and 2001-02.

There is a lot of debate in the literature about fertilizer subsidy. Various economic and non-economic arguments (to promote technology adoption, stimulate rapid market development, market failure, to control output prices, etc.) have been advanced to justify the use of fertilizer subsidies. In contrast many arguments have been invoked against the use of subsidies on fertilizer. For example fertilizer subsidy schemes tend to have extremely high fiscal costs that make them financially unsustainable, high administrative costs, and lead to inefficiency at farm level and corruption in the system. The issue of distribution of subsidies between farmers and fertilizer industry has been a matter of debate.

Chapter 5

FOOD PRODUCTION AND FERTILIZER USE

Fertilizers are increasingly important to improve crop yields needed to feed a growing population. Although demand for food will increase as population increases, the area of cultivated land will not increase significantly. For this reason, methods for improving crop production must be found to satisfy the nutritional requirements of the expanding population. The use of fertilizers is one way to increase food supplies. In this chapter an overview of performance of Indian agriculture and association between fertilizer use and agricultural production is discussed.

Current Agricultural Situation

After several years of being a largely closed economy, India initiated the process of opening up of the economy in 1991 and introduced a series of economic reforms in industrial, trade and financial sectors to increase productivity and competitiveness through improving efficiency. Agriculture was largely left untouched by direct reform measures but affected indirectly through changes in exchange rates, trade liberalization (exports and imports) and reduction in protection to industry. One of the major policy initiatives which had direct impact on agricultural sector was decontrol of fertilizers and increase in prices in early 1990s. In addition, government increased procurement prices significantly with the assumption that profitability in agriculture would improve and induce further technological progress and rising productivity. Therefore it is important to understand impact of reforms in fertilizer sector on agricultural production, productivity and profitability.

There has been a decline in the share of agricultural sector in the national gross domestic product (GDP) mainly due to high growth in services sector. The share of agriculture and allied sectors in GDP has declined from about 30 per cent in early 1990s to 17.1 per cent in 2008-09 (CSO, 2009). The annual compound growth of agriculture and allied sectors was over 4 per cent during the sixth and seventh five year plan, which came down to about 3.8 per cent in the eighth plan and further to 3.21 per cent during the ninth plan (Table 5.1). However, in the tenth five year plan the sector registered about 4.5 per cent average annual compound growth rate at 1999-00 constant prices. But this high growth rate was due to relatively low base (2002-03) because of severe drought in many parts of the country, which affected agricultural growth. The average growth in agricultural GDP during the last seven years was 2.34 per cent. On the other hand, GDP from non-agriculture sector as well as total GDP witnessed acceleration in growth during the successive plan periods with the exception of ninth plan when GDP decelerated from 6.83 in eighth plan to 5.73 per cent in ninth plan but again picked up in the tenth plan (8.74%).

Table 5.1: Compound annual growth rate in GDP Agriculture and Total GDP in India (at 1999-00 prices)

	Total GDP	GDP Agri., Forestry & Fishing	GDP Agri. incl. livestock	GDP Fishing	GDP Forestry	GDP Non-agri.
Sixth Plan 1980-81 to 1984-85	5.13	4.10	4.36	6.75	-0.92	5.74
Seventh Plan 1985-86 to 1989-90	6.16	4.12	4.24	5.81	0.92	7.20
Eighth Plan 1992-93 to 1996-97	6.83	3.79	3.77	7.30	0.88	8.11
Ninth Plan 1997-98 to 2001-02	5.73	3.21	3.21	3.40	2.98	6.59
Tenth Plan 2002-03 to- 2006-07	8.74	4.49	4.72	2.83	1.29	9.84
2001-02 to 2007-08	3.37	2.34	8.26	3.47	3.19	1.26

Source: Computed from CSO (2008)

Disaggregation of agriculture into subsectors shows that high-value agriculture (fisheries, livestock and fruits and vegetables) was the main source for acceleration in growth in agriculture GDP during the eighties and early-1990s (Table 5.2). However, situation for crop sector including cereals, pulses, oilseeds and foodgrains became adverse. The growth rates in value of output from crop sector declined from 4 per cent in seventh plan to 3.34 per cent in eighth plan, while foodgrains declined from 4.3 per cent to 1.93 per cent. In case of oilseeds, growth rate declined from 13.8 per cent to 4.2 per cent during the same period. However, during the ninth plan, the situation became more adverse for crop sector as well as other sectors like livestock, fruits and vegetables and fibres. However, performance of agricultural sector in terms of value of output improved in the 2000s particularly in the later part and fibre sector witnessed the highest growth rate (17.58%) between 2001-02 and 2007-08, followed by oilseeds (6.45%). The value of output from crop, livestock, and fruits and vegetables grew at over 3 per cent compound growth rate. The acceleration in growth in fibre sector was mainly driven by cotton due to introduction of Bt technology which increased cotton production and productivity significantly.

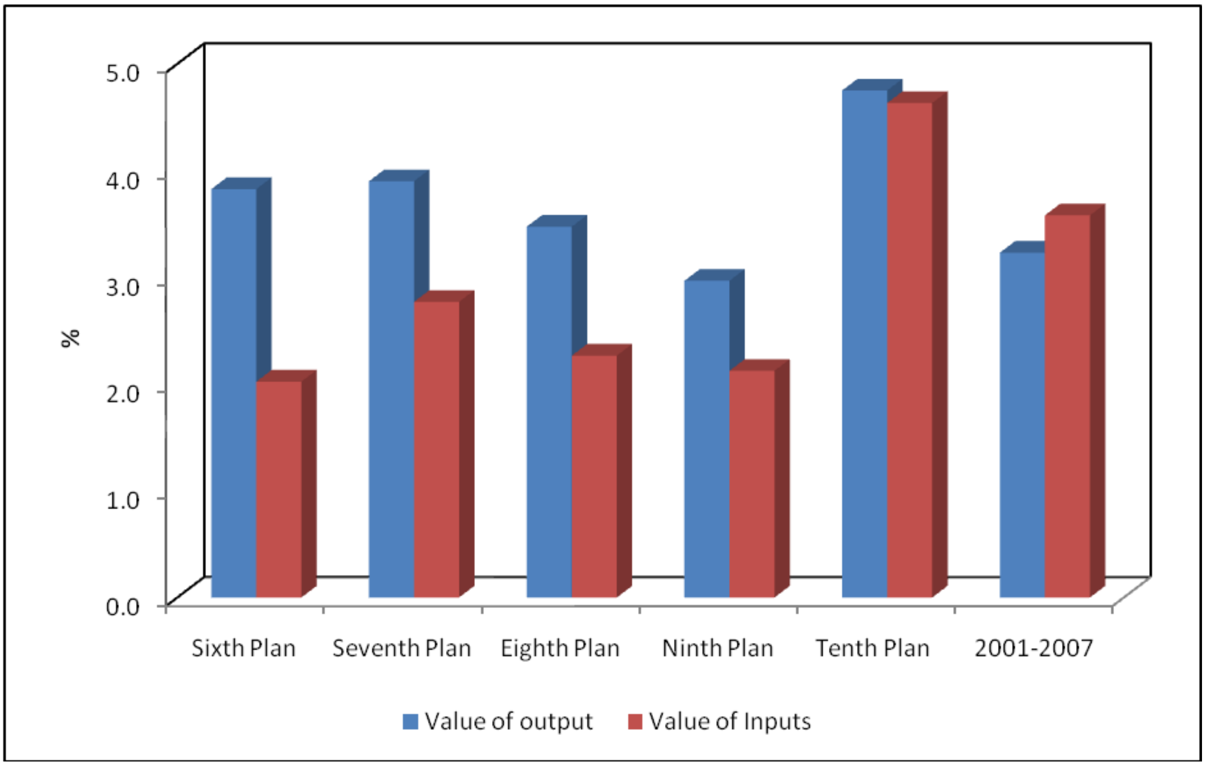
Table 5.2: Compound annual growth rate in value of output from various sub-sectors of agriculture in India (at 1999-00 prices)

	Agriculture	*Livestock*	*Foodgrains*	*Fruits & Vegetables*
Sixth Plan 1980-81 to 1984-85	3.25	5.98	3.52	4.79
Seventh Plan 1985-86 to 1989-90	4.01	3.56	4.30	0.96
Eights Plan 1992-93 to 1996-97	3.34	3.86	1.93	6.77
Ninth Plan 1997-98 to 2001-02	2.75	3.59	1.22	2.27
Tenth Plan 2002-03 to- 2006-07	5.03	4.04	4.43	4.26
2001-02 to 2006-07	3.05	3.76	1.76	4.72
	Cereals	*Pulses*	*Oilseeds*	*Fibre*
Sixth Plan 1980-81 to 1984-85	3.59	3.14	6.50	1.92
Seventh Plan 1985-86 to 1989-90	4.72	1.90	13.81	5.57
Eights Plan 1992-93 to 1996-97	2.05	1.12	4.20	6.87
Ninth Plan 1997-98 to 2001-02	1.58	-1.28	-3.29	-4.82
Tenth Plan 2002-03 to- 2006-07	4.60	3.26	9.24	21.01
2001-02 to 2006-07	1.77	1.70	6.45	17.58

Source: Computed from CSO (2008)

It is important to examine growth rates in value of output and value of inputs because it is the net income to the farmers which is an important indicator. The growth rates in value of output from crop and livestock sector and inputs are presented in Figure 5.1. The growth rate of value of output was significantly higher than value of inputs up to Ninth plan. However, growth rate of value of inputs increased at a much faster rate compared with output growth rate during the last seven years, indicating that the significant increase in value of output has not been able to give higher returns to the farmers.

Figure 5.1: Growth rates of value of output from agriculture and livestock and value of inputs in India (at 1999-00 prices)



Source: CSO (2008)

Growth Rates in Agricultural Production

Annual compound growth rates in production of foodgrains, oilseeds and cotton are given in Table 5.3. The table shows that rice registered the highest growth rate (4.46%) in production during Seventh Five Year Plan and the lowest (1.89%) during the Eight Plan (Post-reforms period). In case of wheat the highest growth rate was observed in early-80s which decelerated substantially in the second-half of 1990s and 2000s. The growth rate in foodgrains production also witnessed a declining trend in the post-reforms period. In case of oilseeds, the highest growth was recorded during the second-half of eighties due to introduction of Technology Mission on Oilseeds in 1986. However, oilseeds production recorded a negative growth rate (-3.51%) during the Ninth Five Year Plan. Cotton production, which had declining trend in the nineties, grew at about 20 per cent in the 2000s.

Table 5.3: Compound annual growth rate in agricultural production in India

	Rice	Wheat	Pulses	Foodgrains	Oilseeds	Cotton
1980-81 to 1984-85	2.94	5.99	3.55	3.73	7.21	1.80
1985-86 to 1989-90	4.46	3.20	0.92	4.35	14.59	8.03
1992-93 to 1996-97	1.89	4.31	1.34	1.92	4.22	6.43
1997-98 to 2001-02	2.36	1.63	-2.36	1.71	-3.51	-4.10
2002-03 to 2006-07	5.77	2.48	3.87	4.22	11.52	24.96
2001-02 to 2007-08	2.41	1.71	2.45	2.37	8.11	19.90

Source: Computed from GOI (2008)

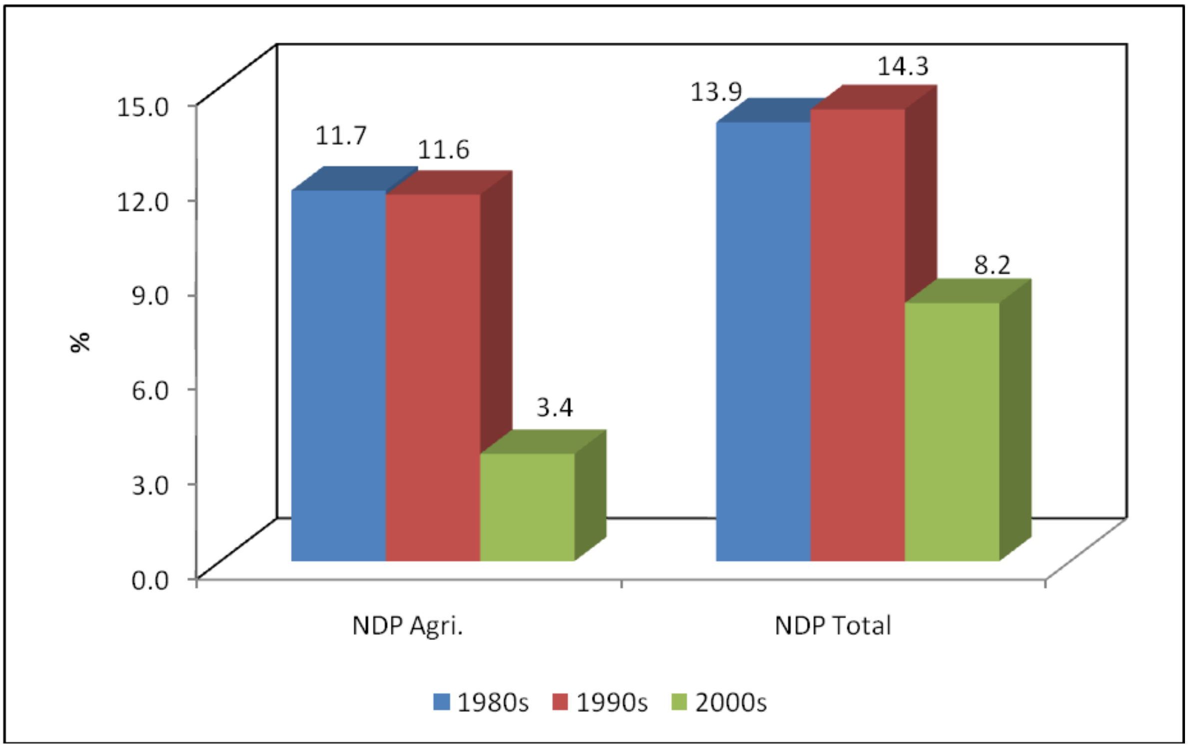
State-wise Trends in Net State Domestic Product

It is evident from Figure 5.2 that there has been a decline in agricultural NDP in the post-reforms period. The growth rate of net domestic product from agriculture has declined from over 11.5 per cent during the 1980s and 1990s to 3.4 per cent in 2000s. With regard to the total NDP, the growth rate came down from over 14 per cent in 1990s to just over 8 per cent in 2000s.

While there has been a decline in agricultural NDP in the post-reforms period, as seen above, there are considerable regional variations across the country. With regard to the period 2001-02 to 2007-08, the state wise analysis shows wide variations in growth of NDP from agriculture from 10.9 per cent to -4.6 per cent (Figure 5.3). The major 20 states in India comprising all states except Goa and North-eastern states have been considered for the present analysis.

Figure 5.3 shows that the state of Gujarat registered the highest growth rate of 10.9 per cent in agricultural NDP (at 1999-00 prices) during the period from 2001-02 to 2007-08 followed by Andhra Pradesh (6.6%), Tamil Nadu (5.6%), and Madhya Pradesh (5.2%). Gujarat and Madhya Pradesh were the only two states which had higher growth rate in agricultural NSDP compared with total NSDP. Apart from these states, Rajasthan, Chhattisgarh, Orissa, Haryana and Maharashtra recorded growth rates higher than all-India average of 3.4 per cent growth in agricultural NDP. Other major states like Punjab, Bihar, Uttar Pradesh, West Bengal and Karnataka have registered growth rate lower than all-India average during this period.

Figure 5.2: Compound annual growth rate of total Net Domestic Product (NDP) at factor cost and agricultural NDP in India: 1981-82 to 2007-08 (at 1999-00 prices)

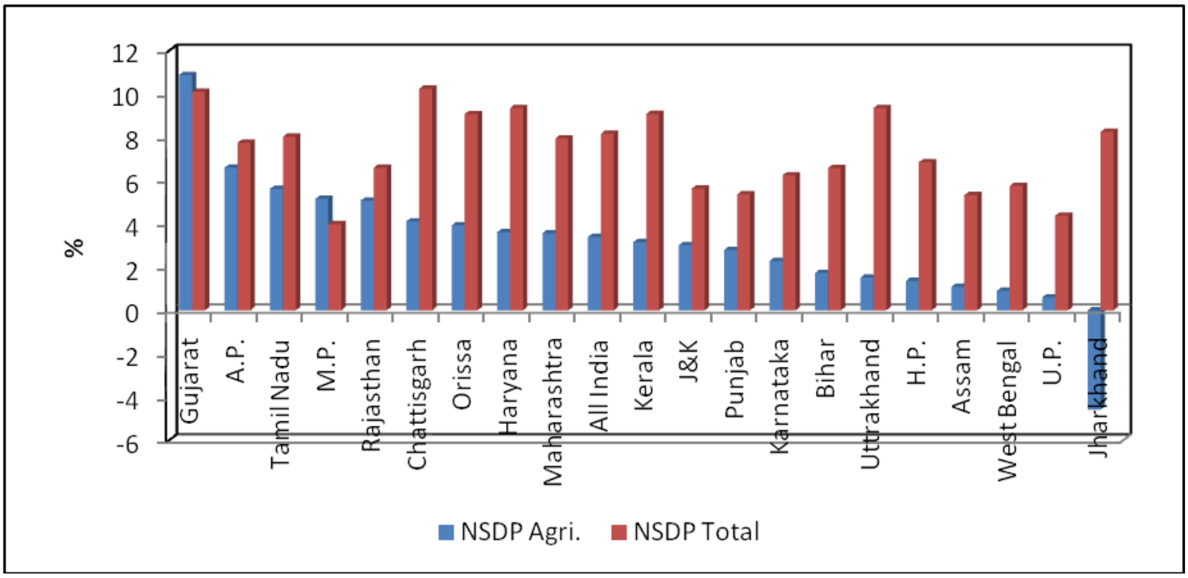


Source: Computed from CSO (2008)

In order to examine association between agricultural NSDP and total NSDP, correlation coefficients were computed and the results are presented in Figure 5.4. Nine out of 20 states included in the analysis had very high correlation coefficient (>0.90) between agricultural and total NSDP. Since there is a strong association between total NSDP and agricultural NSDP in most of the states, there is a need to focus on agricultural sector growth to promote more broad-based and inclusive growth.

Looking at state-wise trends in foodgrains production during 2001-02 to 2007-08, it is interesting to note that while Gujarat again witnessed the highest growth rate (10.9%), followed by Andhra Pradesh (6.6%), Tamil Nadu (5.6%) and Madhya Pradesh (5.2%). However, three out of top five foodgrains producing states like Punjab, Uttar Pradesh and West Bengal have less than national average growth rate (2.37%). More importantly, Uttar Pradesh (0.60) and West Bengal (0.90) registered less than one per cent growth rate in foodgrains production during 2001-02 and 2007-08. Bihar, Kerala and Assam had a negative growth rate in foodgrains production.

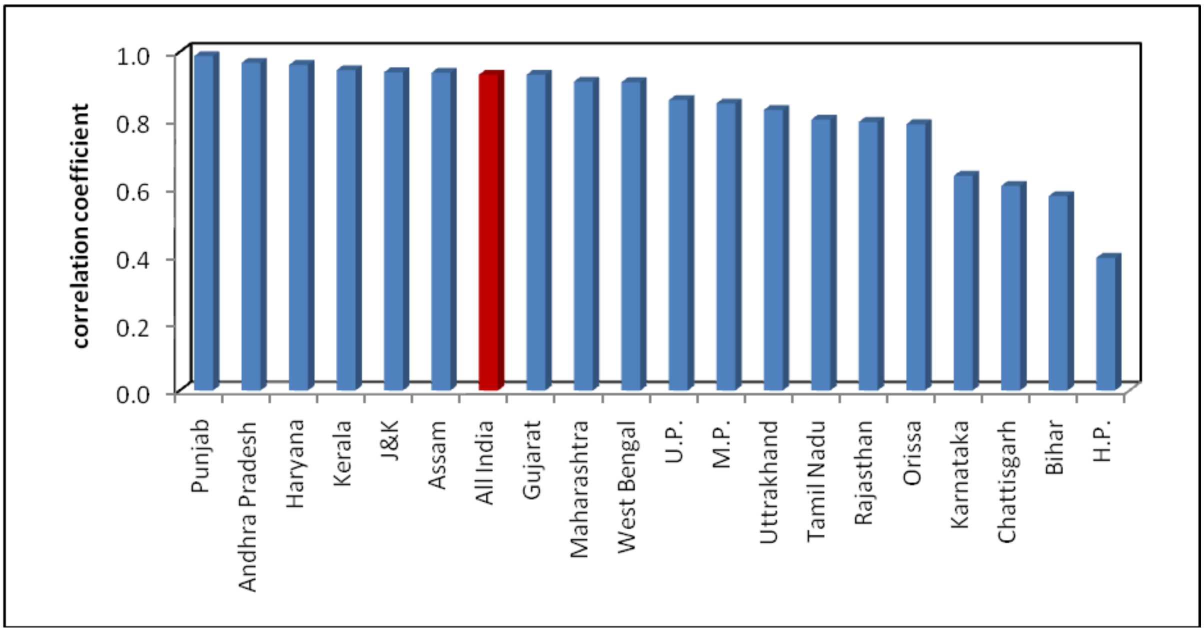
Figure 5.3: Compound annual growth rate of Net State Domestic Product (NSDP) from agriculture and total NSDP in selected states: 2001-02 to 2007-08 (at 1999-00 prices)



Source: Computed from CSO (2008)

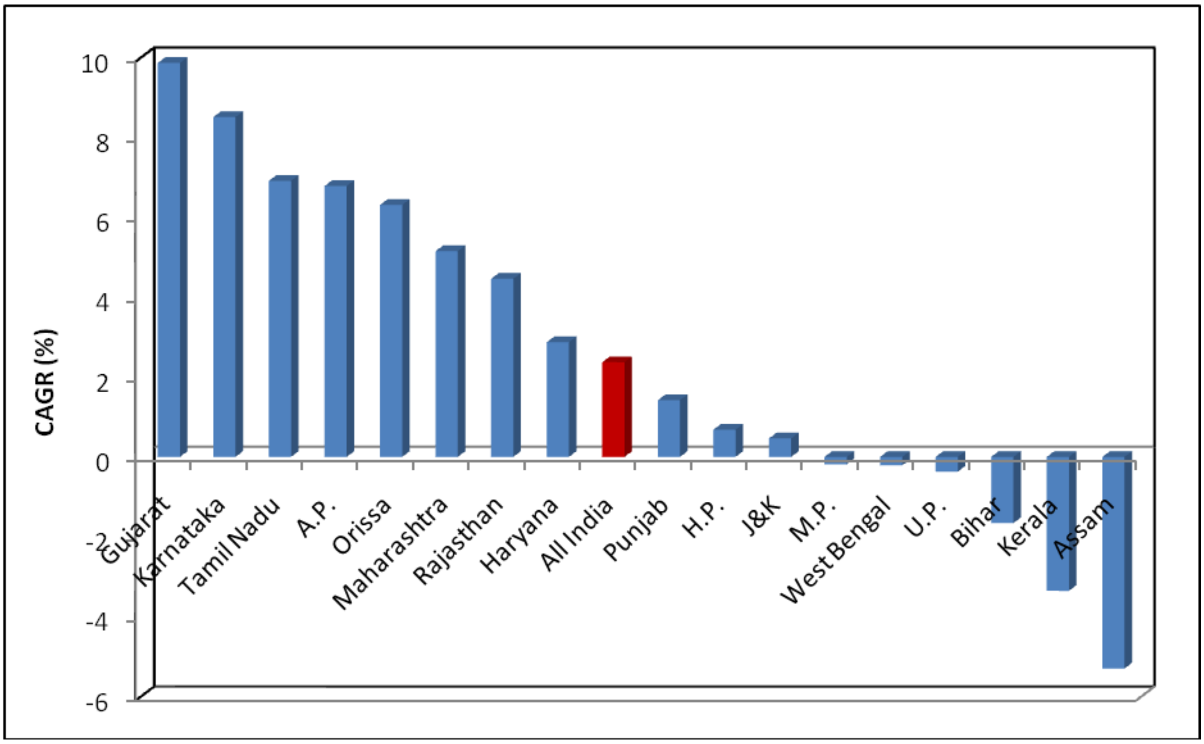
An analysis of growth of yield per hectare of foodgrains shows that Karnataka registered the highest growth of about 6.7 per cent during the 2000s followed by Orissa (5.5%), Andhra Pradesh (5%) and Chhattisgarh (4.9%). Apart from these states, Jharkhand, Maharashtra, Tamil Nadu and Gujarat have shown growth rates higher than all-India average of 1.67 per cent. Gujarat, which witnessed the highest growth rate in both foodgrains production and net state domestic product from agriculture, ranked 8th out of 17 states considered for the analysis in growth rate of foodgrains yield. Major foodgrains producing states such as Haryana (1.62%), Punjab (0.95%), West Bengal (0.63%), Uttar Pradesh (0.18%), Rajasthan (1.35%) and Bihar (-1.14%) registered less than all-India average. In this context, it is important to look at the contribution of technology and inputs and services on agricultural production and productivity in the country. Since the present study is focused on fertilizer sector, we have tried to examine association between fertilizers and agricultural production and productivity during different decades.

Figure 5.4: Correlation coefficient between total Net State Domestic Product (NSDP) and NSDP from agriculture in selected states in India: 2001-02 to 2007-08



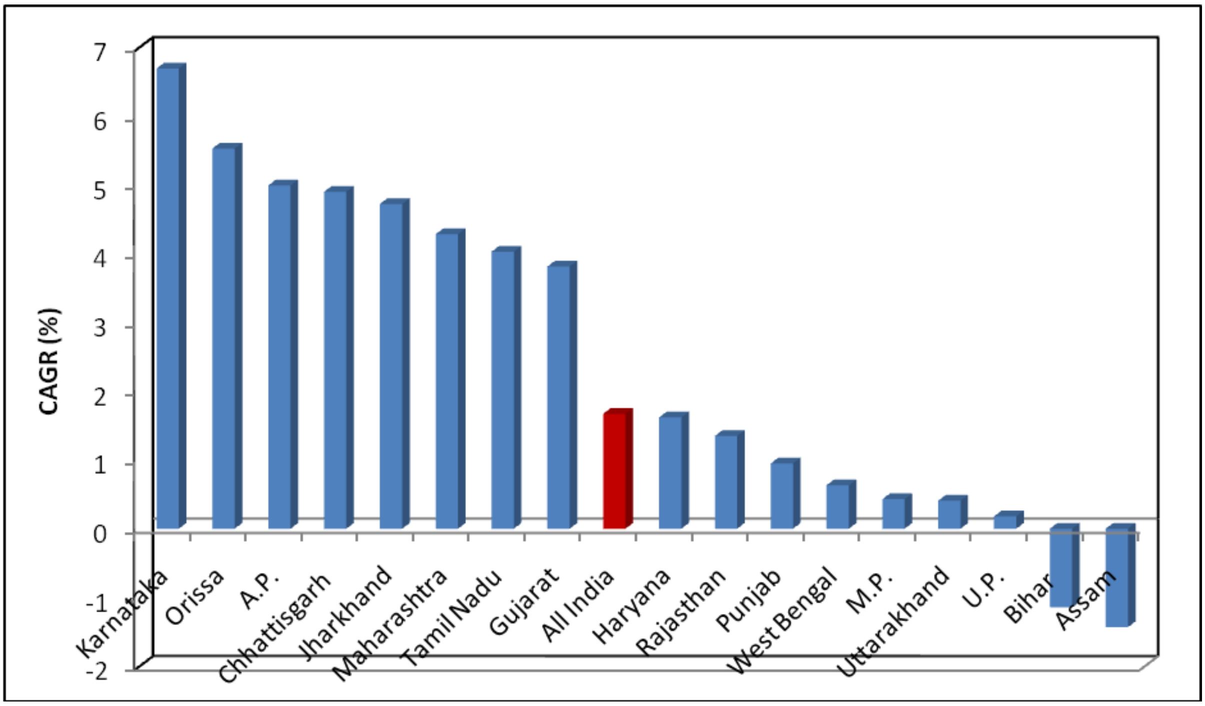
Source: Computed from CSO (2008)

Figure 5.5: State-wise growth of foodgrains production during 2001-02 to 2007-08



Source: Computed from CSO (2008)

Figure 5.6: State-wise growth of foodgrains yield during 2001-02 to 2007-08



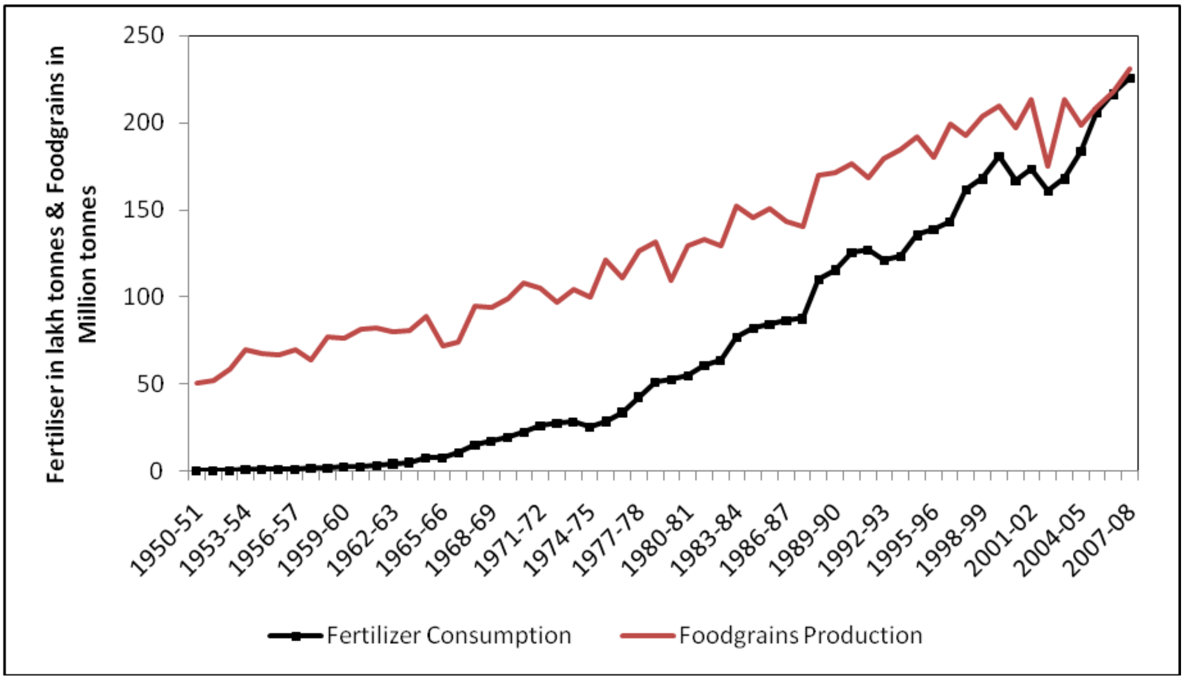
Source: GOI (2008)

Association between Fertilizer Consumption and Foodgrains Production

India has made significant progress in the field of agriculture. The production of foodgrains has increased from 50.8 million tonnes in 1950-51 to about 230.8 million tonnes in 2007-08 (Figure 5.7). Rice production has gone up about five times from 20.6 million tonnes to 96.7 million tonnes and wheat production has gone up more than 13 times. The fertilizer Industry has played an important role in increasing production and improving productivity making country self-sufficient in foodgrains. The fertilizer consumption in terms of nutrients (nitrogen, phosphorus and potash) has increased from less than 70 thousand tonnes in 1950-51 to 22.57 million tonnes in 2007-08 and consumption of plant nutrients per unit of gross cropped area has increased from 0.5 kg per hectare in 1951-52 to 117 kg per hectare in 2007-08 (Figure 5.8). Although in some states, such as Punjab (210 kg/ha), Andhra Pradesh (200 kg/ha), Haryana (188 kg/ha), Tamil Nadu (178 kg/ha), Bihar (163 kg/ha), Uttar Pradesh (150 kg/ha) and West Bengal (144 kg/ha), the consumption is much higher. However, in some states the fertilizer consumption has remained very low, especially in

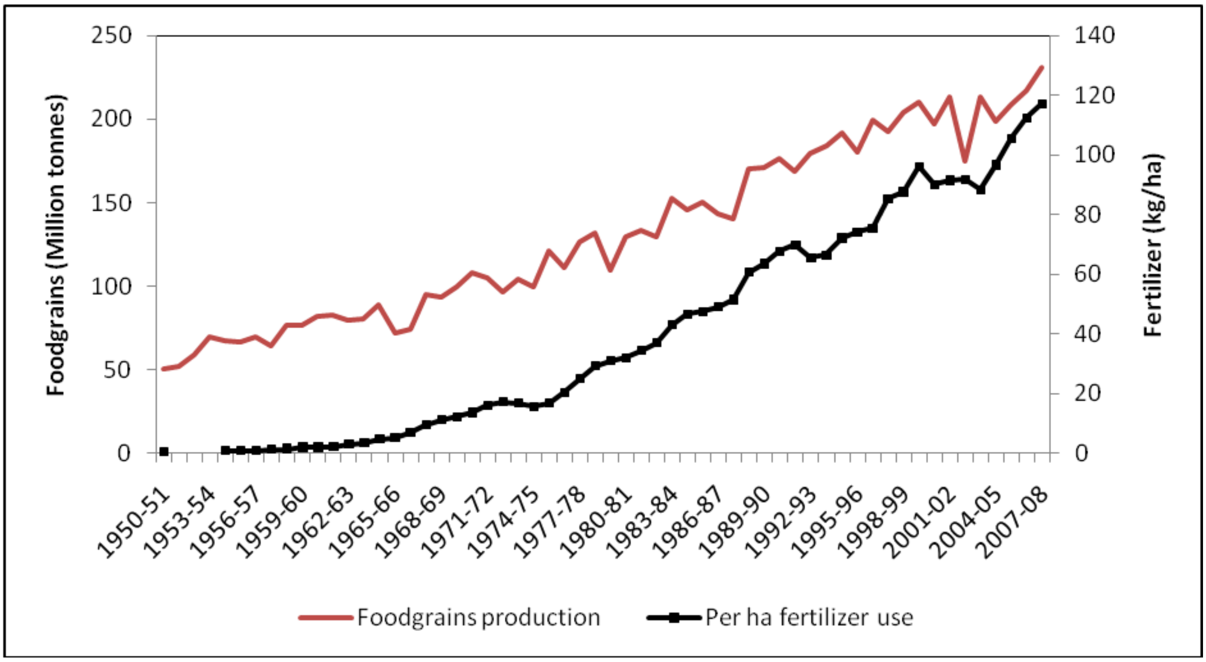
North Eastern States and in the States like Rajasthan (45 kg/ha), Orissa (52 kg/ha), Himachal Pradesh (53 kg/ha), Assam (57 kg/ha) and Madhya Pradesh (66 kg/ha).

Figure 5.7: Trends in total fertilizer consumption and foodgrains production in India: 1950-51 to 2007-08



Source: FAI (2008)

Figure 5.8: Trends in per hectare fertilizer consumption and foodgrains production in India: 1950-51 to 2007-08



Source: FAI (2008)

The impressive growth of consumption of fertilizer in India particularly in the post-green revolution period ensured increase in foodgrains production from 74 million tonnes in 1966-67 to 209.8 million tonnes during 1999-2000. Production had been ranging between 174.8 million tonnes to about 217 million tonnes, during the last 7 years (between 2000-01 and 2007-07) and the rate of growth of food production witnessed a declining trend, in spite of increase in fertilizer consumption during recent times. However, foodgrains production again touched a new record of 230.8 million tonnes in 2007-08 due to concerted efforts of the government.

Trends in consumption of fertilizer nutrients and foodgrains production during the last three and half decades are given in Table 5.4. The average fertilizer consumption during the decade of 1970s (1971-72 to 1980-81) was 37.3 lakh tonnes, which increased to 89.4 lakh tonnes (about 140% increase) in the 1980s, 146.8 lakh tone in 1990s (64% increase over the 1980s) and 190.3 lakh tonnes (29.7% increase over 1990s) in 2000s. On the other hand, foodgrains production rose from 113.6 million tonnes during the 1970s to 151.2 million tonnes (about 33% increase) in 1980s, 190.7 million tonnes (26.1% increase) in 1990s and 208 million tonnes (9.1% increase over 1990s) during the 2000s. As can be seen from the Table 5.4 and Figure 5.9 that fertilizer consumption grew at much faster rate compared with foodgrains production and productivity during the period. The instability measured in terms of coefficient of variation (CV) in fertilizer consumption was higher than foodgrains production but instability witnessed a declining trend during the last three-and-half decades with the exception of foodgrains production during the 2000s. The compound annual growth rate in fertilizer consumption and foodgrains production and productivity decelerated during the 1990s but picked up during the 2000s.

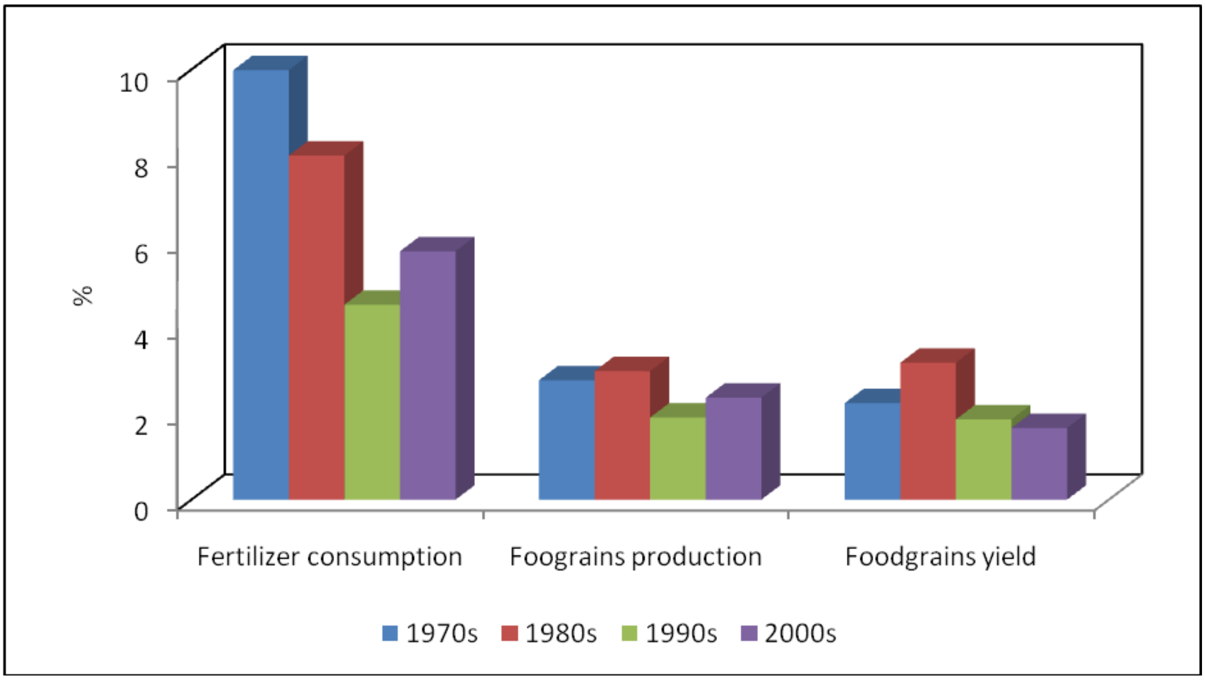
Although the association between foodgrains production/productivity and modern technology/inputs including fertilizers was very strong in the beginning but of late, the association has started weakening. The correlation coefficient between fertilizer consumption and foodgrains production was 0.73 during the 1970s and became much stronger (0.94) during the 1980s and then started weakening and reached a level of 0.84 during the 1990s and further to 0.72 during the 2000s (Figure 5.10). Almost similar trend was observed for correlation coefficient between fertilizer consumption and foodgrains yield but correlation coefficients were higher than production coefficients.

Table 5.4: Trends in consumption of fertilizer nutrients and foodgrains production in India: 1971-72 to 2007-08

	Fertilizer Consumption (lakh tonnes)				Foodgrains Production (million tonnes)			
	Average	Minimum	Maximum	CV	Average	Minimum	Maximum	CV
1970s	37.3	25.7	55.2	31.9	113.6	97.0	131.9	11.2
1980s	89.4	60.7	125.5	24.0	151.2	129.5	176.4	10.8
1990s	146.8	121.5	180.7	14.3	190.7	168.4	209.8	6.6
2000s	190.3	160.9	225.7	13.2	208.0	174.8	230.7	8.4

Source: FAI (2008)

Figure 5.9: Compound annual growth rate of fertilizer consumption, foodgrains production and yield in India: 1971-72 to 2007-08

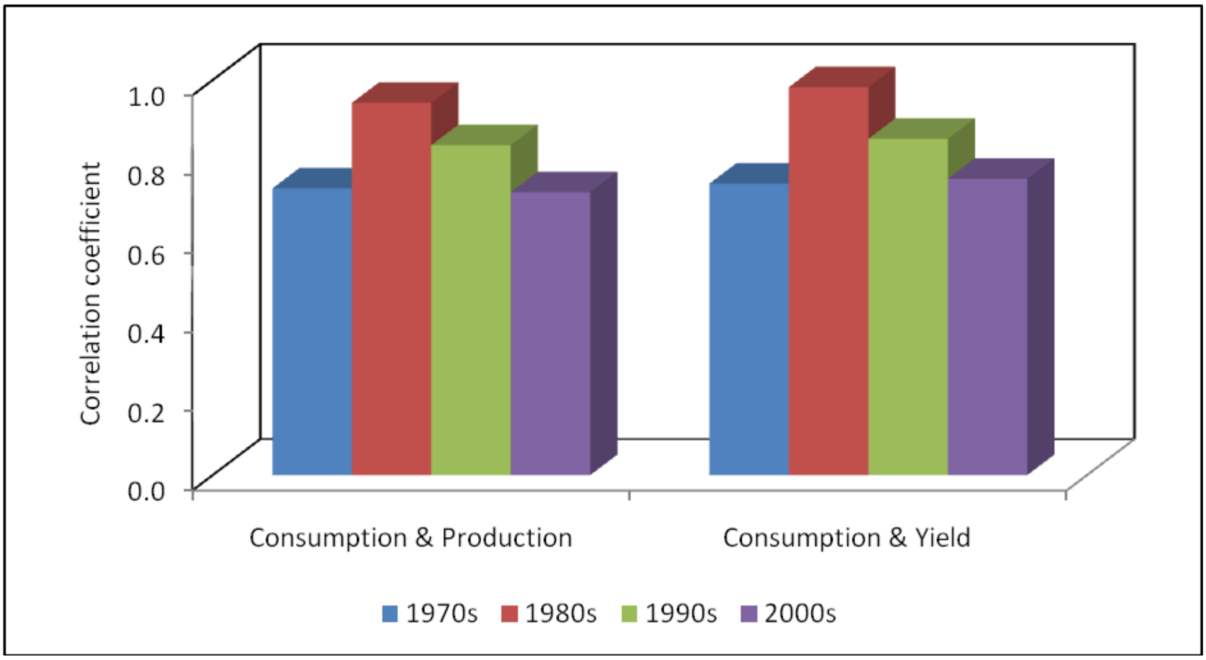


Source: FAI (2008)

The trend of weakening association between fertilizer consumption and foodgrains production is a matter of serious concern and need urgent attention. This weakening association is due to the adverse impact of imbalanced use of fertilizers, deficiency of secondary and micro-nutrients and deteriorating soil health on foodgrains production and productivity. However, government has taken an initiative in this direction and a new

Centrally Sponsored Scheme entitled "National Project on Management of Soil Health and Fertility (NPMSF)" has been approved for implementation during the Eleventh Five Year Plan with a total outlay of Rs. 429.85 crore.

Figure 5.10: Association between fertilizer consumption and foodgrains production and yield in India: 1971-72 to 2007-08



Source: FAI (2008)

Statewise Trends in Fertilizer Consumption and Foodgrains Production

While there has been an incresae in fertilizer consumption and agricultural growth, there are considerable inter-state/regional variations across the country. With regard to the period 2001-02 to 2006-07, the statewise analysis shows wide variations in fertilizer consumption growth rates from 11.7 per cent in Gujarat to about 1.7 per cent in Uttar Pradesh (Figure 5.11). Figure also shows that the state of Gujarat registered the maximum growth of 9.9 per cent in foodgrains prodution during this period, followed by Karnataka (8.15%), Tamil Nadu (6.9%) and Andhra Pradesh (6.80%). West Bengal, Bihar, Kerala and Uttar Pradesh registered a negative growth rate in foodgrain production during the 2000s.

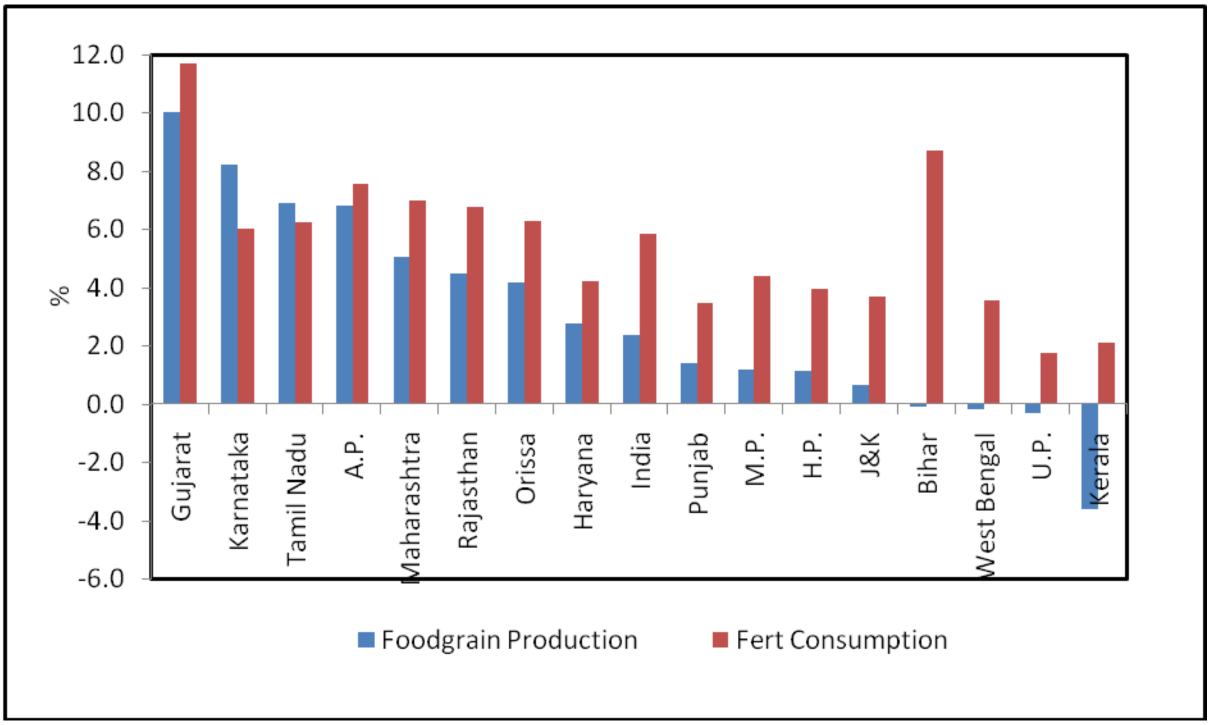
Out of 16 states considered for the present analysis, 7 states had higher growth rate of fertilizer consumption compared with the national average, while in case of foodgrains production, 8 states had higher growth rate. However, results were slightly different in terms of foodgrains productivity. The state of Karnataka registered the highest growth rate

(6.34%) in foodgrains productivity, followed by Andhra Pradesh (5.01%) Maharashtra (4.19%) and Tamil Nadu (4.0%). The traditional high-potential foodgrains growing states like Punjab and Haryana witnessed significantly lower than national average growth rate in productivity. In case of Punjab, compound annual growth rate in foodgrains productivity was less than one per cent.

Grouping of States according to Growth in Foodgrains Production/Yield and Fertilizer Consumption

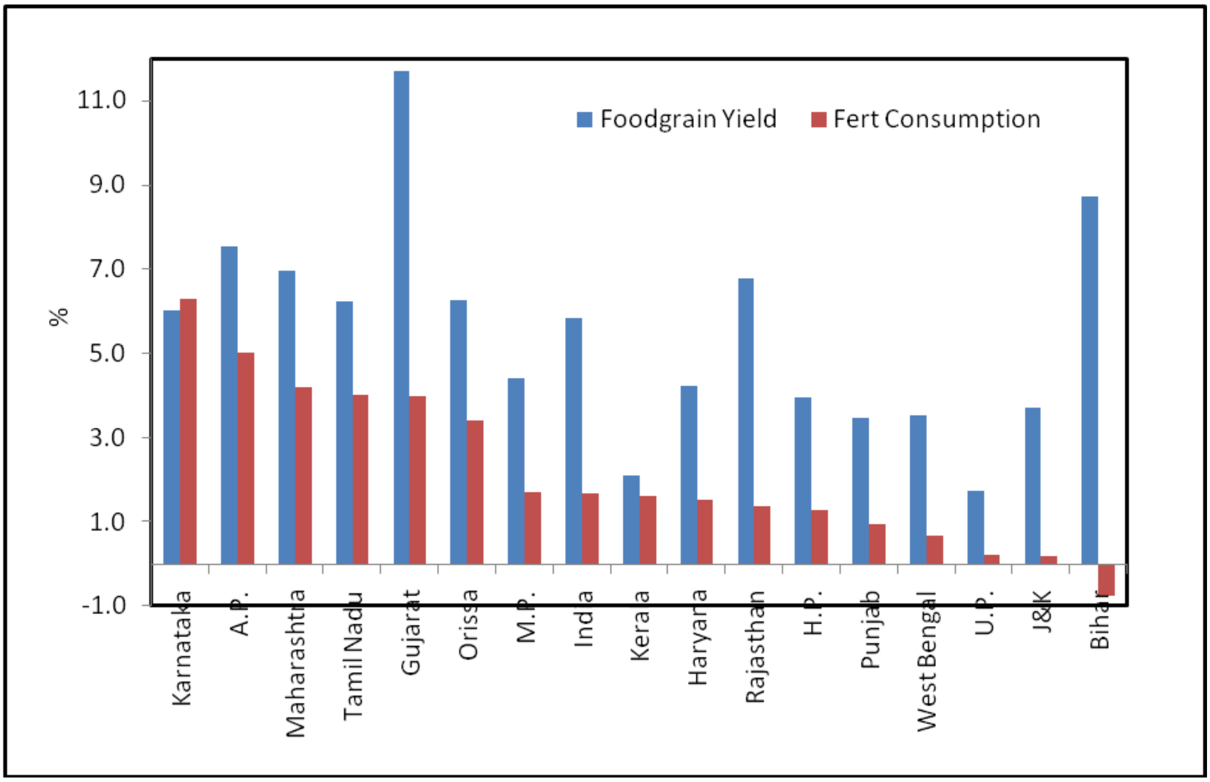
Agricultural production can increase through two ways: through higher production per unit of land, or by increasing the area under cultivation. The dramatic increases in agricultural production in the country - known as the Green Revolution - were mostly through higher yields. Since there is little scope to increase area under cultivation the only way to increase agricultural production is through yield improvements. Crop yields are influenced by natural factors such as soil, water and climatic conditions and economic and social factors like seeds, fertilizers, plant protection materials, irrigation, availability of capital, extension services, etc. Among all inputs, fertilizer is the most important physical input contributor to agricultural growth

Figure 5.11: Compound annual growth rates of foodgrains production and fertilizer consumption in selected states: 2001-02 to 2007-08



Source: FAI (2008)

Figure 5.12: Compound annual growth rates of foodgrains yield and fertilizer consumption in selected states: 2001-02 to 2007-08



Source: FAI (2008)

The growth performance of states is analyzed by classifying states on the basis of the sign and statistical significance of their trends in fertilizer consumption and foodgrains production/productivity levels. There are nine types of association:

1. **AA:** Significant positive growth rate of production/yield associated with significant positive growth rate of fertilizer consumption
2. **AB:** Significant positive growth rate of production/yield associated with significant negative growth rate of fertilizer consumption
3. **AC:** Significant positive growth rate of foodgrains production/yield associated with stagnant (either positive or negative) growth rate of fertilizer consumption
4. **BA:** Significant negative growth rate of production/yield associated with significant positive growth rate of fertilizer consumption
5. **BB:** Significant negative growth rate of production/yield fertilizer consumption associated with significant negative growth rate of fertilizer consumption

6. **BC:** Significant negative growth rate of production/yield fertilizer consumption associated with stagnant growth rate of fertilizer consumption
7. **CA:** Stagnant growth rate of production/yield fertilizer consumption associated with significant positive growth rate of fertilizer consumption
8. **CB:** Stagnant growth rate of production/yield associated with significant negative growth rate of fertilizer consumption
9. **CC:** Stagnant growth rate of production/yield associated with stagnant growth rate of fertilizer consumption

For improvement of the agricultural economy, AA is the best situation while BB is the worst situation. AB would be preferred to BA, AC would be preferred to CA, and CB would be preferred to BC. The grouping of states based on growth rates in foodgrains productivity and fertilizer consumption is presented in Table 5.5. The results show that during the seventies (initial phase of green revolution) out of 17 major states considered in the analysis 7 states were in AA category and the number increased to 11 in the 1980s as the green revolution spread to central and eastern parts of the country. However during the 1990s, this number marginally declined to 10 and Madhya Pradesh shifted from AA to CA category. The number of states with significant growth rate in both foodgrains productivity and fertilizer consumption declined to half (5) during the 2000s. Major grain producing states like Punjab, Uttar Pradesh, Rajasthan, Karnataka, and Tamil Nadu sifted from AA category to CA category during the 2000s. None of the states were in BB category for all the periods, which is a very healthy sign. During the 2000s, 10 states witnessed stagnation in foodgrains yield while fertilizer consumption grew significantly. The analysis shows that the association between fertilizer use and crop productivity has weakened in the recent years.

The distribution of states based on growth rates in foodgrains production and fertilizer consumption is presented in Table 5.6. The number of states in AA category was six during the seventies and eighties, and it increased to nine in 1990s. However, during the 2000s, the number of states declined to six while the number of states in CA category increased to eight. The states like Madhya Pradesh, Orissa, Rajasthan, Uttar Pradesh, Tamil Nadu and West Bengal witnessed stagnation in foodgrains production despite significant increase in fertilizer consumption. Uttar Pradesh and West Bengal, which contribute significantly to national foodgrains production moved to AA to CA. The above results clearly show that the association between foodgrains production and productivity and fertilizer consumption has weakened during the 2000s.

Table 5.5: Classification of States according to growth in foodgrains productivity and total fertilizer consumption (N+P+K)

	1970s	1980s	1990s	2000
AA	Andhra Pradesh Gujarat Haryana Jammu & Kashmir Maharashtra Punjab Uttar Pradesh	Andhra Pradesh Assam Bihar Haryana Himachal Pradesh Kerala Madhya Pradesh Punjab Tamil Nadu Uttar Pradesh West Bengal	Assam Bihar Haryana Karnataka Punjab Rajasthan Tamil Nadu Uttar Pradesh Andhra Pradesh West Bengal	Andhra Pradesh Haryana Jammu & Kashmir Maharashtra West Bengal
AB	-	-	-	-
AC	-	-	Kerala	-
BA	-	-	-	Assam
BB	-	-	-	-
BC	-	-	-	-
CA	Bihar Himachal Karnataka Kerala Madhya Pradesh Orissa Pradesh Rajasthan Tamil Nadu West Bengal	Gujarat Jammu & Kashmir Karnataka Maharashtra Orissa Rajasthan	Gujarat Jammu & Kashmir Madhya Pradesh Maharashtra Orissa	Gujarat Himachal Pradesh Karnataka Kerala Madhya Pradesh Orissa Punjab Rajasthan Tamil Nadu Uttar Pradesh
CB	-	-	-	-
CC	Assam	-	Himachal Pradesh	Bihar

Source: Computed from FAI (2008)

Table 5.6: Classification of States according to growth in foodgrains production and total fertilizer consumption (N+P+K)

	1970s	1980s	1990s	2000
AA	Andhra Pradesh Haryana Jammu & Kashmir Maharashtra Punjab Uttar Pradesh	Assam Madhya Pradesh Orissa Punjab Uttar Pradesh West Bengal	Andhra Pradesh Assam Bihar Haryana Karnataka Punjab Rajasthan Uttar Pradesh West Bengal	Andhra Pradesh Gujarat Haryana Jammu & Kashmir Maharashtra Punjab
AB	-	-	-	-
AC	-	-	-	-
BA	Kerala	Gujarat Kerala	Orissa	Assam Kerala
BB	-	-	-	-
BC	-	-	Kerala	-
CA	Bihar Gujarat Himachal Pradesh Karnataka Madhya Pradesh Orissa Rajasthan Tamil Nadu West Bengal	Andhra Pradesh Bihar Haryana Himachal Pradesh Jammu & Kashmir Karnataka Maharashtra Rajasthan Tamil Nadu	Gujarat Jammu & Kashmir Madhya Pradesh Maharashtra Tamil Nadu	Himachal Pradesh Karnataka Madhya Pradesh Orissa Rajasthan Tamil Nadu Uttar Pradesh West Bengal
CB	-	-	-	-
CC	Assam	-	Himachal Pradesh	Bihar

Source: Computed from FAI (2008)

Association between Fertilizer Consumption and Foodgrains Production/Yield

Looking further at state-wise trends on association between fertilizer consumption and foodgrains production and productivity, it is interesting to note that the share of states having strong association (>0.70) increased from about 41 per cent in 1990s to 57.1 per cent in 2000s but states that registered high correlation in 2000s were different from the states which witnessed high association in 1990s. Classification of states according to correlation coefficient between fertilizer consumption and foodgrains production during the last two and half decades is given in Annexure Table 5.1. For example, Uttar Pradesh, Haryana, West Bengal, Punjab, Assam, Andhra Pradesh, and Bihar reported high correlation coefficient (>0.70) during the 1990s. However during the 2000s, in all states except Andhra Pradesh and Haryana this association weakened while in other states, namely, Karnataka, Gujarat, Tamil Nadu and Madhya Pradesh the association between fertilizer consumption and foodgrains production became stronger. These results clearly indicate that impact of fertilizers on foodgrains production and productivity has weakened in high fertilizer using areas like Punjab, West Bengal, Bihar and Uttar Pradesh.

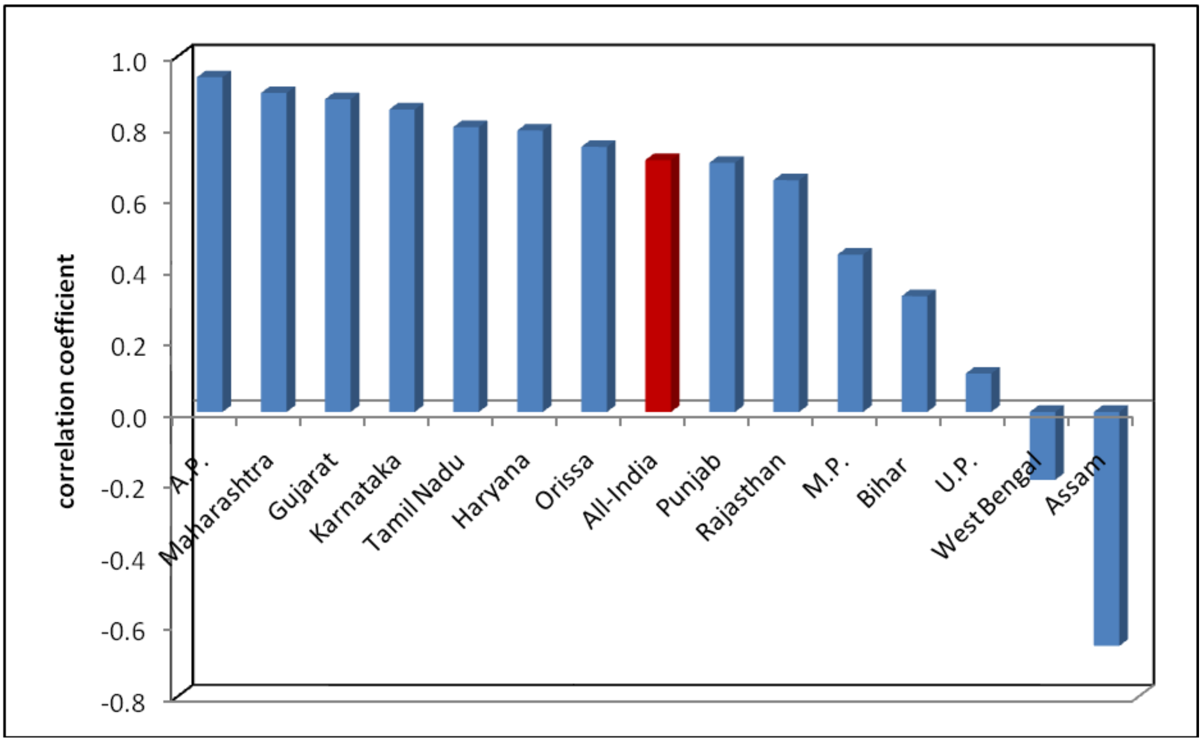
Table 5.7: Association between fertilizer consumption and foodgrains production in selected States: 1971-72 to 2006-07

Range of correlation coefficient	No. of the states			
	1970s	1980s	1990s	2000s
1.0-0.7	3 (17.6)	4 (23.5)	7 (41.2)	8 (57.1)
0.69-0.40	4 (23.5)	5 (29.4)	6 (35.3)	2 (14.3)
0.39-0.01	8 (35.3)	6 (35.3)	2 (11.8)	2 (14.3)
(-) values	2 (11.8)	2 (11.8)	2 (11.8)	2 (14.3)
Total	17 (100.0)	17 (100.0)	17 (100.0)	14 (100.0)

Source: Computed from FAI (2008)

Further looking at state-level association between fertilizer consumption and foodgrains production during the last 7 years (2001-02 to 2007-08), it is interesting to note that Andhra Pradesh registered the highest association (0.94), followed by Maharashtra (0.90) and Gujarat (0.88). Apart form these states, Karnataka (0.85) and Tamil Nadu (0.80) showed strong relationship. States like Punjab, Uttar Pradesh, West Bengal, Madhya Pradesh, Rajasthan and Bihar had correlation coefficient lower than all-India average of 0.71. Assam and West Bengal had negative relationship between foodgrains production and fertilizer consumption.

Figure 5.13: Correlation coefficient between fertilizer consumption and foodgrains production: 2001-02 to 2006-07



Source: Computed from FAI (2008)

In case of association between fertilizer consumption and foodgrains productivity per hectare, it is interesting to note that the association between fertilizer use and foodgrains yield has weakened during the last seven years. The number of states having high correlation coefficient declined from 8 in 1990s to 6 in 2000s. The number of states with correlation coefficient 0.69-0.4 also increased from 2 to 5 during the same period.

Looking further at state-wise results of correlation coefficient between foodgrains productivity and fertilizer consumption during the same period, it is interesting to note that while Andhra Pradesh again registers the highest correlation coefficient (0.92) along with Karnataka (0.83) and Maharashtra (0.81), more importantly a number of major grain producing states like Punjab (0.55), Haryana (0.62), Uttar Pradesh (0.23), West Bengal (0.66), and Rajasthan (0.51) have weak association, as may be seen from Figure 5.14.

It is also important to note that most of the states which had strong association between fertilizer consumption and foodgrains production/productivity had more balanced use of fertilizer nutrients despite the fact some of the states were using higher level of fertilizers.

For example in Andhra Pradesh, average fertilizer consumption per hectare was 2nd highest (200kg/ha) but fertilizer use was more balanced in terms of N, P, and K nutrients (3.8:1.7:1.0). Similarly, in case of Tamil Nadu average fertilizer consumption was 178 kg per hectare but N:P:K ratio was more balanced ((1.8:0.7:1.0). It is evident from the results that imbalanced use of fertilizer nutrients is creating more problems and reducing fertilizer use efficiency. Therefore, efforts are needed to promote balanced use of fertilizer to improve fertilizer efficiency and crop productivity.

Table 5.8: Fertilizer consumption and foodgrains yield: (State-wise)

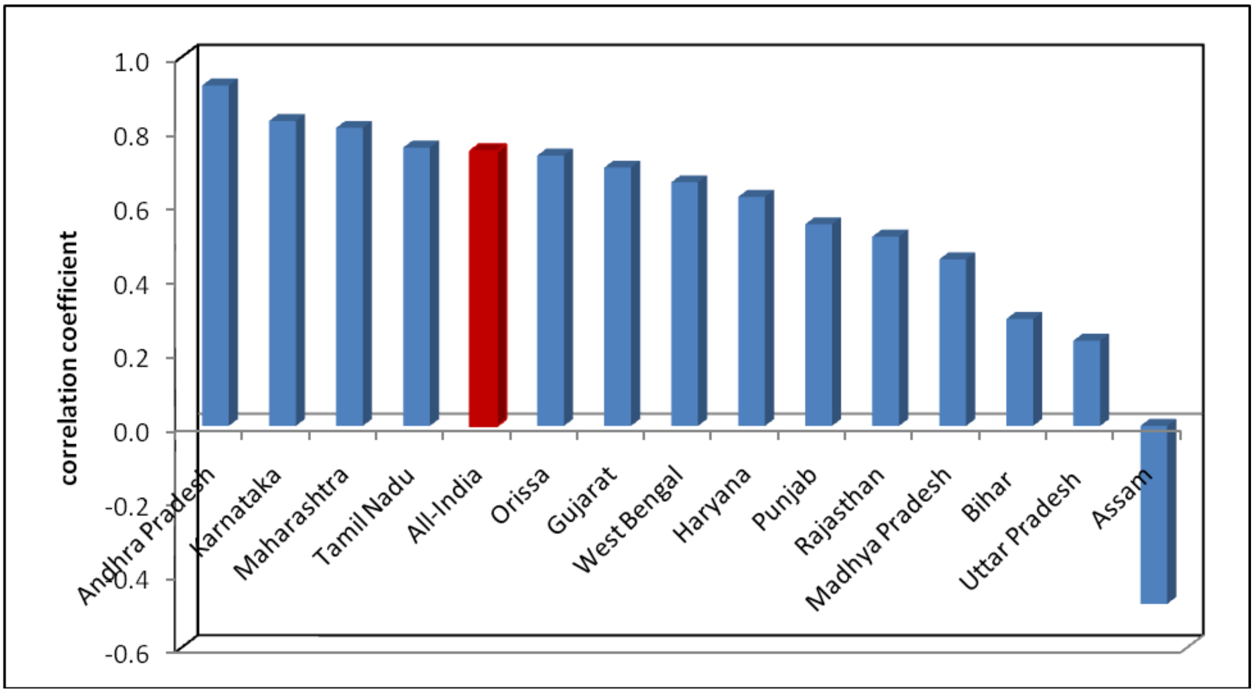
Range of correlation coefficient	No. of the states			
	1970s	1980s	1990s	2000s
1.0-0.7	5 (29.4)	9 (52.9)	8 (47.1)	6 (42.9)
0.69-0.40	4 (23.5)	4 (23.5)	2 (11.8)	5 (35.7)
0.39-0.01	6 (35.3)	2 (11.8)	4 (23.5)	2 (14.3)
(-) values	2 (11.8)	2 (11.8)	3 (17.6)	1 (7.1)
Total	17 (100.0)	17 (100.0)	17 (100.0)	14 (100.0)

Source: Computed from FAI (2008)

Table 5.9 shows the distribution of districts according to range of correlation coefficients during the 1990s and 2000s. In 1990s (1991-92 to 2000-01), 22 out of 182 districts covered in the present analysis had high correlation coefficient (>0.70) and 48 districts had correlation coefficient between 0.40 and 0.70. About one-third of the districts had negative association between fertilizer consumption and foodgrains production. Almost similar distribution was observed during the 2000s. 42 out of 235 districts included in the analysis had high degree of association between foodgrains production and fertilizer consumption. About one-fourth of the districts had correlation coefficient ranging from 0.4 to 0.7. Nearly 30 per cent of districts had negative relationship between foodgrains production and fertilizer consumption. Detailed distribution of districts according to range of correlation coefficient are given in Annexure Table 5.3.

Agriculture and allied sectors contribute about 17 per cent of the total GDP and provide employment to over half of the Indian population. Substantial evidence has demonstrated that chemical fertilizer have played an important role in increasing agricultural production and productivity and in making India self-sufficient in food grain production. However, with the limited arable land resources, and burden of increasing future population numbers, chemical fertilizer will continue to play an important role in food security in India. There is a fear that India's available arable land might decline, if the use of farmland for commercial purpose 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 using the limited arable land, with an emphasis on protecting the environment.

Figure 5.14: Correlation coefficient between fertilizer consumption and foodgrains yield: 2001-02 to 2006-07



Source: Computed from FAI (2008)

The central role played by fertilizer in stimulating agricultural growth has been conclusively demonstrated in many countries, including India, where the widespread adoption of seed-fertilizer technology for cereals production led to the green revolution. There are powerful linkages between increased fertilizer use and agricultural productivity growth. However the results show that these linkages between agricultural production/productivity and fertilizer use in the country have weakened during the past few years. This is a major challenge and needs an urgent attention of policy planners and industry.

Table 5.9: Fertilizer consumption and foodgrains production: (District-wise)

Range of correlation coefficient	No. of the district	
	1990s	2000s
1.0-0.7	22 (12.1)	42 (17.9)
0.69-0.40	48 (26.4)	60 (25.5)
0.39-0.01	50 (27.5)	63 (26.8)
(-) values	62 (34.1)	70 (29.8)
Total	182 (100.0)	235 (100.0)

Note: Figures in parentheses show percentage to total number of districts

Summary and Concluding Remarks

There has been a decline in agricultural NDP in the post-reforms period. The growth rate of net domestic product from agriculture has declined from over 11.5 per cent during the 1980s and 1990s to 3.4 per cent in 2000s. While there has been a decline in agricultural NDP in the post-reforms period, there are considerable regional variations across the country. With regard to the period 2001-02 to 2007-08, the state wise analysis showed wide variations in growth of NDP from agriculture ranging from 10.9 per cent in Gujarat to -4.6 per cent in Jharkhand. Majority of the states had a very high correlation between total NSDP and agricultural NSDP, there is a need to focus on agricultural growth to promote more broad-based and inclusive growth.

The association between foodgrains production/productivity and fertilizer use was strong during the 1970s and 1980s (correlation coefficient 0.94) but weakened thereafter and the reached a level of 0.84 during the 1990s and further to 0.72 during the 2000s. The state-wise trends in association between fertilizer consumption and foodgrains production and productivity revealed that the share of states having strong association declined from about 41 per cent in 1990s to 23.5 per cent in 2000s. Andhra Pradesh registered the highest association (0.94), followed by Maharashtra (0.90) and Gujarat (0.88). Apart form these states, Karnataka (0.85) and Tamil Nadu (0.80) showed strong relationship. States like Punjab, Uttar Pradesh, West Bengal, Madhya Pradesh, Rajasthan and Bihar had correlation coefficient lower than all-India average of 0.72. The results clearly showed that the linkages between agricultural production/productivity and fertilizer use in the country have weakened during the past few years. This is a major challenge and needs an urgent attention of policy planners and industry to reverse this trend.

Chapter 6

DEMAND FOR FERTILIZERS: DETERMINANTS AND OUTLOOK FOR 2015-16

Fertilizer consumption in India has been increasing over the years and today India is one of the largest producer and consumer of fertilizers in the world. The role of fertilizers in agricultural development is well documented in literature. Importance of fertilizers in yield improvement which is essential for achieving increased agricultural production further increases because there is little scope for bringing more are under cultivation as well as majority of Indian soils are deficient in many macro and micro nutrients. Therefore it is important to understand fertilizer use behavior in the country over time as well as role of factors influencing fertilizer consumption at the national and regional/state level because intensity of fertilizer use varies from state to state and area to area. What explains these variations in fertilizer use across states/regions in the country? Why have some states/regions experienced positive growth in fertilizer consumption while others have seen an overall decline/stagnation? What factors (e.g., agro-climatic characteristics, institutional and infrastructure variables, economic factors) play a significant role in shaping fertilizer consumption patterns (Figure 6.1)? To address some of these issues, fertilizer demand models can be constructed to link fertilizer consumption with price and non-price factors using national and state-level data.

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), however, most of these studies pertain to pre-reform period. Therefore, there is a need to examine the likely impacts of the economic policy changes and other factors on fertilizer consumption and agricultural growth. Some of the problems of fertilizer consumption vary from region to region and need to be studied in their local context but there are others which confront most stakeholders all over the country. In this chapter an attempt has been made to understand the factors affecting fertilizers demand at macro level and forecast demand for fertilizers in the country by 2015-16. By estimating demand for fertilizers, one can understand the implications of fertilizers price policy including subsidy and agricultural product price for fertilizer use and their interrelationship.

Figure 6.1: Determinants of Fertilizer Consumption

Organization of I/O sub-sectors
- Structure
- Conduct
- Performance

Basic Services
- Infrastructure
- Quality control
- Banks

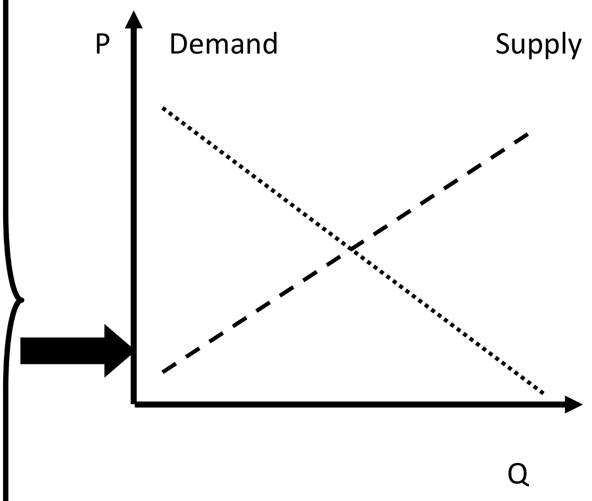
Government Policies
- Taxes & subsidies
- Trade policies
- Exchange rate
- Investment in R&D

Financial Capital Formation
- Income levels
- Credit availability
- Assets

Demographics
- Education
- Extension
- Health/Nutrition

Agro-ecology & Technology
- Rainfall
- Irrigation
- HYVs

Price Factors
- Output demand and prices
- Fertilizer prices



Factors Affecting Demand for Chemical Fertilizers in India

The purpose of this chapter is to estimate three nutrients and total fertilizer demand functions from time series data and to make demand projections for proper planning for production, imports and supply of feedstocks and raw materials. To this end, separate nutrient demand functions were estimated for nitrogen (N), phosphorous (P), potassium (K) and total fertilizers (N+P+K) in the country. The fertilizer demand function is often referred to as a “derived” demand because it is determined to a large extent by the final demand for the crop produced. Though prices may be important in determining fertilizer consumption, they are possibly less important than other non-price factors such as introduction of new technology, high yielding crop varieties, expanded irrigation, availability of credit, changing cropping pattern, etc., causing the derived demand for fertilizers to shift over time.

Specifying a forecasting model is always a challenge, especially the model type and relevant variables. The common models are time series models where the forecast is based on past observations of the variable being forecasted. Causal models and qualitative methods have also been used. Causal models such as simple linear regression models are preferable when projections of the exogenous variables are available. Qualitative methods such as expert opinion are popular when insufficient data is available to estimate a model or when there is the need to augment the results of a quantitative method. In a single equation approach, which has been used widely, typically demand function is estimated using time series of total fertilizer use or per hectare use with some price and non-price variables and often a linear trend. This study uses causal model because time series data on fertilizer consumption as well as variables influencing fertilizer use is available.

We estimated fertilizer demand model using annual time series data, from 1976-77 to 2007-08, for all India and 1980-81 to 2007-08 for state-level analysis using simple linear regression model using ordinary least squares (OLS) method. We hypothesized that the demand for fertilizer is a function of prices (specifically price of fertilizers and foodgrains), subsidy, as well as non-price factors such as gross irrigated area, coverage of high yielding varieties, area under foodgrains and non-foodgrains, cropping intensity, rainfall, capital availability, etc. Among a large number of factors considered in the study, the following variables were finally used in the model based on their statistical significance and stability of the functional relationship to estimate demand for the period 2008-09 to 2015-16. The empirical model for the fertilizer use is specified as follows:

$$Y_{it} = b_0 + b_1\,HYV_t + b_2\,GIA_t + b_2\,CI_t + b_3\,Pfert_{it} + b_4\,Pr{+}w_t + b_5\,Credit_t + U_t$$

Where, Y_{it} is fertilizer consumption; i denotes three nutrients N, P and K and total (N+P+K) fertilizer consumption in thousand tonnes; t denotes year

The following independent variables were hypothesized to influence the adoption positively (+), negatively (-), or either negatively or positively (+/-):

HYV = Percentage of area under HYV to gross cropped area (+)

GIA = Percentage of gross irrigated area to gross cropped area (+)

CI = Cropping intensity (%) (+)

P_{fert} = Prices of fertilizers are represented by price of N through Urea, average price of P_2O_5 through DAP and SSP, price of K through MOP and N+P+K price is the price of N, P and K and weighted by their consumption shares (-)

P_{row} = output price is represented by procurement price of rice and wheat (main users of fertilizers) and weighted by the share of their production (+)

Credit = Short term production credit per hectare of gross cropped area (Rs.) (+)

Two forms of functions, namely, linear and Cobb-Douglas, were tried in this analysis. The results of linear regression equation were used for interpretation as it was found better when compared with Cobb-Douglas production function.

Regression Model Results

The regression estimates for total fertilizer consumption equation are reported in Table 6.1. The high R^2 value (0.99) indicates that explanatory variables in the model have accounted for over 99 per cent variation in fertilizer use and the model best fits when predicting fertilizer demand. The model was significant at 1 per cent level. All explanatory variables used in the model were statistically significant and had theoretically expected signs. Price of fertilizers was negatively related with fertilizers demand while area under high yielding varieties, irrigation, cropping intensity, price of output, and credit had a positive relationship with fertilizer demand.

The results show that non-price factors were more important determinants of fertilizer use. Among the non-price factors, irrigation was the most important factor influencing fertilizer demand, followed by cropping intensity. The price of fertilizers was the third important determinant of fertilizer use in the country. Price of output is less important compared with input price. The results clearly indicate that increase in area under irrigation, and cropping intensity will accelerate fertilizer consumption in the country. In case of pricing policy instruments, increase in prices of fertilizers would lead to reduction in fertilizer use while output price had a positive impact on fertilizer consumption but was less powerful than input prices. Therefore, it is necessary to prioritize input price policy mechanism over higher output prices.

Table 6.1: Estimated regression equation for total fertilizer (N+P+K) use in India

	Coefficient	Standard error	't' value	Rank[2]
(Constant)	-62,426.299	8,881.301	-7.029	-
HYVs	60.022*	35.427	1.694	6
GIA	412.219***	108.129	3.812	1
CI	457.420***	85.457	5.353	2
Price Fertilizers	-694.765***	141.456	-4.912	3
Price Rice+Wheat	6.112**	3.005	2.034	4
Credit	0.041***	0.012	3.312	5
Adj. R Square	0.994			
F	813.337***			
D-W statistics	1.683			

*** Significant at 1 per cent; ** Significant at 5 per cent; * Significant at 10 per cent

N Fertilizers

Table 6.2 presents results for the N fertilizer consumption regression analysis. The results from this model suggest that the regression model provided the best fit to N fertilizer consumption data. The R^2 value was highly significant at one per cent level of significance with the value of 0.995, indicating that over 99 per cent of variation in demand for nitrogenous fertilizers was explained by the explanatory variables included in the model.

As expected, technological factors such as high yielding varieties, irrigation, and cropping intensity and agricultural prices had significant positive impact on N fertilizer consumption.

[2] Based on standardized coefficients (ignoring signs) given coefficients (s.d. of X_i/s.d of Y_i), where s.d. is standard deviation, X_i is i^{th} explanatory variable and Y is dependent variable

Availability of capital also influenced N consumption positively. Price of fertilizer had a significant negative impact on N fertilizer use. Non-price factors, namely, cropping intensity and irrigation, were more powerful in influencing N consumption compared with price factors. Price of N fertilizers was the third important determinant of fertilizer demand. Between, input price and price of agricultural output, price of input (N fertilizer) was more powerful in influencing the consumption. These results were very similar to total fertilizer consumption results.

Table 6.2: Estimated regression equation for N fertilizer use in India

	Coefficient	Standard error	't' value	Rank
(Constant)	-42,465.345	5,639.650	-7.530	-
HYVs	40.842*	24.179	1.689	5
GIA	193.417***	66.730	2.899	2
CI	330.864***	53.101	6.231	1
Price of N Fertilizer	-423.233***	92.407	-4.580	3
Price Rice+Wheat	3.614***	1.565	2.309	4
Credit	0.020***	0.006	3.061	6
Adj. R Square	0.995			
F	916.3*			
D-W statistics	1.622			

*** Significant at 1 per cent; ** Significant at 5 per cent; * Significant at 10 per cent

P Fertilizers

For P fertilizers, the variables included in the model explained about 98 per cent of the variation in consumption of phosphatic fertilizers in the country (Table 6.3). All the variables included in the model had expected signs and were statistically significant except for high a yielding variety, which had expected sign but was statistically non-significant. Irrigation ranked number one in influencing P fertilizer consumption and price of fertilizer turned out to the second most important variable influencing its demand. Price of output ranked fourth in terms of its influence on P fertilizer demand. Availability of credit was also an important determinant of P fertilizer demand and had positive impact.

Table 6.3: Estimated regression equation for P fertilizer use in India

	Coefficient	Standard error	't' value	Rank
(Constant)	-17,537.139	4,095.668	-4.282	-
HYVs	4.222	14.511	0.291	6
GIA	168.678***	50.816	3.319	1
CI	115.604***	40.014	2.889	3
Price of P Fertilizer	-156.859***	26.227	-5.981	2
Price Rice+Wheat	2.339*	1.290	1.814	4
Credit	0.007	0.006	1.128	5
Adj. R Square	0.979			
F	247.1*			
D-W statistics	1.232			

*** Significant at 1 per cent; ** Significant at 5 per cent; * Significant at 10 per cent

K Fertilizers

The variables included in the K fertilizers consumption model explained about 95 per cent of the total variation in fertilizer use (Table 6.4). As expected, irrigation was the most important significant explanatory variable affecting fertilizer consumption. This is logical and expected, as farmers grow fertilizer-intensive crops under irrigated conditions and there is high degree of complementarity between irrigation and fertilizer consumption. The second important determinant of K consumption was availability of capital for buying fertilizers. Price of fertilizers was the third important factor affecting fertilizer demand while price of output was less powerful than fertilizer prices in influencing fertilizer demand.

The demand functions for nitrogen, phosphorus, potassium and total fertilizers (N+P+K) applied per hectare of gross cropped area were also estimated, using linear regression technique and the results are presented in Annexure Tables 6.1 to 6.4. The results suggest that the demand for nitrogen, phosphorus, potassium and total fertilizer consumption per hectare of gross cropped area is price elastic. The fertilizer used per hectare was found to be positively related to gross irrigated area, area under high yielding varieties, cropping intensity and availability of capital. The estimated functions could provide policymakers with some insight for developing fertilizer policies.

Table 6.4: Estimated regression equation for K fertilizer use in India

	Coefficient	Standard error	't' value	Rank
(Constant)	-3,073.680	2,576.136	-1.193	-
HYVs	7.065	9.099	0.776	5
GIA	72.254**	31.987	2.259	1
CI	12.654	25.170	0.503	6
Price of K Fertilizer	-71.484***	26.922	-2.655	3
Price Rice+Wheat	-0.729	0.770	-0.946	4
Credit	0.017***	0.003	5.042	2
Adj. R Square	0.951			
F	100.3*			
D-W statistics	1.986			

*** Significant at 1 per cent; ** Significant at 5 per cent; * Significant at 10 per cent

State-level Demand Functions

The results of estimated regression equations for total fertilizers consumption in major states of the country are given in Table 6.5.

The regression results of the total fertilizer consumption functions are satisfactory in terms of goodness of fit, with high values of R^2 ranging from 0.81 in case of Tamil Nadu to 0.98 in Haryana. Most of the variables having significant t-values are of a priori expectations. Among all variables, irrigation and rainfall were important factors influencing fertilizer use in most of the states. Rainfall had a significant positive impact on fertilizer use in most of the states (8 out of 13 states considered in the analysis) such as Maharashtra, Gujarat, Orissa, Rajasthan, Andhra Pradesh, Tamil Nadu, West Bengal and Haryana. Gross irrigated area also influenced significantly fertilizer use in majority of rainfed states like Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa and Uttar Pradesh. Fertilizer consumption in the previous year influenced current consumption in most of the states. Subsidy was an important determinant of fertilizer demand in six states while output price positively influenced fertilizer consumption in states like Punjab and Uttar Pradesh, where procurement of foodgrains is ensured by the government. Non-price factors were more powerful in influencing fertilizer demand in most of the states compared with price factors with the exception of Punjab and Haryana, where output prices and fertilizer subsidy were more powerful.

Table 6.5: Estimated regression equations for total fertilizer use (N+P+K) in selected states

	Coefficient	Standard error	't' value
	Andhra Pradesh		
Constant	-1345.5180**	553.8078	-2.43
Fertilizer Consumption$_{t-1}$	0.45161***	0.1407	3.21
Fertilizer Subsidy	27.9131*	20.3263	1.37
Gross Irrigated Area	37.9177**	18.5304	2.05
Rainfall	0.1442***	0.0523	2.76
Price Rice+Wheat	0.4350@	0.4043	1.08
Adjusted R square	0.955		
F	111.869		
D-W statistics	1.331		
	Bihar		
Constant	-88.8650	209.7486	-0.42
Fertilizer Consumptiont-1	0.6750***	0.1464	4.61
Fertilizer Subsidy	21.1404*	12.0465	1.75
Gross Irrigated Area	3.4548@	3.6203	0.95
Rainfall	0.0154	0.0391	0.39
Price Rice+Wheat	0.0640	0.2205	0.29
Adjusted R square	0.951		
F	102.064		
D-W statistics	1.631		

Gujarat			
Constant	-288.3588**	140.6421	-2.05
Fertilizer Consumptiont-1	0.2504*	0.1828	1.37
Fertilizer Subsidy	49.5833***	14.7135	3.37
Gross Irrigated Area	18.9501**	8.7934	2.16
Rainfall	0.1042***	0.0357	2.92
Price Rice+Wheat	-0.3132@	0.2994	-1.05
Adjusted R square	0.954		
F	110.04		
D-W statistics	2.197		
Haryana			
Constant	119.1050@	126.9861	0.94
Fertilizer Consumptiont-1	0.9570***	0.1711	5.59
Fertilizer Subsidy	6.9072@	7.2879	0.95
Gross Irrigated Area	-2.1573@	2.0200	-1.07
Rainfall	0.0759*	0.0488	1.55
Price Rice+Wheat	0.0658	0.2508	0.26
Adjusted R square	0.98		
F	261.753		
D-W statistics	2.845		
Karnataka			
Constant	-519.5981**	214.8006	-2.42
Fertilizer Consumptiont-1	0.1527	0.1879	0.81
Fertilizer Subsidy	16.0273@	15.3183	1.05
Gross Irrigated Area	51.8410***	17.1868	3.02
Rainfall	-0.0041	0.0372	-0.11
Price Rice+Wheat	0.1443	0.3671	0.39

Adjusted R square	0.921		
F	61.254		
D-W statistics	1.526		
Madhya Pradesh			
Constant	-209.0704**	104.6600	-2.00
Fertilizer Consumptiont-1	0.4140***	0.1639	2.53
Fertilizer Subsidy	-10.4329	17.2752	-0.60
Gross Irrigated Area	38.3677***	10.7466	3.57
Rainfall	-0.0082	0.0158	-0.52
Price Rice+Wheat	-0.0627	0.3915	-0.16
Adjusted R square	0.93		
F	70.221		
D-W statistics	1.653		
Maharashtra			
Constant	-696.3438**	339.5302	-2.05
Fertilizer Consumptiont-1	0.1313	0.2096	0.63
Fertilizer Subsidy	64.6646***	23.6605	2.73
Gross Irrigated Area	82.5296***	32.6512	2.53
Rainfall	0.0740**	0.0319	2.32
Price Rice+Wheat	-0.4553	0.5801	-0.78
Adjusted R square	0.943		
F	86.694		
D-W statistics	2.441		
Orissa			
Constant	-119.7633***	35.3195	-3.39
Fertilizer Consumptiont-1	0.1835@	0.1516	1.21
Fertilizer Subsidy	-2.5382	3.0838	-0.82

Gross Irrigated Area	5.4858^{***}	1.3765	3.99
Rainfall	$0.0220^{@}$	0.0169	1.30
Price Rice+Wheat	0.4011^{***}	0.0941	4.26
Adjusted R square	0.975		
F	200.3		
D-W statistics	2.046		
Punjab			
Constant	208.7895^{*}	132.2923	1.58
Fertilizer Consumptiont-1	0.7284^{***}	0.1518	4.80
Fertilizer Subsidy	-5.6775	9.5049	-0.60
Gross Irrigated Area	0.4325	1.3752	0.31
Rainfall	0.0253	0.0767	0.33
Price Rice+Wheat	0.3627^{**}	0.1817	2.00
Adjusted R square	0.943		
F	86.253		
D-W statistics	2.076		
Rajasthan			
Constant	$-139.3403^{@}$	153.7672	-0.91
Fertilizer Consumptiont-1	$0.2778^{@}$	0.2171	1.28
Fertilizer Subsidy	-2.2244	11.2008	-0.20
Gross Irrigated Area	1.7937	6.5711	0.27
Rainfall	0.1733^{***}	0.0517	3.35
Price Rice+Wheat	0.8706^{***}	0.3115	2.79
Adjusted R square	0.937		
F	78.105		
D-W statistics	2.49		

Tamil Nadu			
Constant	-238.2319@	268.8721	-0.89
Fertilizer Consumptiont-1	0.7039***	0.1803	3.90
Fertilizer Subsidy	10.4264	13.0990	0.80
Gross Irrigated Area	4.4077	6.8208	0.65
Rainfall	0.2503**	0.1066	2.35
Price Rice+Wheat	-0.0695	0.2506	-0.28
Adjusted R square	0.806		
F	22.557		
D-W statistics	2.022		
Uttar Pradesh			
Constant	143.7226	746.3348	0.19
Fertilizer Consumptiont-1	0.2394@	0.2064	1.16
Fertilizer Subsidy	-30.1831	37.4984	-0.80
Gross Irrigated Area	17.2739@	13.9252	1.24
Rainfall	-0.0040	0.0936	-0.04
Price Rice+Wheat	2.4439**	1.0490	2.33
Adjusted R square	0.941		
F	83.64		
D-W statistics	2.326		
West Bengal			
Constant	-88.0166	125.2097	-0.70
Fertilizer Consumptiont-1	0.8385***	0.1478	5.67
Fertilizer Subsidy	0.4567	12.4779	0.04
Gross Irrigated Area	0.3640	2.3992	0.15
Rainfall	0.0363@	0.0298	1.22
Price Rice+Wheat	0.2341	0.4209	0.56

Adjusted R square	0.962		
F	133.322		
D-W statistics	2.237		

Note: *** Significant at 1 per cent; ** Significant at 5 per cent; * Significant at 10 per cent and @ Significant at 20 per cent

The above results clearly indicate that non-price factors such as irrigation, high yielding varieties, cropping intensity and rainfall were more powerful in influencing demand for fertilizers compared with price factors. Within price factors, price of fertilizers had an adverse affect on fertilizer 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 like better irrigation facilities, high yielding varieties, etc. over pricing policy as an instrument. Second, between output and input prices, there is a need to keep fertilizers prices low as they are more powerful in influencing fertilizer demand than higher output prices.

Fertilizer Demand Forecasts

Based on the estimation results and the projected values of the explanatory variables, we projected the fertilizer demand in year 2011-12 (end of XIth Five Year Plan) and 2015-16. The demand forecasts have been made under two different scenarios. The first scenario assumes the growth in explanatory factors according to the last five year time trend (2002-03 to 2007-08). The second scenario assumes that growth in factors will follow last ten years time trend (1998-99 to 2007-08).

A comparison between the actual fertilizer nutrients consumption and model estimated consumption (Figure 6.2) shows the models track historical data well.

The fertilizer requirement forecasts shown in Table 6.6 were generated by an estimated model using historical fertilizer consumption data. The total demand for fertilizers (N+P+K) is projected to increase to about 28.5 million tonnes by 2011-12 and 34.1 million tonnes by 2015-16 under scenario I and to 23.8 million tonnes and 26.3 million tonnes under scenario II. The demand for N is expected to increase to about 17.4 million tonnes and 20.4 million tonnes under scenario I and 14.7 million tonnes and 15.9 million tonnes under scenario II during the corresponding period. In case of P fertilizers demand is projected at 7.35 and 8.9 million tonnes under scenario I and 6.04 and 6.70 million tonnes under scenario II. For K fertilizers the demand is projected to increase to 3.71 million tonnes and 4.74 million tonnes under scenario I and to about 3 and 3.5 million tonnes under scenario II. The estimated demand for fertilizer nutrients is lower under scenario II because there has been an accelerated growth in factors affecting fertilizer consumption during the last five years (scenario I) compared with last 10 years (scenario II).

The N:P:K ratio remains fairly constant over the projection periods. The ratio, which was 5.5:2.1:1.0 in 2007-08 is projected to be 4.7:2.0:1.0 and 4.3:1.9:1.0 in 2011-12 and 2015-16, respectively. This means slightly more P and K are expected to be consumed in the future relative to N nutrient.

Demand for Fertilizer Products

The demand for fertilizer products such as urea, DAP, SSP, MOP and complex fertilizers was estimated by using averages of their percentage shares in N, P and K consumption, respectively, using data over the period 2003-04 to 2007-08 (Table 6.7).

Figure 6.2: Trends in actual and estimated consumption of fertilizer nutrients in India: 1976-77 to 2007-08

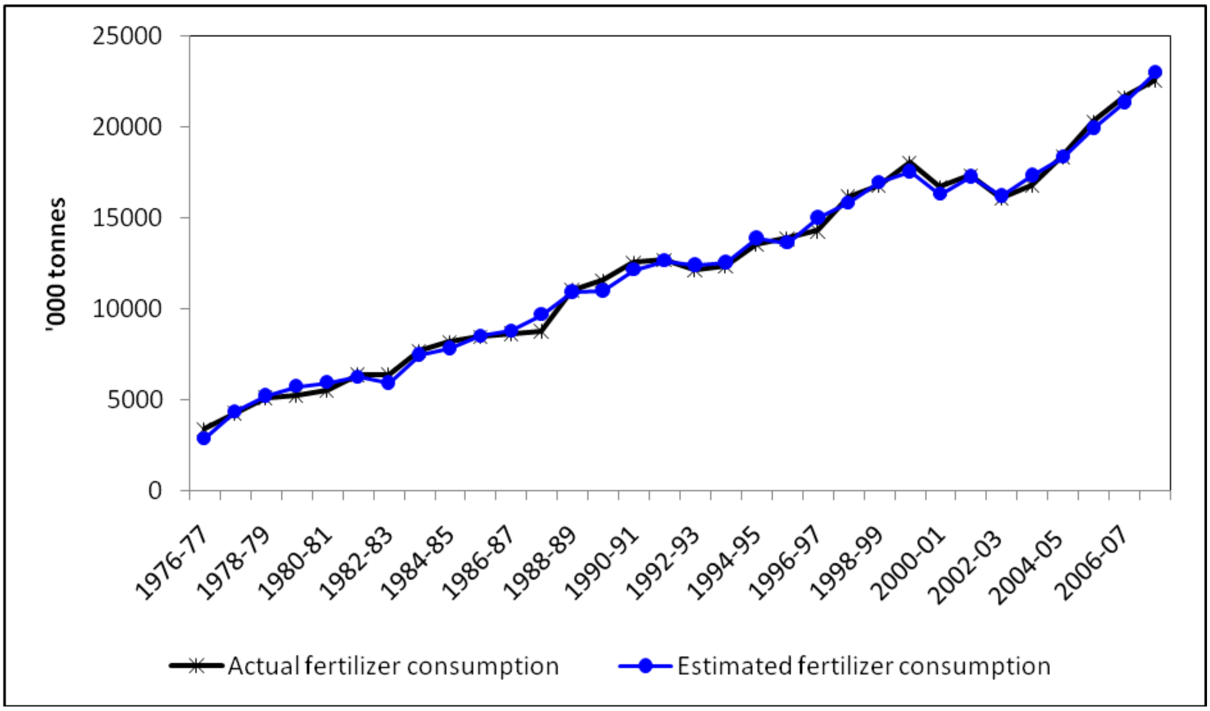


Table 6.6: Annual fertilizer nutrient projections for 2011-12 and 2015-16 under different scenarios

Nutrient	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Scenario I								
N	15101.9	15865.6	16629.3	17393.0	18156.6	18920.3	19684.0	20447.7
P	6190.8	6578.3	6965.8	7353.3	7740.8	8128.3	8515.8	8903.3
K	2948.7	3204.3	3459.9	3715.5	3971.2	4226.8	4482.4	4738.0
Total[3]	24285.7	25712.4	27139.1	28565.8	29992.6	31419.3	32846.0	34272.7
N+P+K	24241.4	25648.2	27055	28461.8	29868.6	31275.4	32682.2	34089.0
Scenario II								
N	13723.7	14038.6	14353.5	14668.3	14983.2	15298.1	15613.0	15927.9
P	5541.4	5707.1	5872.8	6038.5	6204.2	6369.9	6535.6	6701.3
K	2597.8	2733.4	2869.0	3004.6	3140.3	3275.9	3411.5	3547.1
Total	22498.2	23079.2	23660.2	24241.2	24822.2	25403.2	25984.3	26565.3
N+P+K	21879.8	22505.67	23131.55	23757.42	24383.29	25009.16	25635.03	26260.9

Taking into account the average consumption level of 81.6 per cent of N through urea, 61.7 per cent of P through DAP, 28.4 per cent through complex fertilizers, 8.4 per cent P through SSP and 67.8 per cent K through MOP, the product-wise demand for fertilizer products for the period 2011-12 and 2015-16 were worked out and the figure are presented in Table 6.8.

The demand for urea is projected to be around 30.85 million tonnes by 2011-12 and 36.27 million tonnes by 2015-16 under scenario I while the corresponding figure under scenario II were 26.02 and 28.25 million tonnes, respectively. The demand for DAP, complex fertilizers (excluding DAP) and SSP would be nearly 9.86, 8.9, and 3.86 million tonnes, respectively

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

under scenario I and 8.1, 7.32 and 3.17 million tonnes under scenario II by 2011-12. The demand for MOP would be around 4.2 and 3.39 million tonnes under scenario I and II, respectively. The demand for urea is expected to be in the range of 28.25 and 36.27 million tonnes by 2015-26, DAP 8.99-11.94 million tonnes, SSP 3.52-4.67 million tonnes, MOP 4.0-5.35 million tonnes and complex fertilizers 8.1-10.79 million tonnes during the same period. These projections of demand for fertilizer products are based on existing product nutrient ratio and pre-nutrient based pricing regime. However, with introduction of nutrient-based pricing scheme and programmes like national project on Management of Soil and Fertilizer Health to promote balanced use of fertilizer nutrients, the demand for SSP and complex fertilizer might increase at a faster rate in the coming years.

Table 6.7: Share of major fertilizer products in total consumption of N, P_2O_5 and K_2O nutrients: 2003-04 to 2007-08

Year	Share of Urea in Total N	Share of DAP in Total P_2O_5	Share of SSP in Total P_2O_5	Share of MOP in Total K_2O	Share of Complex fert. in Total P_2O_5
2003-04	82.1	62.7	9.9	69.1	27.0
2004-05	81.2	62.2	8.8	70.1	27.9
2005-06	80.6	59.8	8.5	67.9	30.1
2006-07	81.3	61.2	8.4	66.4	28.7
2007-08	82.8	62.5	6.6	65.6	27.9
Average	81.6	61.7	8.4	67.8	28.4

Source: FAI (2008)

Region-wise Demand for Fertilizers

Table 6.9 shows the share of different regions in all-India consumption of fertilizer nutrients during the last five years from 2003-04 to 2007-08. The share of consumption of N is the highest (37.8%) in North region, followed by West (26.6%), South (21.3%) and the lowest in East region (14.3%). The share of consumption of P is the highest in West zone (31.8%), followed by North (29.1%), South (25.7%) and the East (13.3%). In case of K fertilizer nutrients, the share of South region is the highest, followed by West, East and the lowest in North zone. Based on these regional shares, zone-wise demand forecasts of fertilizer nutrients were worked out under different scenarios and the results are presented in Tables 6.10 and 6.11.

Table 6.8: Fertilizer product demand forecasts for 2011-12 and 2015-16

	Urea	DAP	SSP	MOP	Complex fertilizers
Scenario I					
2008-09	26789.5	8303.7	3250.2	3332.0	7501.6
2009-10	28144.2	8823.5	3453.6	3620.9	7971.1
2010-11	29498.9	9343.3	3657.0	3909.7	8440.7
2011-12	30853.7	9863.0	3860.5	4198.5	8910.2
2012-13	32208.2	10382.8	4063.9	4487.5	9379.8
2013-14	33563.0	10902.5	4267.4	4776.3	9849.3
2014-15	34917.7	11422.3	4470.8	5065.1	10318.9
2015-16	36272.4	11942.0	4674.2	5353.9	10788.4
Scenario II					
2008-09	24344.7	7432.7	2909.2	2935.5	6714.7
2009-10	24903.3	7655.0	2996.2	3088.7	6915.5
2010-11	25461.9	7877.2	3083.2	3242.0	7116.3
2011-12	26020.3	8099.5	3170.2	3395.2	7317.1
2012-13	26578.9	8321.7	3257.2	3548.5	7517.8
2013-14	27137.5	8544.0	3344.2	3701.8	7718.6
2014-15	27696.1	8766.2	3431.2	3855.0	7919.4
2015-16	28254.7	8988.5	3518.2	4008.2	8120.2

Table 6.9: Region-wise share (%) to all-India consumption of fertilizer nutrients: 2003-04 to 2007-08 average

	N	P_2O_5	K_2O
East	14.3	13.3	21.8
North	37.8	29.1	11.9
South	21.3	25.7	42.7
West	26.6	31.8	23.7

Source: FAI (2008)

Total demand for fertilizer (N+P+K) in the East region is projected to reach a level of about 5136 thousand tonnes by the end of 2015-16. In case of North region, total fertilizer demand is expected to be about 10895 thousand tonnes, and in South and Western region nearly 8666 and 9393 thousand tonnes, respectively. However, the demand forecasts were on the lower side if we assume slower growth in factors affecting fertilizer consumption (scenario II). But with renewed focus on agricultural sector during the Eleventh Five Year Plan we expect the demand for fertilizer to increase at a faster rate and estimates under scenario I seem to be realistic estimates.

Table 6.10: Zone-wise fertilizer nutrients demand forecasts for 2011-12 and 2015-16 under scenario I

	N	P	K	Total
East Zone				
2008-09	2158.2	822.2	641.7	3622.1
2009-10	2267.3	873.6	697.4	3838.3
2010-11	2376.5	925.1	753.0	4054.6
2011-12	2485.6	976.5	808.6	4270.8
2012-13	2594.7	1028.0	864.3	4487.0
2013-14	2703.9	1079.5	919.9	4703.3
2014-15	2813.0	1130.9	975.5	4919.5
2015-16	2922.2	1182.4	1031.2	5135.7

North Zone				
2008-09	5714.9	1804.4	349.7	7869.0
2009-10	6003.9	1917.4	380.0	8301.3
2010-11	6292.9	2030.3	410.3	8733.6
2011-12	6582.0	2143.3	440.6	9165.8
2012-13	6870.9	2256.2	470.9	9598.1
2013-14	7159.9	2369.1	501.3	10030.3
2014-15	7448.9	2482.1	531.6	10462.6
2015-16	7737.9	2595.0	561.9	10894.8
South Zone				
2008-09	3214.9	1592.6	1258.7	6066.1
2009-10	3377.5	1692.3	1367.8	6437.5
2010-11	3540.0	1791.9	1476.9	6808.8
2011-12	3702.6	1891.6	1586.0	7180.2
2012-13	3865.2	1991.3	1695.1	7551.6
2013-14	4027.7	2091.0	1804.2	7922.9
2014-15	4190.3	2190.7	1913.3	8294.3
2015-16	4352.9	2290.4	2022.4	8665.7
West Zone				
2008-09	4013.9	1971.6	698.6	6684.1
2009-10	4216.9	2095.0	759.2	7071.1
2010-11	4419.8	2218.4	819.7	7458.0
2011-12	4622.8	2341.9	880.3	7845.0
2012-13	4825.8	2465.3	940.9	8231.9
2013-14	5028.8	2588.7	1001.4	8618.9
2014-15	5231.7	2712.1	1062.0	9005.8
2015-16	5434.7	2835.5	1122.5	9392.8

Table 6.11: Zone-wise fertilizer nutrients demand forecasts for 2011-12 and 2015-16 under scenario II

	N	P	K	Total
East Zone				
2008-09	1961.2	735.9	565.4	3262.5
2009-10	2006.2	757.9	594.9	3359.1
2010-11	2051.2	779.9	624.4	3455.6
2011-12	2096.2	801.9	653.9	3552.1
2012-13	2141.2	823.9	683.4	3648.6
2013-14	2186.2	845.9	713.0	3745.1
2014-15	2231.2	868.0	742.5	3841.7
2015-16	2276.2	890.0	772.0	3938.2
North Zone				
2008-09	5193.4	1615.1	308.1	7116.6
2009-10	5312.6	1663.4	324.2	7300.2
2010-11	5431.7	1711.7	340.2	7483.7
2011-12	5550.9	1760.0	356.3	7667.2
2012-13	5670.0	1808.3	372.4	7850.8
2013-14	5789.2	1856.6	388.5	8034.3
2014-15	5908.4	1904.9	404.6	8217.8
2015-16	6027.5	1953.2	420.6	8401.4
South Zone				
2008-09	2921.5	1425.5	1108.9	5455.9
2009-10	2988.5	1468.1	1166.8	5623.4
2010-11	3055.6	1510.8	1224.6	5791.0
2011-12	3122.6	1553.4	1282.5	5958.5
2012-13	3189.6	1596.0	1340.4	6126.1
2013-14	3256.6	1638.6	1398.3	6293.6
2014-15	3323.7	1681.3	1456.2	6461.2
2015-16	3390.7	1723.9	1514.1	6628.7

West Zone				
2008-09	3647.6	1764.8	615.5	6027.9
2009-10	3731.3	1817.6	647.6	6196.5
2010-11	3815.0	1870.4	679.7	6365.1
2011-12	3898.6	1923.1	711.9	6533.6
2012-13	3982.3	1975.9	744.0	6702.2
2013-14	4066.0	2028.7	776.1	6870.8
2014-15	4149.7	2081.4	808.3	7039.4
2015-16	4233.4	2134.2	840.4	7208.0

The findings suggest that increase in area under irrigation, high-yielding varieties, and easy availability of short-term credit is needed to boost fertilizer demand in the country. Of the two price policy instruments, reduction in fertilizer prices or increase in agricultural commodity prices, the former is more powerful in influencing fertilizer consumption. The high product price support policy benefits the large farmers who have net marketed surplus while low input prices benefit all categories of farmers. Therefore, in order to ensure self-sufficiency in foodgrains production in the country, availability of fertilizers at affordable prices to the producers is of utmost importance. The government should give due importance to non-price factors like better seeds, irrigation, credit, etc. to increase fertilizer use in the country. For this, more investment irrigation, agricultural research and development, extension services and infrastructure are indispensable in the context of a country like India. The results also suggest fertilizer subsidy to be more appropriate means to achieve the stated objectives compared with price support policy. However, there is a need to contain and target these subsidies in a better way.

Summary and Concluding Remarks

The above results clearly show that non-price factors were more important than price factors in influencing demand for fertilizers. Among the non-price factors, irrigation was the most important factor influencing fertilizer demand, followed by cropping intensity. The price of fertilizers was the third important determinant of fertilizer use in the country. Price of output was less important compared with input price. It is evident that increase in area under irrigation, and improvement in cropping intensity will accelerate fertilizer consumption in the country. In case of pricing policy instruments, between prices of fertilizers and prices of crops, the former are more important than the latter in determining demand for fertilizers. Therefore, prices of fertilizers which have inverse relationship with fertilizer demand should be kept at affordable levels to promote rapid growth in fertilizer use in different parts of the country. The role of product price support policy in generating growth in effective demand for fertilizers and consequently higher growth in agriculture, however, was overemphasized during the 1990s. Despite very favorable output price conditions during the 1990s, agricultural sector had a low growth rate. Therefore, it is necessary to prioritize input price policy mechanism over higher output prices.

The projections of fertilizer nutrients under different scenarios/assumptions show a range of demand figures of total nutrients between 24 and 28.5 million tonnes by 2011-12, the terminal year of 11th Plan and between 26 and 34 million tonnes by 2015-16. If variables affecting fertilizer use grow at the rate of last five years, the total nutrient requirement will amount to about 34 million tonnes, which includes 20.4 million tonnes of N, 8.9 million tonnes of P and 4.7 million tonnes of K by the end of 2015-16. The N:P:K ratio, which was 5.5:2.1:1.0 in 2007-08 is projected to be 4.3:1.9:1.0 in 2015-16. The demand for urea is projected to be around 30.85 million tonnes by 2011-12 and 36.27 million tonnes by 2015-16 under scenario I (based on last five year growth) while the corresponding figures under scenario II (based on last 10 year growth) were 26.02 and 28.25 million tonnes , respectively. The demand for DAP, complex fertilizers (excluding DAP) and SSP would be nearly 9.86, 8.9, and 3.86 million tonnes, respectively under scenario I and 8.1, 7.32 and 3.17 million tonnes under scenario II by 2011-12. The demand for MOP would be around 4.2 and 3.39 million tonnes under scenario I and II, respectively.

Chapter 7

OVERVIEW OF GLOBAL FERTILIZER INDUSTRY

With steady growth of population, shrinking arable land and rise in standard of living especially in developing countries, increase in agricultural production is essential to ensure adequate food supply. The role of fertilizers in support of a growing demand for agricultural commodities is well established. There is a positive association between agricultural production and fertilizer use in developing countries, which currently use the bulk of fertilizers and exhibit a faster growth relative to developed countries. The continuous increase in food production has increased the importance of, and demand, for fertilizers. This chapter provides and overview of global fertilizer industry.

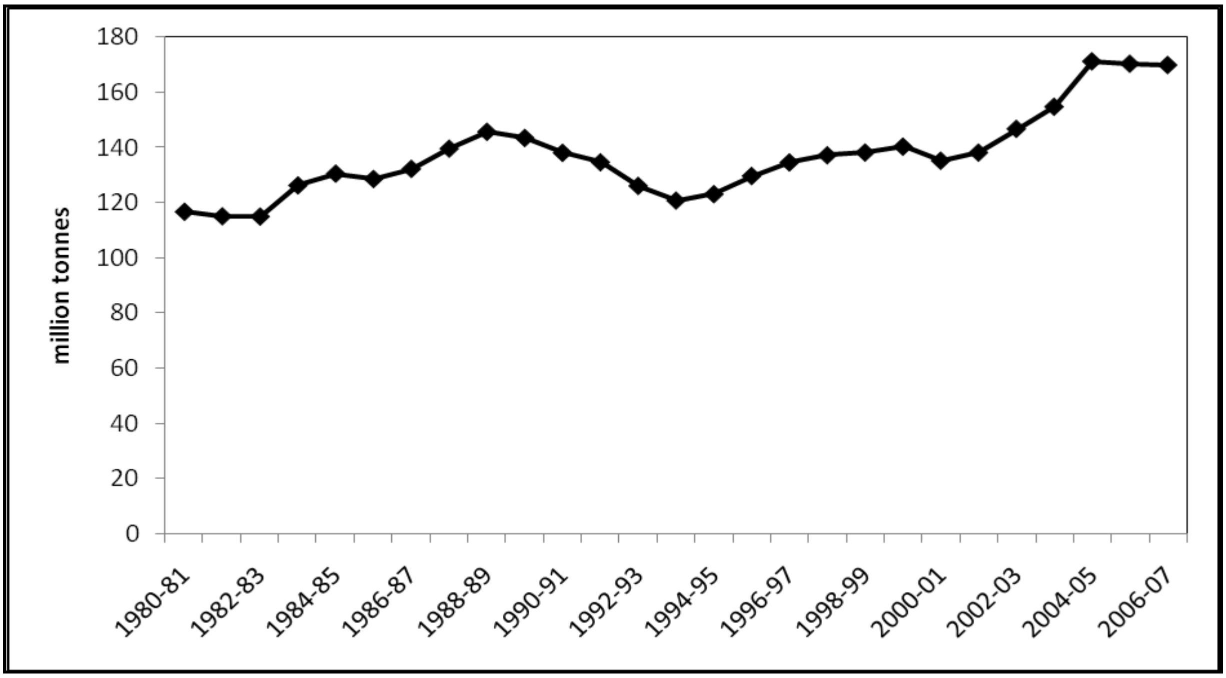
GLOBAL FERTILIZER CONSUMPTION

Trends in world fertilizer consumption during the period 1980-81 to 2006-07 are presented in Figure 7.1. Global consumption of fertilizer (N+P+K) has risen from 116.1 million tonnes in 1980-81 to about 169 million tonnes during 2007-08, representing an annual compound growth rate of just over one per cent. The growth rate in N consumption was maximum (1.62%), followed by P fertilizers (0.48%) and the lowest in K fertilizers (0.11%) between 1980-81 and 2006-07.

Figure 7.2 provides information on the consumption levels of three main types of fertilizer nutrients (N, P and K) from 1980-81 to 2008-09. The share of nitrogenous fertilizers in total fertilizer use is the highest (57.6%), followed by P_2O_5 (24%) and K_2O (18.4%). The share of N fertilizers has increased between during the last two and half decades while share of P and K fertilizers has declined in the world.

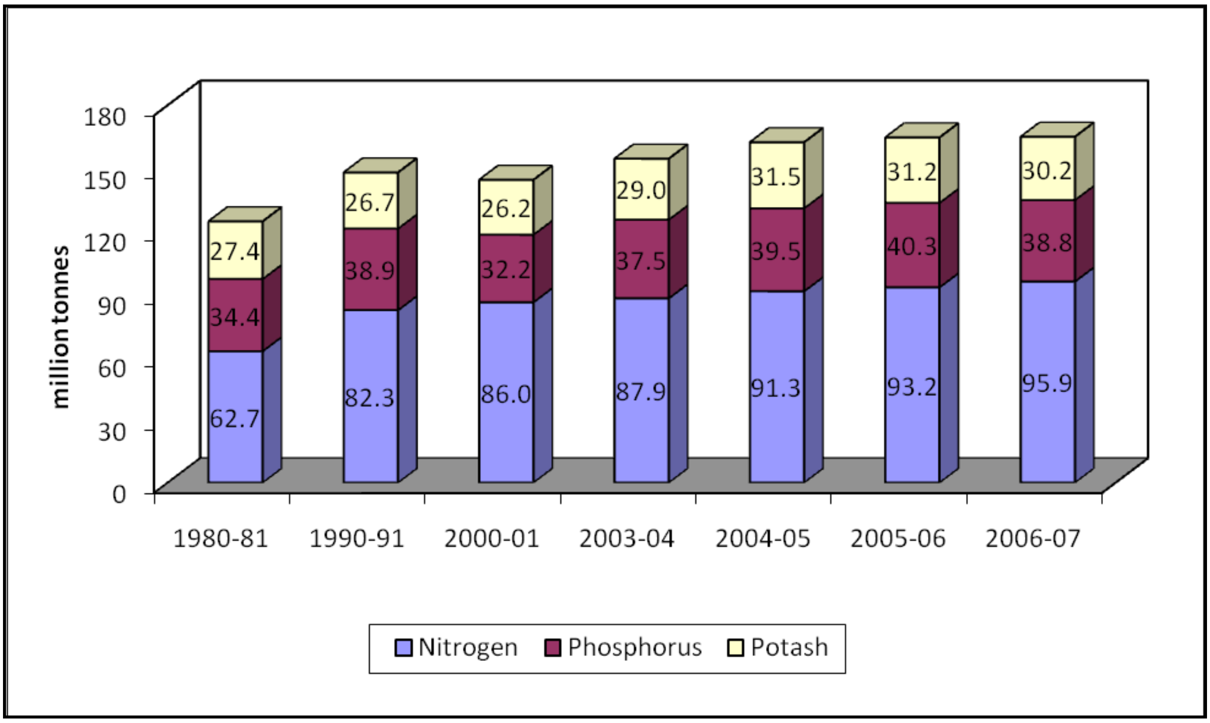
During 2007-08 global fertilizer consumption rose sharply (from about 161 million tonnes in 2006-07 to 168.7 million tonnes in 2007-08) due to strong agricultural commodity prices during the first half of 2008 and strong policy support in many developing countries (Figure 7.3). Because of the economic slow down during the second half of 2008, global fertilizer consumption in 2008-09 is expected to decline by about 2.2 per cent, to 165 million tonnes nutrients. It is expected that after a likely depressed first half of 2009, fertilizer demand could recover during the second half of the year.

Figure 7.1: Trends in world consumption of fertilizers (N+P+K): 1980-80 – 2006-07



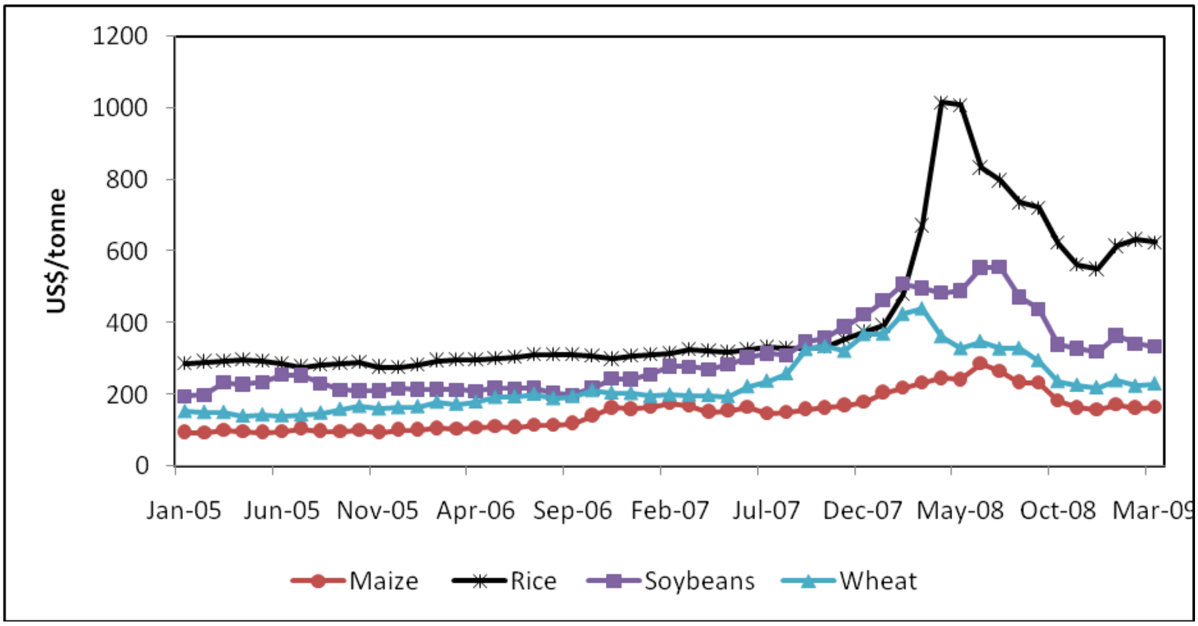
Source: IFA (2009)

Figure 7.2: Trends in global consumption of fertilizers (million tonnes nutrients)



Source: IFA(2009)

Figure 7.3: Trends in world prices (US$ per metric tonne) of selected agricultural commodities



Source: IMF (2009)

Growth Rates in Fertilizer Consumption

Table 7.1 presents the growth trends of N, P and K fertilizer nutrients consumption from 1980-81 to 2007-08. Between 1980-81 and 2006-07, total fertilizer consumption grew at a modest rate of just over one per cent. The steady growth in nitrogen consumption was accompanied by stagnant growth in phosphatic and potassic consumption. The growth rates were significantly lower during the decade of 1990s compared with 1980s. P and K fertilizer consumption witnessed negative growth rate during the nineties. However, during 2000s fertilizer consumption picked up and witnessed significant positive growth in all nutrients.

The annual compound growth rates of total fertilizer consumption in the world were computed and the classification of countries according to the compound growth rates of consumption during the 1980s, 1990s and 2000s are given in Table 7.2. In 1980s, Mexico and Australia showed significant positive growth in fertilizer consumption, wherein during the nineties and 2000s these two countries recorded positive but statistically non-significant growth rate. Egypt, Bangladesh and China showed a positive and significant growth in fertilizer consumption during the 1990s as well as in 2000s. India witnessed a positive but non-significant growth in fertilizer use in 1980s and 2000s whereas in 1990s India had significant positive growth rate. New Zealand during the 1980s and Nepal in the current decade reported significantly negative growth in fertilizer consumption.

Table 7.1: Growth rates in global consumption of fertilizers

	1980s	1990s	2000s	All period
Nitrogen	3.40	1.45	4.09	1.62
Phosphorus	2.39	-0.34	4.51	0.48
Potash	1.84	-0.45	6.42	0.11
Total	2.82	0.68	4.59	1.05

Source: Computed from IFA (2009)

Table 7.2: Classification of countries according to Growth in total fertilizer consumption

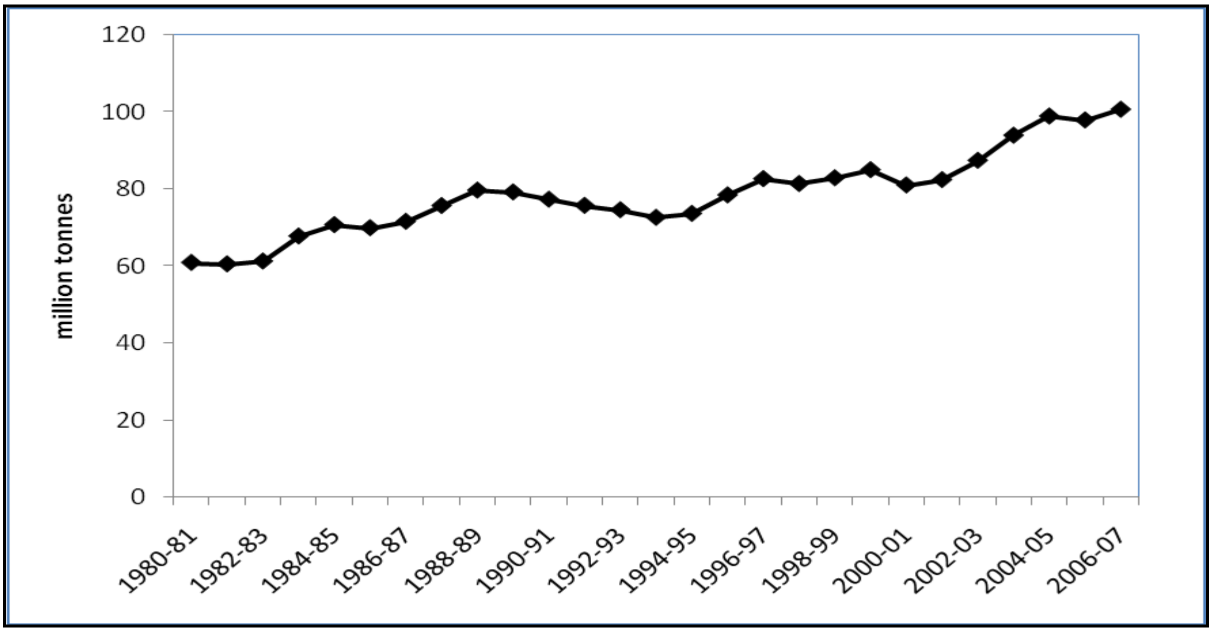
	1980s	1990s	2000s	All period
Significant +ve growth	Mexico 2.9 Australia 2.2	Egypt 4.6 Bangladesh 5.1 China 4.9 India 5.5 Nepal 4.2 Pakistan 6.0 New Zealand 4.7	Egypt 13.2 Brazil 9.1 Bangladesh 5.5 China 7.4	USA 0.4
Non-significant +ve growth	Egypt 3.9 Brazil 2.0 Bangladesh 9.1 China 6.0 India 13.2 Japan 0.5 Pakistan 7.1 Sri Lanka 2.2 France 0.9 UK 1.3	Mexico 2.3 USA 1.7 Brazil 7.3 Sri Lanka 5.0 Germany 0.8 UK 0.2 Australia 8.1	Mexico 2.9 USA 2.4 India 1.6 Japan 5.9 Pakistan 2.9 Sri Lanka 1.2 Netherlands 5.2 UK 0.4 Ukraine 1.0 Australia 0.2 New Zealand 4.8	Egypt 3.3 Mexico 0.6 Brazil 4.8 Bangladesh 6.0 China 4.7 India 5.2 Pakistan 4.9 Sri Lanka 0.8 Australia 3.6 New Zealand 2.8
Significant -ve growth	New Zealand -3.6		Nepal -23.6	UK -1.3
Non-significant -ve stagnant	USA -1.2 Netherlands -1.2	Japan -3.7 France -0.3 Netherlands -0.1 Ukraine -20.5	France -0.3 Germany -0.5	Japan -1.6 Nepal -3.3 France -1.5 Germany -0.9 Netherlands -2.0 Ukraine -11.9

Source: Computed from IFA (2009)

Nitrogen Fertilizers

The global market for nitrogenous fertilizers is the largest of the three main nutrients, accounting for 61.3 per cent of total fertilizer consumption in 2007-08. The share of nitrogen has increased from about 52 per cent in 1980-81 to over 60 per cent in 2007-08. In contrast, the share of phosphatic fertilizers has declined from about 27 per cent to 23 per cent and potassic fertilizers from about 21 per cent to 17.5 per cent during the corresponding period. The bias towards nitrogenous fertilizers has been encouraged in part by increased production in areas where cheap natural gas is available (including major consuming regions such as South Asia and China) and in part by the policies favorable to N fertilizers.

Figure 7.4: World N fertilizer consumption: 1980-81 – 2006-07



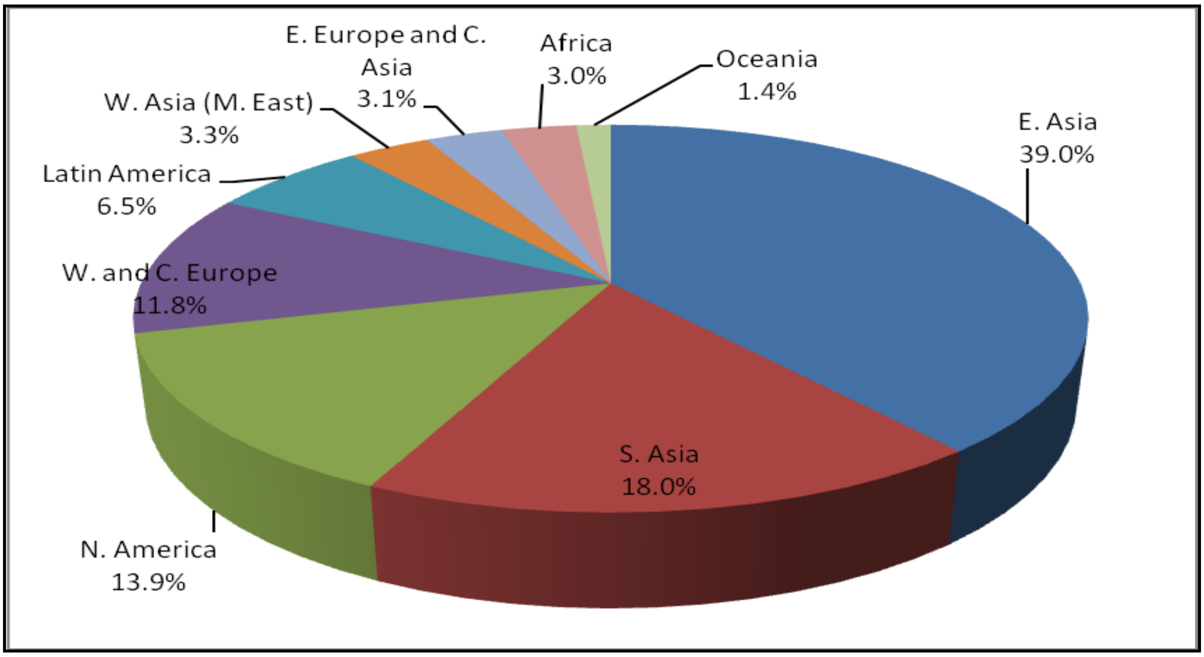
Source: IFA (2009)

World consumption of nitrogen fertilizers increased from about 60 million tonnes in early 1980s to over 100 million tonnes in 2007, an increase of about 67 per cent (Figure 7.4). The growth rate in consumption of N fertilizers was higher during the decade of eighties compared with the 1990s. However, N fertilizer consumption again increased significantly during the last seven years mainly because of high commodity prices.

Regional Shares

Demand for nitrogenous fertilizers continues to be high in East and South Asia, which accounted for about 57 per cent of world consumption in the Triennium Ending (TE) 2006 (Figure 7.5). North America accounted for 13.9 per cent of world consumption and Western and Central Europe 11.8 per cent. The other regions (Africa, Eastern Europe, Central Asia and Oceania) each account for about 2-3 per cent of world N fertilizer consumption.

Figure 7.5: Global N fertilizers consumption (TE 2006): Percentage breakdown of consumption volumes by region



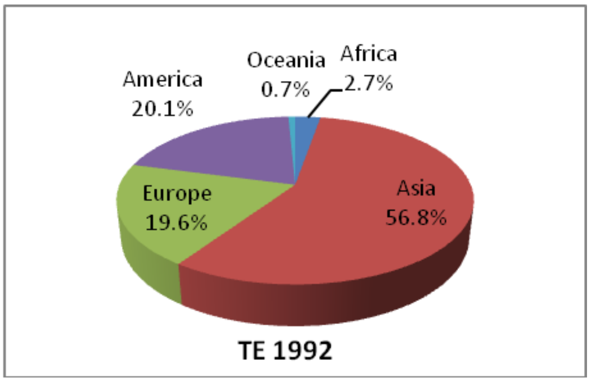
Source: IFA (2009)

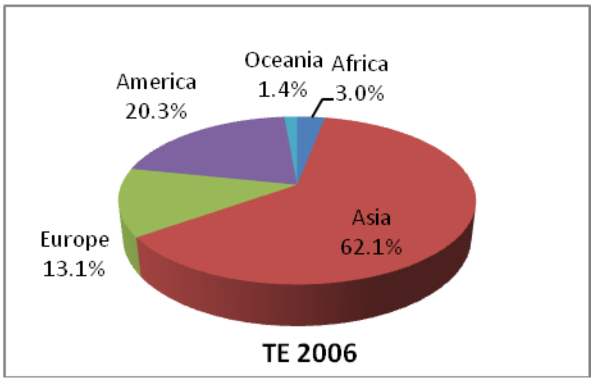
A comparison of N consumption changes by region between TE 1992 and TE 2006 is shown in Figure 7.6. In the TE 1992, share of Asia in total N consumption was 56.8 per cent, which increased to 62.1 per cent in TE 2006. Africa has a small share (about 3%) in global N consumption. The share of Europe has declined from 19.6 per cent in TE 1992 to 13.1 per cent in TE 2006. America accounted for about 20 per cent of the world consumption of nitrogenous fertilizers.

Major N Fertilizer Consuming Countries

Major consumers of nitrogenous fertilizers are given in Table 7.3. About two-third of N consumption is concentrated in three countries, namely, China, USA and India. China is the largest consumer of N fertilizers in the world accounting for 34.6 per cent share, followed by the USA (14.4%). India is the third largest consumer of N fertilizers with estimated share of 13.7 per cent. France is the fourth largest consumer with 2.2 per cent share during 2006-07. India and China have gained share in global consumption between 1995-96 and 2006-07, while the share of USA has remained almost constant at around 14 per cent.

Figure 7.6: Regional shares in global N consumption: Selected comparisons





Source: IFA (2009)

Table 7.3: Major consumers of N fertilizers (% share in global consumption)

Country	1995-96	2000-01	2006-07
China	30.4	27.3	34.6
USA	14.2	12.9	14.4
India	12.5	13.5	13.7
France	3.1	3.0	2.2
India’ rank	2nd	3rd	3rd

Source: FAI (2008)

Table 7.4 shows growth rates in consumption of nitrogenous fertilizers in major consuming countries during the last two and half decades. During the 1980s and 1990s, India experienced the highest growth rate in N consumption, followed by China among the top five consumers. However, in the last seven years (2001-2007) China surpassed India and recorded the highest growth rate (8%), followed by USA (2.18%) and India (1.20%).

The compound annual growth rates in consumption of N fertilizers in different countries of the world were calculated and distribution of countries according to growth rates during the last two and half decades are presented in Annexure Table 7.1. The results show that most of the countries witnessed positive growth rates in N consumption and growth rates were higher in developing countries compared with developed countries.

Table 7.4: Classification of major N consuming countries according to growth rates in N fertilizer consumption

	1980s	1990s	2000s	1980-2000s
Significant +ve growth rate	Russia (3.47)	China (2.91) USA (1.06)	China (8.00)	-
Non-significant +ve growth rate	China (5.46) India (7.64)	France (1.31) India (4.80)	France (0.21) India (1.20) USA (2.18)	China (3.69) India (4.86) USA (0.78)
Significant -ve growth rate	-	-	-	-
Non-significant -ve growth rate	USA (-0.34)	-	-	France (-0.09)

Figures in parentheses show compound annual growth rates
Source: FAI (2008)

Product Usage Trends

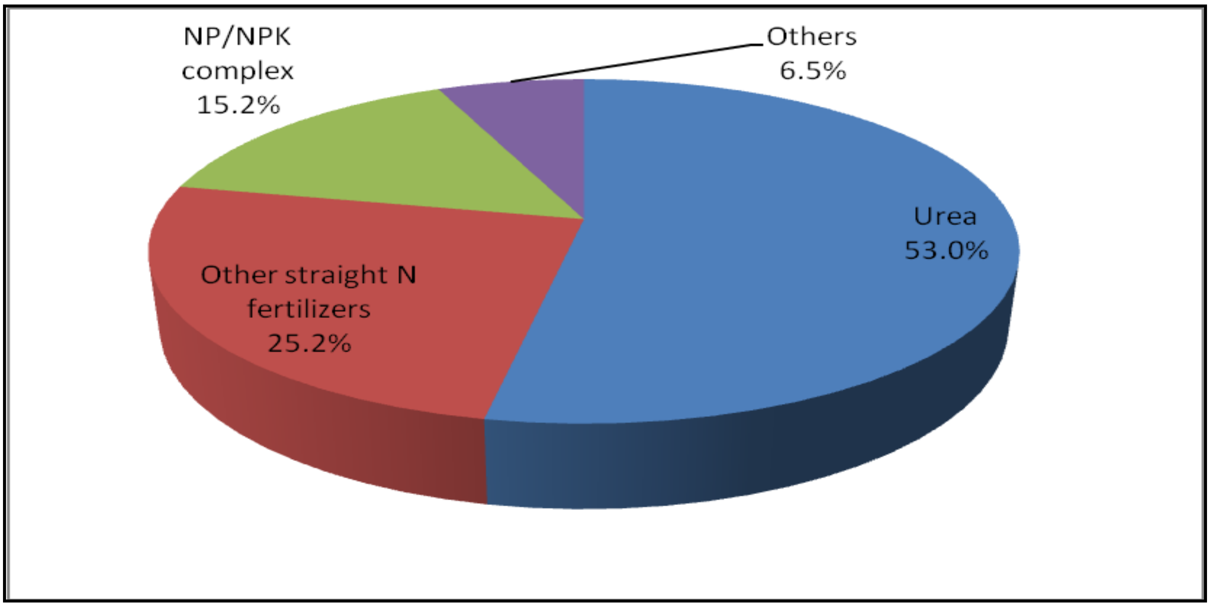
Urea

Urea is the most commonly used nitrogenous fertilizer product and is widely used in developing countries. In the global market, it is more widely traded than other nitrogenous fertilizer products. As shown in Figure 7.7, urea represented 53.0 per cent of all nitrogenous fertilizer products consumed globally during the TE 2006-07. The share of other straight nitrogenous fertilizer products was 25.2 per cent and NP/NPK compounds 15.2 per cent.

Figure 7.8 shows the global consumption of urea between 1980-81 and 2006-07. With the increasing share of urea in the nitrogen fertilizer mix, overall urea share reached a record level of 53.5 per cent in 2006-2007, while share of other straight nitrogenous fertilizers (ammonium sulphate, ammonium nitrate, calcium ammonium nitrate, etc.) declined from

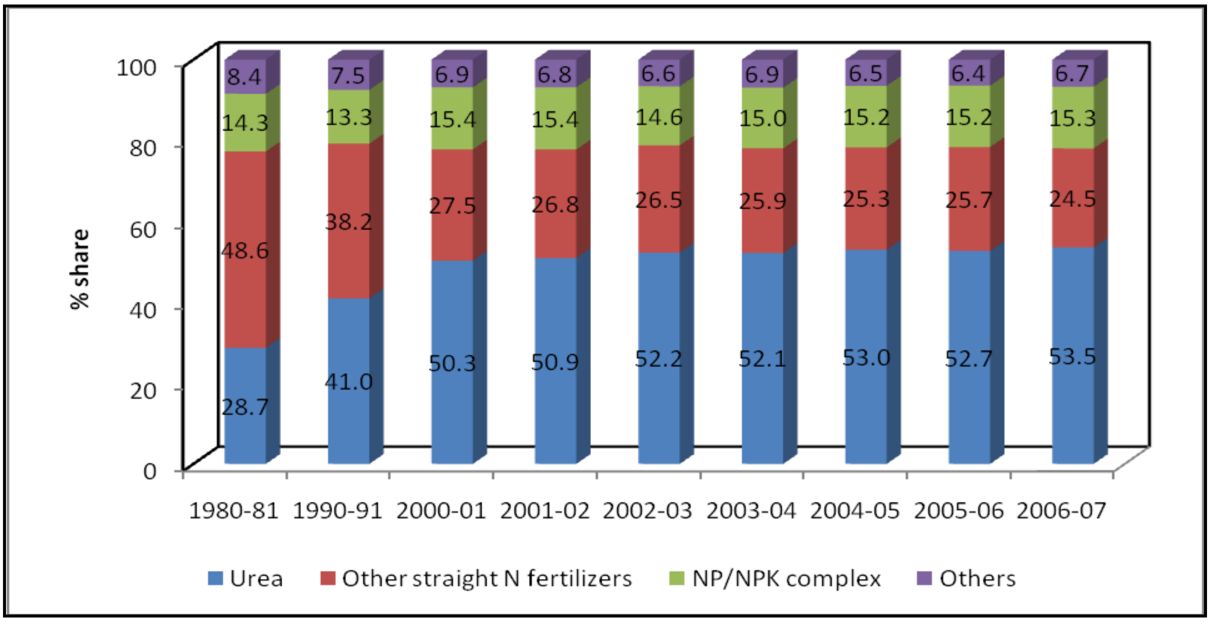
48.6 per cent in 1980-81 to 24.5 per cent in 2006-07 (Figure 7.8). The share of NP and NPK compounds remained constant at about 15 per cent during the last two and half decades.

Figure 7.7: Share of nitrogenous fertilizer products in global consumption of N fertilizers during the TE 2006-07



Source: IFA (2009)

Figure 7.8: Breakdown of global nitrogenous fertilizers consumption (% share)

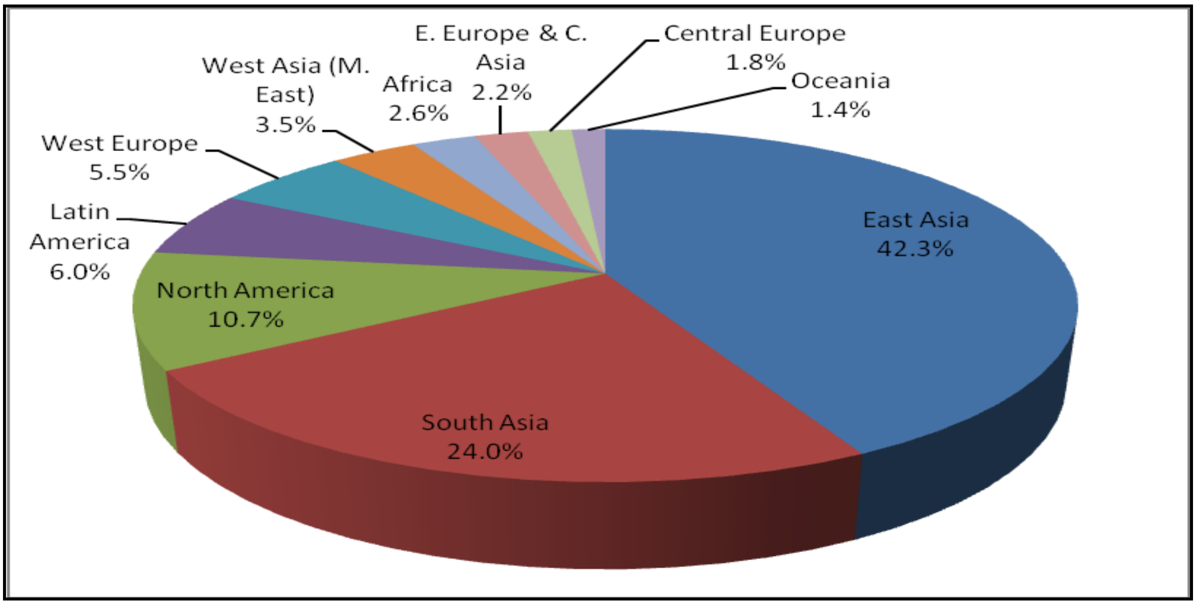


Source: IFA (2009)

Asia was the largest consumer of urea with over two-third of total consumption during the TE 2007 (Figure 7.9). North America accounted for 10.7 per cent of world consumption and

Latin America and Western Europe for 6 per cent each. The other regions, Africa, Central Europe, Middle East, Eastern Europe and Oceania, each account for some 2-3 per cent of world consumption.

Figure 7.9: Global urea markets: Percentage share of consumption by region



Source: IFA (2009)

Phosphate Fertilizers

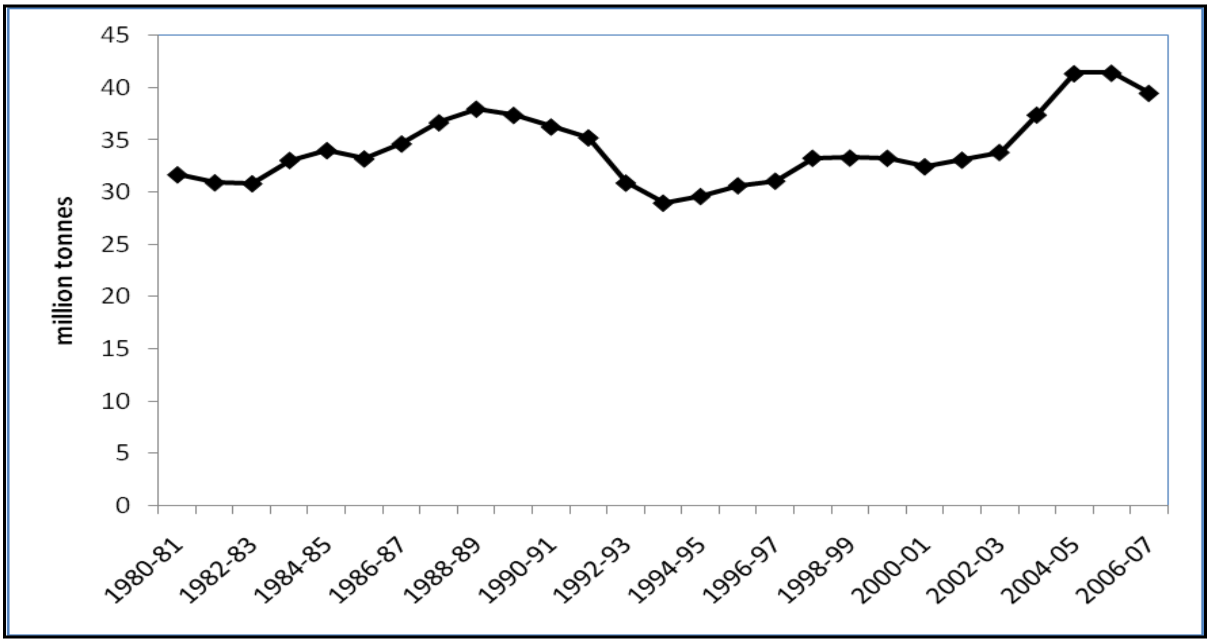
Global phosphate consumption has increased from about 33 million tonnes in early 1980s to 41.4 million tonnes in 2006 (Figure 7.10). However, during the 1990s, P consumption fell significantly from about 36 million tonnes in 1991 to nearly 33 million tonnes in 2000. P fertilizer consumption picked up in the 2000s due to strong agricultural commodity prices. However, average growth in consumption of P fertilizers was lower than N fertilizers between 1981 and 2007.

Regional Consumption Patterns

Regional phosphate consumption trends are shown in Figure 7.11. It can be seen that in case of phosphatic fertilizers, Asia (East and South Asia) is the largest consumer accounting for 53.5 per cent share, followed by Latin America (13.1%) and North America (12.5%) in the TE 2006. The share of other regions, Africa, Eastern Europe and Central Asia, Middle East, and Oceania, is about 2-4 per cent.

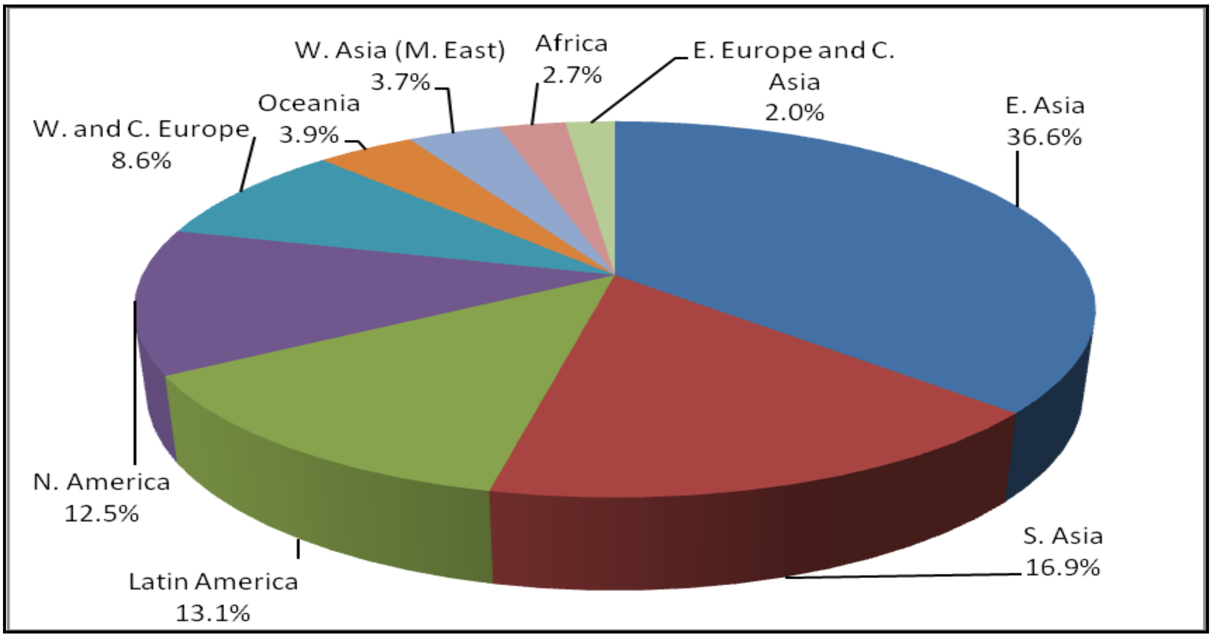
There have been some changes in regional shares of P consumption between TE 1992 and TE 2006 and are shown in Figure 7.12. Asia and Americas have improved their share in global P consumption, while Europe has lost its share from 20 per cent in 1990 to 9.2 per cent in 2006-07. Asia still is the largest consumer of phosphatic fertilizers in the world, accounting for 58.6 per cent of global consumption.

Figure 7.10: World phosphate (P_2O_5) consumption trends: 1980-81 – 2006-07



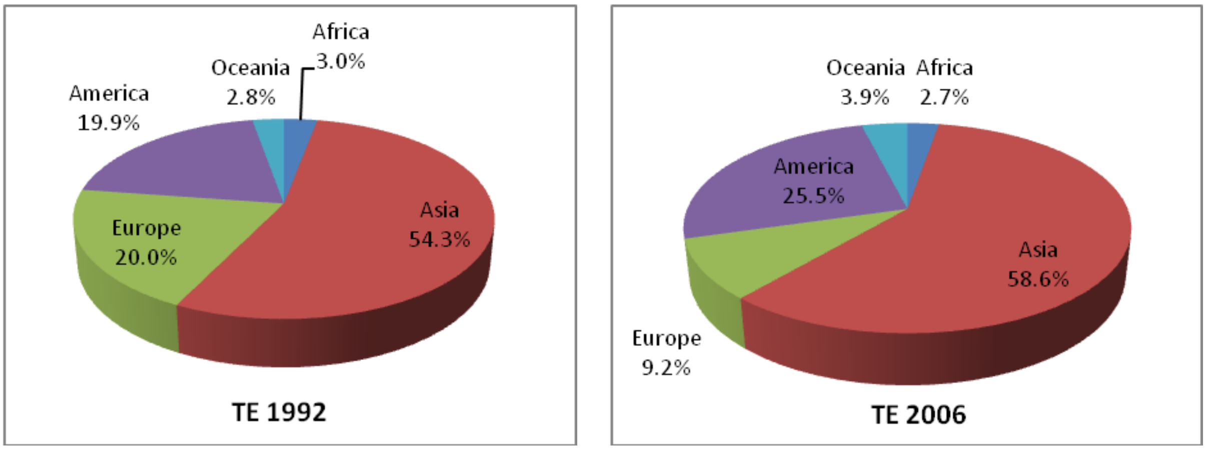
Source: FAI (2008)

Figure 7.11: World consumption of Phosphate fertilizers (P_2O_5): Percentage breakdown by region



Source: IFA (2009)

Figure 7.12: Regional shares in global P consumption



Source: IFA (2009)

Major P Fertilizer Consuming Countries

China was the largest consumer of P fertilizers in the world with a share of 33.7 per cent during 2006-07 (up from 29.1% in 1995-96). India, which was the third largest consumer of P fertilizers in mid-nineties, has become the second largest consumer with a share of 14 per cent during 2006-07. The share of USA in global P consumption has declined from 13.4 per cent in 1995-96 to 12.8 per cent in 2006-07. Top four consumers accounted for over two-third of global consumption and have increased their share during the last decade.

Table 7.5: Major consumers of P fertilizers (% share in global consumption)

Country	1995-96	2000-01	2006-07
China	29.1	26.5	33.7
USA	13.4	11.9	12.8
India	9.4	13.0	14.0
Brazil	4.2	7.2	7.2
India' rank	3^{rd}	2^{nd}	2^{nd}

Source: FAI (2008)

During the decade of eighties, India recorded the highest (9.93%) growth rate in P consumption, followed by China (6.6%) and Russia (5.38%). In contrast USA witnessed negative growth in P consumption. During the nineties, P consumption grew at a rate of 5.2 per cent in China, while growth rate in India fell to 4.33 per cent mainly due to certain policy changes. For instance, India decontrolled the phosphatic fertilizers in 1992 and also increased P prices significantly, which adversely affected consumption of P fertilizers in India. However, concession on P fertilizers was introduced by the government in mid-90s, which led to some recovery in P consumption. During the 2000s, all four major consumers witnessed positive growth rate but was significant in case of Brazil and China.

Table 7.6: Classification of major P consuming countries according to growth rates

	1980s	1990s	2000s	1980-2000s
Significant +ve growth rate	China 6.60	India 4.33	Brazil 10.30 China 4.33	
Non significant +ve growth rate	India 9.93 Russia 5.38	Brazil 3.78 China 5.20 USA 0.42	India 1.25 USA 2.15	Brazil 6.34 China 6.08 India 5.20
Significant -ve growth rate	USA -2.30			
Non-significant -ve growth rate				USA -0.06

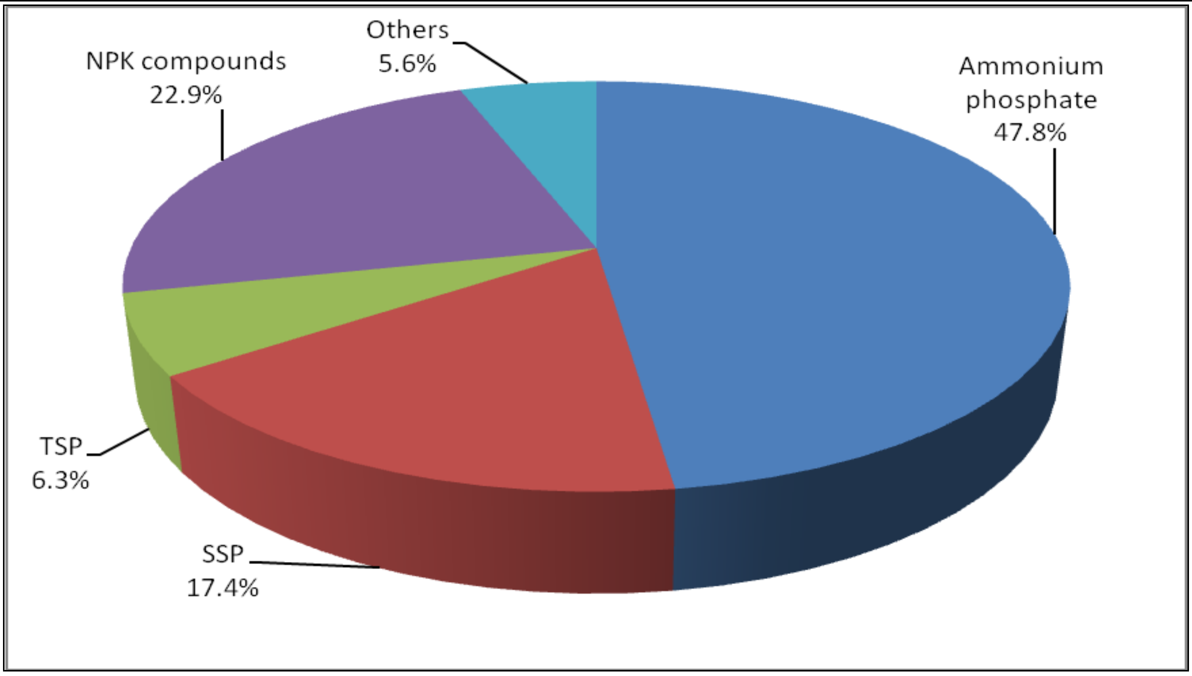
Source: Computed from FAI (2008)

Compound annual growth rates of P consumption in different countries in the world were also computed and are reported in Annexure Table 6.2. China witnessed the highest growth rate in P consumption during the 1980s and 1990s while during the 2000s, growth rate in P consumption was the highest in case of Mexico, followed by Bangladesh and Brazil. The number of countries with significant positive growth rates increased from 2 in 1980s and 1990s to five in 2000s.

Product Trends

During the last few decades a large proportion of the increase in phosphate fertilizer consumption has been in the form of phosphoric acid based fertilizers mainly ammonium phosphates (di-ammonium and mono-ammonium phosphates) and superphosphates (single and triple superphosphates). The product-wise percentage share to world consumption is given in Figure 7.13. The ammonium phosphates accounted for 47.8 per cent of global fertilizer phosphate fertilizer consumption in 2005. The share of NPK complexes was 22.9 per cent, SSP 17.4 per cent and TSP 6.3 per cent.

Figure 7.13: Product-wise share to world consumption of P_2O_5: 2005



Source: IFA (2009)

Diammonium Phosphate (DAP)

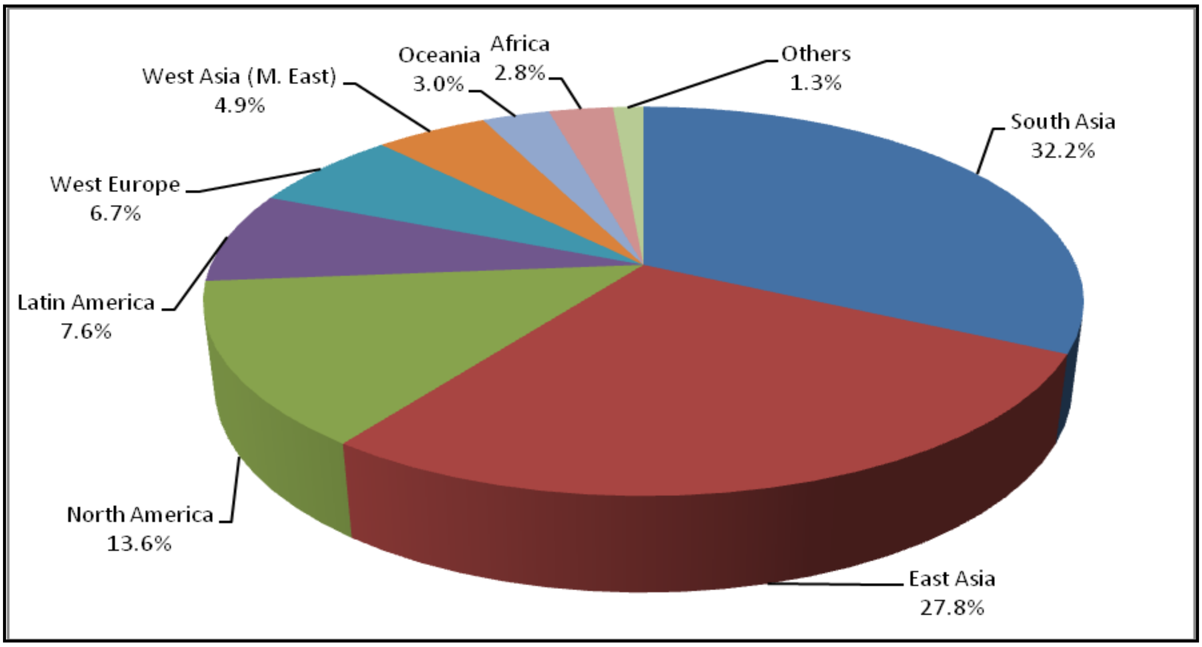
DAP is the most widely-produced and consumed phosphate fertilizer in the South and East Asia, accounting for 60 per cent of total consumption (Figure 7.14). The share of South Asia was the highest (32.2%), followed by East Asia (27.8%). North America accounted for 13.6 per cent of global DAP consumption and Latin America for 7.6 per cent. The share of other regions in global consumption is low varying from about 3 per cent in Africa to nearly 5 per cent in West Asia.

Trends in DAP consumption between 1999 and 2007 are given in Figure 7.15. It is evident from the figure that DAP consumption has remained almost stagnant during last nine years.

Mono-ammonium Phosphate (MAP)

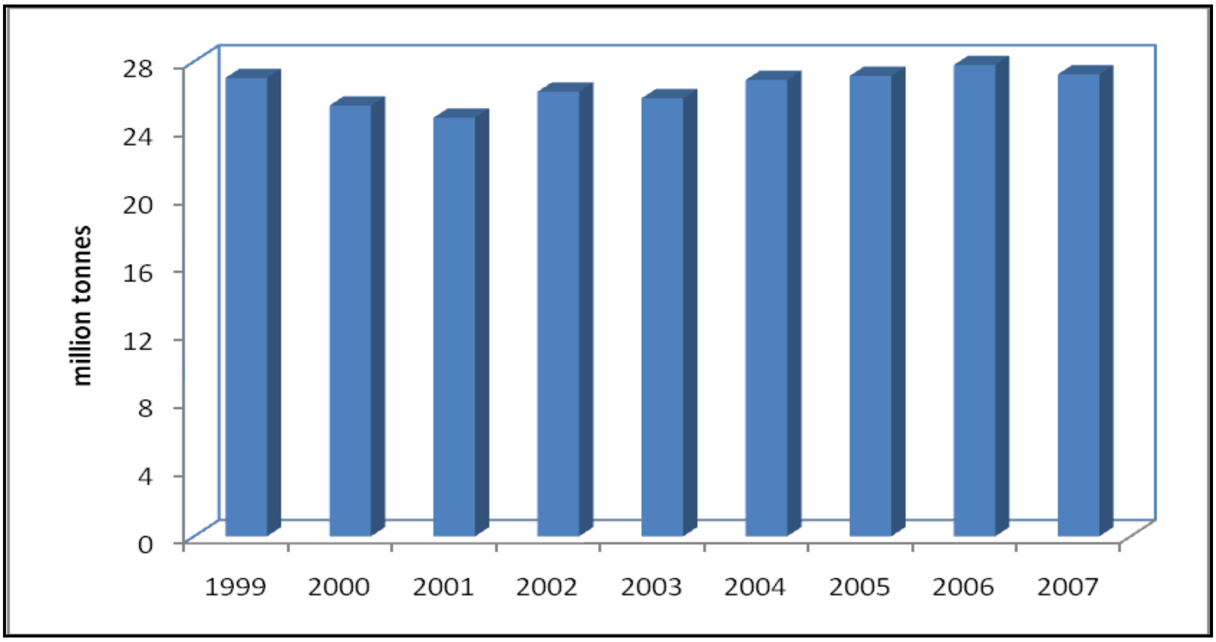
MAP is an important phosphatic fertilizer in East Asia and North American regions with a share of about 58 per cent in world MAP consumption (Figure 7.16). The share of South Asia, which is the largest consumer of DAP, was very low (2.1%). Other major MAP consuming regions are Latin America (21.3%), East Europe and Central Asia (5.1%). The remaining regions Oceania, Central Europe, West Europe and Africa had a combined share of 12-13 per cent in the TE 2007.

Figure 7.14: World DAP consumption (TE 2007); Percentage share of different regions



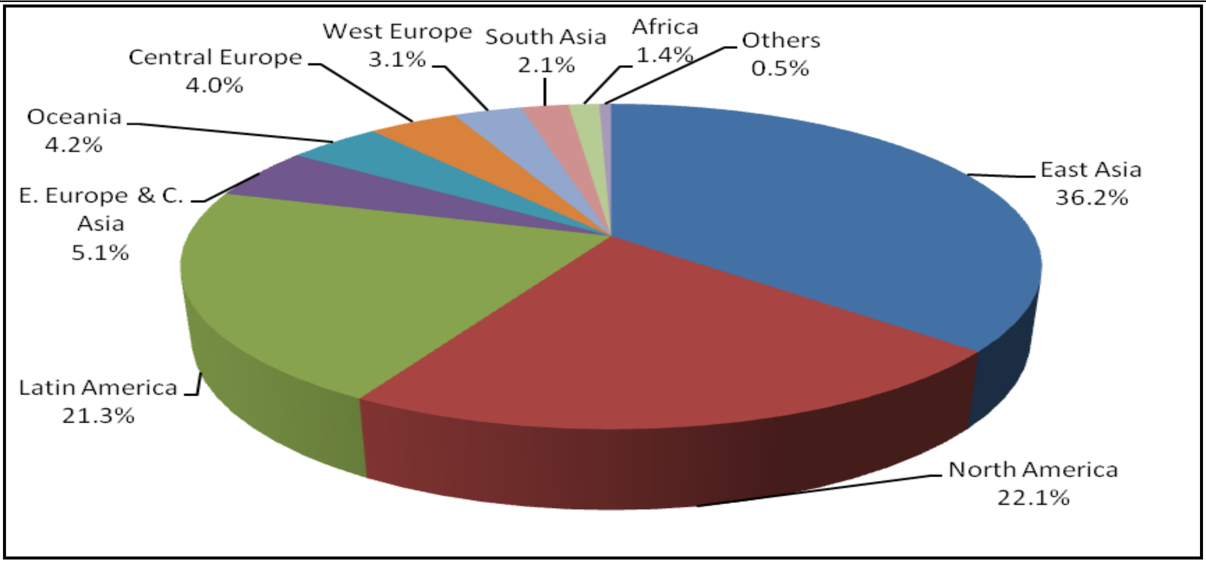
Source: IFA (2009)

Figure 7.15: Trends in consumption of DAP fertilizer: 1999 - 2007



Source: IFA (2009)

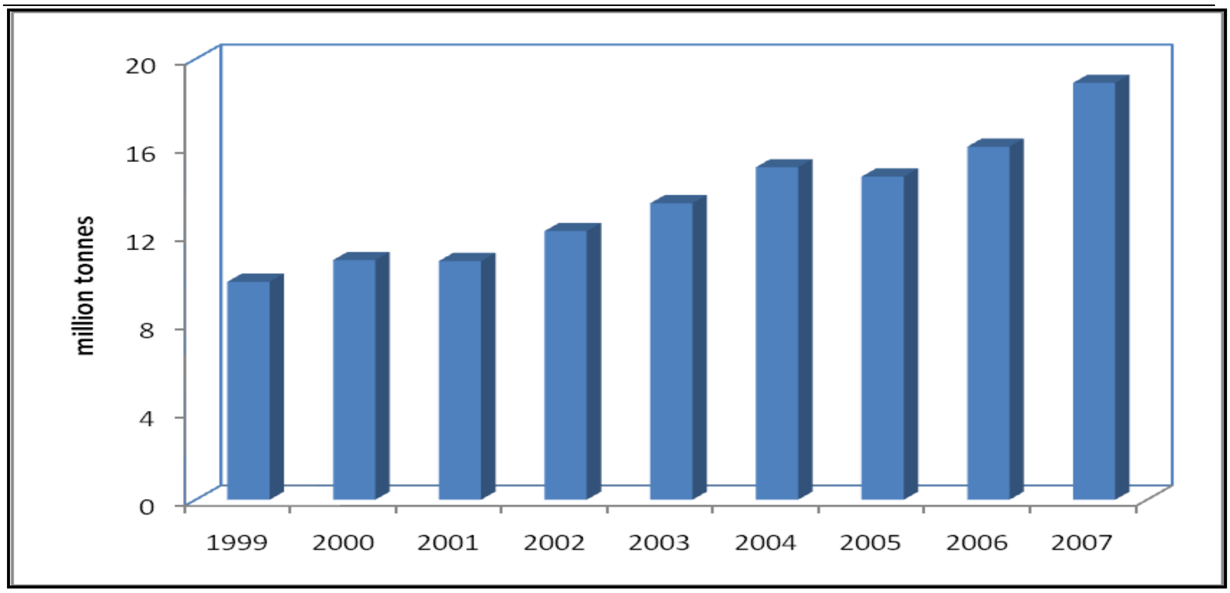
Figure 7.16: Regional shares in world MAP consumption during the TE 2007



Source: IFA (2009)

There has been steady growth in MAP consumption in the past decade as shown in Figure 7.17. World MAP consumption has increased from about 10.9 million tonnes in 1999 to 18.9 million tonnes in 2007 at an annual compound growth rate of about 8 per cent. MAP witnessed the highest growth rate among all phosphatic fertilizers and the growth was mainly driven by high growth rate in the East Asian region. Latin America and South Asia also reported high growth rate in MAP consumption.

Figure 7.17: Trends in global consumption of MAP fertilizer: 1999-2007



Source: IFA (2009)

Triple Superphosphate

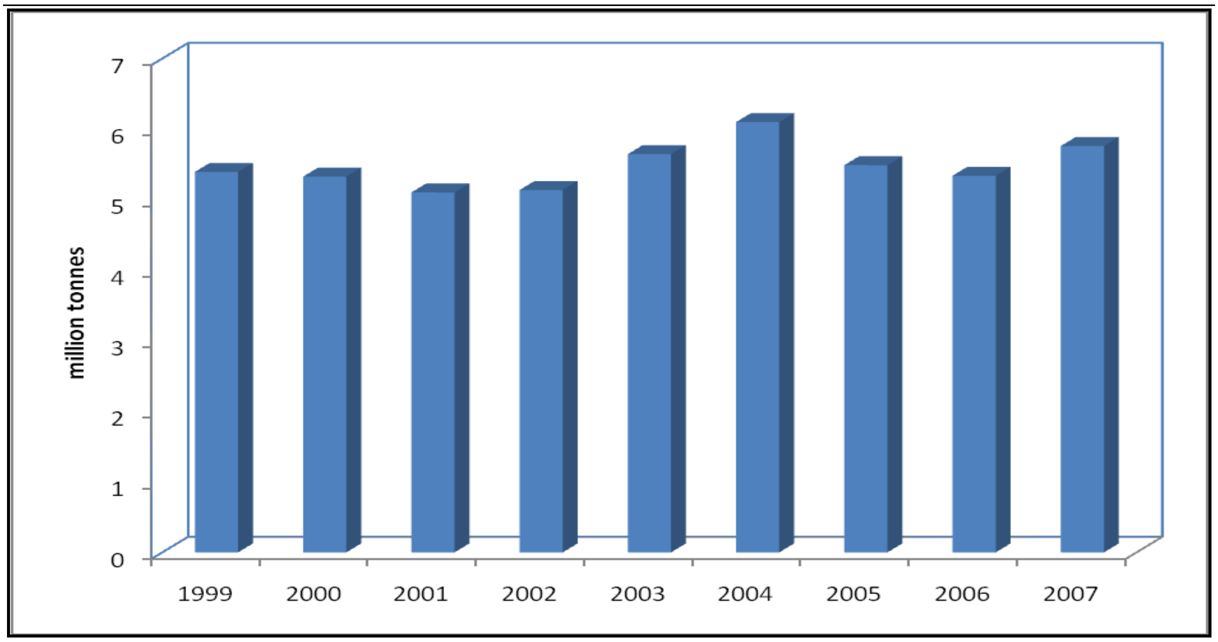
The market share for superphosphate, which used to be about 70 per cent in late 1970s, has come down to around 25 per cent of total phosphorous consumption. The consumption of TSP has remained stagnant between 1999 and 2007 at around 5.5 million tonnes (Figure 7.18).

Latin America is the largest user of TSP with an estimated share of 37.4 per cent in total consumption (Figure 7.19). Middle East is the second largest consumer of TSP (21.6%), followed by West Europe (12%), East Asia (9.9%) and south Asia (9%). TSP is not commonly used phosphatic fertilizer in the Asian region. DAP and MAP are preferred over superphosphates.

Potash Fertilizers

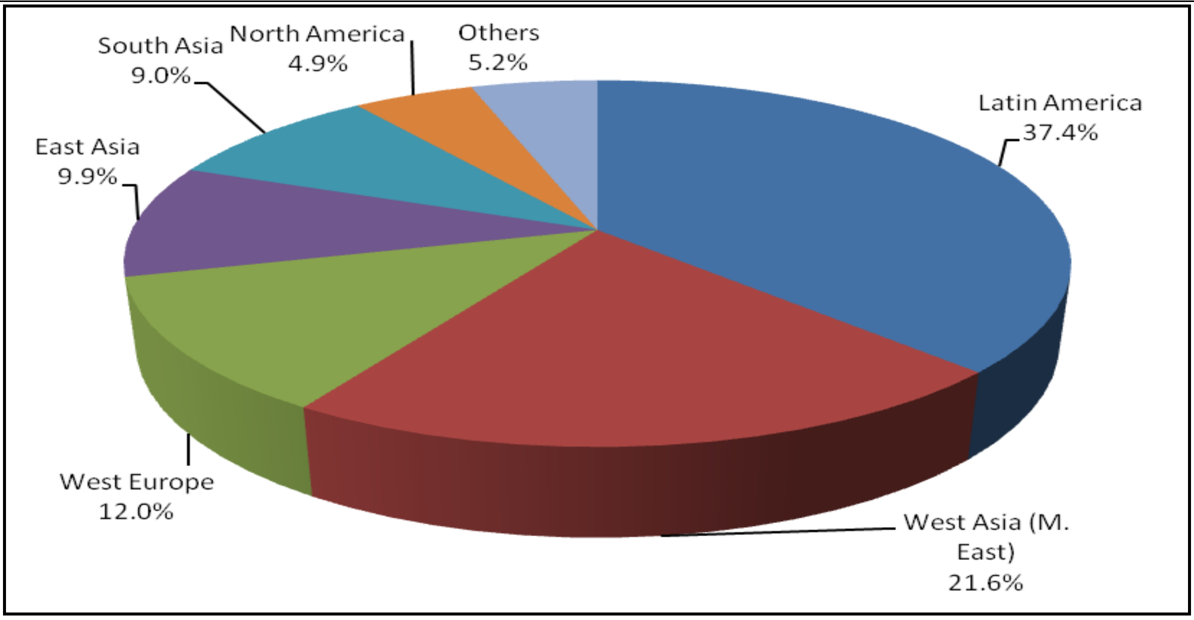
Consumption of K_2O equivalent has increased significantly from 22 million tonnes in 1999 to 31 million tonnes in 2005-06 but declined in 2006-07 (Figure 7.20). World potash market witnessed a stronger than expected demand in 2007-08 especially from India, China and Brazil. The increased demand led to a significant rise in production from 48.8 million tonnes of muriate of potash (MOP) in 2006 to 55.7 million tonnes 2007.

Figure 7.18: Trends in world consumption of TSP: 1999 – 2007



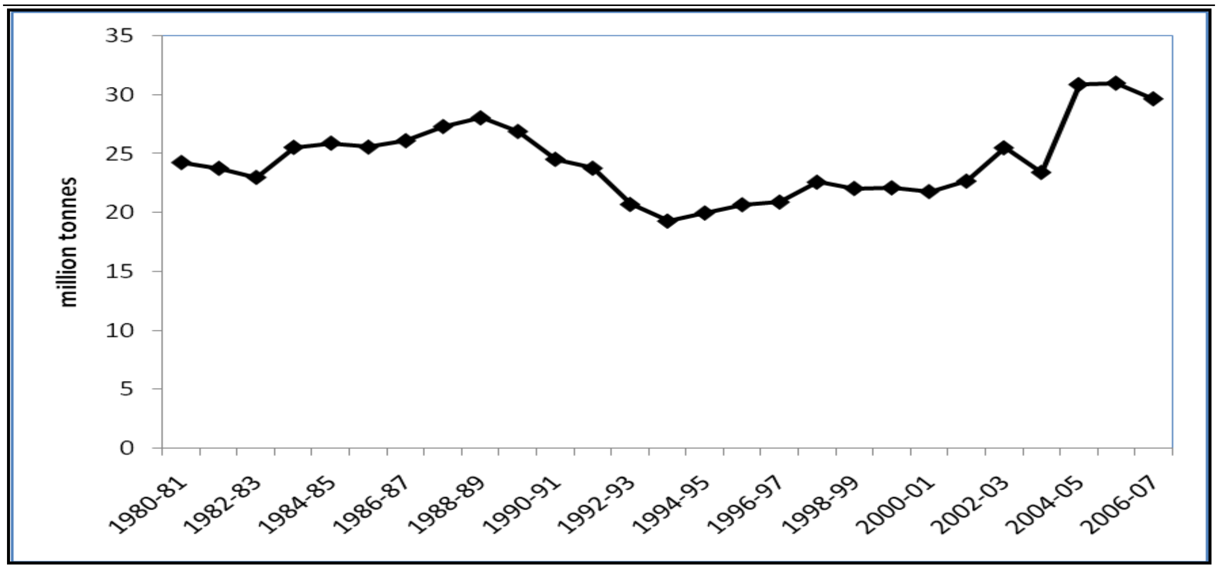
Source: IFA (2009)

Figure 7.19: Regional shares in TSP consumption: TE 2007



Source: IFA (2009)

Figure 7.20: World potash (K_2O) consumption trends: 1980-81 – 2006-07



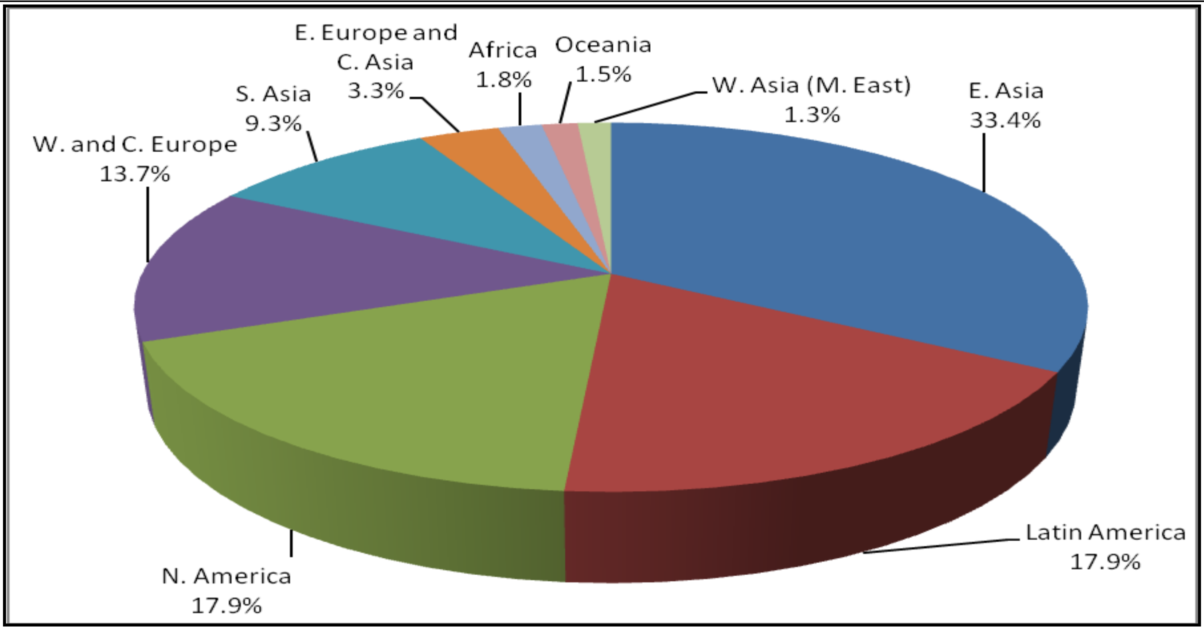
Source: IFA (2009)

Regional Shares

East Asia accounted for about one-third of world K_2O consumption during the TE 2006 (Figure 7.21). Latin America and North America each with 17.9 per cent share were the second largest consumers of K_2O. Other important K_2O consuming regions are West and

Central Europe (13.7%) and South Asia (9.3%). The share of other regions ranged from 1 to 3 per cent.

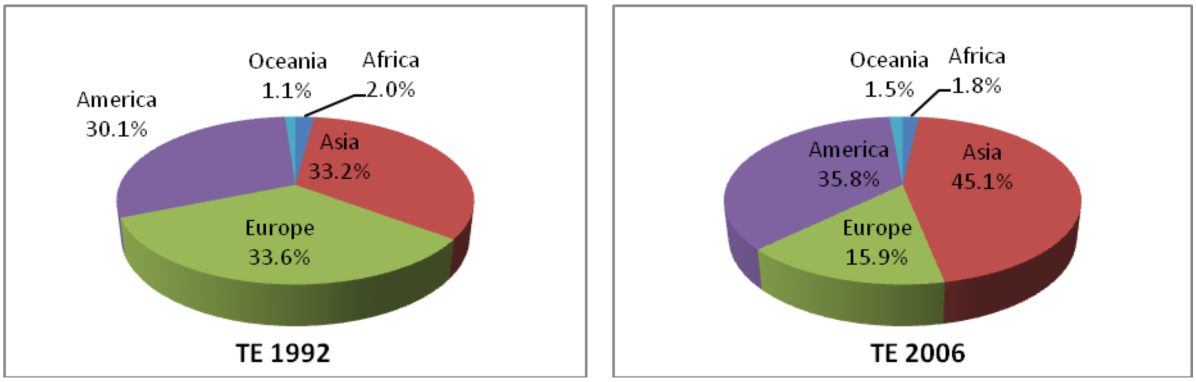
Figure 7.21: World K_2O consumption by regions, TE 2006



Source: IFA (2009)

The share of Asian region in global consumption of potassic fertilizers has increased significantly from 33.2 per cent in TE 1992 to 45.1 per cent in TE 2006. In contrast, the share of Europe has declined from 33.6 per cent to 15.9 per cent during the corresponding period. Americas, which was the third largest consumer of potassic fertilizers with 30.1 per cent share in 1992 has become second largest consumer (35.8%) of K_2O. The share of Africa and Oceania has remained less than 2 per cent.

Figure 7.22: Regional shares in global K consumption



Source: IFA (2009)

Major K Fertilizer Consuming Countries

Table 7.7 lists the major consumers of potassic fertilizers in the world. China ranks number one in K consumption with a share of 26.4 per cent during 2006-07, followed by USA (19.4%) and Brazil (11.4%). India is the fourth largest consumer with a share of 7.9 per cent. India has increased its share from 5.6 per cent in 1995-96 to 7.9 per cent in 2006-07. China and Brazil have also increased their share between 1995-96 and 2006-07, while USA has lost its share (from 23.1% in 19995-96 to 19.4% in 2006-07). France has also lost its share in global consumption from over 7 per cent in mid-1990s to 2.5 per cent in 2006-07.

Table 7.7: Major consumers of K fertilizers (% share in global consumption)

Country	1995-96	2000-01	2006-07
China	14.0	15.9	26.4
USA	23.1	20.5	19.4
India	5.6	7.2	7.9
Brazil	8.7	11.8	11.4
France	7.2	4.7	2.5
India' rank	4^{th}	4^{th}	4^{th}

Source: FAI (2008)

Among top five major consumers, India had the highest growth rate (6.15%) during the 1980s while during the nineties and 2000s Brazil registered the highest growth in consumption of K fertilizers (Table 7.8). China also registered double digit growth in K consumption during the 2000s. The growth rate in consumption of K fertilizers in India was the lowest during the nineties compared with eighties and 2000s. France witnessed negative growth rate in K consumption during the last one and half decade.

The classification of countries according to growth rates in K consumption are given in Annexure Table 6.3. The results show that the growth rates in K consumption were generally higher in developing countries, mainly India, Pakistan, China, Brazil, Bangladesh, Sri Lanka, and Ukraine compared with developed countries

Table 7.8: Classification of major K consuming countries according to growth rates

	1980s	1990s	2000s	1980-2000s
Significant +ve growth rate	Brazil 4.72		Brazil 14.66 China 13.24	China 10.54
Non-significant +ve growth rate	France 1.56 India 6.15 Russia 4.30	Brazil 7.37 China 6.96 India 2.80 USA 0.09	India 5.18 USA 2.03	India 4.15
Significant -ve growth rate	USA -1.98	France -2.95		
Non-significant -ve growth rate			France -1.49	France -2.83 USA -0.28

Source: Computed from FAI (2008)

Products

Muriate of Potash

Approximately 95 per cent of the current global consumption of potassium is used for fertilizers and potassium chloride or muriate of potash (MOP) is the most popular potassium fertilizer with an estimated share of 88 per cent, followed by Potassium sulphate (8%) and Potassium nitrate (4%).

Regional Shares

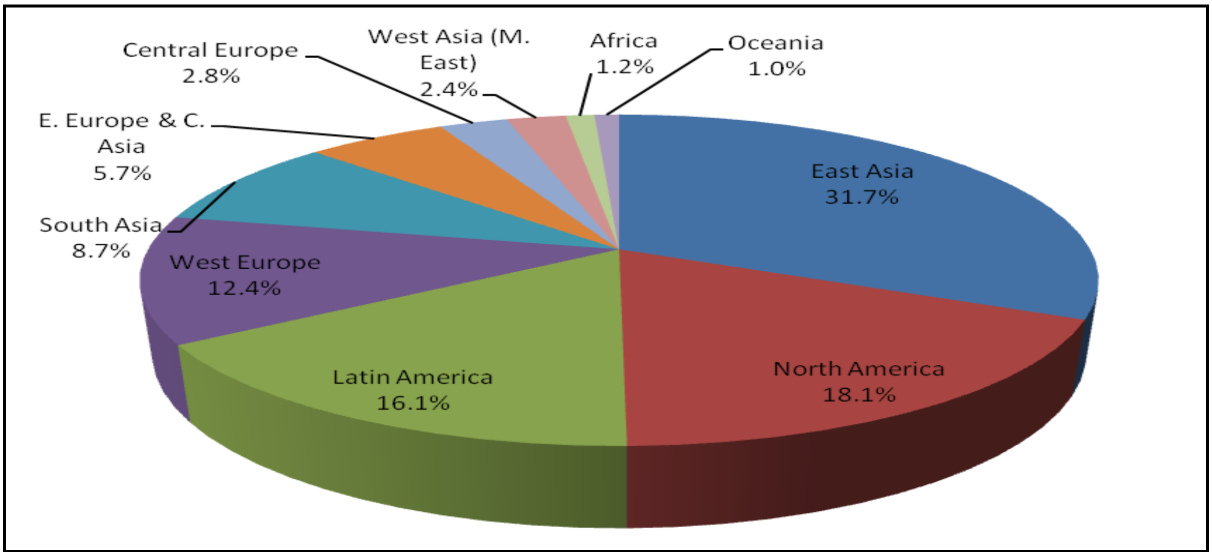
Regional shares of MOP consumption during the TE 2007 are given in Figure 7.23. It is evident that East Asia is the largest consumer of MOP consuming about two-third of (31.7%) of world consumption. North America accounts for 18.1 per cent and Latin America 16.1 per cent. West Europe’s share in world consumption was 12.4 per cent while share of South Asia was 8.7 per cent. Rest of the regions consumes less than 15 per cent of total consumption. MOP consumption has increased continuously since 1999 at an annual compound growth rate of over 3.5 per cent with the exception of 2006 when its consumption fell significantly from 54.3 million tonnes in 2005 to 48.8 in 2006. Trends in global consumption of MOP during the last 10 years are presented in Figure 7.24.

Fertilizer Consumption Intensity

Fertilizer application rates vary widely among the major world regions and countries. Per hectare fertilizer use varies from about 9 kg in Sub-Saharan Africa to 278 kg in East Asia

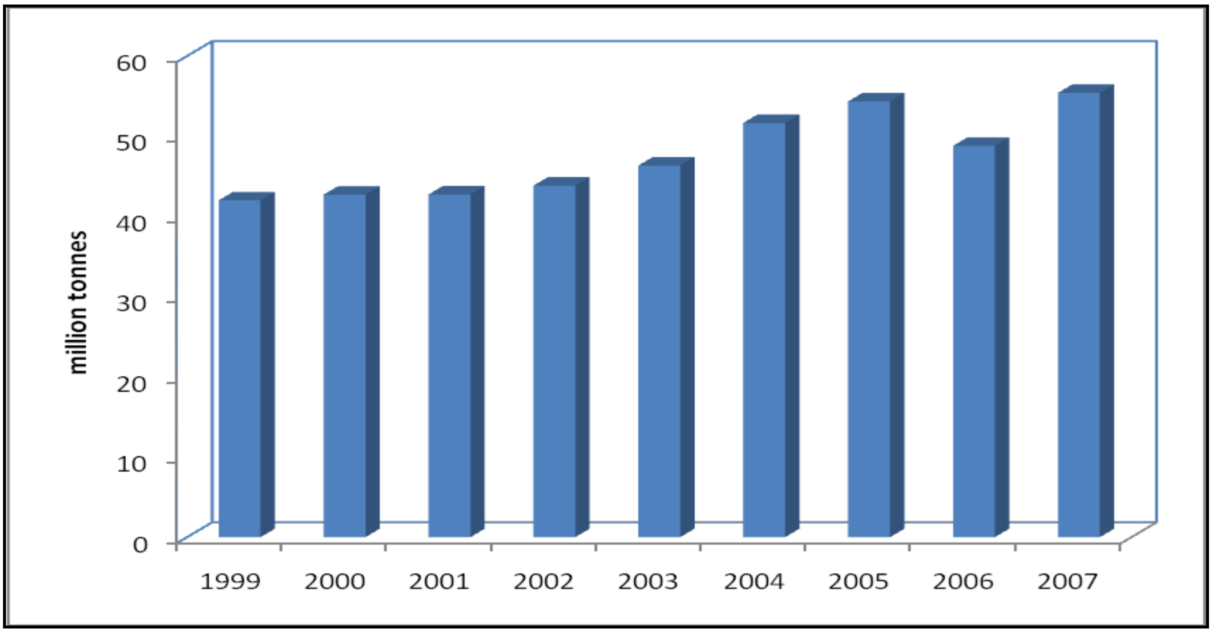
(Figure 7.25). North America, Western Europe and Asia have higher per hectare fertilizer consumption compared with the world average. Wide variations are also prominent among different countries of the world. For example, fertilizer use varies from a low of about 18 kg per hectare of arable land and land under permanent crops in Nepal to a high of about 666 kg per hectare in Netherlands. The world average application rate is about 109 kg per hectare (Figure 7.26).

Figure 7.23: World consumption of muriate of potash (MOP) by regions, TE 2007



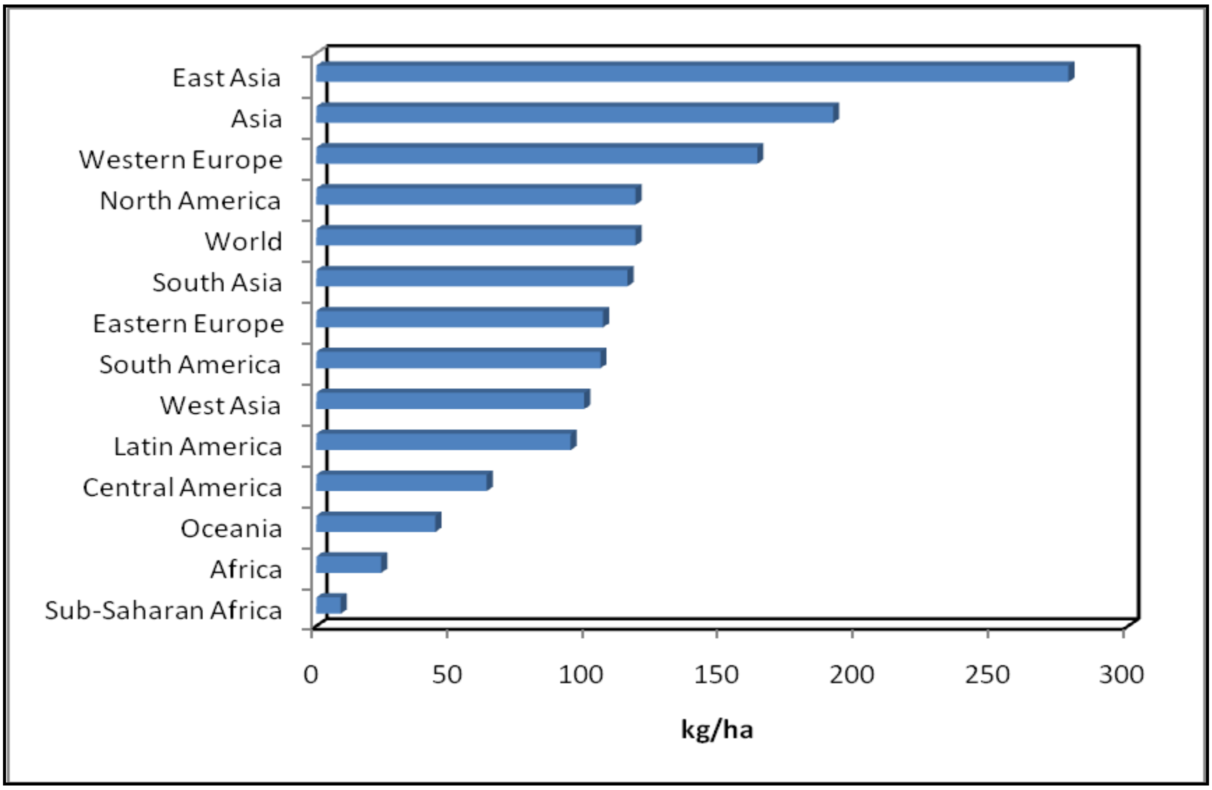
Source: IFA (2009)

Figure 7.24: Trends in world consumption of MOP: 1999 - 2007



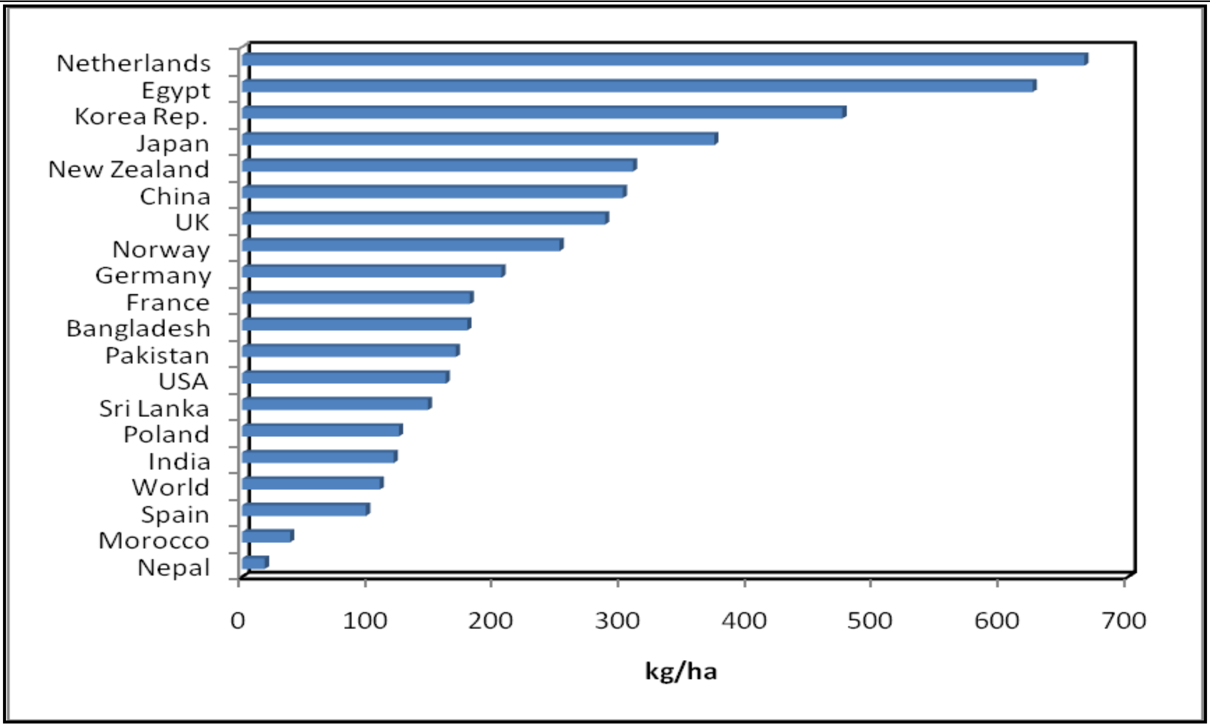
Source: IFA (2009)

Figure 7.25: Per hectare fertilizer use by markets, 2006-07 (kg/ha)



Source: IFA (2009)

Figure 7.26: Fertilizer consumption per hectare of arable land and land under permanent crops in selected countries, 2005



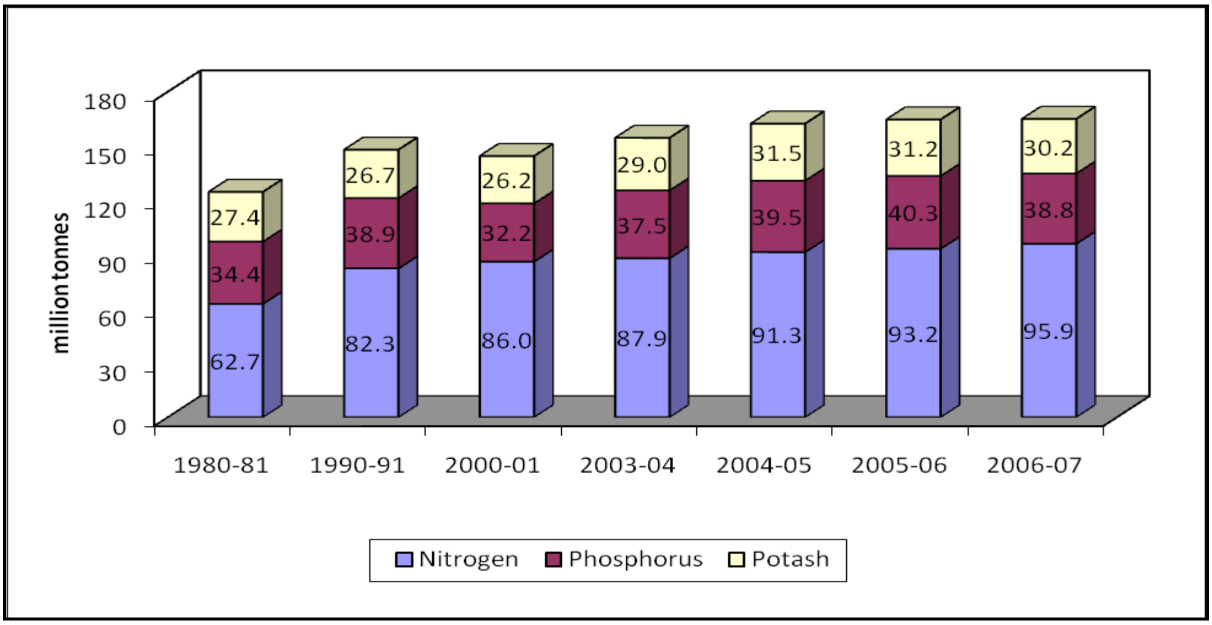
Source: FAI (2008)

GLOBAL FERTILIZER SUPPLY

To meet the growing demand, fertilizer production increased from 124.6 million tonnes in 1980-81 to about 160 million tonnes in 2006-07. Nutrient-wise production during 1980-81 and 2006-07 is given in Figure 7.27. The production of nitrogenous fertilizers has increased from 62.7 million tonnes in 1980-81 to 95.9 million tonnes in 2006-07, while P production increased from 34.4 million tonnes in 1980-81 to 40.3 million tonnes in 2005-06 and then declined to 38.8 million tonnes in 2006-07. Almost similar trend was observed in case of potassic fertilizers. World fertilizer production has stagnated over the last three years.

Among all fertilizer products, nitrogenous fertilizers are the most widely produced globally. Production of nitrogenous fertilizers comprised 58.2 per cent of total production in 2006-07, while the shares of phosphatic and potassic fertilizers were 23.5 and 18.3 per cent, respectively. Furthermore, among all nitrogenous fertilizers, urea is the most commonly produced and used fertilizer product in the world.

Figure 7.27: Trends in global production of fertilizers (million tonnes nutrients)

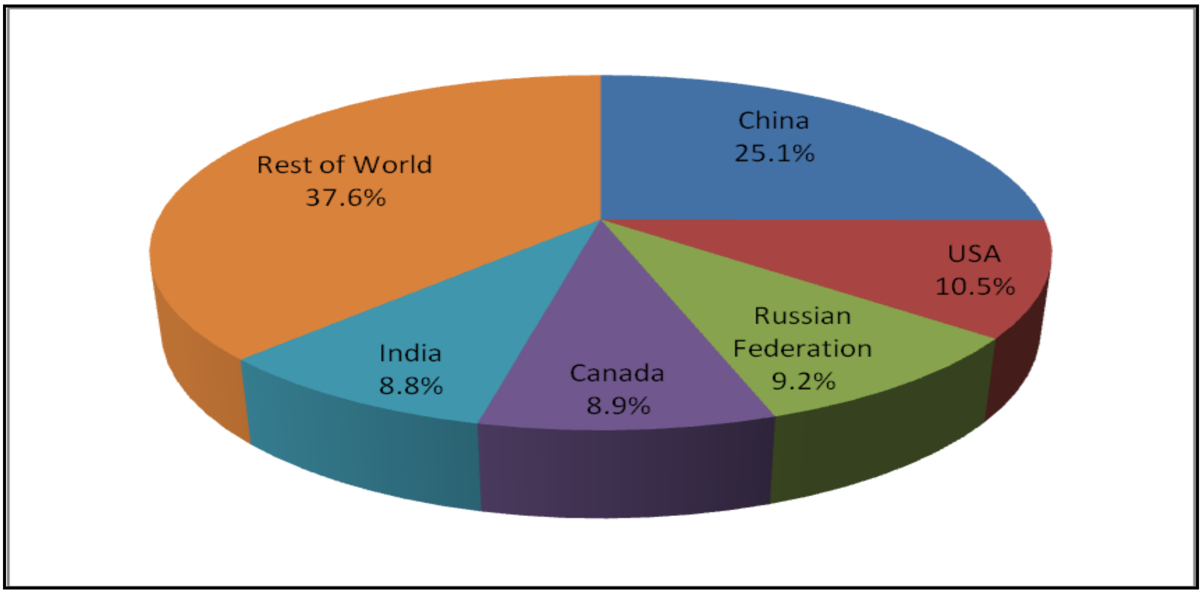


Source: IFA (2009)

Major Producers

China is the world's largest producer and accounts for 25 per cent of world production, the U.S. 10.5 per cent, Russian Federation 9.2 per cent, Canada 8.9 per cent and India 8.8 per cent (Figure 7.28). Top five producers account for about 62 per cent of global fertilizer production.

Figure 7.28: Top world fertilizer producers, 2005-06



Source: FAI (2008)

Growth Rates in World Production

The growth trends of the three major nutrients during the last two and half decades are given in Table 7.9. During the 1980s, global fertilizer production grew at an annual compound growth rate of 3.24 per cent, while during the nineties, fertilizer production grew at a compound growth rate of 0.47 per cent. P fertilizer production experienced statistically significant negative growth rate while K fertilizer production remained stagnant (0.25%). However, fertilizer production growth rate accelerated (2.62%) during 2000s and was mainly driven by high growth in phosphatic (3.65%) and potassic fertilizer (3.52%) production.

Table 7.9: Growth rates in global production of fertilizers

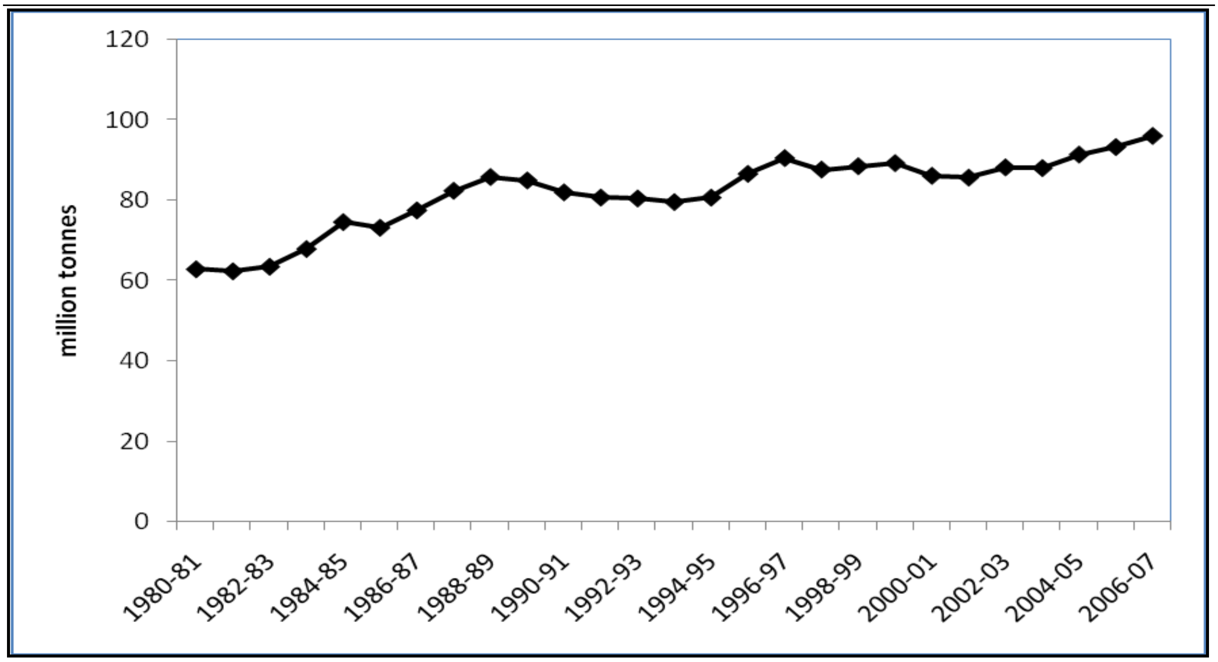
	1980s	1990s	2000s	All period
Nitrogen	4.10	1.40	1.92	1.33
Phosphorus	2.62	-1.53	3.65	0.14
Potash	1.83	0.22	3.52	0.08
Total	3.24	0.47	2.62	0.79

Source: Computed from IFA (2009)

Nitrogenous Fertilizers

Nitrogen is currently produced in over 78 countries world wide. The primary raw material for nitrogen production is natural gas, but nitrogen can also be produced from coal, fuel oil and naphtha. The world N production has witnessed an increasing trend during the last two-and-half decades (Figure 7.29). The rate of increase in production was the highest during the 1980s, which slowed down during the nineties but picked up in 2000s.

Figure 7.29: Trends in World N production: 1980-81 – 2006-07



Source: IFA (2009)

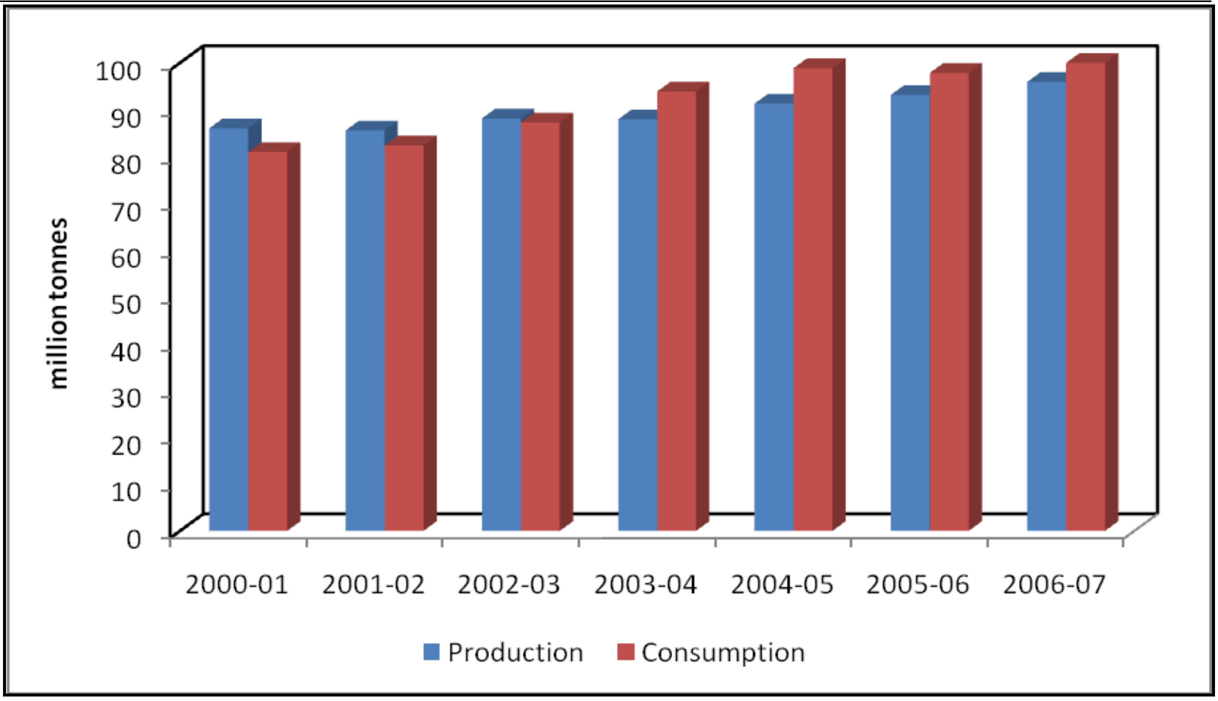
Supply-Demand Balance

The supply and demand balances of nitrogen for the period 2000-01 to 2006-07 are shown in Figure 7.30. During the period 2000-01 to 2002-03, production exceeded consumption while supply and demand balance for the period 2003-04 to 2006-07 showed a deficit of over 5 million tonnes, which was responsible for rising fertilizer prices since 2002.

Production-Trade Balance

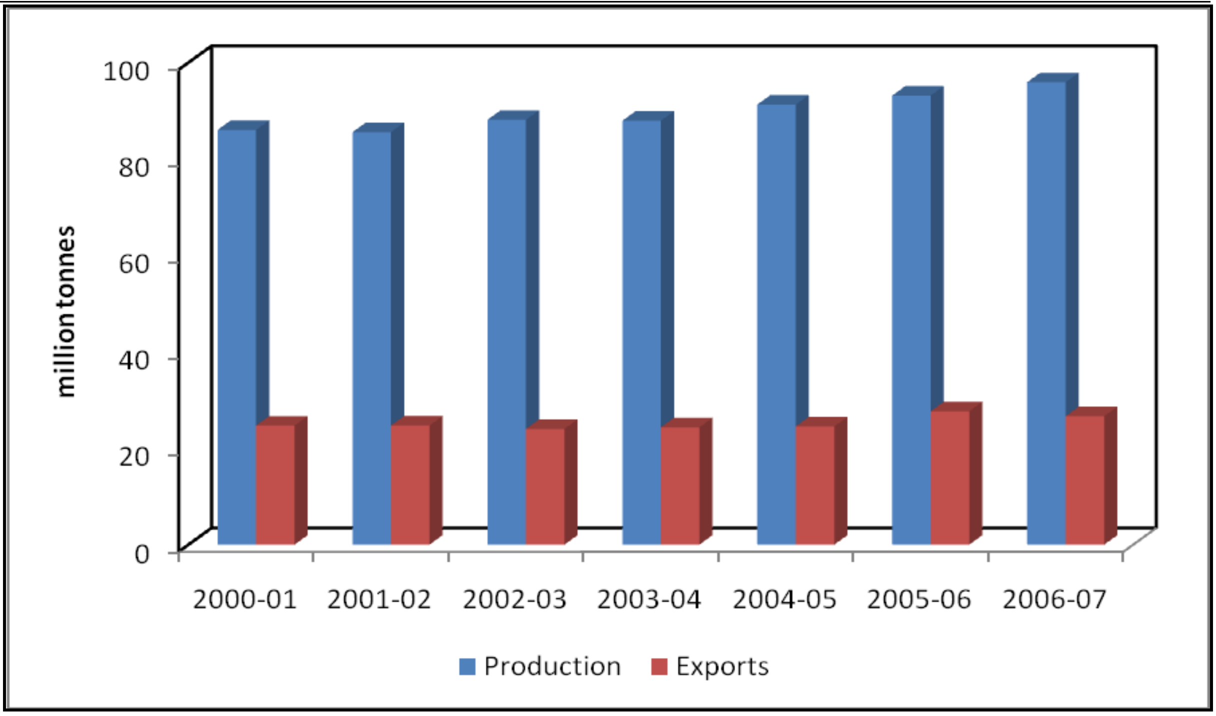
World nitrogen production and trade trends are given in Figure 7.31. About 70 per cent of world nitrogen production is consumed in the producing countries and nearly 30 per cent is traded globally. World N production and trade follow the same trend and grew at a modest rate of nearly 2 per cent per year during the 2000s.

Figure 7.30: World nitrogen production and consumption balance



Source: IFA (2009)

Figure 7.31: World nitrogen production and trade



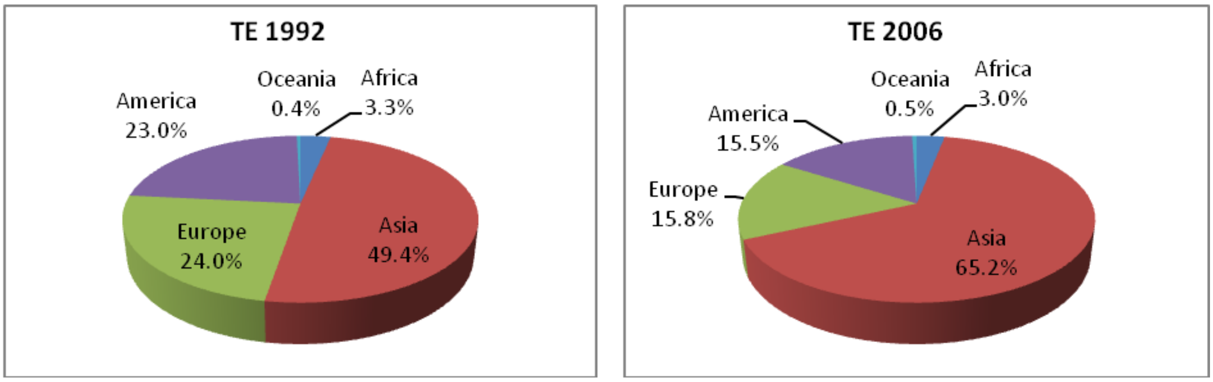
Source: IFA (2009)

Regional Shares

Asia is the largest producer as well as consumer of N fertilizers. Asia's share in global nitrogenous fertilizer production during the TE 2006 was 65.2 per cent (up from 49.4% in TE 1992). America and Europe have lost share in world production between TE 1992 and 2006.

China is the largest producer of nitrogenous fertilizers in the world and accounted for 36.8 per cent of world N production in 2006-07 (Table 7.10). India's share was 12 per cent and USA 8.5 per cent. India and China have increased their share in N production while USA has lost its share from 16.5 per cent 1995-96 to 8.5 per cent in 2006-07.

Figure 7.32: Regional shares in global N production



Source: IFA (2009)

Table 7.10: Major producers of N fertilizers (% share in global production)

Country	1995-96	2000-01	2006-07
China	22.0	25.1	36.8
India	10.1	12.7	12.0
USA	16.5	11.5	8.5
Russia	5.6	6.3	4.6
India' rank	3rd	2nd	2nd

Source: FAI (2008)

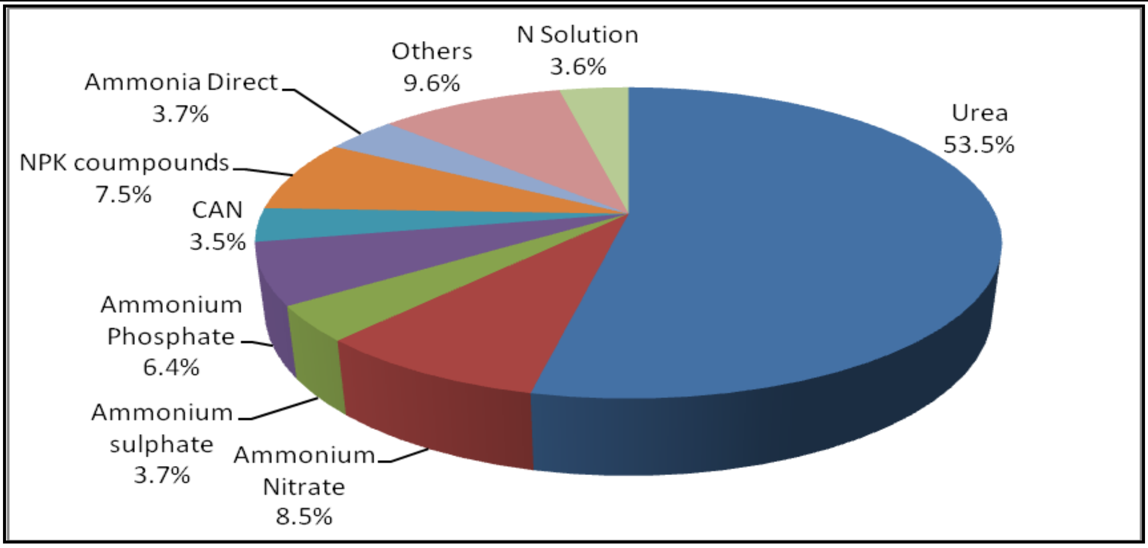
Products

Urea

Among all nitrogenous fertilizers, urea is the most commonly produced and used fertilizer product in the world. In 2005, urea accounted for 53.5 per cent of the world N production

(Figure 7.33). Other important straight nitrogenous fertilizers, namely, ammonium nitrate, ammonium sulphate and calcium ammonium nitrate (CAN) contributed about 16 per cent to world production. The share of NP and NPK compounds was about 14 per cent.

Figure 7.33: Product-wise share to world production of nitrogenous fertilizers, 2005



Source: IFA (2009)

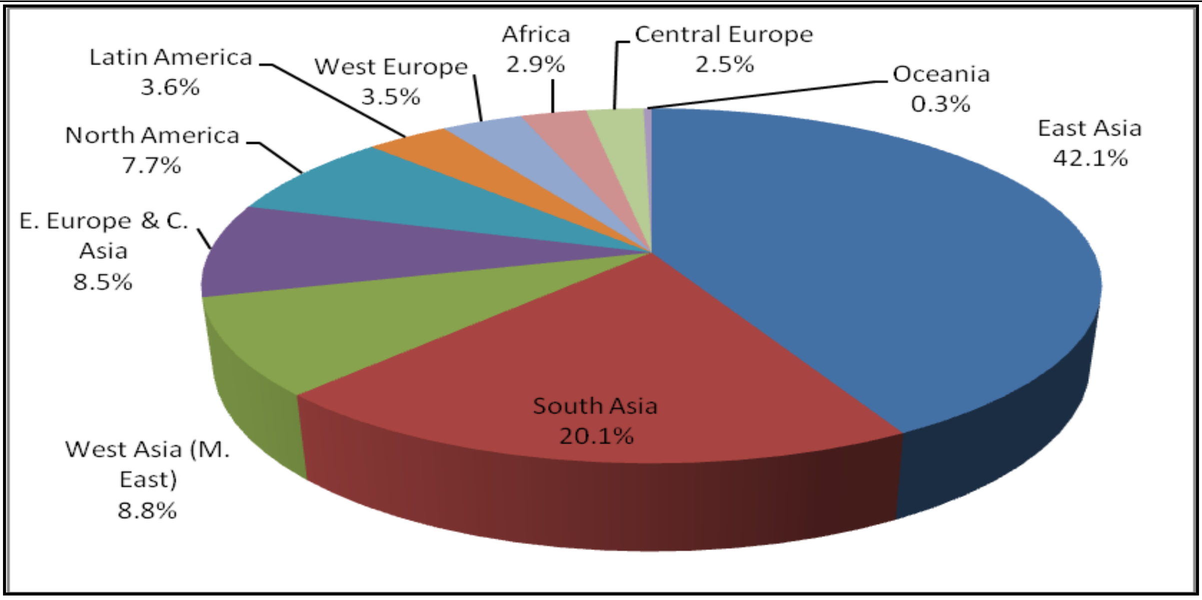
Regional Shares

Urea is produced in many countries and is a major product in world trade, but economics favor those countries/regions with cheap natural gas. Representing more than 40 per cent of the world's production, East Asia remains the top urea producer (Figure 7.34). Other notable producers include the South Asia (20.1%), Middle East (8.8%), Eastern Europe and Central Asia (8.5%) and North America (7.7%).

South Asia is the second largest producer of urea but consumption is higher than production (Figure 7.35). Middle East, Eastern Europe and Central Asia, Central Europe and Africa have urea surpluses while North America, Latin America, Western Europe and Oceanic regions are deficit in urea production. Demand and supply is in balance in East Asia.

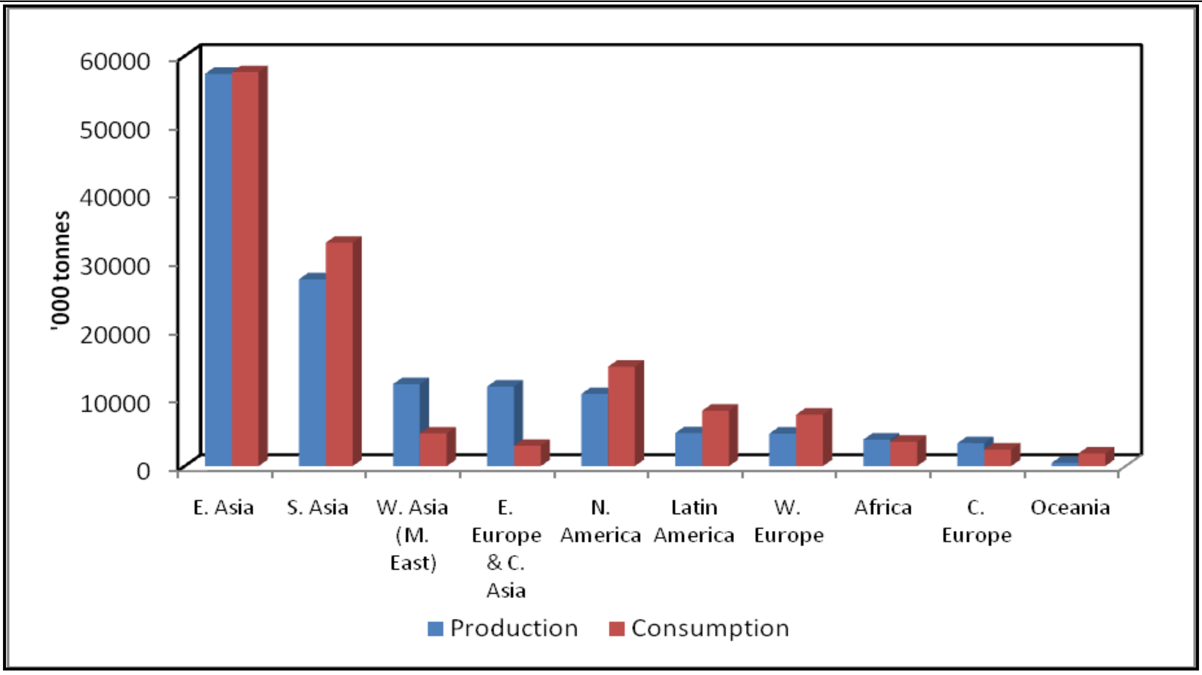
World urea production has increased significantly during the last seven years from 107.4 million tonnes in 2001 to 144 million tonnes in 2007. World urea exports have also increased from about 25 million tonnes to 36.4 million tonnes during the corresponding period at an annual compound growth rate of 4.6 per cent. The share of exports to world production has been about 23-25 per cent.

Figure 7.34: Regional shares in global production of urea during the TE 2007



Source: IFA (2009)

Figure 7.35: Regional urea production and consumption balance during the TE 2007

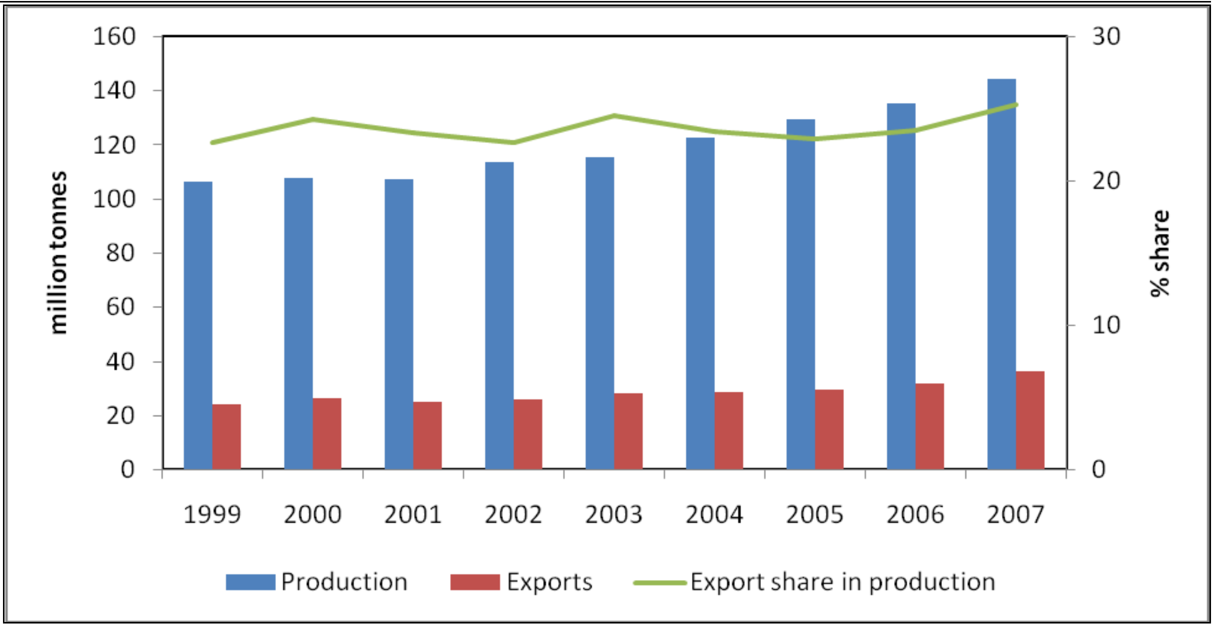


Source: IFA (2009)

Phosphatic Fertilizers

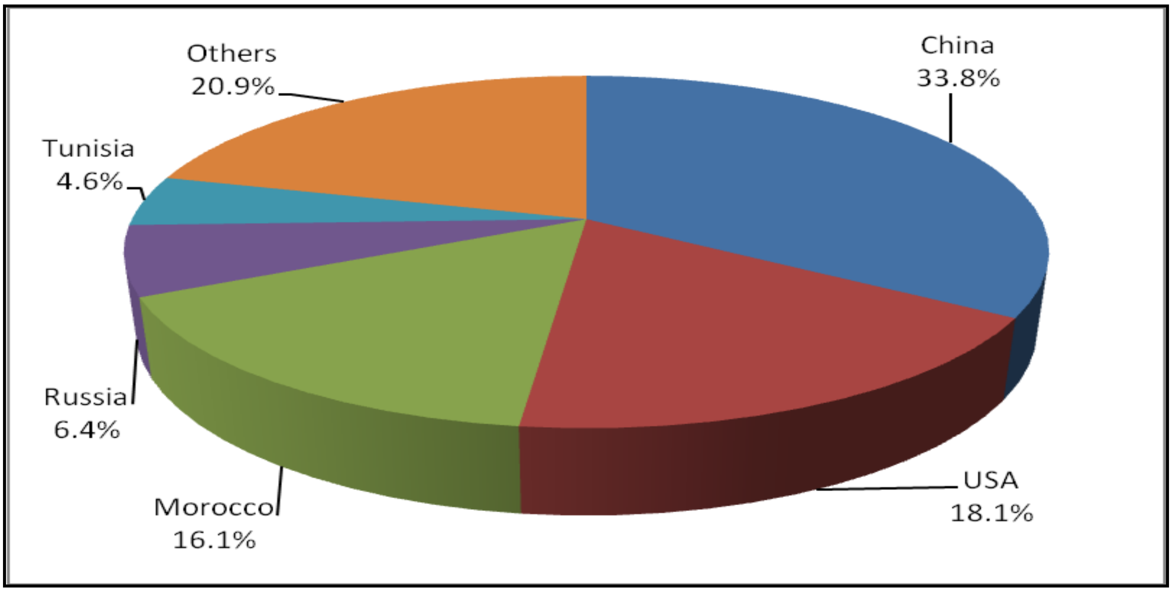
World production of phosphate fertilizers was 38.8 million tonnes in 2006-07 and accounted for about 24 per cent of the world's total fertilizer production. The production of phosphate fertilizers begins at the mine. The manufacture of phosphate fertilizers requires rock phosphate and sulfur. Rock phosphate reserves have been identified in over 30 countries world wide, but the economic extraction of the rock is limited to fewer countries. The biggest phosphate deposits are found in North America, Morocco, Tunisia, Togo, Israel, Jordan, and China. The world's major producers are China, USA, Morocco, Russia and Tunisia (Figure 7.37). The top three producers, namely, China, USA and Morocco account for 68 per cent of total world production while the top 5 account for about 80 per cent.

Figure 7.36: World Urea Production and Trade; 1999 to 2007



Source: IFA (2009)

Figure 7.37: Production of rock phosphate by major producing countries, 2006

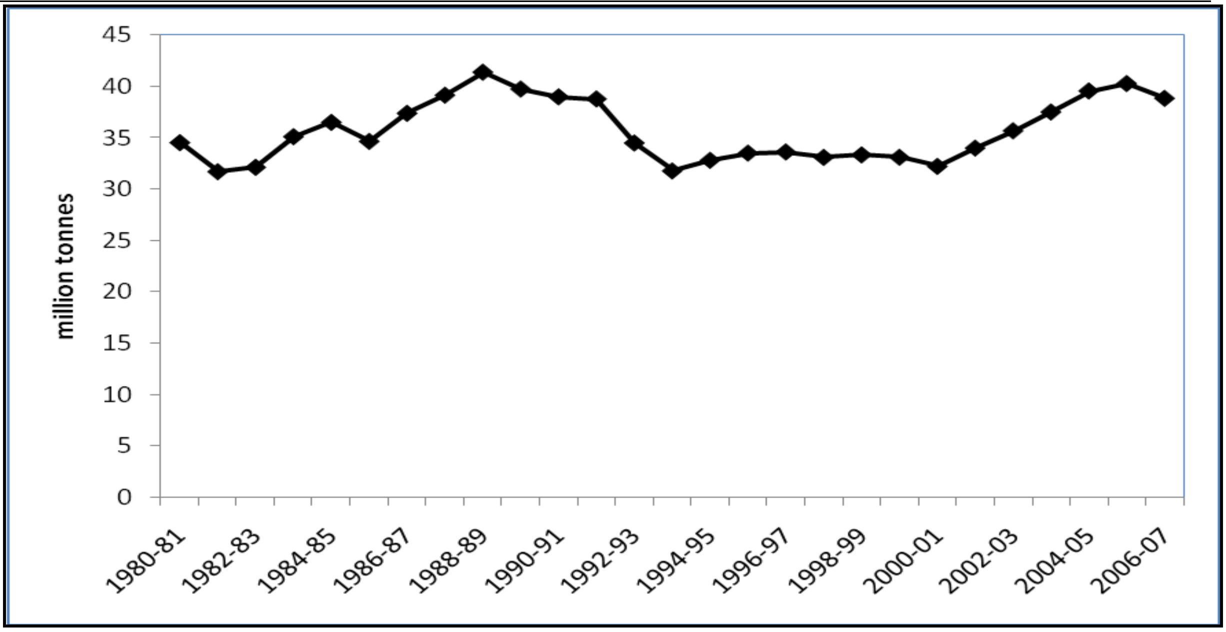


Source: IFA (2009)

Production-Consumption Balance

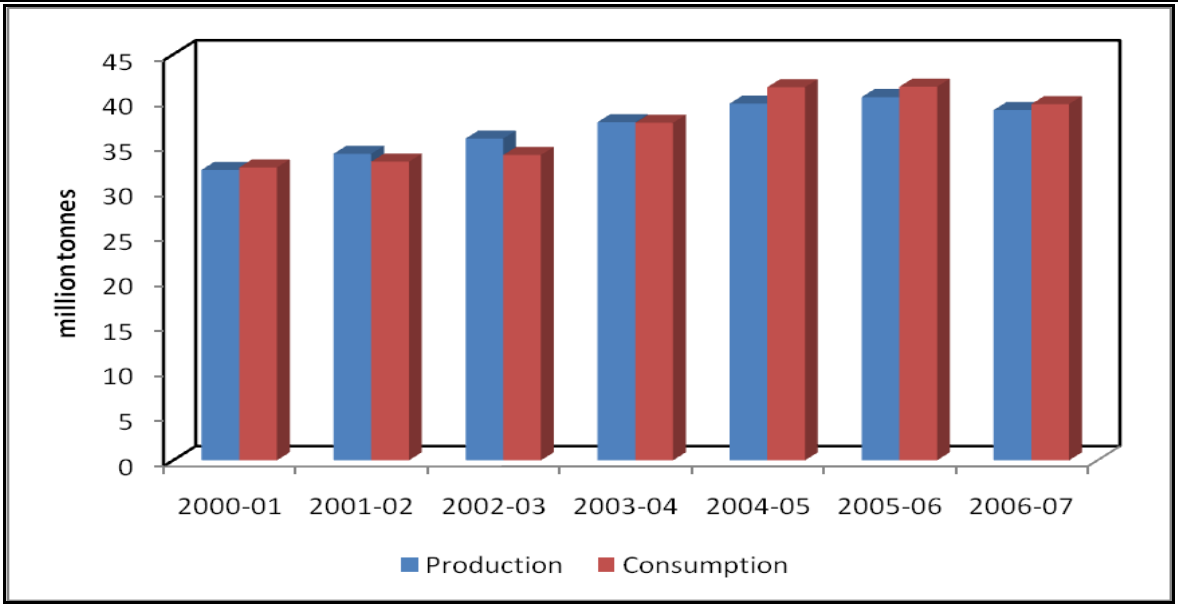
World production of phosphatic fertilizers has increased from 32.2 million tonnes in 2001-02 to 40.3 million tonnes in 2005-06 but declined marginally to 38.8 million tonnes in 2006-07 (Figure 7.38). The consumption has exceeded production during the last three years leading to global shortage and price rise.

Figure 7.38: Trends in World P_2O_5 production: 1980-81 – 2006-07



Source: IFA (2009)

Figure 7.39: World phosphorus production and consumption balance

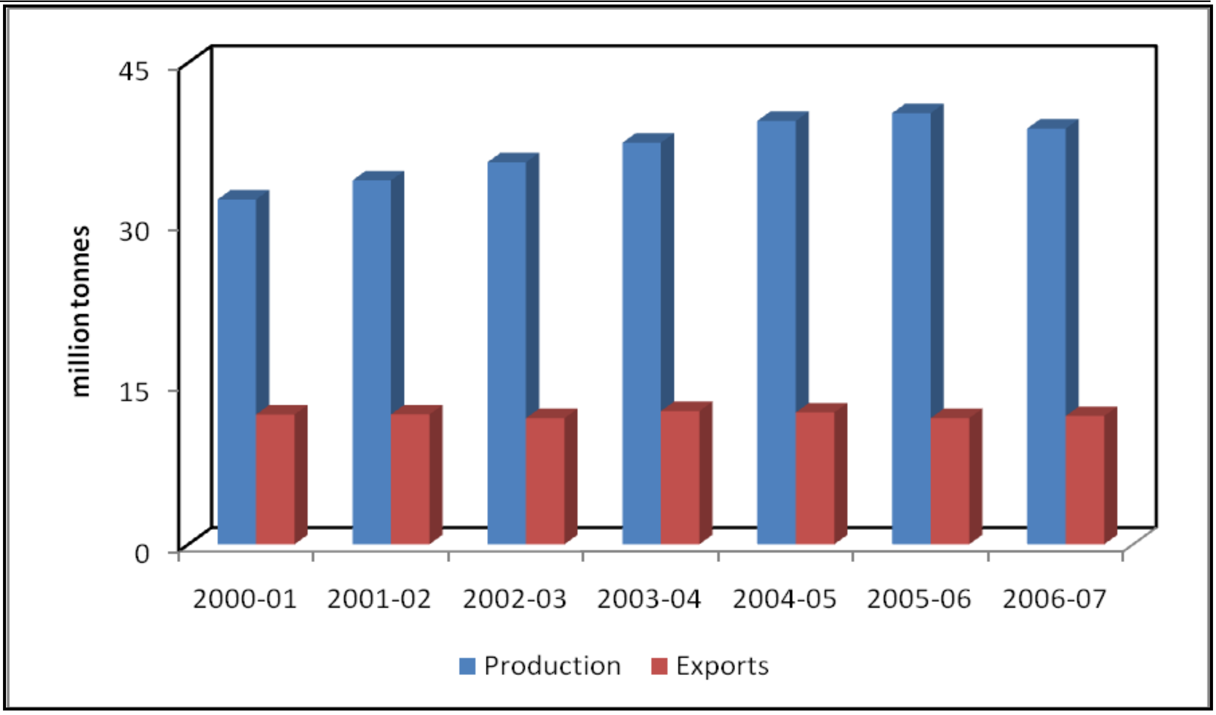


Source: IFA (2009)

Production-Trade Balance

Exports of phosphatic fertilizers averaged around 12 million tonnes and account for about 33 per cent of world production (Figure 7.40). Production of phosphatic fertilizers had increased between 2001 and 2006 while exports have remained stable.

Figure 7.40: World phosphorus production and trade

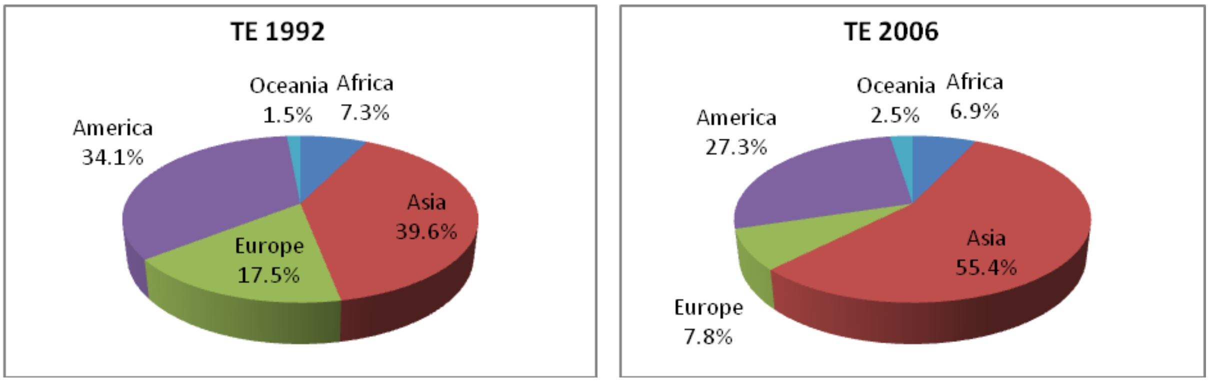


Source: IFA (2009)

Regional Shares

Global phosphate fertilizer production has grown from 33.8 million tonnes in the TE 1992 to 38.4 million tonnes during the TE 2006. Asia and America, which account for over 82 per cent of total production, dominate the market. (Figure 7.41) The share of Asia has increased from 39.6 per cent in TE 1992 to 55.4 per cent in the TE 2006 while the share of Europe and America has declined from 17.5 per cent to 7.8 per cent and 34.1 per cent to 27.3 per cent between 1992 and 2006, respectively. China, USA and India are the three largest producers of phosphate fertilizers, which account for over two-third of global production (Table 7.11). China, India and Russia have increased their share in global P production while the USA has lost its share between 1995-96 and 2006-07.

Figure 7.41: Regional shares in global P production



Source: IFA (2009)

Table 7.11: Major producers of P fertilizers (% share in global production)

Country	1995-96	2000-01	2006-07
China	18.2	20.8	32.4
USA	31.3	22.5	23.7
India	7.8	11.6	11.5
Russia	5.8	7.2	7.0
India' rank	3rd	3rd	3rd

Source: FAI (2008)

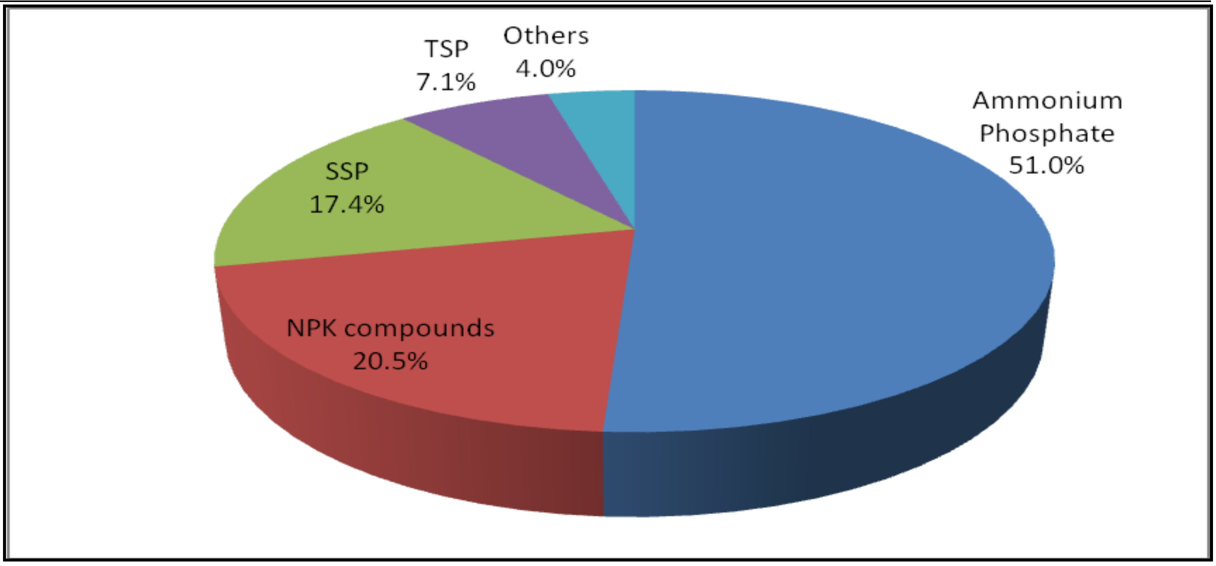
Diammonium Phosphate (DAP)

DAP, diammonium phosphate, is the main solid phosphate fertilizer. The DAP trade is the dominant element in the phosphate fertilizers, heavily influencing production and prices, about 35-40 per cent of the global output of phosphoric acid is used in DAP manufacture. More than 40 per cent of the global production of DAP is traded across borders, much more than ammonia, but significantly less than potash.

World production of DAP is about 27 million tonnes product and has remained stagnant during the last ten years (Figure 7.43). In the last decade, about 12-16 millions tonnes DAP have been exported with a declining trend between 1999 and 2007. Over half of this traded DAP went to South and East Asia, being India and China the key importers. About half of

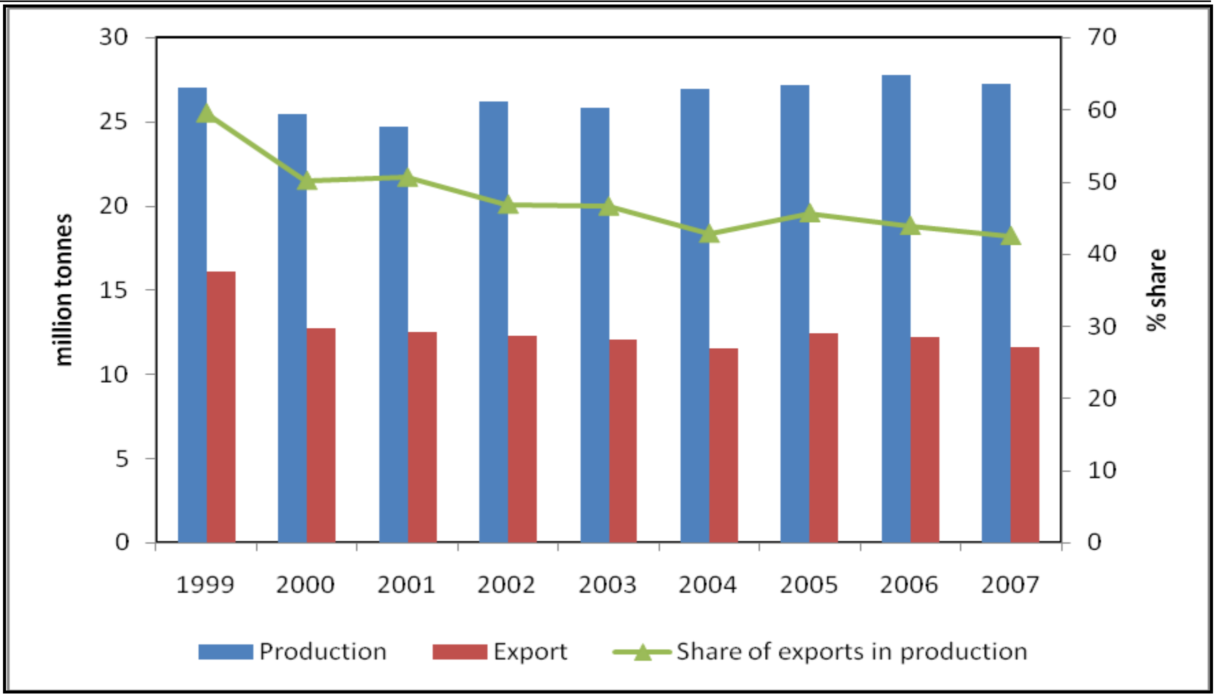
DAP production is exported but the share of exports in total production showed a declining trend during the last decade.

Figure 7.42: Share of major fertilizer products in world production of phosphatic fertilizers, 2005



Source: IFA (2009)

Figure 7.43: World DAP production and trade trends

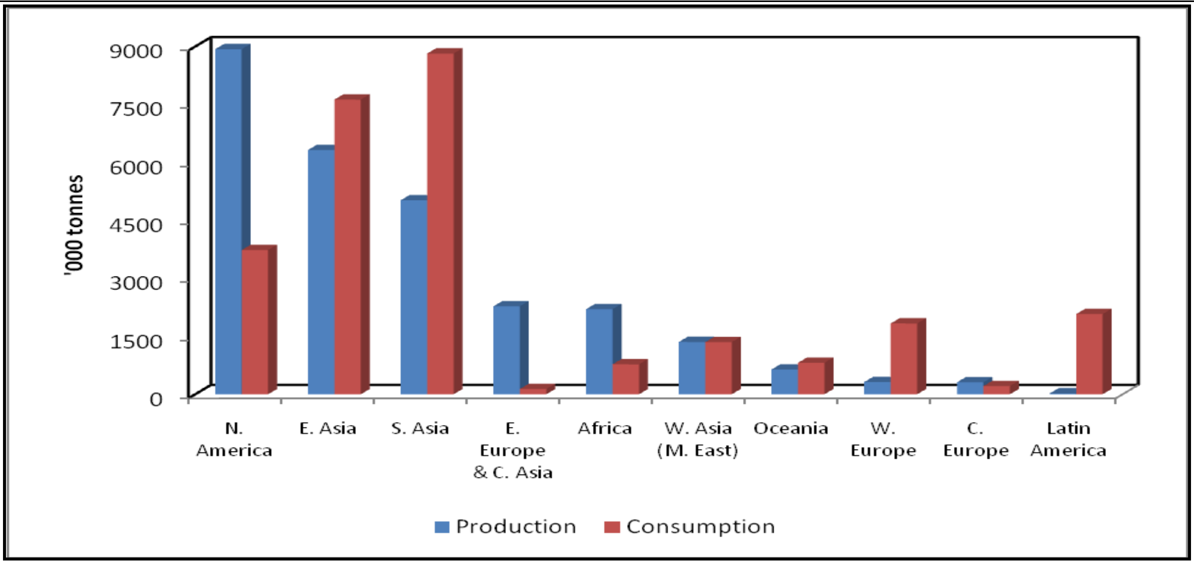


Source: IFA (2009)

Regional Shares

North America, Eastern Europe, Africa and Central Europe have DAP surpluses while South and East Asia, Western Europe, Latin America and Oceanic region are deficit in DAP production and meet their requirements through imports (Figure 7.44).

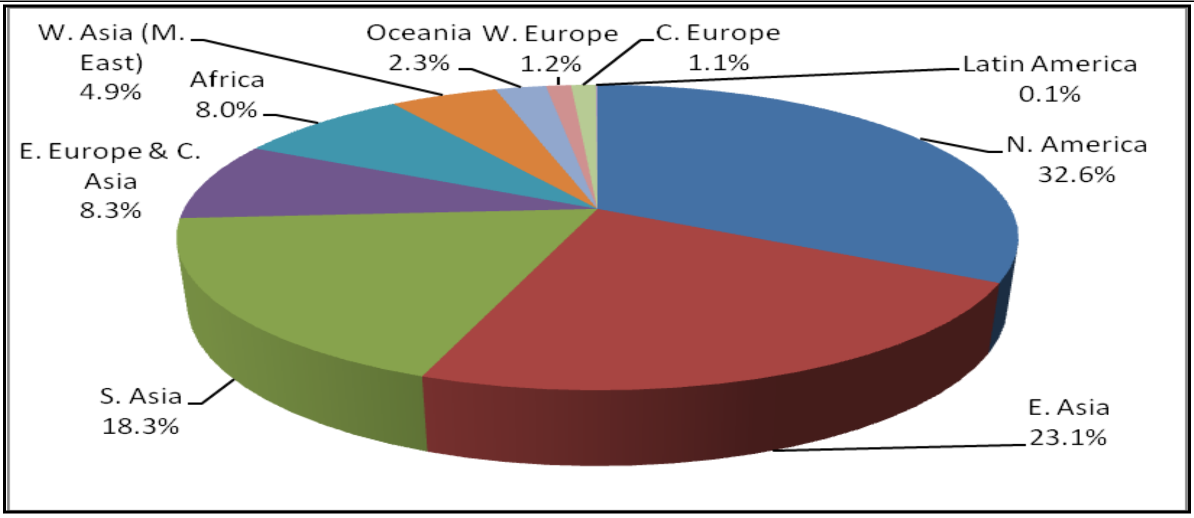
Figure 7.44: Regional DAP production and consumption balance during the TE 2007



Source: IFA (2009)

Representing about one-third of the world's production, North America remains the top DAP producer (Figure 7.45). Other notable producers include the East Asia (23.1%), South Asia (18.3%), Eastern Europe and Central Asia (8.3%) and Africa (8.0%).

Figure 7.45: Regional shares in global production of DAP during the TE 2007

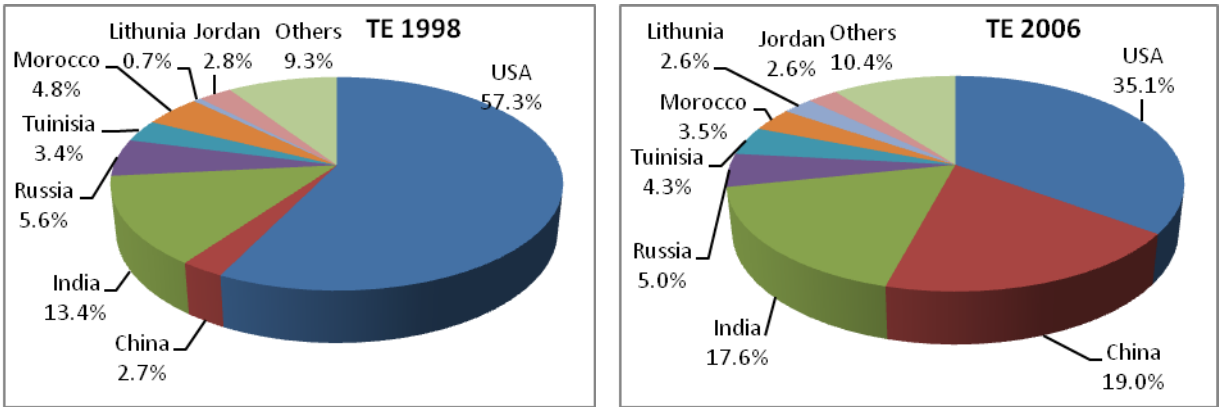


Source: IFA (2009)

Major DAP Producers

The US is the largest producer of DAP and account for 35.1 per cent share in global production, followed by China with a share of 19 per cent in the TE 2006. India is the third largest producer of DAP in the world with a share of 17.6 per cent. Other major players are Russia (5%), Tunisia (4.3%), Morocco (3.5%), and Lithuania and Jordan with 2.6 per cent share each during the TE 2006. Between 1998 and 2006, US has lost its share from 57.3 per cent to 35.1 per cent while China and India have improved their shares in global DAP production due to rising domestic demand.

Figure 7.46: Share of major producers in world DAP production



Source: IFA (2009)

Rock Phosphate

Rock phosphate is the world's most important source of phosphorus, and it is estimated that around 90 per cent of the global rock phosphate consumption is used for production of fertilizers like single superphosphate (SSP), triple superphosphate (TSP), and Diammonium Phosphate (DAP), all of which have a high percentage of phosphorus.

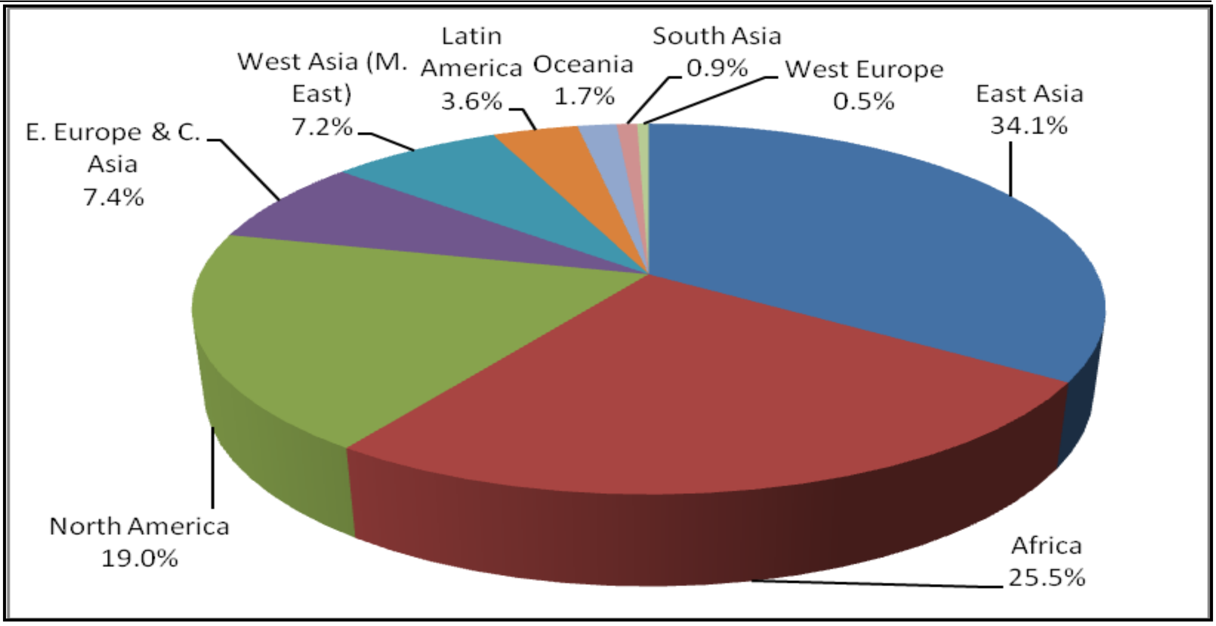
Phosphate is produced in more than 40 countries, and its production has been rising over the years, reaching 176.1 million tonnes in 2007, with China being the world's leading producer of phosphate, followed by USA and Morocco. These three countries combined contributed to 68 per cent of total world production in 2006.

East Asia has the largest share (34.1%) in world rock phosphate production, followed by Africa (25.5%) and North America (19%). Other important producing regions include Eastern

Europe and Central Asia (7.4%), Middle East (7.2%), and Latin America (3.6%). South Asia has less than one per cent share in global production.

East Asia showed the largest growth in phosphate production in absolute terms, soaring by 31.3 million tonnes since 1999, increasing from 32.98 million tonnes to 64.29 million tonnes in 2007. Africa showed the second largest increase in phosphate production (5.34 million tonnes) during the same period.

Figure 7.47: Regional distribution of rock phosphate production in the World during TE 2007

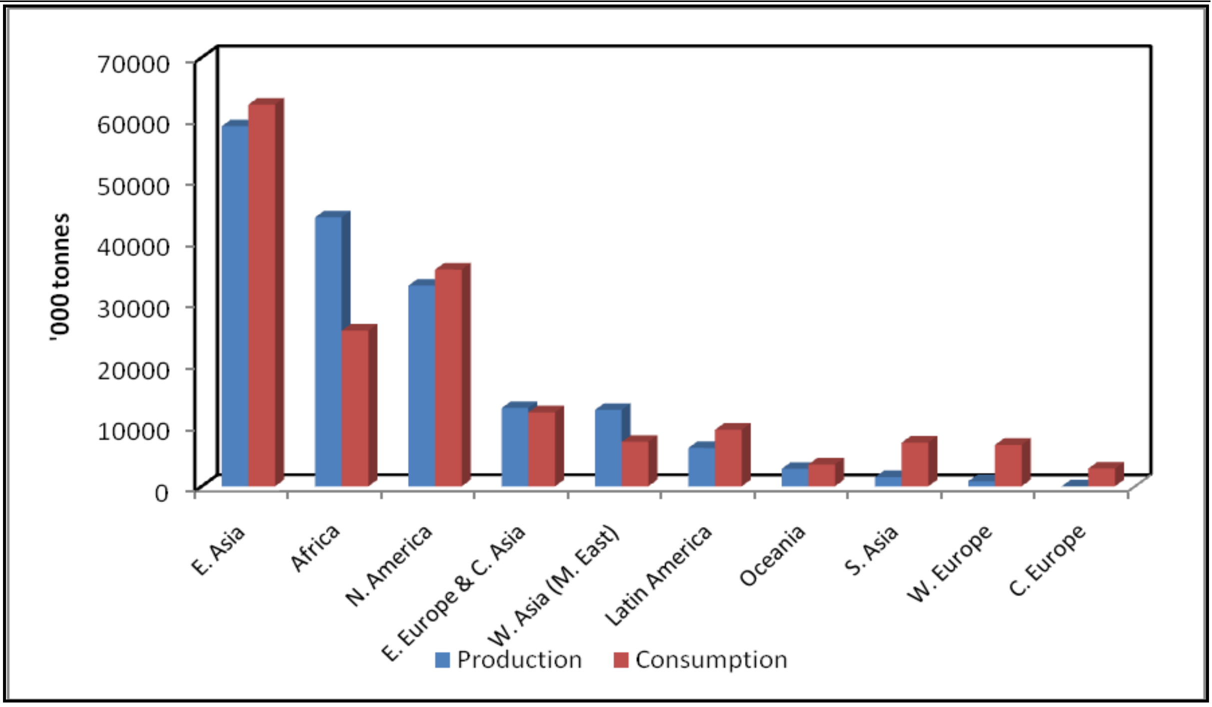


Source: IFA (2009)

Africa, Eastern Europe and Central Asia, and Middle East have surplus rock phosphate while East Asia, North America, Latin America, Oceania, South Asia, Western and Central Europe are deficit in rock phosphate (Figure 7.48).

In 2007, world rock phosphate production reached a record level of 176.1 million tonnes compared to 144.1 million tonnes in 2001 (Figure 7.49). Exports of rock phosphate have remained stable between 30-32 million tonnes during the last nine years and share of exports in world production has declined from 22.4 per cent in 1999 to 19.4 per cent in 2007.

Figure 7.48: Regional rock phosphate production and consumption balance during the TE 2007



Source: IFA (2009)

Figure 7.49: World rock phosphate production and trade trends

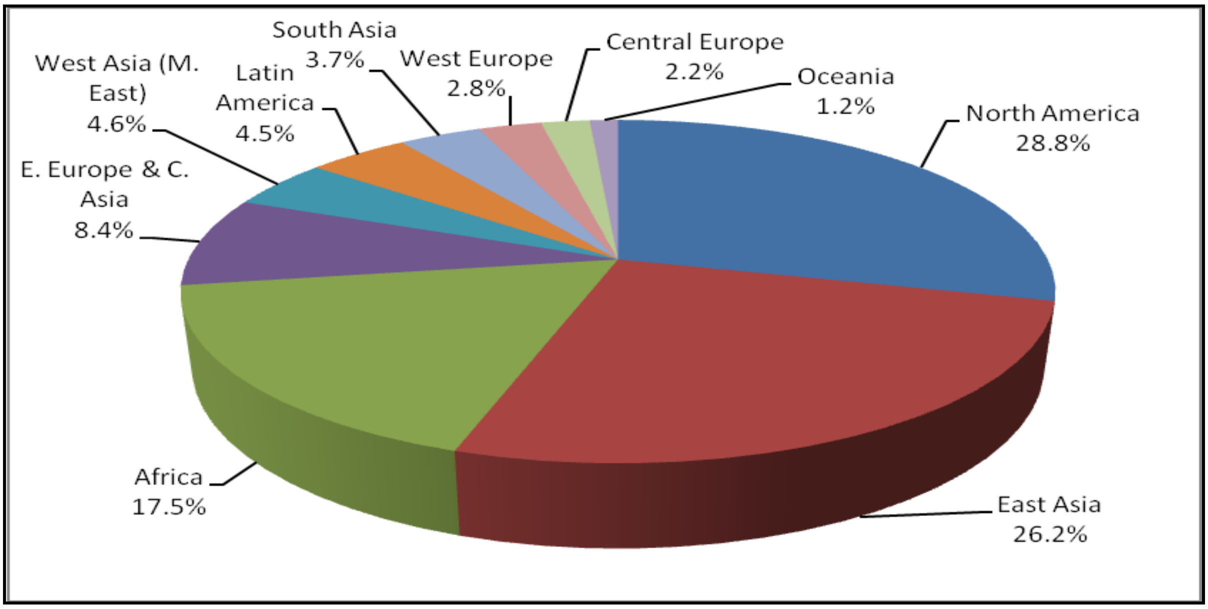
Source: IFA (2009)

Phosphoric Acid

The primary market for wet phosphoric acid is the production of phosphate fertilizer products—ammonium phosphate and triple superphosphate. Fertilizer production accounts for an estimated 80–85 per cent of the global market for wet phosphoric acid. About two-thirds of global phosphoric acid production is directed to the concentrated solid fertilizers, DAP, MAP and TSP. Of these, DAP is the most commonly used and attracts the largest share of phosphoric acid production. The remainder is consumed in a variety of industrial applications.

Much of global phosphate production is either owned or controlled by governments. While the percentage of state ownership has declined over the past three decades, about 47 per cent remains controlled by governments and production decisions are often subject to non-economic factors. Phosphate produced in countries such as Morocco, Tunisia and Jordan is largely government-owned, with production primarily directed to export markets. Higher production volumes support employment objectives and government initiatives, but can reduce profits and be disruptive to global markets.

Figure 7.50: Regional distribution of phosphoric acid production in the World during TE 2007

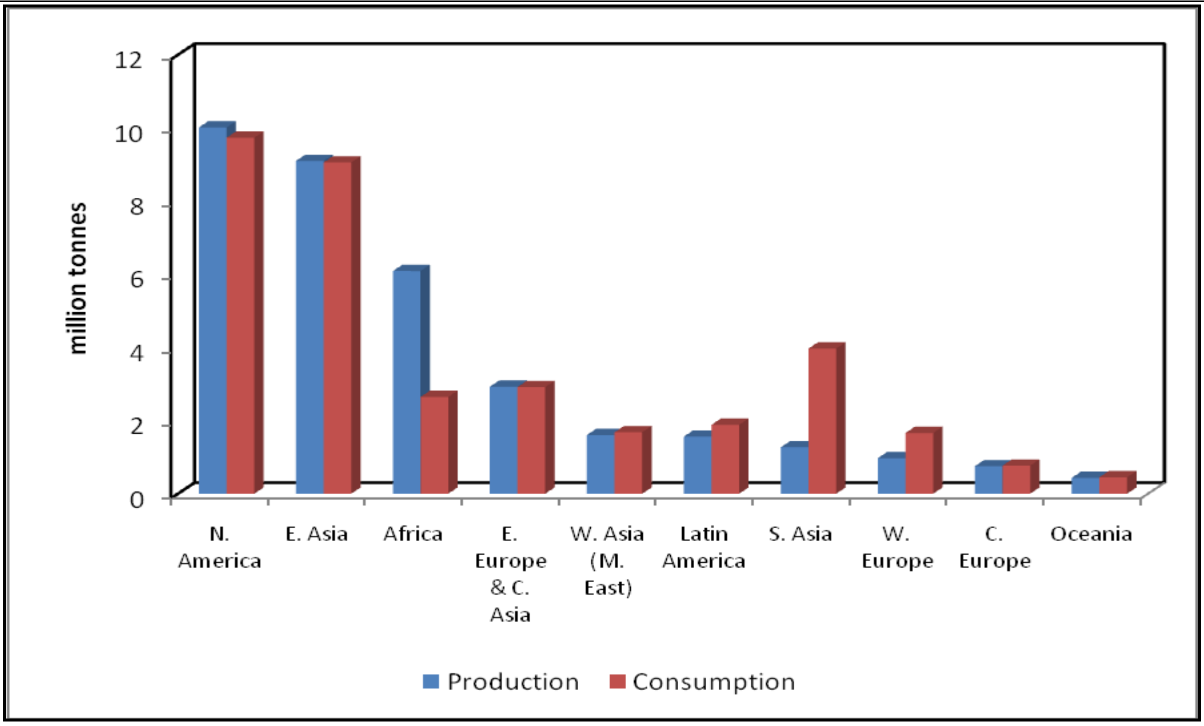


Source: IFA (2009)

North America is the largest producer of phosphoric acid, accounting for nearly 29 per cent of world production in the TE 2007. East Asia has the second largest share (26.2%), followed by Africa (17.5%). South Asia has less than four per cent share in global production.

The export market for wet phosphoric acid is dominated by Africa, which accounted for 74 per cent of world exports in 2005. No other region accounted for as much as 10 per cent. Africa has the largest surplus of phosphoric acid in the world while South Asia is the largest importer of phosphoric acid (Figure 7.51). India imports about 55 per cent of world phosphoric acid exports, accounting for about 54 per cent. Latin America, Western Europe and West Asia are also deficit in phosphoric acid.

Figure 7.51: Regional phosphoric acid production and consumption balance during the TE 2007



Source: IFA (2009)

The world wet phosphoric acid industry has recovered from a trough in the early 1990s that was induced by economic problems in the Eastern block. The recovery of the world industry overall is a result of the substantial growth that has occurred in the developing world. Markets have been relatively stagnant in the developed countries and regions. The supply/demand balance has also recovered from a serious dip at the end of the 1990s that resulted from the financial difficulties experienced by a number of rapidly growing economies in Southeast Asia.

The information on production and trade is summarized in Figure 7.52. World production of phosphoric acid increased from about 28 thousand tonnes in 1999 to over 36 thousand tonnes in 2007, at an annual growth rate of over 3.5 per cent. The exports remained almost stable at about 4.7 thousand tonnes and the share of exports in total production has declined from 16.7 per cent in 1999 to 13.1 per cent in 2007.

Figure 7.52: World phosphoric acid production and trade trends: 1999 to 2007

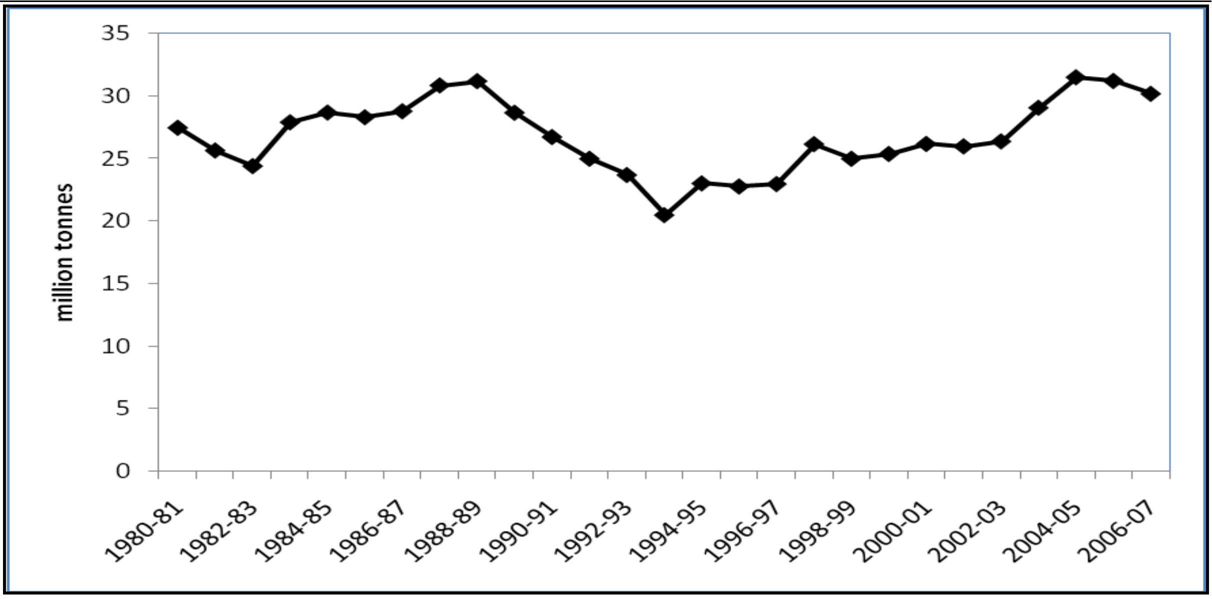
Source: IFA (2009)

K Fertilizers

Potash is a mineral found in a few regions around the world, with about 12 countries producing it, and more than 150 countries consuming it. Canada is the largest producer of potash followed by Russia, Belarus and China, which account for over 70 per cent of world production.

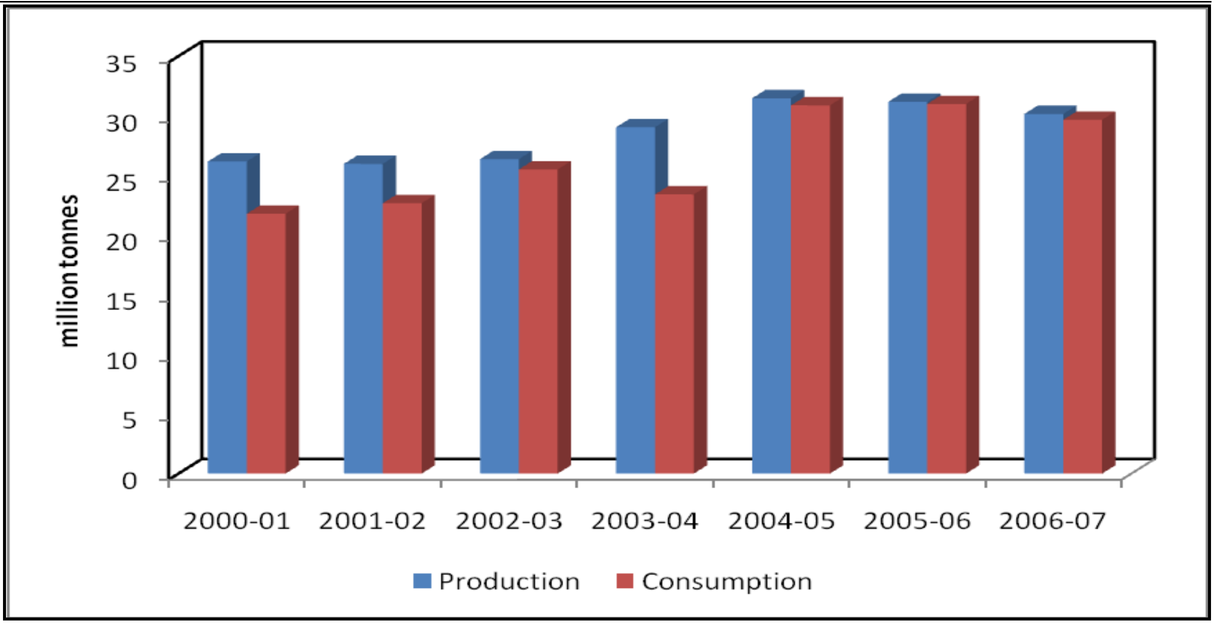
World potash production has increased from 26.2 million tonnes in 2001-02 to 30.2 million tonnes in 2006-07, while consumption has increased from 21.8 million tonnes to 29.7 million tonnes during the same period (Figure 7.54). Potassic fertilizer production has been rising over the years, growing by a compound annual growth rate of 3.5 per cent. Due to the rising demand for food, fiber, fuel and feed, the potash market has been experiencing growth in the last few years, with the largest consumers being those countries where potash reserves are not available and meet their demand through imports. China is the largest consumer, followed by India and Brazil.

Figure 7.53: Trends in World K2O production: 1980-81 – 2006-07



Source: IFA (2009)

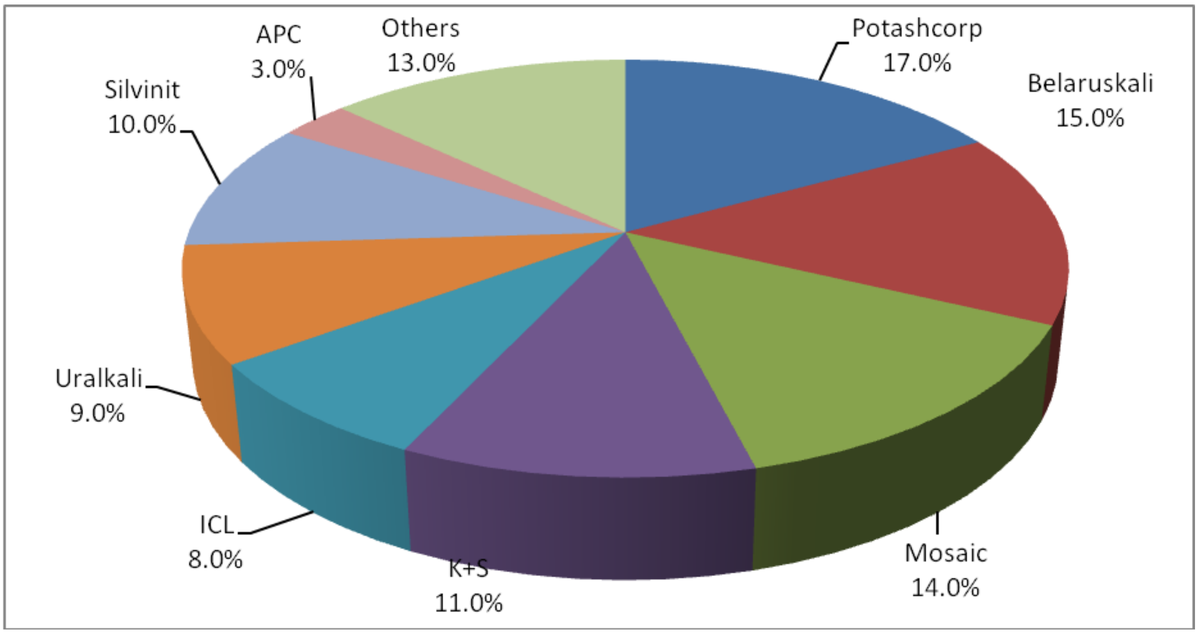
Figure 7.54: World potash (K2O) production and consumption balance



Source: IFA (2009)

Total consumption of potassic fertilizers has increased at a compound annual growth rate of 6.4 per cent between 2001-02 and 2006-07, surpassing the growth in production. The average production of potassic fertilizers has generally exceeded consumption during all the years but the gap between production and consumption has narrowed indicating low carry-over stocks. The world's largest potash producing companies are Potashcorp, Belaruskali and Mosaic, which combined produced 46 per cent of total potash production in 2007 (Figure 7.55)

Figure 7.55: Global potash producing companies; 2007



Source: ABC Investments (2008)

With many consumers but only a few producers, global potassic fertilizers trade is significant. More than 85 per cent of global production is traded internationally. In 2006-07, the global potassic fertilizer trade volume was 25.5 million tonnes (Figure 7.56).

America is the largest producer of potassic fertilizers accounting for 37.5 of global production, followed by Asia (33.6%) and Europe (28.9%). Asia has increased its share while Europe has lost the share between the TE 1992 and TE 2006 (Figure 7.57).

Muriate of Potash (MOP)

Of total potash fertilizers, over 90 per cent are in form of muriate of potash, MOP (KCl). North America and Eastern Europe and Central Asia produce almost two-thirds of the total MOP. Other producers of MOP are in Western Europe (14.3%), Middle East (10.2%) and East

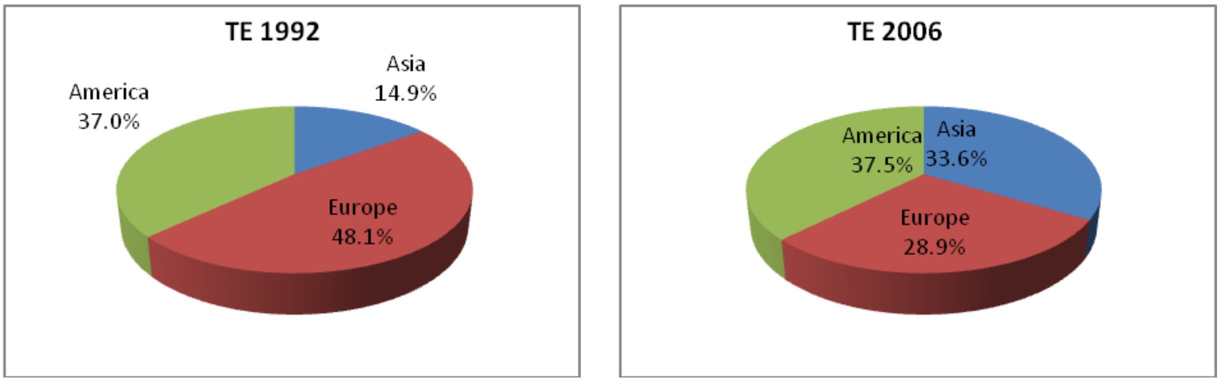
Asia (5.2%). Due to its relatively low price, it is the common source of potash for most field crops. The other potash products, namely sulphate of potash (SOP), and nitrate of potash (NOP), account for about 10 per cent.

Most of the countries/regions in the world are deficit in potassic fertilizers (Figure 7.60). In East Asia, average consumption was about 50.2 million tonnes as against the production of 8.2 million tonnes. Similarly, there was a huge deficit in production and consumption in Latin America (21.6 million tonnes), South Asia (13.7 million tonnes) and Central Europe (4.4 million tonnes).

Figure 7.56: World potash (K_2O) production and trade

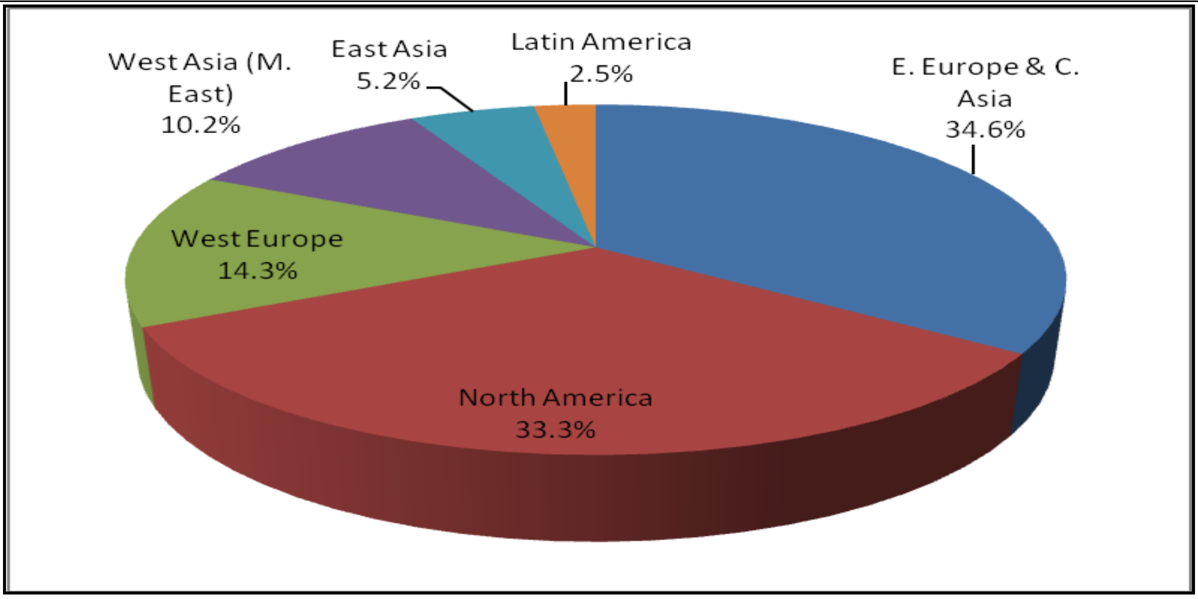
Source: IFA (2009)

Figure 7.57: Regional shares in global K fertilizers *(K2O)* production



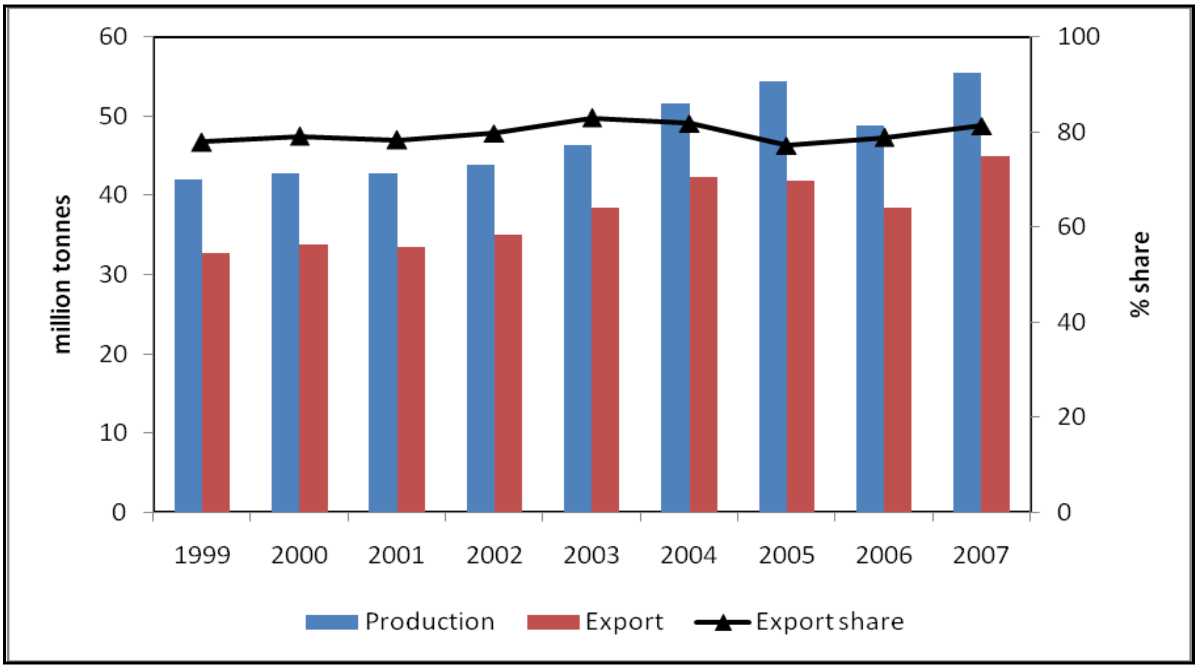
Source: IFA (2009)

Figure 7.58: Regional distribution of potash production in the World during TE 2007



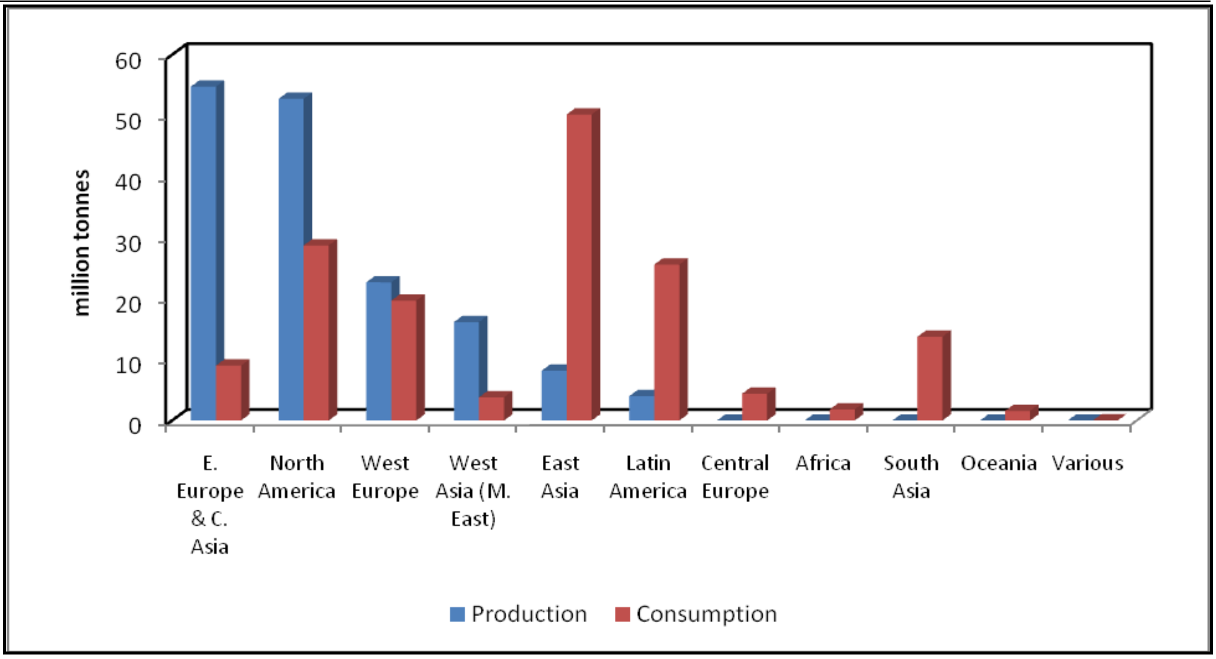
Source: IFA (2009)

Figure 7.59: World potash production and export trends during TE 2007



Source: IFA (2009)

Figure 7.60: World potash production and consumption balance during TE 2007



Source: IFA (2009)

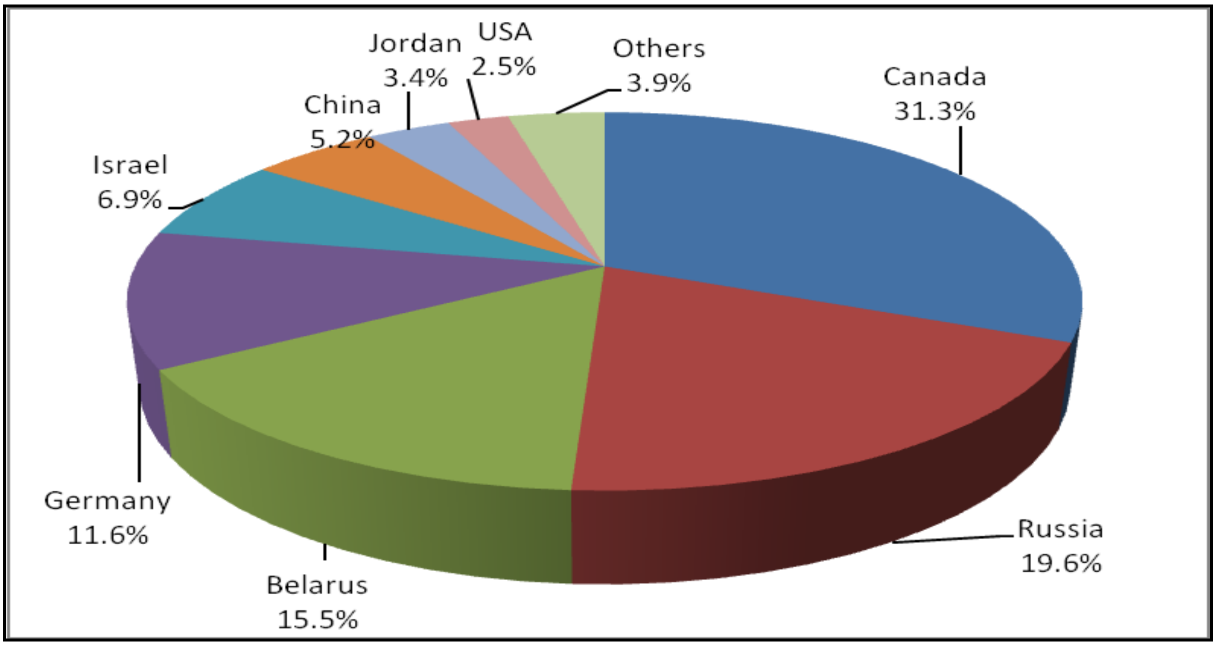
Major Potash Producers

Total global potash production capacity was at about 43.5 million tonnes K_2O in 2007 while capacity for the production of potassium chloride (KCl) was about 65.4 million tonnes (39.3 million tonnes of K_2O) and capacity for production of other forms of potash such as sulphate of potash (SOP) and nitrate of potash (NOP) was about 4.3 million tonnes of K_2O globally.

Major potash producing countries are presented in Figure 7.61. Canada is the largest producer of potash in the world, accounting for 31.3 per cent of total production of 52.05 million tonnes of KCl during the TE 2007. Russia and Belarus are ranked as second and third leading potash producers in the world. Russia produced 19.6 per cent and Belarus produced 15.5 per cent of global KCl output. The other important producers include Germany (11.6%), Israel (6.9%), China (5.2%), Jordan (3.4%) and USA (2.5%). Production of KCl is more concentrated in few countries and top five producer produce over 85 per cent of global KCl production.

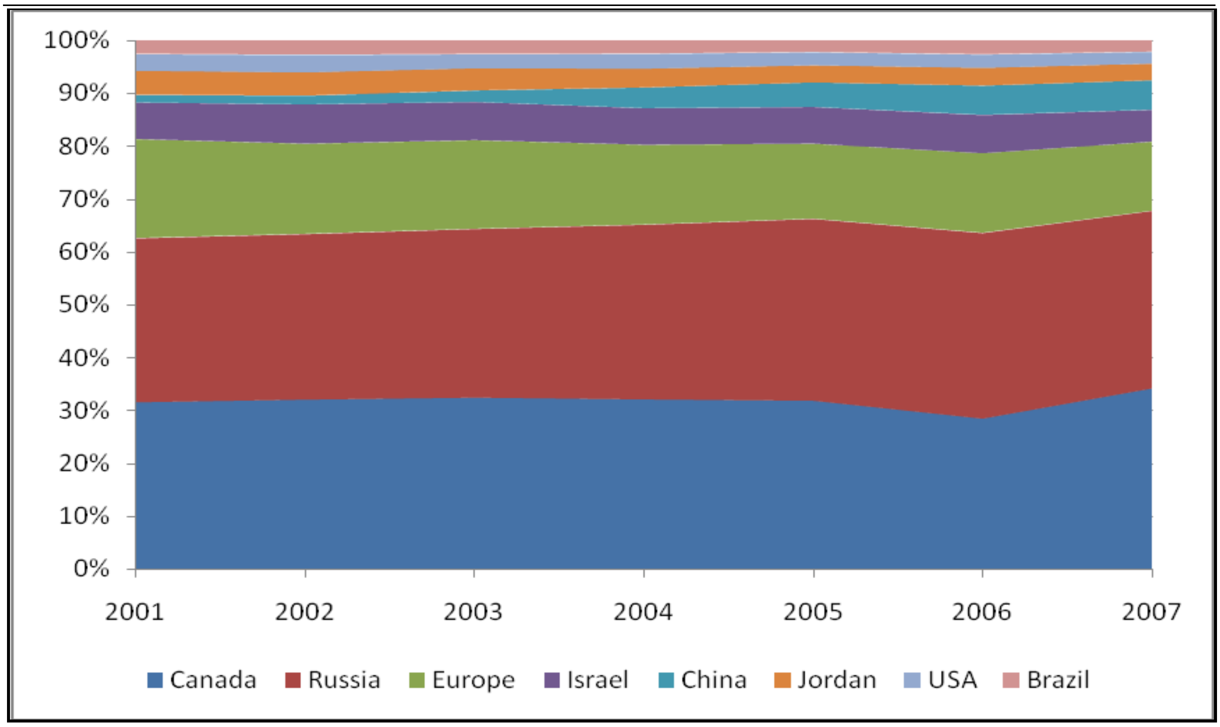
Trends in production of potash in major countries of the world are presented in Figure 7.62. Canada, Russia, and China have increased their share in world production while Europe has lost its share. There has been some reduction in the shares of Israel, Jordan and US.

Figure 7.61: Potassium chloride production by country, 2007



Source: IFA (2009)

Figure 7.62: World potash production trends by country/region, 2001-2007



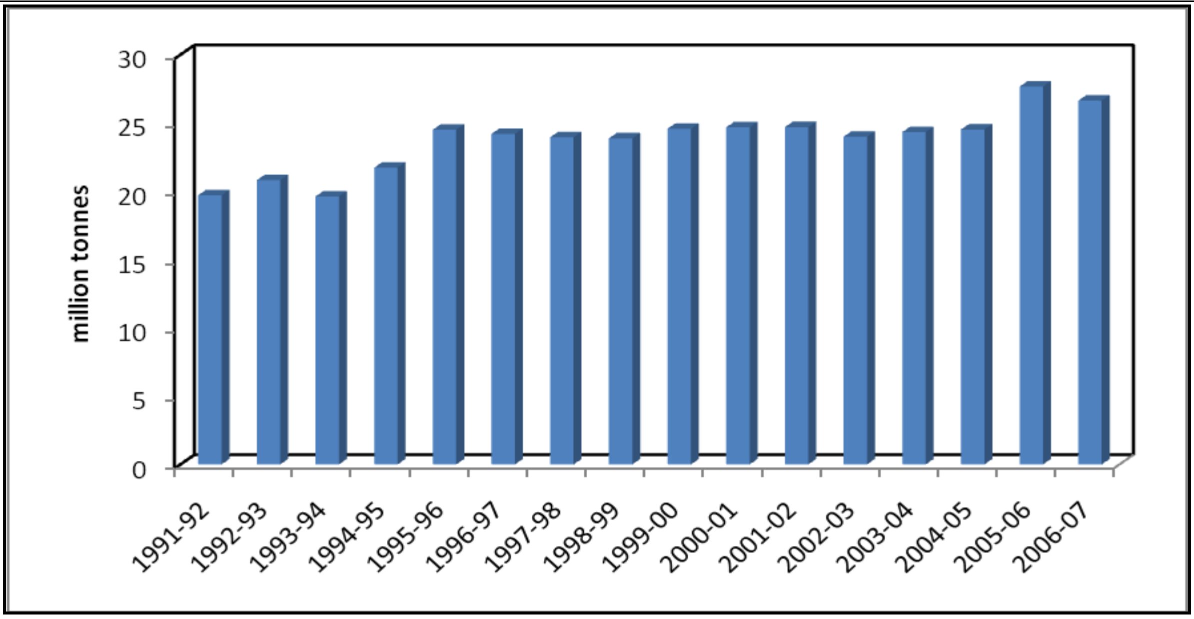
Source: IFA (2009)

WORLD FERTILIZER TRADE

Nitrogenous Fertilizers

Trends of exports of nitrogenous fertilizers between 1991-92 and 2006-07 are presented in Figure 7.63. Total exports of N fertilizers increased from 19.7 million tonnes in 1991-92 to about 27.6 million tonnes in 2006-07 at a growth arte of about 1.7 per cent. The growth in exports of N fertilizers was marginally higher (2.7%) during the 1990s compared with 2000s (2.3%). The exports ranged from 19.7 million tonnes to about 27.7 million tonnes.

Figure 7.63: Trends in exports of nitrogenous fertilizers (million tonnes)



Source: IFA (2009)

Products

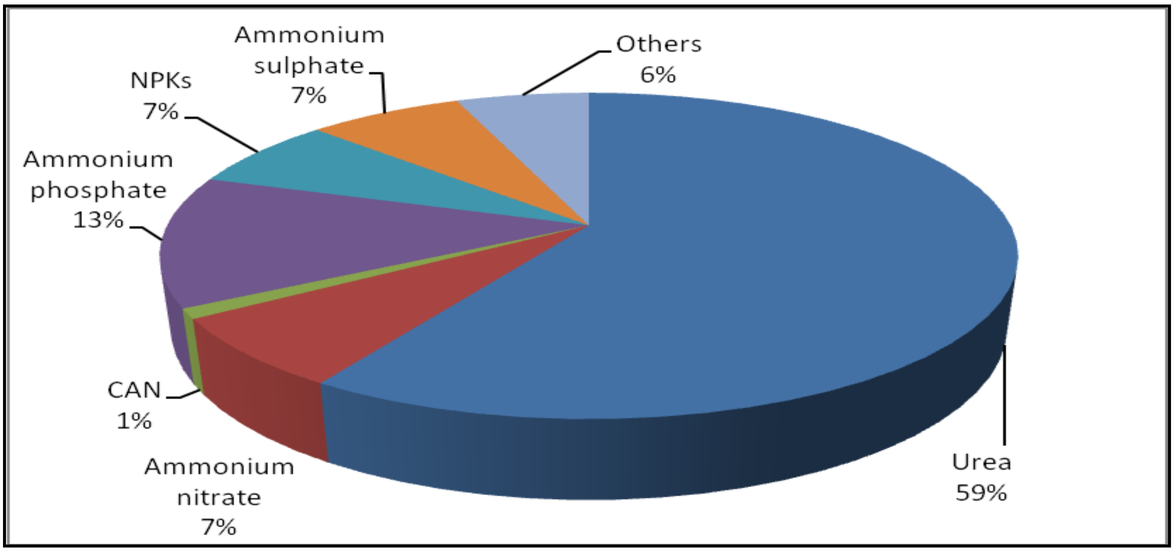
In 2006, about 59 per cent of international nitrogen trade was as urea, about 13 as ammonium phosphate, 7 per cent NPK compounds and the remainder as ammonium sulphate, ammonium nitrate or ammonium nitrate based products, such as calcium ammonium nitrate and ammonium sulphate nitrate (Figure 7.64).

Major Exporters and Importers

Table 7.12 contains summary information on the major exporters and importers. In the triennium ending 2006, Russian Federation was the largest exporter of nitrogenous fertilizers, accounting for 17.5 per cent share in global exports. Ukraine was the second largest exporter with a share of 6.1 per cent. The top five exporting countries controlled about 44 per cent of global exports.

USA was the largest importer of nitrogenous fertilizers with a share of 17.4 per cent in world imports. Brazil was the second (6.1%) and India the third largest (5.7%) importer of nitrogenous fertilizers in TE2006.

Figure 7.64: World trade in nitrogen fertilizers by products, 2006



Source: IFA (2009)

Table 7.12: International N fertilizer trade, TE 2006 (Million tonnes of N)

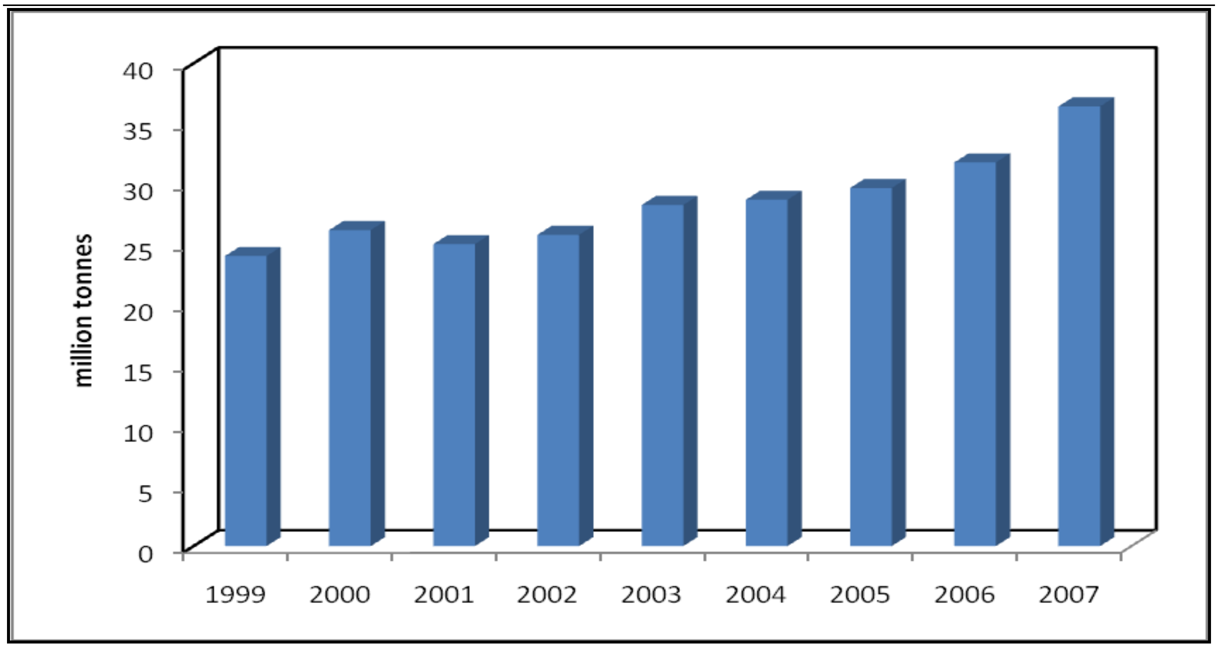
Country	Exports	Share (%)	Country	Imports	Share (%)
Russian Federation	4.97	17.5	USA	4.62	17.4
Ukraine	2.16	7.6	Brazil	1.61	6.1
Canada	2.06	7.3	India	1.50	5.7
United States	1.86	6.6	France	1.38	5.2
China	1.48	5.2	Turkey	1.08	4.1
Belgium	1.28	4.5	Germany	1.06	4.0
Qatar	1.24	4.4	Thailand	0.98	3.7
Saudi Arabia	1.15	4.1	Mexico	0.81	3.1
Netherlands	1.15	4.1	Vietnam	0.79	3.0
Romania	0.78	2.8	Australia	0.72	2.7
Others	10.18	36.0	Others	12.00	45.2
Total	28.32	100.0	Total	26.55	100.0

Source: IFA (2009)

Urea

The urea international trade volume reached around 36.4 million tonnes in 2007, accounting for about 25 per cent of world urea output (Figure 7.65)**.** The exports of urea have increased at an annual compound growth rate of 4.6 per cent between 1999 and 2007. Urea exports registered the highest growth among all straight nitrogenous fertilizers as it is the most commonly used fertilizer product particularly in developing countries.

Figure 7.65: Trends in exports of urea



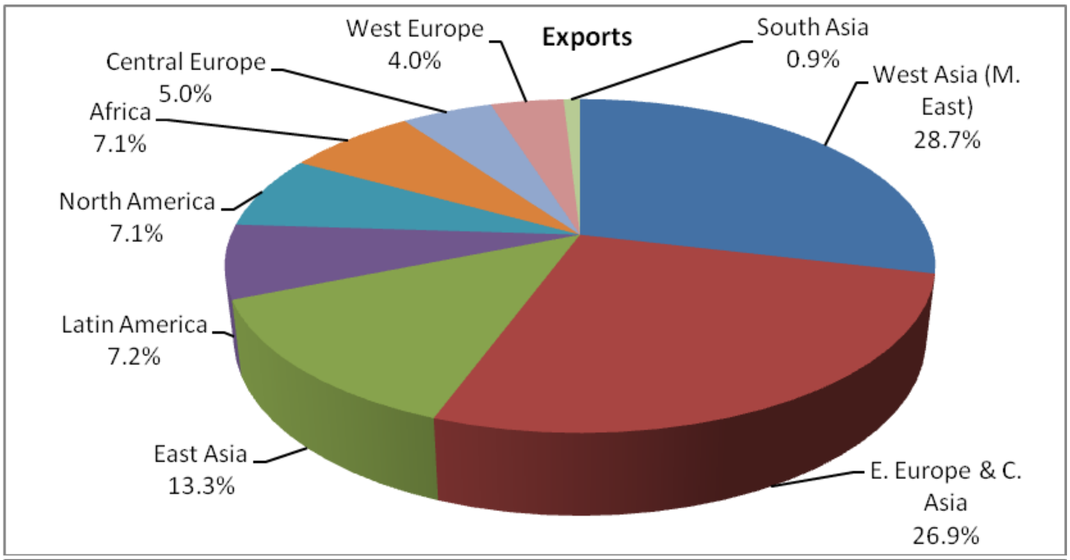
Source: IFA (2009)

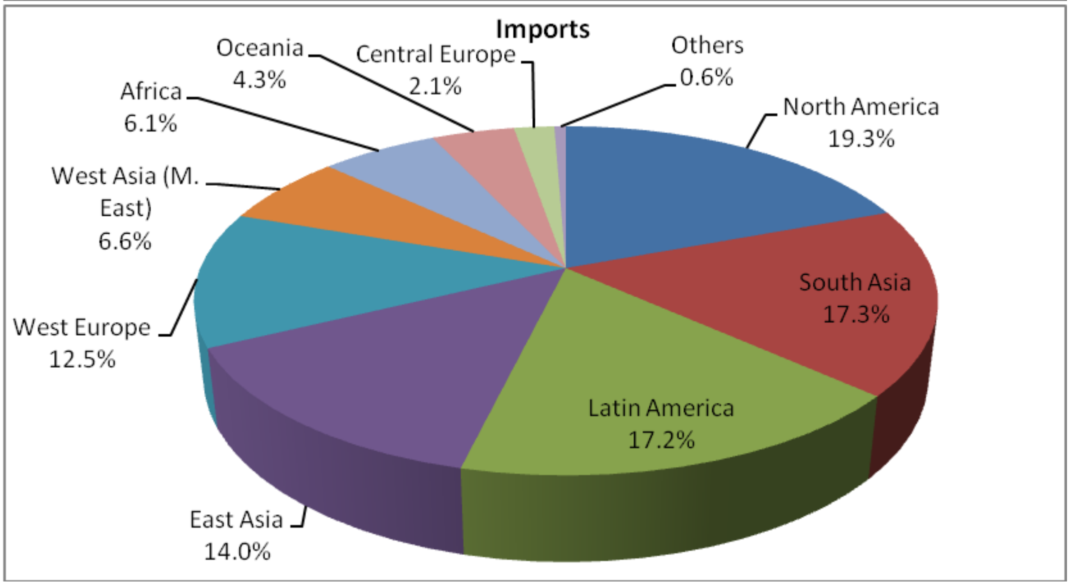
Regional Shares

The main exporters of urea are producers in areas where feedstock costs are lowest, notably the Middle East, Eastern Europe and Central Asia. Urea exports from the Middle East were about 10.2 million tonnes in 2007, around 29 per cent of the international trade volume (Figure 7.66). Eastern Europe and Central Asia is the second largest exporter of urea accounting for 26.9 per cent of world exports, followed by East Asia (13.3%). Latin America, North America and Africa are other main exporters of urea, each accounting for about 7 per cent share.

With each hovering at about 17-18 per cent, North America, South Asia, and Latin America are the world's largest urea importers (Figure 7.66). In terms of apparent consumption, however, Asia, at more than 65 per cent of the world's market, appears to be the largest consumer, with North America consuming about 11 per cent of the total supply.

Figure 7.66: Regional shares in international urea trade, TE 2007



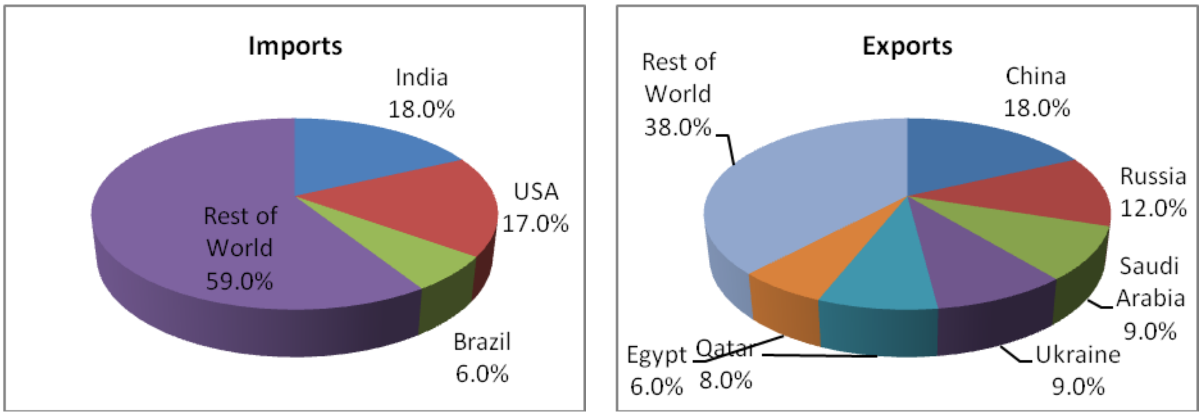


Source: IFA (2009)

Major Exporters and Importers

Urea import markets are highly concentrated, India and the USA being the largest importers with a combined share of about 35 per cent in world imports (Figure 7.67). Brazil accounted for about 6 per cent share. Export markets are slightly more diversifies. China was the largest exporter of urea in 2007 accounting for about 18 per cent global share, followed by Russia (12%), Saudi Arabia and Ukraine each with about 9 per cent share. The share of Qatar is 8 per cent while Egypt contributes about 6 per cent to global exports.

Figure 7.67: Concentration of urea import and export markets, 2007



Source: IFA (2009)

Phosphatic Fertilizers

Word exports of phosphatic fertilizers (P_2O_5) have been stagnant in the recent years after having registered a sustained growth during the period between 1992 and 1998 (Figure 7.68). During the period from 1998 to 2007, trade declined by over 1.0 million tonnes of P_2O_5. The decline in the trade of processed phosphates coincides with a rapid growth in production of phosphoric acid. A strong recovery of global phosphate market in 2002 resulted in higher production in all regions. This trend emphasizes the shift toward the processing of ammonium phosphate at local level using indigenous and imported raw material and intermediates.

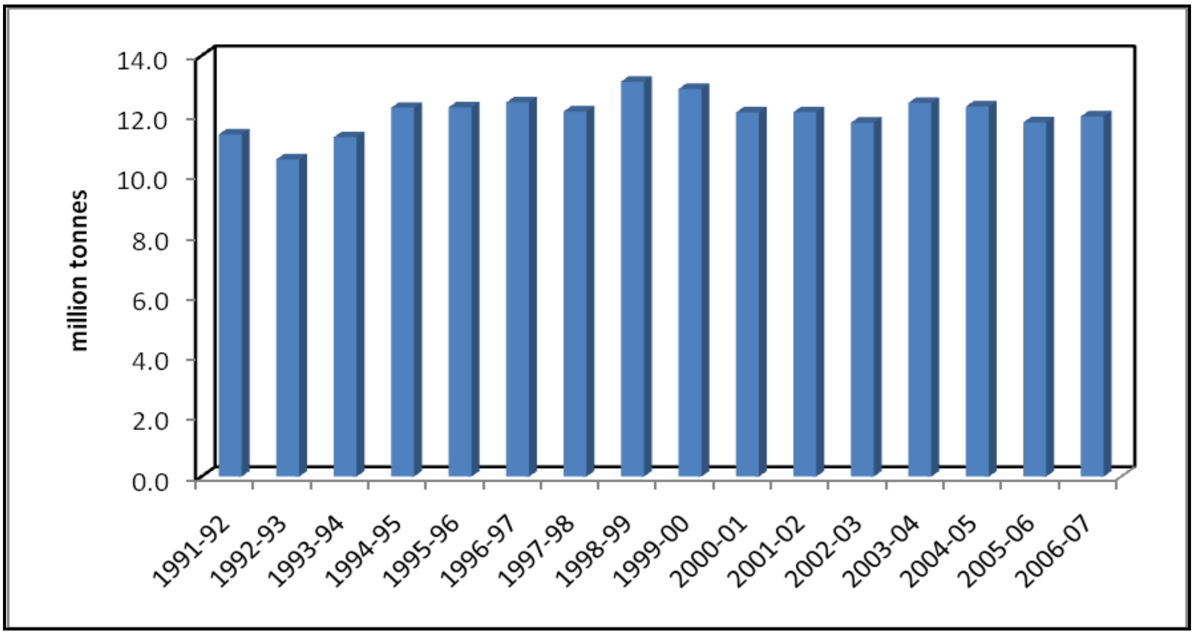
As regards international trade patterns, the higher level of production of processed phosphates in major consuming countries such as China, India and to some extent Brazil continues to be supplemented with imports from key exporters. Major exporters and importers of phosphatic fertilizers (P_2O_5) during the TE 2006 are given in Table 7.13.

Major Exporters and Importers

USA is the largest exporter of phosphatic fertilizers, which accounts for nearly one-third of the global trade. Russian Federation is the second largest exporter (17%), followed by Morocco (7.8%) and Tunisia (7.1%). The top five exporters control over 70 per cent of global trade in phosphatic fertilizers.

The largest markets for P_2O_5 are Brazil, China, India, Pakistan and Argentina with a combined share of over 37 per cent of world imports. World exports are more concentrated in a few countries while imports are more dispersed around the world.

Figure 7.68: Trends in world exports of P_2O_5



Source: IFA (2009)

Table 7.13: International P fertilizer trade, TE 2006 (Million tonnes of P_2O_5)

Country	Exports	Share (%)	Country	Imports	Share (%)
USA	4.10	32.2	Brazil	1.57	12.6
Russian Federation	2.16	17.0	China	1.10	8.8
Morocco	0.99	7.8	India	0.94	7.5
Tunisia	0.91	7.1	Pakistan	0.55	4.4
Belgium	0.87	6.8	Argentina	0.52	4.2
China	0.37	2.9	Australia	0.45	3.6
Lithuania	0.36	2.8	France	0.43	3.5
Jordan	0.34	2.7	Turkey	0.36	2.8
Israel	0.32	2.5	Mexico	0.35	2.8
Norway	0.28	2.2	Canada	0.33	2.7
Others	1.94	16.0	Others	6.60	47.1
Total	12.738	100.0	Total	12.492	100.0

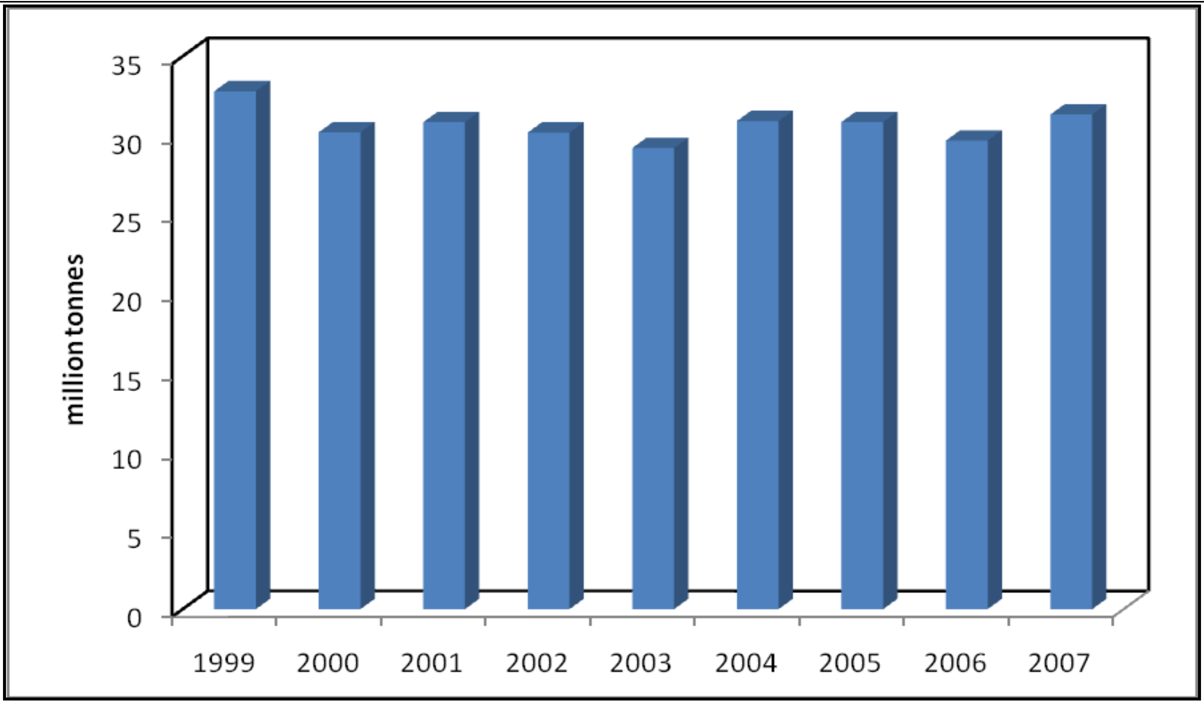
Source: IFA (2009)

Rock Phosphate

Rock phosphate is the world's most important source of phosphorus, and it is estimated that around 90 per cent of the global rock phosphate is directed to the production of fertilizers such as superphosphate, triple superphosphate and diammonium phosphate, all of which have a high percentage of phosphorus.

There has been a change in structure of phosphate industry. Initially, the main form of phosphorus was rock phosphate but this trade has declined sharply over the last three decades as vertically integrated industries have developed at or close to the site of mines. Although rock phosphate trend has fluctuated widely since 1970s, the general trend has been downwards. World rock phosphate exports fell from 53 million tonnes product in 1979 to 31.3 million tonnes in 2007. Between 1999 and 2007 exports of rock phosphate declined from 32.8 million tonnes to 29.7 million tonnes (Figure 7.69).

Figure 7.69: World exports of rock phosphate, 1999-2007



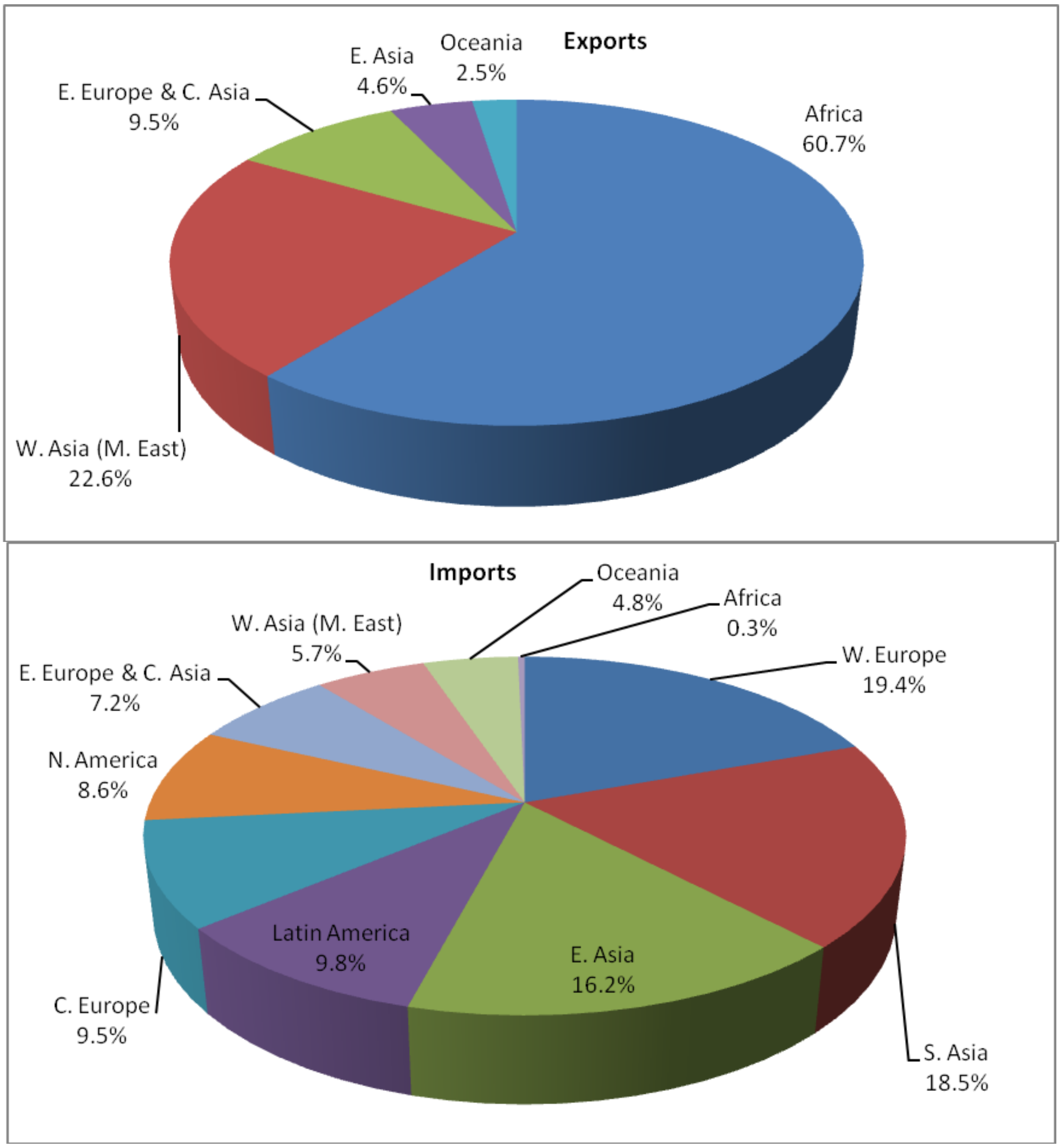
Source: IFA (2009)

Regional Shares

Details of rock phosphate trade by regions are given in Figure 7.70. About 30.6 million tonnes of rock phosphate were traded in the TE 2007. Africa with 60.7 per cent share is by far the largest exporter of rock phosphate. Middle East with 22.6 per cent share in world export comes second.

The major markets for rock phosphate are Western Europe (19.4%), South Asia (18.5%) and East Asia (16.2%) with more than half of global imports (Figure 7.70). Latin America, Central Europe and North America are other major importers of rock phosphate.

Figure 7.70: World market for rock phosphate (TE 2007): Percentage breakdown of volume of exports and imports by regions



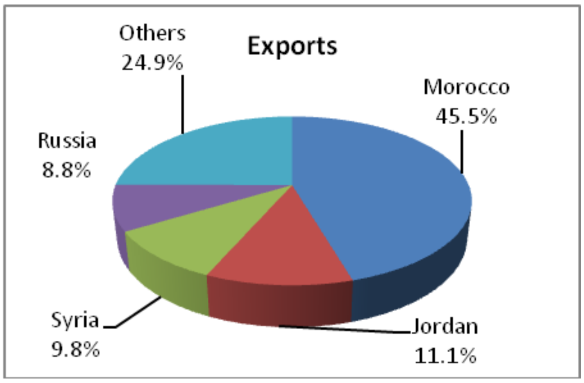
Source: IFA (2009)

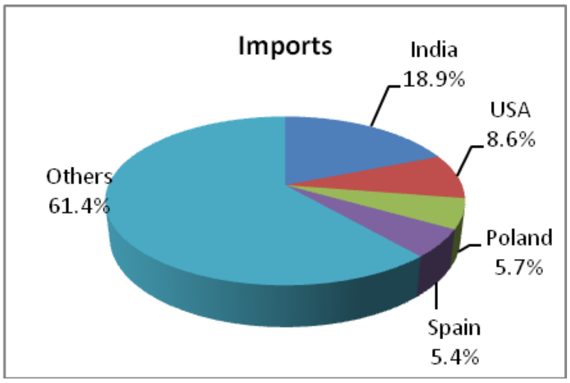
Major Exporters and Importers

Morocco remains the world's largest rock exporter with a 45.5 per cent share of global exports (Figure 7.71) Jordan is the second largest exporter with about 11 per cent share, followed by Syria (9.8%) and Russia (8.8%).

India is the world's leading consumer of rock phosphate accounting for about 19 per cent of world imports during the TE 2007 (Figure 7.71). The United States was the second largest importer, at 8.6 per cent of the total imports. The world exports are concentrated while imports are more diversified.

Figure 7.71: World market for rock phosphate (TE 2007): Percentage breakdown of volume of exports and imports by countries





Source: IFA (2009)

Phosphoric Acid

About 4.8 million tonnes of phosphoric acid were traded in the TE 2007. The global phosphoric acid trade showed a declining trend between 1999 and 2003, increased by about 13 per cent in 2004 and decreased by about 5 per cent in 2006 (Figure 7.72).

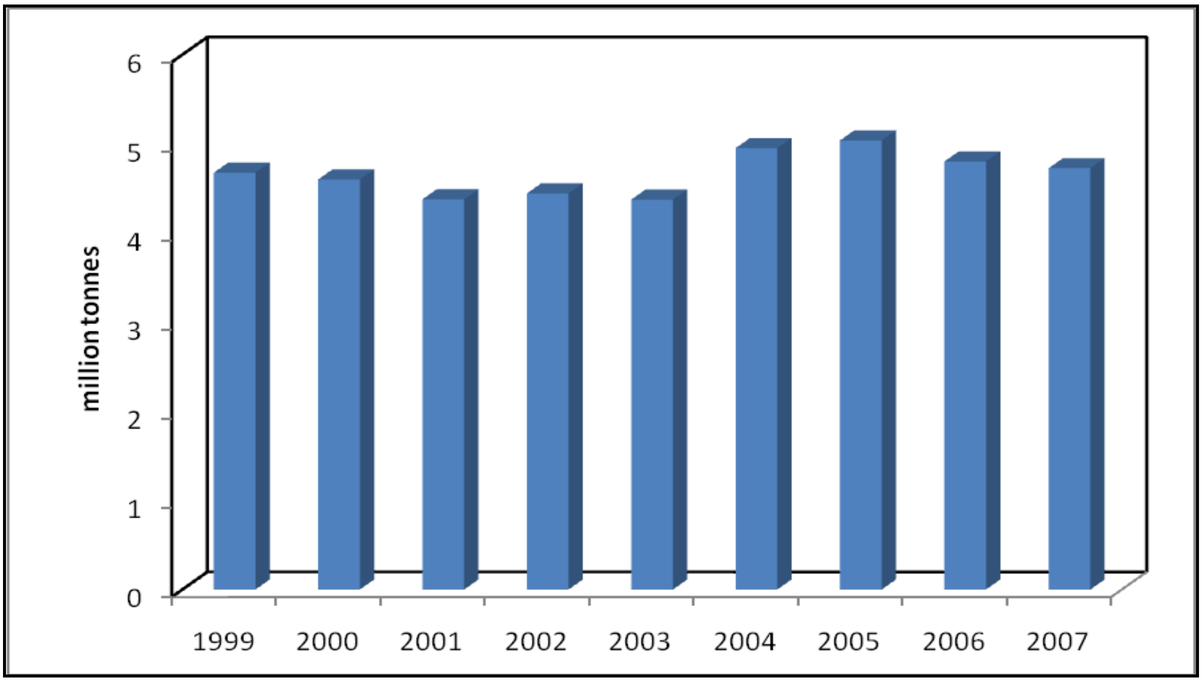
Regional Shares

Africa with 72.8 per cent share in global exports is the largest exporter of phosphoric acid (Figure 7.73). North America with 7.7 per cent share is the second largest exporter followed by Middle East (7%) and Western Europe (6.3%). South Asia is the largest importer of phosphoric acid accounting for about 56 per cent of global imports. Western Europe, with 20.6 per cent share, comes second to Asia in world imports. Middle East, Latin America and East Asia are other important markets for phosphoric acid.

Major Exporters and Importers

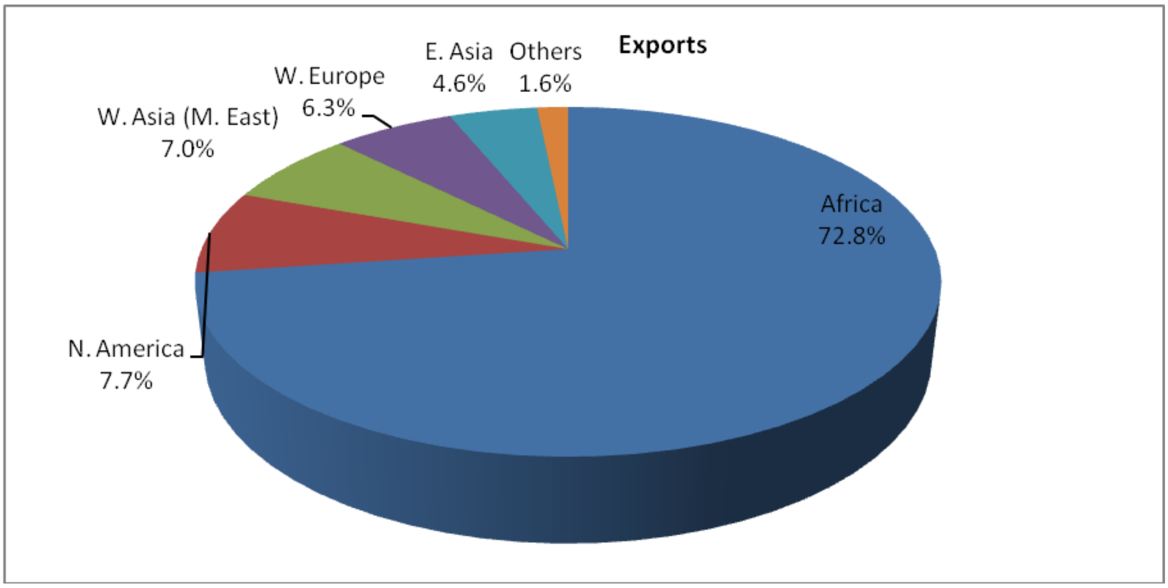
Morocco with 43.8 per cent share is by far the largest exporter of phosphoric acid. South Africa, with about 10.4 per cent share, comes second to Morocco and is the second largest exporter to India (21.8% share in India's imports). USA is also a major player in the phosphoric acid market.

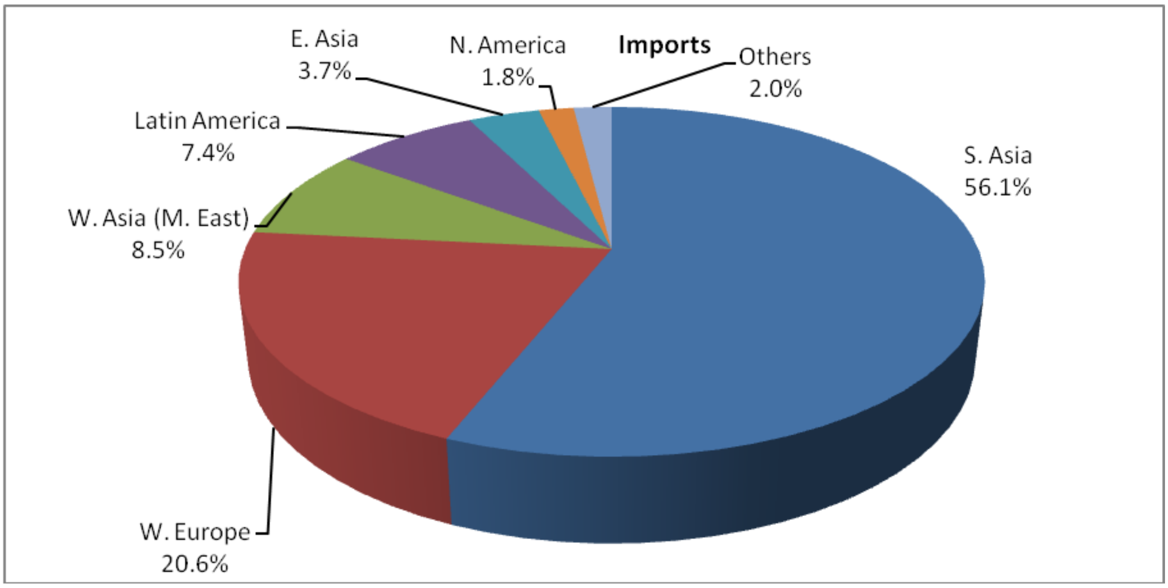
Figure 7.72: World exports of phosphoric acid, 1999-2007



Source: IFA (2009)

Figure 7.73: World market for phosphoric acid (TE 2007): Percentage breakdown of volume of exports and imports by regions

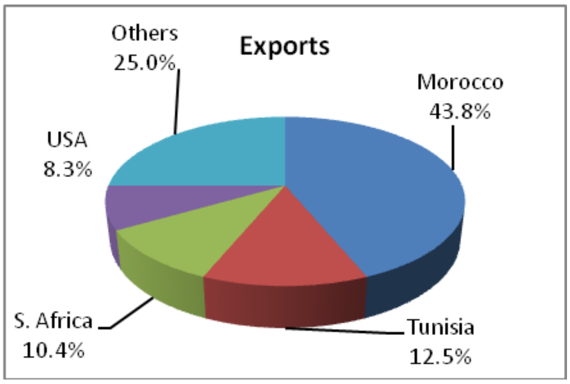


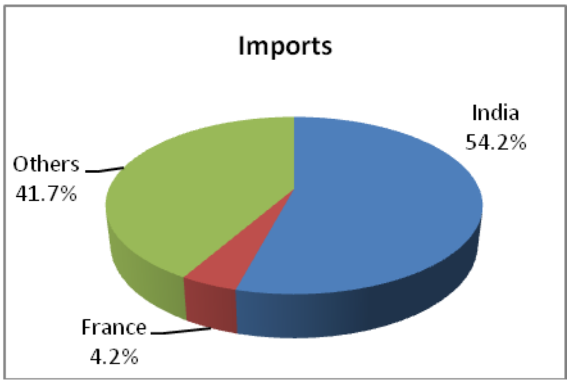


Source: IFA (2009)

India is the largest importer of phosphoric acid in the world accounting for 54.2 per cent of world imports (Figure 7.74). India has traditionally been Morocco's largest market and in 2007 India imported about 43 per cent of phosphoric acid from Morocco. South Africa is also a major exporter of phosphoric acid to India. India also imports phosphoric acid from Senegal, Tunisia and USA.

Figure 7.74: World market for phosphoric acid (TE 2007): Percentage breakdown of volume of exports and imports by countries





Source: IFA (2009)

Diammonium Phosphate – Regional Shares

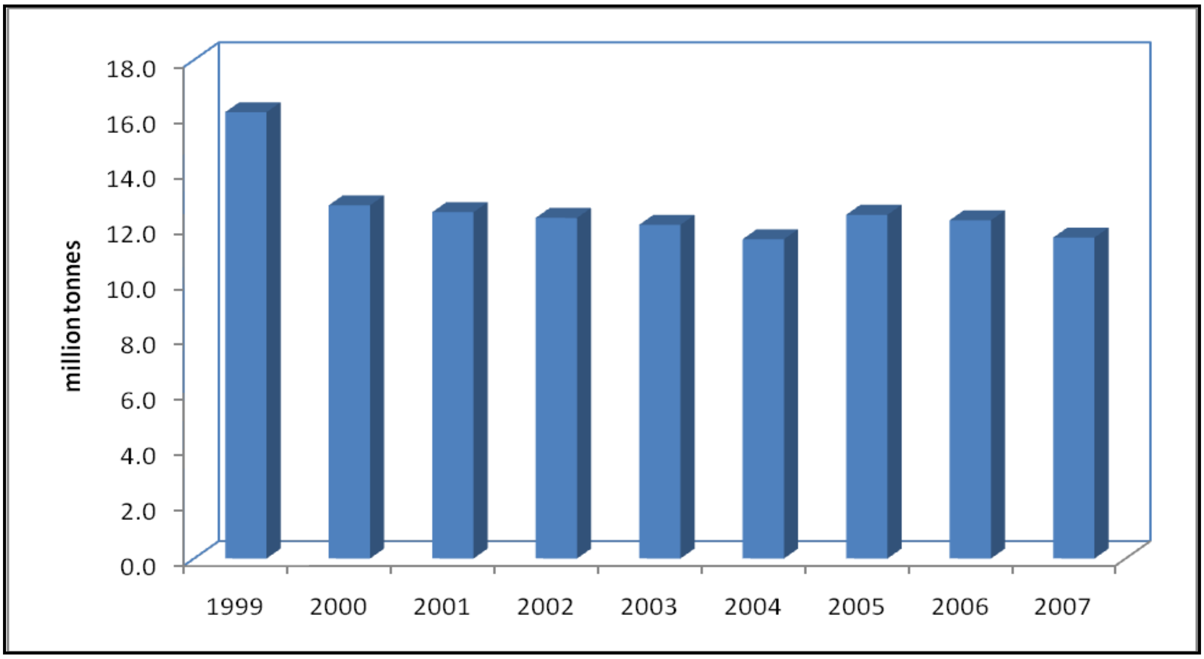
Exports of diammonium phosphate have declined during the last decade from 16.1 million tonnes in 1999 to 11.6 million tonnes in 2007 (Figure 7.75).

Summarized trade data for diammonium phosphate are given in Figure 7.76. North America is the largest exporter of DAP with 44.4 per cent of total exports. Eastern Europe and

Central Asia (17.8%), Africa (16.5%) and East Asia (11.3%) are also large exporters, accounting for over 45 per cent of world exports.

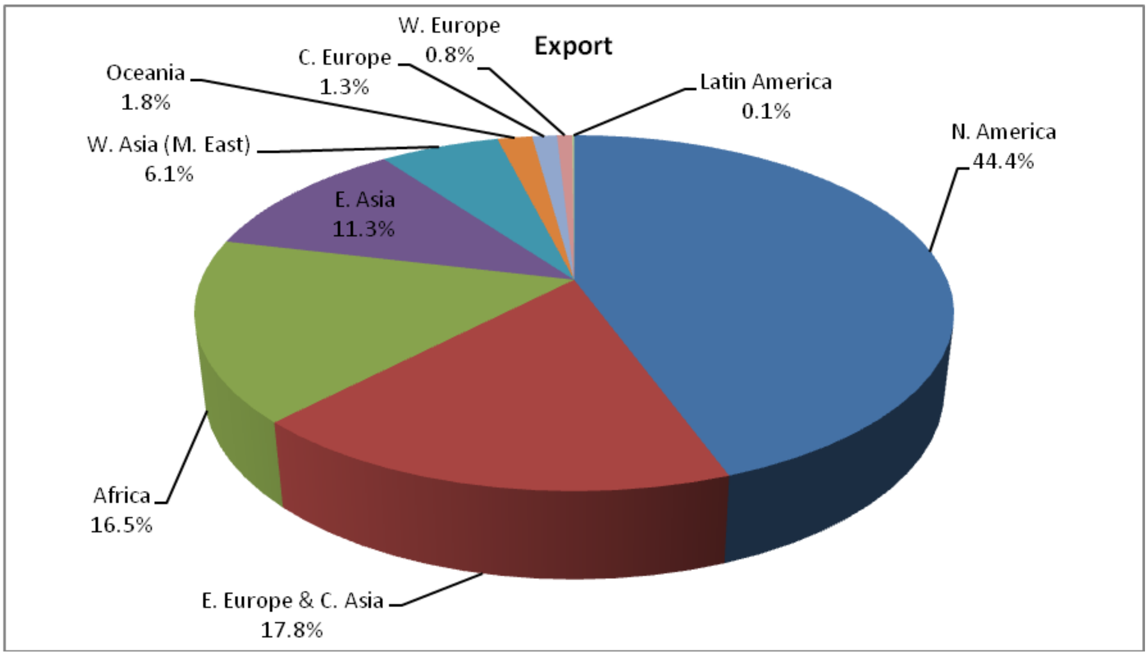
More than half of diammonium phosphate exports go to the South and East Asia (Figure 7.76) and most new demand for the product will also come from this region. Latin America and Western Europe are also important markets for diammonium phosphate.

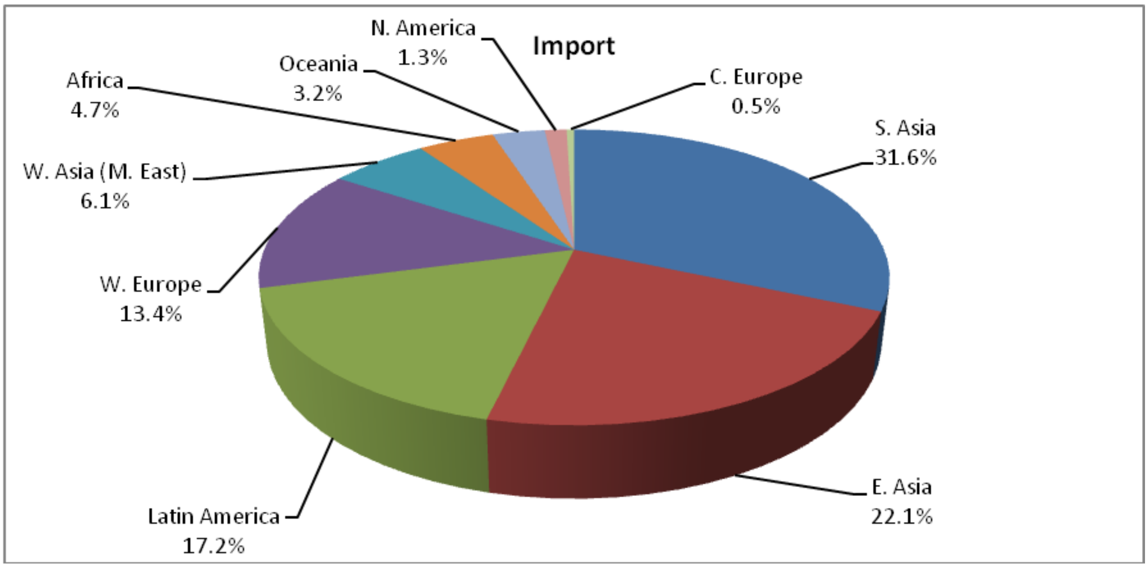
Figure 7.75: Trends in world exports of DAP, 1999 to 2007



Source: IFA (2009)

Figure 7.76: Regional shares in international DAP trade, TE 2007



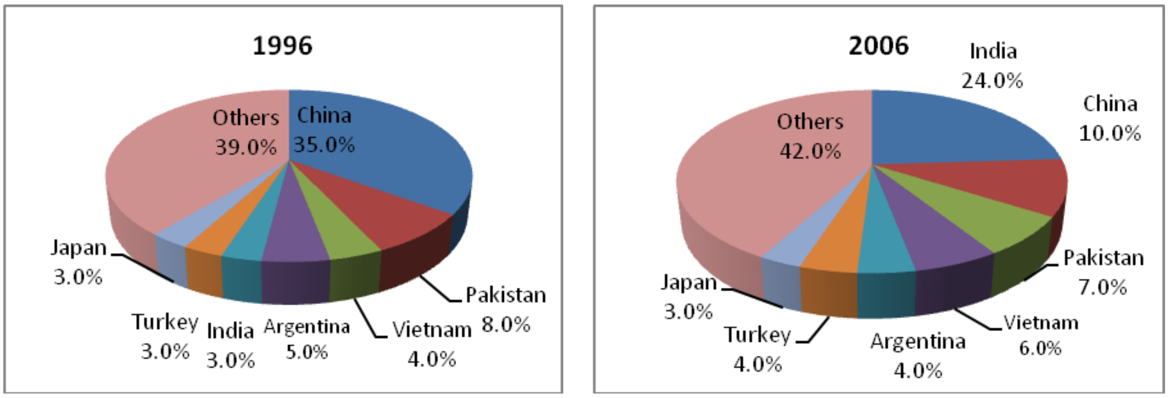


Source: IFA (2009)

Major Exporters and Importers

China was the largest importer with 35 per cent share of world imports in 1996, followed by Pakistan (8%) and Vietnam (4%). In 2006, India was the largest importer with 24 per cent share. China (10%), Pakistan (7%) and Vietnam (6%) were also large importers. The share of China has declined significantly from 35 per cent in 1996 to 10 per cent in 2006 due to increased domestic production. In contrast the share of India has increased substantially.

Figure 7.77: Share of major importers in global DAP imports



Source: IFA (2009)

Mono-ammonium Phosphate (MAP)

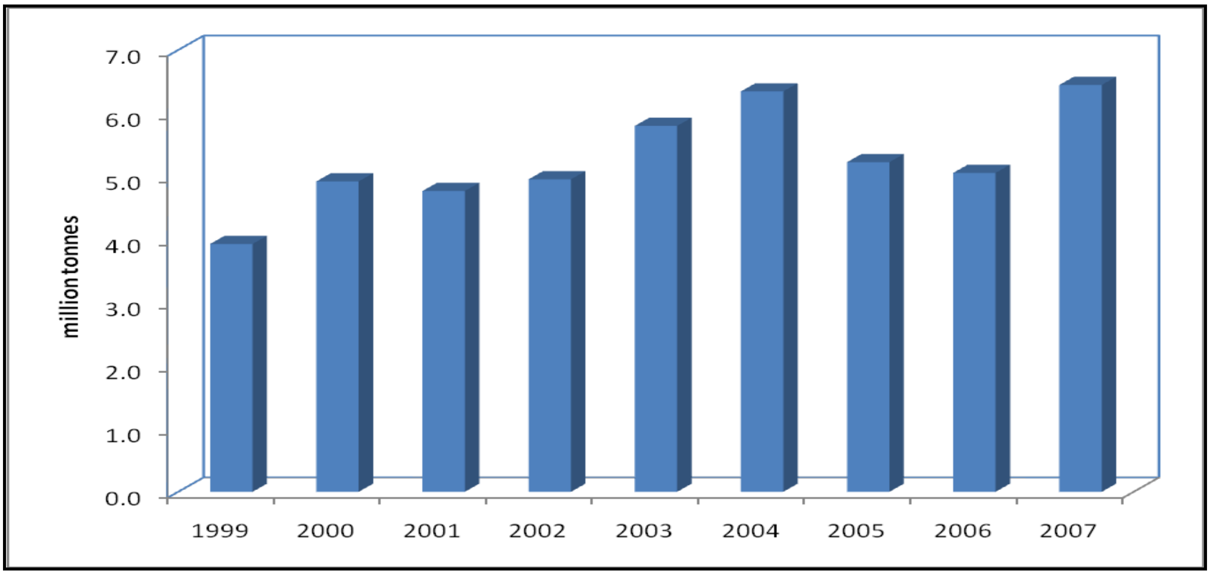
MAP imports have taken a growing share of the world trade in ammonium phosphates, from 22 per cent in 1992 to about 35 per cent in 2006. MAP exports expanded by an overall 64 per cent from 3.9 million tonnes to 6.4 million tonnes during the period of 1999-2007

(Figure 7.78). The main trade feature of the past ten years has been the steady decline of DAP exports and continuous rise of MAP exports.

Regional Shares

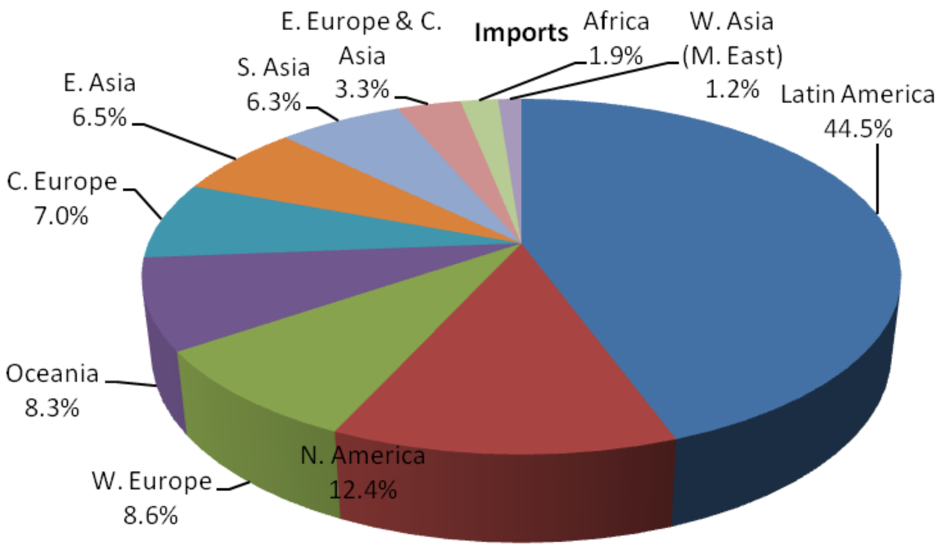
North America and Eastern Europe and Central Asia are the leading exporters of MAP with a combined share of over 72 per cent (Figure 7.79). East Asia and Africa contribute about 25 per cent of global exports. Latin America and North America imports about two-third of world imports of MAP. Other leading importers of MAP are Western Europe, Oceania, Central Europe and East Asia. South Asia's share in world imports is 6.3 per cent.

Figure 7.78: Trends in exports of MAP, 1999 - 2007



Source: IFA (2009)

Figure 7.79: Regional shares in international MAP trade, TE 2007

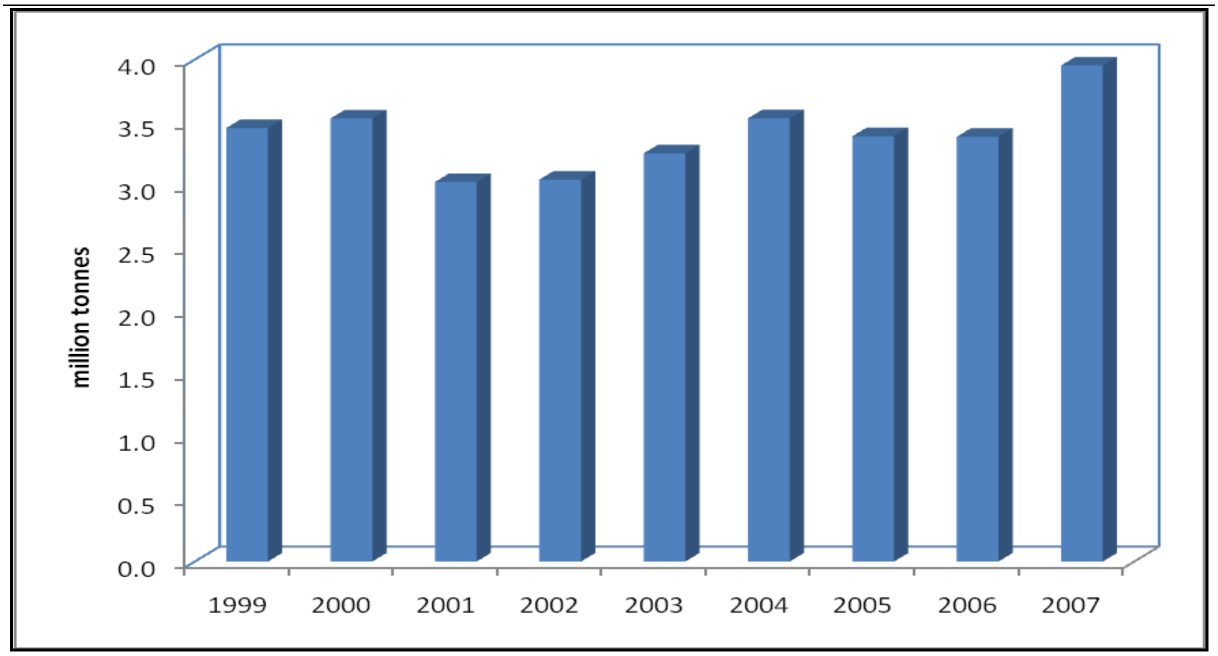


Source: IFA (2009)

Triple Superphosphate (TSP)

Trends in exports of TSP are presented in Figure 7.80. It is evident from the figure that TSP exports have increased from 3 million tonnes in 2001 to 4 million tonnes in 2007 at annual compound growth rate of about 3.9 per cent.

Figure 7.80: Trends in world exports of TSP

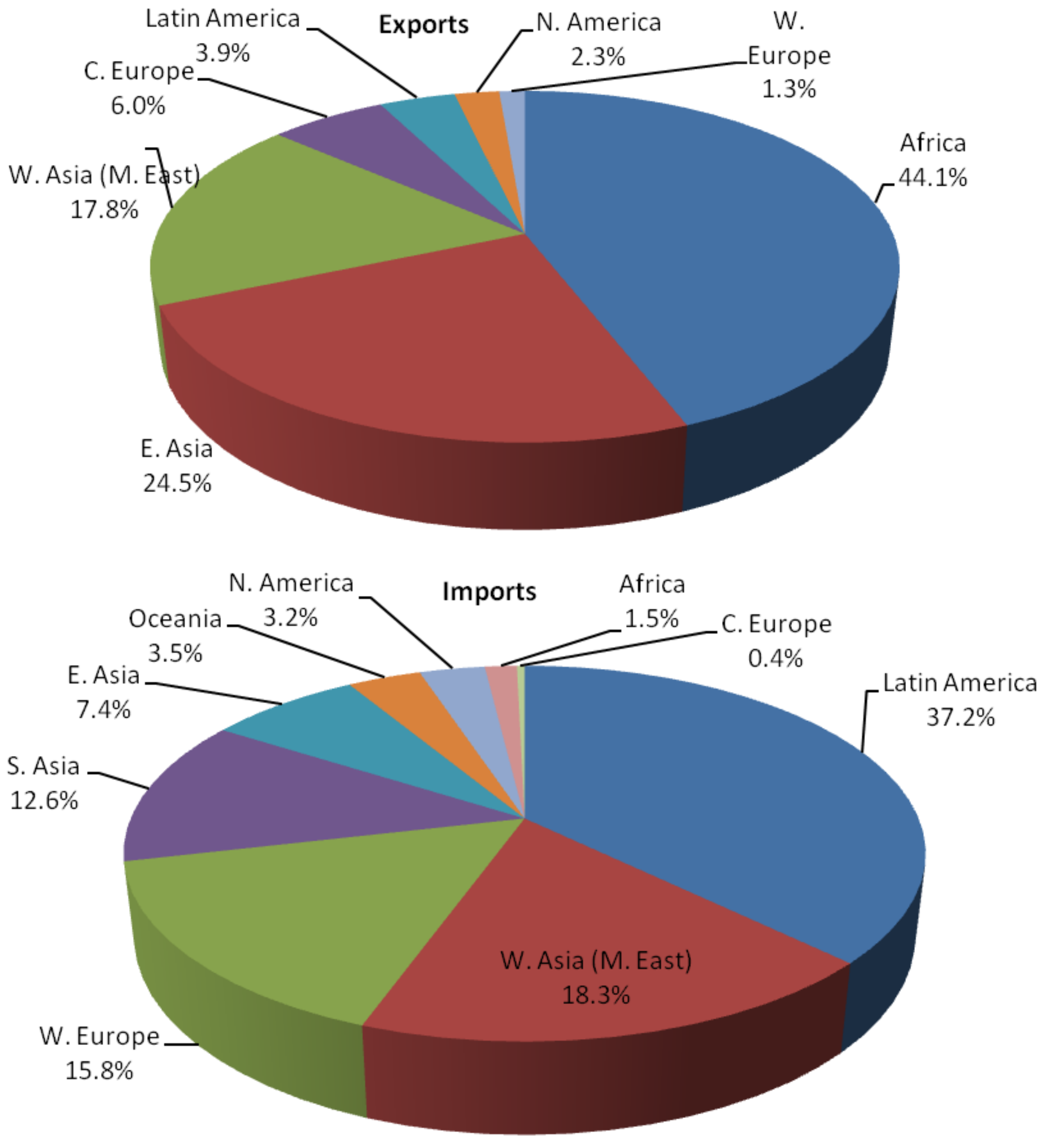


Source: IFA (2009)

Africa is the leading exporter of TSP accounting for about 44 per cent of world exports, followed by East Asia (24.5%) and Middle East (17.8%). Latin America is a major market for

TSP with a share of 37.2 per cent. Other important importers include Middle East (18.3%), Western Europe (15.8%) and South Asia (12.6%)

Figure 7.81: Regional shares in international TSP trade, TE 2007

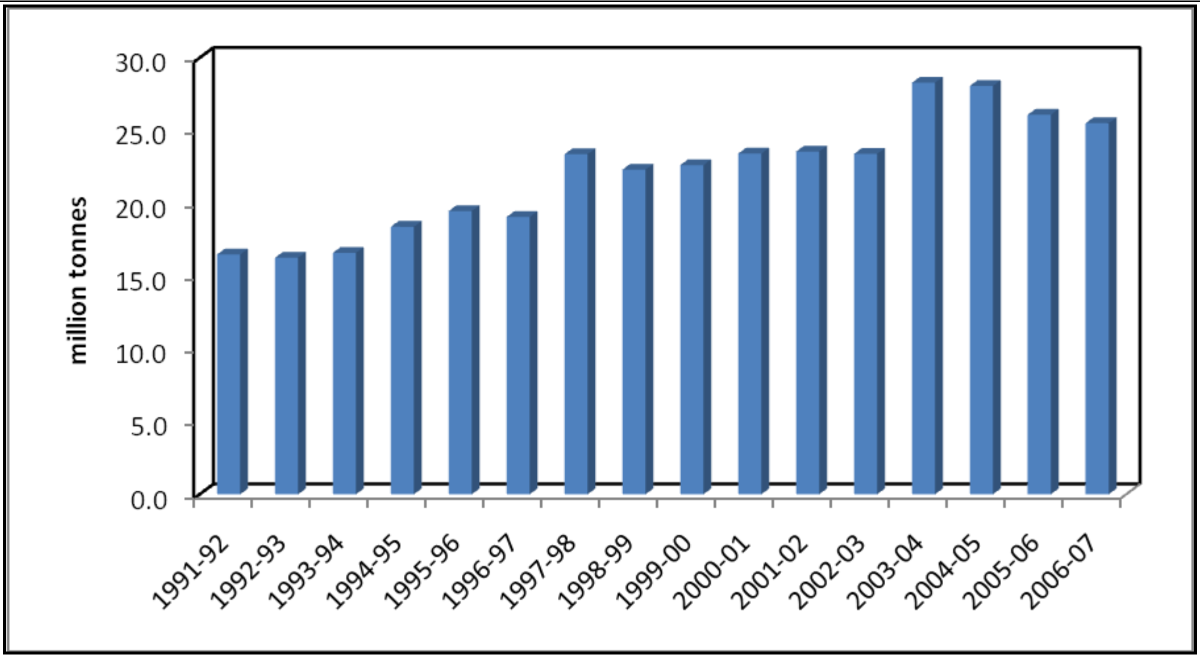


Source: IFA (2009)

Potassic Fertilizers

With many consumers but only a few producers, global potash trade is significant. More than 80 per cent of global production is traded internationally. There has been a significant increase in global potash trade. World potash exports have increased from about 16.5 million tonnes in early 1990s to over 28 million tonnes in 2004-05 (Figure 7.82). However, world exports declined during the last two years 2005-06 and 2006-07. Growth in world potash trade was the highest (3.7%) among three nutrients between 1991-92 and 2006-07.

Figure 7.82: Trends in exports of K fertilizers, 1991-92 – 2006-07



Source: IFA (2009)

Regional Shares

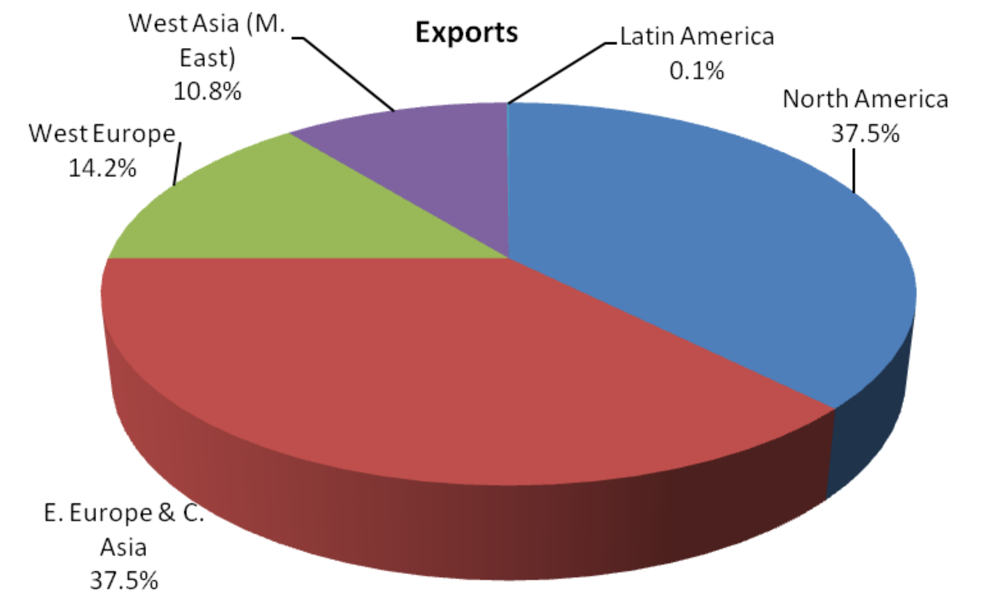
Regional share in exports and imports of potash are given in Figure 7.83. North America and Eastern Europe and Central Asian regions account for about 75 per cent of world potash exports (Figure 7.83). East Asia, North America and Latin America are important markets for potash with a combined share of nearly 70 per cent. This unique situation defines potash trade and production, which are largely driven by importing countries.

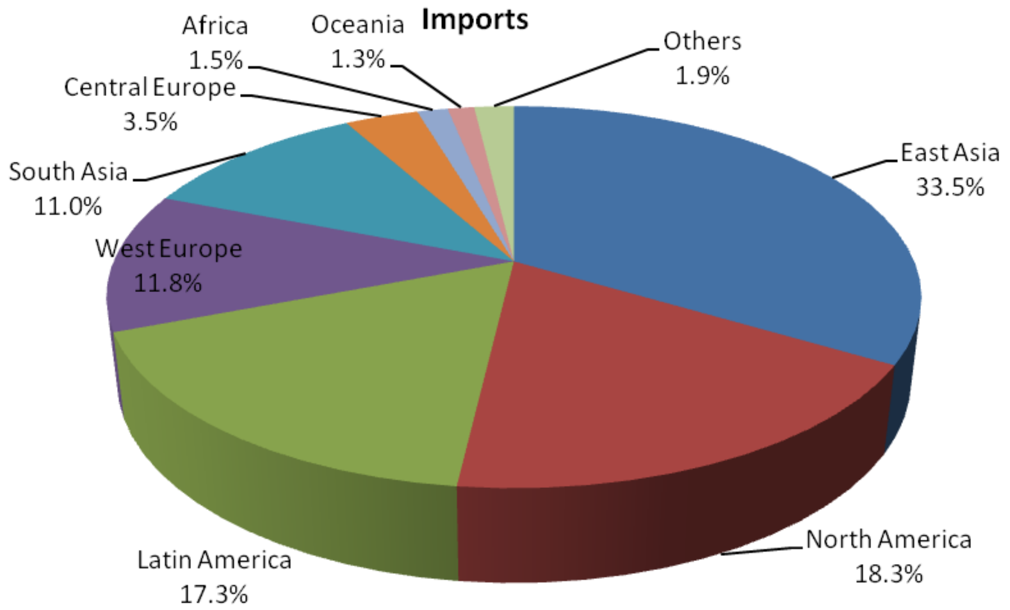
Major Exporting and Importing Countries

Table 7.14 contains information on the major exporters and importers of potash. The six leading potash producing countries (Canada, Russia, Belarus, Germany, Israel, and Jordan) accounted for about 90 per cent of global potash trade during the TE 2006. The export shares were 33.9 per cent for Canada, 20.1 per cent for Russia, 15 per cent for Belarus, 11.1 per cent for Germany, 6.8 per cent for Israel and 3.8 per cent for Jordan.

Asia is the largest potash-consuming and importing region with two leading potash consumers, China and India. The United States was the largest consuming country until 2004 when it was overtaken by China. China was the largest importer (18.7%) of K_2O in the TE 2006. The second largest importer was the United States, with a share of 17.99%, followed by Brazil 12.6 per cent and India at number four (8.5%).

Figure 7.83: World market for potash (TE 2007): Percentage breakdown of export and import volumes by regions





Source: IFA (2009)

Table 7.14: International K fertilizer trade, TE 2006 (Million tonnes of K_2O)

Country	Exports	Share (%)	Country	Imports	Share (%)
Canada	9.22	33.9	China	5.05	18.7
Russian Federation	5.46	20.1	USA	4.82	17.9
Belarus	4.08	15.0	Brazil	3.39	12.6
Germany	3.01	11.1	India	2.30	8.5
Israel	1.84	6.8	France	1.14	4.2
Jordan	1.03	3.8	Malaysia	0.97	3.6
Spain	0.34	1.2	Indonesia	0.85	3.1
Chile	0.32	1.2	Poland	0.53	2.0
United Kingdom	0.27	1.0	Viet Nam	0.42	1.6
USA	0.26	1.0	Italy	0.28	1.0
Others	1.38	5.1	Others	7.23	26.8
Total	27.21	100.0	Total	26.98	100

Source: IFA (2009)

Summary and Concluding Remarks

Global consumption of fertilizer (N+P+K) has increased from about 116 million tonnes in 1980-81 to about 169 million tonnes during 2007-08, representing an annual compound growth rate of just over one per cent. The growth rate in N consumption was maximum (1.62%), followed by P fertilizers (0.48%) and the lowest in K fertilizers (0.11%). The share of N fertilizers has increased between during the last two and half decades while share of P and K fertilizers has declined in the world.

Demand for nitrogenous fertilizers continues to be high in East and South Asia, which accounted for about 57 per cent of world consumption, North America accounted for 13.9 per cent of world consumption and Western and Central Europe 11.8 per cent. About two-third of N consumption is concentrated in three countries, namely, China, USA and India.

Urea is the most commonly used nitrogenous fertilizer product and represented about 54 per cent of all nitrogenous fertilizer products consumed globally.

In the case of phosphatic fertilizers, China, USA and India are the top consumers accounting for over 60 per cent of global consumption. The ammonium phosphates (mono- and di-ammonium) accounted for 47.8 per cent of global fertilizer phosphate fertilizer consumption in 2005. The share of NPK complexes was 22.9 per cent, SSP 17.4 per cent and TSP 6.3 per cent.

East Asia accounted for about one-third of world K_2O consumption while Latin America and North America each with 17.9 per cent share were the second largest consumers of K_2O. Other important K_2O consuming regions are West and Central Europe (13.7%) and South Asia (9.3%). China ranks number one in K consumption with a share of 26.4 per cent, followed by USA (19.4%) and Brazil (11.4%). India is the fourth largest consumer with a share of 7.9 per cent. The muriate of potash (MOP) is the most popular potassium fertilizer with an estimated share of 88 per cent, followed by Potassium sulphate (8%) and Potassium nitrate (4%).

Fertilizer application rates vary widely among the major world regions and countries. Per hectare fertilizer use varies from about 9 kg in Sub-Saharan Africa to 278 kg in East Asia. Wide variations are also prominent among different countries of the world. For example, fertilizer use varies from a low of about 18 kg per hectare in Nepal to a high of about 666 kg per hectare in Netherlands. The world average application rate is about 109 kg per hectare.

Russian Federation, the largest exporter of nitrogenous fertilizers, accounts for 17.5 per cent share in global exports. Ukraine was the second largest exporter with a share of 6.1 per cent. The top five exporting countries controlled about 44 per cent of global exports. USA was the largest importer of nitrogenous fertilizers with a share of 17.4 per cent in world imports. Brazil was the second (6.1%) and India the third largest (5.7%) importer of nitrogenous fertilizers in TE2006.

USA is the largest exporter of phosphatic fertilizers, which accounts for nearly one-third of the global trade. Russian Federation is the second largest exporter (17%), followed by Morocco (7.8%) and Tunisia (7.1%). The top five exporters control over 70 per cent of global trade in phosphatic fertilizers. The largest markets for P2O5 are Brazil, China, India, Pakistan and Argentina with a combined share of over 37 per cent of world imports. World exports are more concentrated in a few countries while imports are more dispersed around the world.

Africa with 60.7 per cent share is by far the largest exporter of rock phosphate. Middle East with 22.6 per cent share in world export comes second. The major markets for rock phosphate are Western Europe (19.4%), South Asia (18.5%) and East Asia (16.2%) with more than half of global imports. Latin America, Central Europe and North America are other major importers of rock phosphate.

Morocco remains the world's largest rock exporter with a 45.5 per cent share of global exports while Jordan is the second largest exporter with about 11 per cent share, followed by Syria (9.8%) and Russia (8.8%). India is the world's leading consumer of rock phosphate accounting for about 19 per cent of world imports. The world exports are concentrated while imports are more diversified.

The six leading potash producing countries (Canada, Russia, Belarus, Germany, Israel, and Jordan) accounted for over 90 per cent of global potash trade during the TE 2006. The export shares were 33.9 per cent for Canada, 20.1 per cent for Russia, 15 per cent for Belarus, 11.1 per cent for Germany, 6.8 per cent for Israel and 3.8 per cent for Jordan. Asia is the largest potash-consuming and importing region with two leading potash consumers, China and India.

Global fertilizer demand increased sharply in 2007-08, boosted by strong agricultural commodity prices during the first half of 2008. However, unprecedented rise in prices of fertilizers due to high raw material costs, freight rates, and slow down in the global and national economies adversely affected the demand for fertilizers in 2008-09. The softening of oil prices, fall in ocean freight rates and improvement in market conditions in some regions might improve prospects for global fertilizer demand.

Chapter 8

SUMMARY, CONCLUDING OBSERVATIONS AND POLICY IMPLICATIONS

Agriculture sector is the mainstay of the Indian economy, contributing about 17 per cent of national Gross Domestic Product (GDP) and more importantly, more than half of India's workforce is engaged in agriculture as principal occupation for their livelihood and employment. Successive Five Year plans have stressed on self-sufficiency and self-reliance in foodgrains production and concerted efforts in this direction have resulted in substantial increase in agricultural production and productivity. The main source of this growth was through improvement in yield per unit of cropped area through better seeds, fertilizers, irrigation, rural credit, extension services, product price support, and other institutional and policy interventions. The yield of foodgrains has increased from more than three times from 522 kg per hectare in 1950-51 to 1854 kg per hectare ha in 2007-08, and foodgrains production increased from about 51 million tonnes in 1950-51 to about 231 million tonnes in 2007-08. Production of oilseeds, sugarcane, and cotton have also increased more than four-fold over the period, reaching 29.75 million tonnes, 348 million tonnes and 25.88 million bales, respectively.

Chemical fertilizers are key element of modern technology and have played an important role in the success of Indian agriculture. During the decades of 1970s and 1980s, both foodgrains production and fertilizer consumption registered significant growth but in the 1990s and 2000s there has been a slow down in growth rates in foodgrains production as well as fertilizer consumption. This deceleration in agricultural sector, although more prominent in dryland areas, occurred in almost all states and almost all sub-sectors such as horticulture, livestock, and fisheries where growth was expected to be high. However, during the last 3-4 years there has been some improvement in their growth but is still less than expected. In order to achieve 4 per cent growth in agriculture during the XIth Five Year Plan, there is a need to sustain this momentum and put these vital sectors on a high growth trajectory.

With the limited arable land resources, and burden of increasing future population, development of new technologies and efficient use of available technologies and inputs will continue to play an important role in sustaining food security in India. It is expected that India's available arable land might drop below the current level of about 140 million hectares, if the use of farmland for commercial/non-agricultural purpose is not restricted in the near future. Therefore, the only way to improve food security is to increase crop yields through the scientific use of fertilizers along with other inputs like high yielding variety seeds, irrigation, etc. using the limited arable land, with an emphasis on protecting the environment.

The Government of India has been consistently pursuing policies conductive to increased availability and consumption of fertilizers in the country. Over the last five and half decades, production and consumption of fertilizers has 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 last 4-5 years there has been a significant increase in imports of fertilizers because there has not been any major domestic capacity addition due to uncertain policy environment. Imports of fertilizers ($N+P_2O_5+K_2O$) have increased significantly during the last 5 years, from about 1.9 million tonnes in 2002-03 to nearly 7.8 million tonnes in 2007-08

The significance of fertilizer industry and its related policy in the country arises from the fact that agriculture still contributes a sizeable share of country's GDP and more importantly, it supports nearly two-third of population. Therefore, fertilizer policy in India has been mainly driven by the socio-political objectives of making fertilizer available to farmers at affordable prices and increasing fertilizer consumption. Given the socio-political importance of fertilizer pricing on one hand and ever increasing subsidies on the other hand, the need for streamlining the sector has been felt for a long time. However, fertilizer has become the most contentious issue in reforming Indian economy exposing deep contradictions between economics and politics in the democratic set-up. The economic reforms initiated in 1991 marked the first major attempt at fertilizer sector reforms in India and set the stage for major policy changes in the sector. In view of importance of fertilizers in agricultural growth and the changing policy environment, there is need to have an overview of the technical, economic, and policy issues of relevance to fertilizer policy design and implementation for achieving the targeted growth in agricultural sector. The present study attempts a comprehensive and in-depth analysis of the Indian fertilizer sector under the new economic policy regime and its impact on agricultural sector.

The study is based in secondary time series data related to fertilizer production, consumption, and imports along with fertilizer prices, output prices, area under irrigation, high yielding varieties, rainfall, subsidies, etc. for global, national and state level in order to examine trends and pattern of growth of fertilizers. A comprehensive review of fertilizer policy was done based on synthesis of major policy documents related to Indian fertilizer industry. In order to estimate the likely impact of the policy changes affecting price and non-price factors on the fertilizer use and hence on the agricultural growth in the country, fertilizer demand functions were estimated.

Main Findings

The Indian fertilizer industry with a capacity of about 12.28 million tonnes of nitrogen (N) and 5.86 million tonnes of phosphatic (P_2O_5) fertilizers is one of the largest in the world and has played an important role in development of agricultural sector. The Green Revolution in the late sixties and introduction of RPS in the seventies gave an impetus to the growth of fertilizer industry in India and the 1970s and 1980s witnessed a significant addition to the fertilizer production capacity. However, there has not been any substantive capacity addition to fertilizer production during the last 10 years.

Urea is the largest straight nitrogenous fertilizer in terms of capacity and accounted for 78.8 per cent of installed capacity while share of other straight nitrogenous fertilizers such as Ammonium Sulphate, Calcium Ammonium Nitrate and Ammonium Chloride is about 3 per cent. The share of public sector in N capacity has declined over time while share of private and cooperative sector has increased.

In case of phosphatic fertilizers, DAP constitutes about 55 per cent of total capacity and share of SSP is about 21 per cent and rest is constituted by NP/NPK complexes. The capacity of phosphatic fertilizers, which remained stagnant during the 1950s and early part of 1960s, increased significantly during the seventies and eighties and has stagnated during the last few years. Over the years public sector has lost its share to private and cooperative sectors and today about two-third of the phosphatic fertilizer capacity is in the private sector. Due to limited availability of phosphatic raw materials/intermediates such as phosphoric acid and rock phosphate in the country, domestic units are highly dependent on imports. The high dependence on imports of raw materials exposes the Indian phosphatic industry to highly volatile markets.

Fertilizer production, which grew at an impressive growth rate of over 10 per cent during the 1970s and 1980s, suffered a lot in the post-reforms period. The production increased at an annual compound growth rate of about 5.5 per cent during the 1990s (1991-92 to 2000-01) and growth rate decelerated to one per cent between 2001-02 and 2007-08. Fertilizer production grew at a much faster rate compared to consumption in the pre-reforms period but in post-reforms period growth in fertilizer consumption was higher than production resulting in increased dependency on imports.

The total investment in the fertilizer industry at the end of first plan was Rs. 64.9 crore and reached a level of Rs. 25,644 crore by the end of the 9th Plan. The growth in investment was much faster during the fourth, fifth, sixth and seventh plan periods. However, there was hardly any investment during the 10th Plan which led to a big gap between demand and supply. The cooperative sector which entered fertilizer sector during the fifth plan witnessed a significant increase in its share. The share of private sector also increased significantly, while share of public sector declined.

During 1950s and 1960s, about two-third of domestic requirement of N fertilizers was met through imports. With the introduction of the high yielding varieties of wheat and rice in mid-1960s, the fertilizer imports increased significantly in 1966-67 and thereafter. During the 1980s and 1990s imports were at low levels with few exceptions. However, during the last few years imports have increased significantly due to low addition in domestic capacity coupled with rise in demand for fertilizers. India imported 7.767 million tonnes of fertilizer nutrients (N+P+K) in 2007-08 as against 1.931 million tonnes in 2002-03. In addition, imports of raw materials and intermediates have also increased substantially. The unprecedented volatility and increase in world fertilizer prices mainly due to increased demand for fertilizers in cereal producing countries and rising crude oil prices, affected the cost of imported fertilizers adversely for India. The total value of imports in India increased from Rs. 7423.83 crore in 2005-06 to Rs. 18454.10 crore in 2007-08, an increase of nearly 150 per cent, whereas the total quantity of imported fertilizers increased by about 47 per cent – from 5.3 million tonnes in 2005-06 to 7.7 million tonnes in 2007-08**.**

Total Fertilizer consumption in India is also among the top in the world with total consumption (in nutrient terms) of about 22.57 million tonnes in 2007-08. However, India ranks low in terms of intensity of fertilizers 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 tonnes in 1951-52 to 22.57 million tonnes in 2007-08. Accordingly, per hectare consumption of fertilizers, which was less than one kg in 1951-52, has gone up to the level of 117 kg in 2007-08.

Fertilizer consumption in India is highly skewed, with wide inter-regional, inter-state, inter-district and inter-crop variations. About 18 per cent of the districts in the country accounted for half of total fertilizer use while bottom 53 per cent of the districts accounted for only 15 per cent of total fertilizer used in the country. The intensity of fertilizer use varied greatly from 45 kg per hectare in Rajasthan to 210 kg per hectare in Punjab. 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.

One of the major constraints to fertilizer use efficiency in India is imbalance of applied nutrients partly as the result of a difference in price of nutrients, and partly due to the lack of knowledge among farmers about the need for balanced fertilizer applications. Based on country-wide soil test results, it has been found that at the All-India level, the deficiency of nitrogen in the soil is 89 per cent, phosphorous 80 per cent and potassium 50 per cent. In addition, the deficiency of secondary and micro nutrients in the soil is widespread. For instance, the deficiency of sulphur in the soil is about 40 per cent, zinc 48 per cent, boron 33 per cent, iron 12 per cent and manganese 5 per cent.

The N:P:K ratio was little skewed towards N in 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 steep increase in prices in the early 1990s resulted in decline in their consumption and consequent imbalance in the use of fertilizers. The NPK ratio which was at 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 concerted efforts of the government like increase in concessions on phosphatic and potassic fertilizers and an increase in price of urea in 1997 led to improvement in NPK ratio and reached a level of 5.5:2.1:1.0 in 2007-08. There are wide inter-regional and inter-state disparities in N:P:K ratios. Greatest degree of N:P:K imbalance was seen in case of Haryana (37.7:10.7:1.0) followed by Rajasthan (37.4:14.3:1.0) and Punjab (27.7:7.6:1.0) in 2007-08 but the ratio has improved over time.

Use pattern of fertilizer by each crop depends upon the need for nutrient by the crop based on fertility status of soil. The introduction of fertilizer responsive HYV seeds of paddy and wheat called for increasing use of fertilizers on these crops, which enabled the country to become self-sufficient in foodgrains. The application rates of fertilizers as well as area under rice and wheat are significantly high. As per the report of “All India Input Survey 2001-02”, per hectare use of total nutrients was about 126 kg on rice and 132 kg on wheat in 2001-02. Area under rice and wheat was 44.9 million hectares and 26.3 million hectares, respectively in 2001-02 out of total gross cropped area of 189.7 million hectares. Therefore, there is a high degree of inequality in fertilizer consumption among crops and rice, wheat and sugarcane are the prime beneficiaries. Rice is the largest user of fertilizer (36.8% of total consumption), followed by wheat (23.8%) Fruits, vegetables, and sugarcane combined represented another 10 per cent of fertilizer use. In view of shrinking area under cultivation due to growing urbanization and industrialization, additional production of food grains will come only from higher productivity in future instead of increase in area and fertilizers will play an important role. In addition rising demand for high-value crops (fruits and vegetables) due to increasing income level, urbanization, changing lifestyle, demand for fertilizer is also expected to increase as these crops are fertilizer-intensive crops.

Fertilizer consumption also varies across farm sizes but there is a fair degree of inter-farm size equity in fertilizer consumption. As per the All-India Report on Input Survey 2001-02, the average use of fertilizers per hectare by marginal farmers was 126kg, small farmers 102kg, as against these the rates of application by semi-medium and medium categories of farmers was between 78 and 92 kg. The application of fertilizer by large holding size group was only 57 kg of N+P+K. The finding also reveal that there is more balanced application of fertilizers by the farmers under small and marginal holding size group compared to medium and large category. The NPK use ratio in the marginal size group was 4.0:1.8:1 and in small 4.9:2.4:1. Conversely, in the large size group, it was 16.1: 6.9:1. In the semi-medium category, it was 5.9:2.8:1 and in medium 9.5:4.3:1. The share of small and marginal farmers in gross cropped area was 42.6 per cent and they consumed 52 per cent of total fertilizer used in the country. On the other hand, share of medium and large farmers in gross cropped area was nearly one-third and consumed over one-fourth of total fertilizers.

Recognizing the importance of fertilizer in the enhancement of agricultural productivity, the Government of India declared fertilizer as an essential commodity and notified the Fertilizer Control Order (FCO) in 1957. FCO was notified as a subordinate legislation to regulate the sale, price, and the quality of fertilizers. The Indian Fertilizer industry, given its strategic importance in ensuring self-sufficiency of foodgrains production in the country, has been under strict government control for most of the period since independence. Major controls on prices and distribution of fertilizers were introduced in 1973 (Fertilizer Movement Control Order) and movement of fertilizer was brought under the Essential Commodity Act (ECA). In 1977, the Retention Price cum Subsidy Scheme (RPS) was implemented, which encouraged investment in the sector by assuring a 12 per cent post-tax return over net worth to the fertilizer producers. Though the government interventions helped in meeting the objective of ensuring creation of capacities and ultimately achieving self-sufficiency in foodgrains production, it did not encourage improving efficiencies in the sector

However, the policies framed in the post-reform period aimed at reducing the level of subsidy only with addressing the basic issues relating to rise in fertilizer subsidy. All the committees set up during the post-reform period were concerned mainly with the review of the existing system of subsidization of fertilizers and suggest measures for rationalization of subsidies. None of these policies have been able to reduce the levels of fertilizer subsidy. The level of subsidy increased from Rs. 4800 crore in 1991-92 to about Rs. 95849 crore in 2008-09. The steep increase in subsidy during the period was due to the three factors, (i), increase in consumption of fertilizers, (ii), steep increase in cost of production and imports due to escalation in costs of feedstock, raw materials/intermediates and (iii), stagnant retail prices. Any measure without addressing these basic issues cannot check the rising subsidy bill.

With the burgeoning subsidy bill and the need to focus on fiscal prudence, government polices in the post-reforms period were aimed at encouraging efficiencies in the sector. The economic reforms initiated in 1991 marked the first major attempt at fertilizer sector reforms in India and set the stage for major policy changes in the sector. In August 1992, government decontrolled prices, distribution and movement for phosphatic and potassic fertilizers, while the low analysis nitrogenous fertilizers were also decontrolled in June 1994. However, urea, the main nitrogenous fertilizer continued to remain under government controls. The government's efforts at initiating reforms in fertilizer sector in general and urea in particular has involved the appointment of a number of committees including Joint (Parliamentary) Committee on Fertilizer Pricing in 1992, High Powered Fertilizer Pricing Policy Review Committee in 1998, Expenditure Reforms Commission in 2000, Cost Price Study of Complex Fertilizers (Tariff Commission) in 2001 and on DAP and MOP in 2003, Cost Price Study of Single Super Phosphate in 2004, Expert Group on Phosphatic Fertilizer Policy in 2005, Cost Price Study of DAP, Complex Fertilizers and MOP by Tariff Commission in 2007, etc. All these committees were concerned mainly with the review of the existing system of subsidization of fertilizers and suggest measures for rationalization of subsidies.

The recommendations of the GoM formed the basis for the New Pricing Scheme (NPS) announced in 2003, which aims at inducing urea units to achieve efficiency besides bringing transparency and simplification in subsidy administration. The NPS is being implemented in stages (3 stages) and phased decontrol of urea has been undertaken under the NPS. In the case of phosphatic fertilizers, based on the recommendations of the Expert Group on Phosphatic Fertilizer Policy the pricing of the phosphatic fertilizers were linked to price in the international market and future scenario and the pricing of indigenous DAP to the price of imported DAP in the international market. The decontrol of phosphatic, potassic, complex fertilizers, and controls on urea led to imbalanced use of fertilizers. Although phosphatic and potassic fertilizers are decontrolled but these are being controlled indirectly as movement of these fertilizers are being monitored by the Government through Fertilizer Monitoring System for the payment of subsidy. In order to promote balanced use of fertilizers and improve soil health, government took a positive step and introduced nutrient-based pricing of subsidized fertilizers including complex fertilizers in June 2008, which is expected to increase use of complex fertilizers, thereby promote balanced use of nutrients. The policy encourages the joint venture projects in raw material surplus countries through committed off-take contracts with pricing decided on the basis of prevailing market conditions and in mutual consultation with the joint venture partners.

While world fertilizer prices have been rising gradually since 2004 and in 2007 and 2008 the world witnessed an escalating phenomenon with prices reaching four digit figures. Prices were mainly driven up by an imbalance between supply and rapidly increasing demand mainly in Asia, particularly strong in China and India. Another factor was increased demand for fertilizers to produce biofuels in the United States, Brazil and Europe. High energy prices led to an increase in the price of natural gas (main raw material for nitrogenous fertilizer production), and sulphur and phosphoric acid (used for production of phosphatic fertilizers) which also caused the fertilizer prices to rise. World fertilizer prices started falling significantly in late-2008 after reaching all time highs in 2008 mainly due to low demand because of slow down in world economic growth and declining energy prices. The results clearly showed that fertilizer prices are driven by agricultural commodity prices as well as feedstock prices

As against high volatility in world prices of fertilizers, domestic prices have remained fairly stable in the country. Prices of major fertilizers like urea, DAP and MOP remained constant during the decade of 1980s. During the decade of 1990s prices of all fertilizers witnessed large increases but have remained at the same level since 2002-03. Relative prices of N, P and K are important as they affect the consumption pattern. The results of relative prices of fertilizers to foodgrains (wheat and paddy) revealed that whenever the parity ratio between wheat/paddy and fertilizer increased, there was either decline in consumption of fertilizers or consumption almost remained stagnant. In the post reforms period (1991-92 to 2007-08) the parity ratio between crop and fertilizer prices favored crop and became more favorable overtime. Consequently, these years witnessed significant increase in consumption of fertilizers

The burden of fertilizer subsidies on the budget of central government has grown dramatically over the years, from Rs. 505 crore in 1980-81 to a historical high of about Rs.75849 crore in 2007-08. Fertilizer subsidy as a proportion of GDP at current prices after expanding from 0.24 per cent in the 1981-82 to a peak of 1.03 per cent in 1989-90, started to decline and reached at 0.62 per cent in 1993-94. In a subsequent reversal of trend, it reached almost 0.74 per cent in 1999-2000, but declined since and was estimated at 0.47 per cent in 2003-04. However, it started increasing from 2004-05 onwards and reached a record level of 1.52 per cent in 2008-09.

The distribution of fertilizer subsidy among states showed that a large share of total fertilizer (54.5%) subsidy is cornered by top five states, namely, Uttar Pradesh, Andhra Pradesh, Maharashtra, Madhya Pradesh and Punjab. The average subsidy on per hectare basis more than doubled between 1992-93 and 1999-00 (from Rs. 331/ha to Rs. 703/ha) and almost tripled between 1999-00 and 2007-08. Overtime, however, the inequalities in fertilizer subsidy among states have declined sharply. The benefits of fertilizer subsidy have spread to unirrigated areas as the share of area treated with fertilizers has increased from 41 per cent in 1996-97 to 53.5 per cent in 2001-02 on unirrigated lands. It is evident that benefits of fertilizer subsidy are not restricted to only resource-rich areas but have spread to other areas as well. Among crops, paddy and wheat are the major users of fertilizer subsidy accounting for over half of the total subsidy. The inter-farm size distribution of fertilizer subsidy showed that subsidy is distributed more equitably among different farm sizes compared with crop-wise and state-wise distribution of fertilizer subsidy. The average subsidy as well as share in total subsidy was the highest on marginal farms and the lowest on large farms.

There is a lot of debate in the literature about fertilizer subsidy. Various economic and non-economic arguments (to promote technology adoption, stimulate rapid market development, market failure, to control output prices, etc.) have been advanced to justify the use of fertilizer subsidies. In contrast many arguments have been invoked against the use of subsidies on fertilizer. For example fertilizer subsidy schemes tend to have extremely high fiscal costs that make them financially unsustainable, high administrative costs, and lead to inefficiency at farm level and corruption in the system. The issue of distribution of subsidies between farmers and fertilizer industry has been a matter of debate. Gulati and Narayanan (2003) estimates showed that the share of subsidy going to farmers varied from 24.54 per cent in the TE 1983-84 to 127.83 per cent in the TE 1995-96 with an average of 67.5. However this simple comparison between farm-gate cost of imported fertilizers and the actual price paid by the farmer is not a good indicator due to the invalid assumptions of world fertilizer markets being perfectly competitive and that India's entry into the world market, as an importer of fertilisers does not affect world price. There is evidence that entry of major importers like China and India influences the world price significantly.

There has been a decline in agricultural NDP in the post-reforms period. While there has been a decline in national agricultural NDP in the post-reforms period, there are considerable regional variations across the country. With regard to the period 2001-02 to 2007-08, the state wise analysis showed wide variations in growth of NDP from agriculture ranging from 10.9 per cent in Gujarat to -4.6 per cent in Jharkhand. Majority of the states had a very high correlation between total NSDP and agricultural NSDP, there is a need to focus on agricultural growth to promote more broad-based and inclusive growth.

The association between foodgrains production/productivity and fertilizer use was strong during the 1970s and 1980s (correlation coefficient 0.94) but weakened thereafter and the reached a level of 0.84 during the 1990s and further to 0.71 during the 2000s. The state-wise trends in association between fertilizer consumption and foodgrains production and productivity revealed that the share of states having strong association declined from about 41 per cent in 1990s to 23.5 per cent in 2000s. The results clearly showed that the linkages between agricultural production/productivity and fertilizer use in the country have weakened during the past few years. This is a major challenge and needs an urgent attention of policy planners and industry to reverse this trend.

While examining major determinants of fertilizer use, it was found that non-price factors were more important in influencing demand for fertilizers. Among the non-price factors, irrigation was the most important factor influencing fertilizer demand, followed by cropping intensity. The price of fertilizers was the third important determinant of fertilizer use in the country. Price of output was less important compared with input price. The results clearly indicated that increase in area under irrigation, and cropping intensity will accelerate fertilizer consumption in the country. In case of pricing policy instruments, between prices of fertilizers and prices of crops, the former are more important than the latter in determining demand for fertilizers. Therefore, prices of fertilizers which have inverse relationship with fertilizer demand should be kept at affordable levels to promote rapid growth in fertilizer use in different parts of the country. The role of product price support policy in generating growth in effective demand for fertilizers and consequently higher growth in agriculture, however, was overemphasized during the 1990s. Despite very favorable output price conditions during the 1990s, agricultural sector had a low growth rate. Therefore, it is necessary to prioritize input price policy mechanism over higher output prices.

The projections of fertilizer nutrients under different scenarios/assumptions show a range of demand figures of total nutrients between 24 and 28.5 million tonnes by 2011-12, the terminal year of 11th Plan and between 26 and 34 million tonnes by 2015-16. If variables affecting fertilizer use grow at the rate of last five years, the total nutrient requirement will amount to about 34 million tonnes, which includes 20.4 million tonnes of N, 8.9 million tonnes of P and 4.7 million tonnes of K by the end of 2015-16. The N:P:K ratio, which was 5.5:2.1:1.0 in 2007-08 is projected to be 4.3:1.9:1.0 in 2015-16. The demand for urea is projected to be around 30.85 million tonnes by 2011-12 and 36.27 million tonnes by 2015-16 under scenario I (based on last five year growth) while the corresponding figures under scenario II (based on last 10 year growth) were 26.02 and 28.25 million tonnes, respectively. The demand for DAP, complex fertilizers (excluding DAP) and SSP would be nearly 9.86, 8.9, and 3.86 million tonnes, respectively under scenario I and 8.1, 7.32 and 3.17 million tonnes under scenario II by 2011-12. The demand for MOP would be around 4.2 and 3.39 million tonnes under scenario I and II, respectively.

Global consumption of fertilizer (N+P+K) has risen from 116.1 million tonnes in 1980-81 to about 169 million tonnes during 2007-08, representing an annual compound growth rate of just over one per cent. The growth rate in N consumption was maximum (1.62%), followed by P fertilizers (0.48%) and the lowest in K fertilizers (0.11%) between 1980-81 and 2006-07. The share of nitrogenous fertilizers in total fertilizer use is the highest (57.6%), followed by

P_2O_5 (24%) and K_2O (18.4%). The share of N fertilizers has increased between during the last two and half decades while share of P and K fertilizers has declined in the world.

During 2007-08 global fertilizer consumption rose sharply due to strong agricultural commodity prices during the first half of 2008 and strong policy support in many developing countries (Figure 7.3). Because of the economic slow down during the second half of 2008, global fertilizer consumption in 2008-09 is expected to decline by about 2.2 per cent, to 165 million tonnes nutrients. It is expected that after a likely depressed first half of 2009, fertilizer demand could recover during the second half of the year.

About two-third of N consumption is concentrated in three countries, namely, China, USA and India. Urea is the most commonly used nitrogenous fertilizer product and represented about 54 per cent of all nitrogenous fertilizer products consumed globally. In the case of phosphatic fertilizers, China, USA and India are the top consumers of P fertilizers and accounted for over 60 per cent of global consumption. The ammonium phosphates (mono- and di-ammonium) accounted for 47.8 per cent of global fertilizer phosphate fertilizer consumption in 2005. The share of NPK complexes was 22.9 per cent, SSP 17.4 per cent and TSP 6.3 per cent. China ranks number one in K consumption with a share of 26.4 per cent, followed by USA (19.4%) and Brazil (11.4%). India is the fourth largest consumer with a share of 7.9 per cent. The muriate of potash (MOP) is the most popular potassium fertilizer with an estimated share of 88 per cent, followed by Potassium sulphate (8%) and Potassium nitrate (4%).

Fertilizer application rates vary widely among the major world regions and countries. Per hectare fertilizer use varies from about 9 kg in Sub-Saharan Africa to 278 kg in East Asia. Wide variations are also prominent among different countries of the world. For example, fertilizer use varies from a low of about 18 kg per hectare in Nepal to a high of about 666 kg per hectare in Netherlands. The world average application rate is about 109 kg per hectare.

China is the world's largest producer and accounts for 25.1 per cent of world production, the U.S. 10.5 per cent, Russian Federation 9.2 per cent, Canada 8.9 per cent and India 8.8 per cent and the top five producers account for about 62 per cent of global fertilizer production.

Total exports of N fertilizers increased from 19.7 million tonnes in 1991-92 to about 27.6 million tonnes in 2006-07 at a growth rate of about 1.7 per cent. Russian Federation, the largest exporter of nitrogenous fertilizers, accounts for 17.5 per cent share in global exports. Ukraine was the second largest exporter with a share of 6.1 per cent. The top five exporting countries controlled about 44 per cent of global exports. USA was the largest importer of nitrogenous fertilizers with a share of 17.4 per cent in world imports. Brazil was the second (6.1%) and India the third largest (5.7%) importer of nitrogenous fertilizers in TE 2006.

USA is the largest exporter of phosphatic fertilizers, which accounts for nearly one-third of the global trade. Russian Federation is the second largest exporter (17%), followed by Morocco (7.8%) and Tunisia (7.1%). The top five exporters control over 70 per cent of global trade in phosphatic fertilizers. The largest markets for P_2O_5 are Brazil, China, India, Pakistan and Argentina with a combined share of over 37 per cent of world imports. World exports are more concentrated in a few countries while imports are more dispersed around the world.

Morocco remains the world's largest rock exporter with a 45.5 per cent share of global exports while Jordan is the second largest exporter with about 11 per cent share, followed by Syria (9.8%) and Russia (8.8%). India is the world's leading consumer of rock phosphate accounting for about 19 per cent of world imports. The world exports are concentrated while imports are more diversified.

The six leading potash producing countries (Canada, Russia, Belarus, Germany, Israel, and Jordan) accounted for over 90 per cent of global potash trade during the TE 2006. The export shares were 33.9 per cent for Canada, 20.1 per cent for Russia, 15 per cent for Belarus, 11.1 per cent for Germany, 6.8 per cent for Israel and 3.8 per cent for Jordan. Asia is the largest potash-consuming and importing region with two leading potash consumers, China and India.

Important Policy Implications

What are the policy implications of the above conclusions to generate sustainable rapid growth in fertilizer use to ensure national food security? There is undisputable need for continuous rapid growth in fertilizer use especially in less-consuming regions in the country in the coming years to increase agricultural production and productivity at the desired rate. In order to meet the additional demand, there is a need to increase fertilizer supplies and generate effective demand. Sustained growth in fertilizer demand mainly depends on increase in supplies (domestic vs. imports), creation of adequate and efficient distribution network and increase in effective demand for fertilizers at farm level. Major policy recommendations in these three areas are given below:

Enlargement of Domestic Capacity and Production

With rising demand for fertilizers and no major domestic capacity addition during the last few years, the industry has been exposed to world markets, which are not perfectly competitive and thus highly volatile. The rising imports of fertilizers are a cause of concern and require an urgent attention. India being one of the largest consumers of fertilizers in the world has significant impact on world trade and prices.

Several academicians have criticized the Indian fertilizer industry for its inefficiencies (Gulati, 1990, Gulati and Narayanan, 2003, Srivastava and Rao, 2002). However, some of these studies have not taken into account the nature of world fertilizer markets and role of fertilizers in achieving broad-based employment-led economic growth. First, the world fertilizer market is not perfectly competitive as production and trade are highly concentrated in few countries/players, which leads to high volatility in world prices. Moreover, entry of large countries like India and China influences the world markets greatly as the world fertilizer markets (mainly N and P) are thin markets. For example, there was an increase in imports of fertilizers by India in the recent years and these imports influenced the world prices and imports were costlier than domestic costs. The import parity price of urea increased from Rs. 7240 per tonne in July-September 2003 to about Rs. 25717 per tonne in April-June 2008 (more than 350% increase). Likewise, the average concession on imported DAP fertilizer increased from about Rs. 6000 per tonne in early-2007 to Rs. 15795 per tonne in March 2008 and Rs. 50081 per tonne in June 2008 (more than 800% increase). Second, fertilizer subsidies benefit small and marginal farmers more than large farmers and also farmers in less-developed regions as fertilizer use has increased in unirrigated areas over time.

The above discussion clearly suggests that domestic markets need to be insulated from world markets. Therefore it is necessary to encourage domestic capacity additions to achieve self-sufficiency in fertilizer production in the country.

Another important issue confronting the sector is with respect to the feedstock. Natural gas which is the main feedstock for production of nitrogenous fertilizers is available in limited quantities and the industry competes with the power sector for its share. With the Government policy favoring conversion to gas based units, the demand for gas is only expected to go up in the future, which may in turn lead to further shortages. There is a need to ensure stable supplies of gas to fertilizer sector and also promote investments in gas-surplus countries. It is true that gas is the most efficient feedstock for urea production but some plants using mixed feedstock like gas as well as naphtha (although less efficient) would promote efficient utilization of available naphtha and enlarge the choice of raw materials. In the case of phosphatic fertilizers due to limited availability of domestic phosphoric acid and rock phosphate, the industry is dependent to a large extent on imports. In view of the limited domestic availability of the feedstock, promoting joint ventures in surplus countries would improve the efficiency of the sector.

Promote Effective Demand for Fertilizers at Farm Level

The findings suggest that non-price factors mainly irrigation, and high yielding varieties are the most important factors affecting fertilizer demand in the country. Therefore, important measures required to increase demand for fertilizers include development of irrigation facilities with better water use efficiency, concerted efforts for promotion of fertilizers under rainfed conditions and more coverage of area under high yielding varieties particularly in central and eastern regions of the country. The disparities between fertilizer use in irrigated and unirrigated areas will continue to remain as use of fertilizer requires assured water for most of the crops. Moreover in the rainfed areas due to uncertainty of rainfall, fertilizer use continues to remain limited. Crops generally grown in the rainfed area are pulses, oilseeds, millets, etc. for which per hectare recommendation of fertilizer use is low. Availability of credit is also important determinant of fertilizer use in the country, and hence, easy availability of credit would facilitate rapid growth in fertilizer. Therefore, there is a need to prioritize technological/non-price factors over the price policy instruments.

Price Policy Instruments

Price factors, fertilizer prices and crop prices, influenced fertilizer consumption but were less powerful in influencing fertilizer demand than non-price factors. The price of fertilizer had adverse impact on fertilizer use while output prices had a positive impact on fertilizer consumption. Between prices of fertilizers and prices of crops, the former were more important than the latter in determining demand for fertilizers. The prices of fertilizers which have negative affect on fertilizer demand should be kept at affordable levels to promote rapid growth in fertilizer use in different parts of the country. Therefore, it is necessary to give priority to input price policy mechanism over higher output prices.

Fertilizer Pricing Policy

In order to promote efficient and balanced use of fertilizers, an appropriate fertilizer pricing policy is a prerequisite. Current pricing and subsidy schemes generally do not include secondary and micronutrients, which are deficit in Indian soils. The pricing policy should address the issue and promote balanced use of macro, secondary and micro nutrients. Government intends to move from product based subsidy to nutrient based subsidy. Hon'able Finance Minister in his budget speech 2009 has already expressed intention of the government to move towards nutrient based subsidy instead of the current product-pricing regime. He also mentioned about the intentions of the government to move to a system of transfer of subsidy direct to the farmers in the place of the existing system of routing it through the manufacturers. There is a need to keep parity between N, P and K prices. The unchanged fertilizer prices over a period of time also cause adverse impact on viability of the industry and increase subsidy burden. Therefore, a long-term fertilizer pricing policy that promotes fertilizer use as well as production is needed. The fertilizer prices should be increased marginally periodically but not completely linked to procurement prices as high procurement prices benefit the large farmers while input subsidies benefit all categories of farms in general and small and marginal farmers.

Fertilizer Subsidies

The burden of fertilizer subsidies has increased substantially during the last few years but these subsidies are justified on several grounds. Although there is a high degree of inequity in distribution of fertilizers across states and crops, there is a fair degree of equity in distribution of these subsidies across different farms sizes. Small and marginal farmers are key beneficiaries of fertilizer subsidies but they do not benefit from higher output prices. Majority of small and marginal farmers do not have any marketable surplus but produce grains for self-consumption only. Moreover, benefits of fertilizers subsidies are not restricted to only irrigated areas but have spread to rainfed areas. A reduction in fertilizer subsidy is, therefore, likely to have adverse impact on the income of marginal and small farmers. Increase in fertilizer prices would lead to reduction in fertilizer use on these farms and consequently lower production and productivity. An increase in prices of fertilizers is also likely to have adverse impact on agricultural production in low-fertilizer using regions growing mainly coarse cereals, pulses and oilseeds.

The targeting of fertilizer subsidies (geographical targeting between regions, states and districts, and farm size targeting between different categories of households) is a critical and sensitive issue. Since it is practically not feasible to develop an effective targeting system that reaches poorer households/regions, comprehensive coverage of all farm households is a better alternative than ineffective targeting. However, efforts are required to contain subsidies through periodic revisions of farm-gate prices of fertilizers and reducing costs of production of fertilizers. Feedstock/intermediates/raw materials account for bulk of the cost of production. If these are available at reasonable prices, the cost of production may reduce. So far as feedstock is concerned, there should be adequate availability of gas at reasonable price to the fertilizer manufacturers. In regard to intermediates/raw materials, there is need for more joint ventures abroad and prices should be fixed on long term basis like the agreement of quality and price made by the Govt. of India with the joint venture urea plant OMIFCO, Oman. If there is a significant reduction/withdrawal of fertilizer subsidy, it would have serious adverse affect on agricultural production and consequently threaten the national food security. On the other hand no change in prices of fertilizers over a period of time and disparity in prices of different nutrients also lead to adverse impact on fertilizer production and land productivity.

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ANNEXURE TABLES

Annexure Table 2.1: Product and zone wise installed capacity of fertilizers in India

	North	South	East	West	Total
1981-82					
N	1381.1 (26.7)	1279.5 (24.7)	1095.0 (21.1)	1422.8 (27.5)	5178.4 (100.0)
P	56.7 (4.0)	530.6 (37.4)	140.8 (9.9)	692.3 (48.7)	1420.4 (100.0)
Ammonium sulphate	-	236.8	551.8	282.6	1071.2
CAN	320	-	480.0	0.0	800
Urea	1683	2041.0	1870.0	2449.0	8043
Ammonium chloride	41	110.8	-	0.0	151.8
APS	-	200.0	-	0.0	200
DAP	-	-	-	108.0	108
Nitro Phosphate	-	-	-	661.0	661
NP/NPKs	-	1352.5	-	950.0	2302.5
Single Superphosphate	354.3	546.6	175.4	792.8	1869.1
1991-92					
N	2929.8 (37.4)	2010.4 (25.7)	989.3 (12.6)	1902.5 (24.3)	7832 (100.0)
P	960.2 (27.8)	1050.8 (30.4)	413.9 (12.0)	1029.7 (29.8)	345436 (100.0)
Ammonium sulphate	20.1	228.2	67.4	227.2	542.9
CAN	143.5	2817.8	107.2	54.8	3123.3
Urea	5555.9	139.6	1733.5	3144.5	10573.5
Ammonium chloride	35.7	68.9	21.5	0.6	126.7
APS	-	-	-	-	-
DAP	1676.1	1231.3	586.2	1311.5	4805.1
Nitro Phosphate	-	-	-	-	-
NP/NPKs	172.6	1874.7	254.8	3840.4	6142.5
Single Superphosphate	853.2	353.8	469.6	1372.6	3049.2
2001-02					
N	3695 (30.9)	2195.9 (18.4)	1022.9 (8.6)	5037.6 (42.2)	11951.4 (100.0)
P	281.5 (5.5)	1179.7 (23.2)	1613.4 (31.7)	2008.7 (39.5)	5083.3 (100.0)
Ammonium sulphate	-	266.7	108.7	389.1	764.5
CAN	320.0	-	480.0	142.6	942.6
Urea	7824.9	3127.1	660.0	9236.5	20848.5
Ammonium chloride	66.0	105.0	-	-	171.0
APS	-	1003.5	-	-	1003.5
DAP	-	1200.0	2895.0	1744.0	5839.0
Nitro Phosphate	-	-	-	1033.0	1033.0
NP/NPKs	-	1440.0	420	1260.1	3120.1
Single Superphosphate	1759.5	742.5	1056.7	4156.9	7715.6

2007-08					
N	3741.9 (30.5)	2175.8 (17.7)	952.8 (7.8)	538939 (44.0)	12260.4 (100.0)
P	93.3 (1.6)	1376.7 (24.3)	1544.9 (27.2)	2656.2 (46.8)	5671.1 (100.0)
Ammonium sulphate	-	266.7	108.7	241.1	616.5
CAN	320.0	-	480.0	142.5	942.5
Urea	7962.2	2767.0	510.0	9553.8	20793.0
Ammonium chloride	-	105.0	-	-	105.0
APS	-	1227.6	-	-	1227.6
DAP	-	1337.0	2890.0	2760.0	6987.0
Nitro Phosphate	-	-	-	1103.5	1103.5
NP/NPKs	-	1790.0	420.0	1545.4	3755.4
Single Superphosphate	583.0	757.0	642.7	4695.0	6677.7

Source: FAI (2008)

Annexure Table 2.2: Consumption, production, imports and stocks of nitrogenous fertilizers in India: 1952-53 to 2007-08

Year	Consumption	Production	Imports	Carry-over stocks	Total supply	Ending Stock	Stocks as % on consumption
1952-53	57.8	53.1	44.0	0.0	97.1	39.3	67.9
1953-54	89.3	52.9	19.0	39.3	111.2	21.9	24.5
1954-55	94.8	68.5	20.0	21.9	110.4	15.6	16.4
1955-56	107.5	76.9	53.0	15.6	145.5	38.0	35.3
1956-57	123.1	78.8	57.0	38.0	173.8	50.7	41.1
1957-58	149.0	81.1	110.0	50.7	241.8	92.8	62.2
1958-59	172.0	80.8	97.0	92.8	270.6	98.6	57.3
1959-60	229.3	83.7	142.0	98.6	324.3	95.0	41.4
1960-61	211.7	112.0	399.0	95.0	606.0	394.3	186.2
1961-62	249.8	154.3	307.0	394.3	855.6	605.8	242.5
1962-63	333.0	194.2	244.0	605.8	1044.0	711.0	213.5
1963-64	376.1	219.1	228.0	711.0	1158.1	782.0	207.9
1964-65	555.2	243.2	232.0	782.0	1257.2	702.0	126.4
1965-66	574.8	237.9	326.0	702.0	1265.9	691.1	120.2
1966-67	737.8	309.0	632.0	691.1	1632.1	894.3	121.2
1967-68	1034.6	402.6	867.0	894.3	2163.9	1129.3	109.1
1968-69	1208.6	563.0	844.0	1129.3	2536.3	1327.7	109.9
1969-70	1356.0	730.6	667.0	1327.7	2725.3	1369.3	101.0
1970-71	1479.3	832.5	477.0	1369.3	2678.8	1199.5	81.1
1971-72	1798.0	949.2	481.0	1199.5	2629.7	831.7	46.3
1972-73	1839.0	1054.5	665.0	831.7	2551.2	712.2	38.7
1973-74	1829.0	1049.9	659.0	712.2	2421.1	592.1	32.4
1974-75	1765.7	1186.6	884.0	592.1	2662.7	897.0	50.8
1975-76	2148.6	1506.0	996.0	897.0	3399.0	1250.4	58.2
1976-77	2456.9	1862.4	750.1	1250.4	3862.9	1406.0	57.2
1977-78	2913.0	1999.8	758.1	1406.0	4163.9	1250.9	42.9

1978-79	3419.5	2173.0	1233.1	1250.9	4657.0	1237.5	36.2
1979-80	3498.1	2224.3	1295.3	1237.5	4757.1	1259.0	36.0
1980-81	3678.1	2163.9	1510.2	1259.0	4933.1	1255.0	34.1
1981-82	4068.7	3143.3	1055.1	1255.0	5453.4	1384.7	34.0
1982-83	4242.5	3429.7	424.6	1384.7	5239.0	996.5	23.5
1983-84	5204.4	3491.5	656.1	996.5	5144.1	-60.3	-1.2
1984-85	5486.1	3917.3	2008.6	0.0	5925.9	439.8	8.0
1985-86	5660.8	4322.9	1615.8	439.8	6378.5	717.7	12.7
1986-87	5716.0	5412.2	1105.6	717.7	7235.5	1519.5	26.6
1987-88	5716.8	5465.6	174.8	1519.5	7159.9	1443.1	25.2
1988-89	7251.0	6712.4	218.8	1443.1	8374.3	1123.3	15.5
1989-90	7385.9	6747.4	523.1	1123.3	8393.8	1007.9	13.6
1990-91	7997.2	6993.1	412.3	1007.9	8413.3	416.1	5.2
1991-92	8046.3	7301.5	566.1	416.1	8283.7	237.4	3.0
1992-93	8426.8	7430.6	1152.3	237.4	8820.3	393.5	4.7
1993-94	8788.3	7231.2	1588.8	393.5	9213.5	425.2	4.8
1994-95	9507.1	7944.3	1473.2	425.2	9842.7	335.6	3.5
1995-96	9822.8	8768.8	2008.2	335.6	11112.6	1289.8	13.1
1996-97	10301.8	8593.1	1156.4	1289.8	11039.3	737.5	7.2
1997-98	10901.8	10083.0	1377.4	737.5	12197.9	1296.1	11.9
1998-99	11353.8	10477.3	657.0	1296.1	12430.4	1076.6	9.5
1999-00	11592.5	10873.2	855.9	1076.6	12805.7	1213.2	10.5
2000-01	10920.2	10943.0	163.6	1213.2	12319.8	1399.6	12.8
2001-02	11310.2	10690.0	282.9	1399.6	12372.5	1062.3	9.4
2002-03	10474.1	10508.0	134.9	1062.3	11705.2	1231.1	11.8
2003-04	11077.0	10556.8	205.1	1231.1	11993.0	916.0	8.3
2004-05	11713.9	11304.9	413.1	916.0	12634.0	920.1	7.9
2005-06	12723.3	11332.9	1389.9	920.1	13642.9	919.6	7.2
2006-07	13772.9	11524.9	2704.0	919.6	15148.5	1375.6	10.0
2007-08	14419.1	10902.8	3707.6	1375.6	15986.0	1566.9	10.9

Source: FAI (2008)

Annexure Table 2.3: Consumption, production, imports and stocks of phosphatic fertilizers in India: 1952-53 to 2007-08

Year	Consumption	Production	Imports	Carry-over stocks	Total supply	Ending Stock	Stocks as % on consumption
1952-53	4.6	7.4	-	0.0	7.4	2.8	61.8
1953-54	8.3	13.8	-	2.8	16.7	8.4	100.9
1954-55	15.0	14.3	-	8.4	22.7	7.7	51.5
1955-56	13.0	12.4	-	7.7	20.1	7.1	54.8
1956-57	15.9	17.6	-	7.1	24.7	8.8	55.5
1957-58	21.9	25.8	-	8.8	34.6	12.7	58.1
1958-59	29.5	31.0	-	12.7	43.7	14.2	48.2
1959-60	53.9	51.4	4.0	14.2	69.6	15.7	29.2
1960-61	53.1	53.7	-	15.7	69.4	16.3	30.7
1961-62	60.5	65.4	-	16.3	81.7	21.2	35.1
1962-63	82.8	88.2	10.0	21.2	119.4	36.6	44.2
1963-64	116.5	107.8	13.0	36.6	157.4	40.9	35.1
1964-65	148.7	131.0	12.0	40.9	183.9	35.2	23.7
1965-66	132.5	118.8	14.0	35.2	168.0	35.5	26.8
1966-67	248.6	145.7	148.0	35.5	329.2	80.6	32.4
1967-68	334.8	207.1	349.0	80.6	636.7	301.9	90.2
1968-69	382.1	213.2	138.0	301.9	653.1	271.0	70.9
1969-70	416.0	223.7	94.0	271.0	588.7	172.7	41.5
1970-71	541.0	228.1	32.0	172.7	432.8	-108.2	-20.0
1971-72	558.2	290.3	247.8	0.0	538.1	-20.1	-3.6
1972-73	581.3	330.3	204.7	0.0	535.0	-46.3	-8.0
1973-74	649.7	324.5	212.7	0.0	537.2	-112.5	-17.3
1974-75	471.5	331.2	285.9	0.0	617.1	145.6	30.9
1975-76	466.8	319.7	361.0	145.6	826.3	359.5	77.0
1976-77	634.7	478.3	22.8	359.5	860.6	225.9	35.6
1977-78	866.6	669.9	163.9	225.9	1059.7	193.1	22.3
1978-79	1106.0	778.0	243.5	193.1	1214.6	108.6	9.8
1979-80	1150.9	763.1	237.1	108.6	1108.8	-42.1	-3.7
1980-81	1213.6	841.5	452.1	0.0	1293.6	80.0	6.6
1981-82	1322.3	950.0	343.2	80.0	1373.2	50.9	3.8
1982-83	1432.7	983.7	63.4	50.9	1098.0	-334.7	-23.4
1983-84	1730.3	1064.1	142.6	0.0	1206.7	-523.6	-30.3

1984-85	1886.4	1317.9	745.2	0.0	2063.1	176.7	9.4
1985-86	2005.2	1430.1	804.8	176.7	2411.6	406.4	20.3
1986-87	2078.9	1661.9	279.3	406.4	2347.6	268.7	12.9
1987-88	2187.1	1666.1	0.0	268.7	1934.8	-252.3	-11.5
1988-89	2720.7	2252.5	407.4	0.0	2659.9	-60.8	-2.2
1989-90	3014.2	1795.3	1311.3	0.0	3106.6	92.4	3.1
1990-91	3221.0	2051.1	1015.7	92.4	3159.2	-61.8	-1.9
1991-92	3321.2	2561.6	967.8	0.0	3529.4	208.2	6.3
1992-93	2843.8	2320.8	727.3	208.2	3256.3	412.5	14.5
1993-94	2669.3	1874.3	721.7	412.5	3008.5	339.2	12.7
1994-95	2931.7	2556.7	376.1	339.2	3272.0	340.3	11.6
1995-96	2897.5	2593.5	686.3	340.3	3620.1	722.6	24.9
1996-97	2976.8	2578.6	218.5	722.6	3519.7	542.9	18.2
1997-98	3913.6	3058.3	715.9	542.9	4317.1	403.5	10.3
1998-99	4112.2	3181.2	984.8	403.5	4569.5	457.3	11.1
1999-00	4797.9	3448.0	1534.1	457.3	5439.4	641.5	13.4
2000-01	4214.6	3734.0	436.7	641.5	4812.2	597.6	14.2
2001-02	4382.4	3835.0	494.3	597.6	4926.9	544.5	12.4
2002-03	4018.8	3904.0	228.2	544.5	4676.7	657.9	16.4
2003-04	4124.3	3626.6	371.5	657.9	4656.0	531.7	12.9
2004-05	4623.8	4038.4	307.3	531.7	4877.4	253.6	5.5
2005-06	5203.7	4202.6	1144.7	253.6	5600.9	397.2	7.6
2006-07	5543.3	4440.0	1373.2	397.2	6210.4	667.1	12.0
2007-08	5514.7	3714.3	1391.2	667.1	5772.6	257.9	4.7

Source: FAI (2008)

Annexure Table 3.1: State-wise Share of Gross Cropped Area and Fertilizer Consumption in India

	1981-82		1991-92		2001-02		2006-07	
Zone/States	**GCA**	**Fertilizer**	**GCA**	**Fertilizer**	**GCA**	**Fertilizer**	**GCA**	**Fertilizer**
East	**18.5**	**10.2**	**18.4**	**13.1**	**17.3**	**15.0**	**17.5**	**14.9**
Assam	1.9	0.2	2.0	0.3	2.0	0.9	2.0	0.9
Bihar[4]	6.5	4.1	5.8	4.7	5.2	5.1	5.2	5.5
Orissa	4.7	1.4	5.1	1.5	4.4	2.0	4.6	1.9
West Bengal	4.5	4.5	4.6	5.9	4.8	6.8	4.9	6.3
North	**22.0**	**39.2**	**22.6**	**33.2**	**22.4**	**34.4**	**22.3**	**31.5**
Haryana	3.2	4.1	3.3	5.0	3.3	5.7	3.4	5.2
Himachal Pradesh	0.5	0.3	0.5	0.3	0.5	0.2	0.5	0.2
Jammu & Kashmir	0.6	0.4	0.6	0.4	0.6	0.4	0.6	0.4
Punjab	3.8	13.5	4.1	9.8	4.2	8.1	4.2	7.8
Uttar Pradesh[5]	13.9	20.9	14.1	17.7	13.8	20.0	13.6	17.9
South	**19.9**	**27.1**	**19.1**	**28.1**	**18.5**	**25.0**	**18.0**	**24.7**
Andhra Pradesh	7.5	10.8	7.3	12.4	7.1	11.3	6.6	11.5
Karnataka	6.4	6.3	6.6	7.1	6.4	7.2	6.7	6.9
Kerala	1.6	1.6	1.6	1.8	1.5	1.0	1.6	1.0
Tamil Nadu	4.4	8.4	3.6	6.6	3.4	5.4	3.1	5.2
West	**39.6**	**23.5**	**39.9**	**25.6**	**41.8**	**25.6**	**42.2**	**28.9**
Gujarat	5.9	6.6	5.8	5.8	5.6	5.3	5.8	6.5
Madhya Pradesh[6]	12.4	4.9	12.6	6.4	13.5	6.0	13.6	7.6
Maharashtra	11.3	8.7	11.0	9.9	11.5	9.7	11.7	10.4
Rajasthan	10.0	3.3	10.5	3.5	11.1	4.5	11.0	4.3
All India	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

[4] Bihar includes Bihar and Jharkhand

[5] Uttar Pradesh includes both Uttar Pradesh and Uttrakhand

[6] Madhya Pradesh includes Madhya Pradesh and Chhattisgarh

Annexure Table 3.2: State-Wise Consumption Ratio of N and P in Relation to K: 1981-82 to 2007-08

State/Region	1981-82			1991-92			1993-94		
	N	P	K	N	P	K	N	P	K
East Zone	**5.7**	**1.7**	**1.0**	**3.7**	**1.5**	**1.0**	**5.8**	**1.8**	**1.0**
Arunachal Pradesh	-	-	-	5.9	2.8	1.0	3.5	2.6	1.0
Assam	5.3	0.8	1.0	2.3	0.9	1.0	3.7	0.7	1.0
Bihar	9.9	1.8	1.0	9.1	2.8	1.0	31.4	6.6	1.0
Manipur	37.3	5.3	1.0	25.0	9.9	1.0	16.1	17.2	1.0
Meghalaya	10.3	6.8	1.0	4.6	4.4	1.0	6.8	4.3	1.0
Mizoram	-	-	-	8.9	9.7	1.0	2.3	2.8	1.0
Nagaland	-	-	-	3.8	4.7	1.0	3.6	3.3	1.0
Orissa	5.5	1.8	1.0	4.5	1.5	1.0	7.8	1.8	1.0
Sikkim	-	-	-	14.5	8.4	1.0	6.8	3.1	1.0
Tripura	4.3	1.2	1.0	5.1	2.0	1.0	6.0	1.9	1.0
West Bengal	4.0	1.6	1.0	2.5	1.3	1.0	2.9	1.3	1.0
North Zone	**13.7**	**3.3**	**1.0**	**24.2**	**7.3**	**1.0**	**70.4**	**15.7**	**1.0**
Haryana	19.3	3.0	1.0	91.9	31.6	1.0	1413.2	401.2	1.0
Himachal Pradesh	6.3	1.4	1.0	5.6	1.4	1.0	15.1	1.4	1.0
Jammu & Kashmir	18.3	4.7	1.0	13.6	4.6	1.0	59.6	11.1	1.0
Punjab	17.4	6.6	1.0	51.8	17.8	1.0	126.7	32.9	1.0
Uttar Pradesh	10.6	2.6	1.0	16.9	4.5	1.0	48.9	9.3	1.0
South Zone	**3.6**	**1.3**	**1.0**	**3.0**	**1.5**	**1.0**	**4.3**	**1.6**	**1.0**
Andhra Pradesh	9.3	3.1	1.0	7.7	3.5	1.0	12.3	4.2	1.0
Karnataka	2.7	1.2	1.0	2.7	1.8	1.0	4.0	1.8	1.0
Kerala	1.3	0.8	1.0	0.9	0.6	1.0	1.2	0.5	1.0
Tamil Nadu	2.9	0.9	1.0	1.7	0.7	1.0	2.0	0.8	1.0
Pondicherry	2.0	0.6	1.0	1.6	0.7	1.0	2.9	1.0	1.0
West Zone	**7.8**	**2.8**	**1.0**	**6.2**	**3.2**	**1.0**	**11.4**	**4.1**	**1.0**
Gujarat	5.9	2.8	1.0	7.6	3.6	1.0	12.1	4.0	1.0

Madhya Pradesh	7.7	3.9	1.0	9.8	6.4	1.0	31.0	14.0	1.0
Maharashtra	3.7	1.4	1.0	3.7	1.7	1.0	6.2	2.0	1.0
Rajasthan	19.1	4.6	1.0	35.6	17.2	1.0	139.3	50.9	1.0
Goa	2.4	1.4	1.0	2.1	1.4	1.0	2.9	1.7	1.0
India	**6.0**	**1.9**	**1.0**	**5.9**	**2.4**	**1.0**	**9.6**	**2.9**	**1.0**
	2000-01			**2002-03**			**2007-08**		
	N	**P**	**K**	**N**	**P**	**K**	**N**	**P**	**K**
East Zone	**4.5**	**1.6**	**1.0**	**3.5**	**1.5**	**1.0**	**4.1**	**1.6**	**1.0**
Arunachal Pradesh	4.0	1.7	1.0	2.9	2.4	1.0	11.3	3.0	1.0
Assam	2.4	1.2	1.0	2.0	1.0	1.0	2.6	1.0	1.0
Bihar	12.3	3.0	1.0	28.7	4.9	1.0	10.3	2.3	1.0
Jharkhand	-	-	-	9.9	7.3	1.0	9.1	4.7	1.0
Manipur	13.8	1.7	1.0	7.3	1.1	1.0	13.2	2.7	1.0
Meghalaya	17.1	9.4	1.0	22.8	14.8	1.0	8.1	5.5	1.0
Mizoram	1.7	1.7	1.0	1.3	1.1	1.0	2.1	1.3	1.0
Nagaland	11.5	7.5	1.0	4.7	4.0	1.0	2.5	2.1	1.0
Orissa	5.1	1.8	1.0	3.0	1.2	1.0	4.4	2.0	1.0
Sikkim	10.5	6.5	1.0	1.7	1.7	1.0	-	-	-
Tripura	12.8	3.3	1.0	4.4	2.0	1.0	3.2	0.8	1.0
West Bengal	2.5	1.3	1.0	2.0	1.3	1.0	2.2	1.3	1.0
North Zone	**29.0**	**8.5**	**1.0**	**17.5**	**6.5**	**1.0**	**19.2**	**5.3**	**1.0**
Haryana	73.9	21.3	1.0	86.7	30.7	1.0	34.1	8.7	1.0
Himachal Pradesh	5.3	1.4	1.0	2.2	1.2	1.0	3.9	1.1	1.0
Jammu & Kashmir	36.6	14.4	1.0	23.5	9.3	1.0	11.3	3.4	1.0
Punjab	42.6	11.9	1.0	47.8	15.9	1.0	33.3	6.5	1.0
Uttar Pradesh	22.4	6.7	1.0	12.0	4.7	1.0	15.3	4.9	1.0
Uttaranchal	-	-	-	7.2	3.0	1.0	12.0	2.6	1.0
South Zone	**3.8**	**1.7**	**1.0**	**3.3**	**1.4**	**1.0**	**2.8**	**1.3**	**1.0**
Andhra Pradesh	6.5	2.9	1.0	5.0	2.0	1.0	4.2	1.9	1.0

Karnataka	3.1	1.6	1.0	3.0	1.7	1.0	2.5	1.3	1.0
Kerala	1.2	0.6	1.0	1.1	0.5	1.0	1.3	0.6	1.0
Tamil Nadu	2.6	1.0	1.0	2.7	0.9	1.0	1.8	0.8	1.0
Pondicherry	2.3	1.0	1.0	2.8	1.3	1.0	2.5	1.2	1.0
West Zone	**7.2**	**3.4**	**1.0**	**6.5**	**3.1**	**1.0**	**5.5**	**2.6**	**1.0**
Gujarat	8.9	3.5	1.0	6.2	2.4	1.0	7.1	2.9	1.0
Madhya Pradesh	10.2	7.2	1.0	13.9	9.7	1.0	10.5	5.7	1.0
Chhattisgarh	-	-	-	5.9	3.0	1.0	6.0	2.3	1.0
Maharashtra	4.1	1.9	1.0	3.4	1.8	1.0	2.9	1.6	1.0
Rajasthan	92.0	30.5	1.0	59.2	17.9	1.0	32.8	12.6	1.0
Goa	1.7	0.9	1.0	1.7	0.9	1.0	2.1	1.1	1.0
India	**7.0**	**2.7**	**1.0**	**6.3**	**2.6**	**1.0**	**5.5**	**2.2**	**1.0**

Annexure Table 3.3: State-wise growth rate in total fertilizer consumption in India

States	1970s	1980s	1990s	2000s	All period
Arunachal Pradesh		18.5	4.2	0.003	
Assam	-2.0	12.3	19.0	5.2	11.6
Bihar	8.6	13.7	6.9	8.7	7.4
Manipur	16.6	12.3	10.4	18.6	8.8
Meghalaya		2.5	3.7	0.3	
Mizoram		27.2	4.5	17.3	
Nagaland		10.3	-1.0	4.4	
Orissa	4.1	10.1	7.0	6.3	6.7
Sikkim		12.3	-3.8	-27.6	
Tripura	15.4	18.5	0.0	4.1	9.9
West Bengal	14.4	12.8	6.0	3.5	8.0
Haryana	13.4	9.6	4.8	4.2	7.8
Himachal Pradesh	8.9	8.1	2.5	3.9	5.5
Jammu & Kashmir	16.7	9.8	5.2	3.7	6.5
Punjab	11.6	3.7	1.5	3.5	4.8
Uttar Pradesh	12.4	5.5	4.5	1.9	6.1
Andhra Pradesh	10.5	9.7	4.1	7.5	6.3
Karnataka	8.2	9.0	6.0	6.0	6.1
Kerala	7.2	10.9	-1.0	2.1	3.4
Tamil Nadu	5.2	5.7	2.7	6.2	3.6
Pondicherry	5.7	5.1	2.6	6.5	5.9
A & N Islands		24.2	2.3	4.7	
Gujarat	10.1	6.4	3.2	11.7	6.0
Madhya Pradesh	5.4	15.2	4.8	4.4	8.1
Maharashtra	8.0	10.6	5.1	7.0	6.8
Rajasthan	11.1	9.3	6.3	6.8	8.5
Goa, Daman & Diu	5.8	4.5	-0.9	3.5	2.1
Dadra & Nagar Haveli		15.2	-1.2	0.8	
India	10.2	8.0	4.2	5.8	6.2

Annexure Table 3.4: State-wise growth rate in N fertilizer consumption in India

States	1970s	1980s	1990s	2000s	All period
Arunachal Pradesh		17.7	5.7	2.0	
Assam	-0.4	9.2	18.4	4.3	10.4
Bihar	9.4	13.2	6.5	3.37.1	7.3
Manipur	14.4	10.1	12.3	-8.2	9.2
Meghalaya		2.3	7.1	1.1	
Mizoram		24.7	5.1	21.3	
Nagaland		10.9	7.4	-7.7	
Orissa	3.1	10.5	6.3	6.3	6.4
Sikkim		19.8	-4.1	-26.0	
Tripura	10.4	16.6	1.4	8.1	8.8
West Bengal	15.4	11.3	5.2	3.9	7.3
Haryana	12.4	8.3	5.0	5.2	7.4
Himachal Pradesh	10.8	7.6	2.5	2.9	5.7
Jammu & Kashmir	12.8	8.4	4.9	3.4	6.4
Punjab	9.5	3.9	1.6	3.7	5.0
Uttar Pradesh	12.8	5.6	4.0	-1.31.4	4.8
Andhra Pradesh	11.2	9.0	3.0	4.6	6.0
Karnataka	10.4	7.8	5.8	5.5	5.8
Kerala	4.6	8.5	0.3	1.6	3.3
Tamil Nadu	6.6	3.8	3.4	5.0	3.0
Pondicherry	8.6	4.0	2.4	5.2	5.7
A & N Islands		24.9	5.5	0.3	
Gujarat	9.0	6.8	3.2	13.6	6.1
Madhya Pradesh	3.9	14.0	3.6	3.4	8.0
Maharashtra	10.2	10.0	4.7	5.4	6.8
Rajasthan	12.6	7.4	6.9	10.2	8.1
Goa, Daman & Diu	7.8	2.5	-0.8	5.5	1.9
Dadra & Nagar Haveli		12.5	0.6	0.7	
India	10.5	7.4	4.1	6.7	5.9

Annexure Table 3.5: State-wise growth rate in total P_2O_5 consumption in India

States	1970s	1980s	1990s	2000s	All period
Arunachal Pradesh		23.3	0.1	-3.2	
Assam	-13.0	22.3	25.4	3.8	14.4
Bihar	7.9	16.9	7.8	5.1	7.8
Manipur		21.4	2.0	0.9	
Meghalaya		2.3	0.3	-1.5	
Mizoram		35.6	4.3		
Nagaland		14.6	11.1	-0.8	
Orissa	6.1	8.9	9.5	9.6	7.2
Sikkim		10.7	-6.0	-24.3	
Tripura		23.9	-2.6	6.9	
West Bengal	18.9	15.1	7.4	2.9	9.5
Haryana	20.9	18.1	4.4	2.7	10.5
Himachal Pradesh	1.4	9.7	6.2	4.7	4.7
Jammu & Kashmir	14.6	14.6	8.9	2.5	8.4
Punjab	16.8	4.4	1.3	3.3	4.5
Uttar Pradesh	13.9	7.2	4.9	2.7	6.9
Andhra Pradesh	9.1	11.6	4.7	8.4	6.9
Karnataka	7.5	12.3	5.1	6.6	6.7
Kerala	2.6	10.2	-0.6	1.9	2.9
Tamil Nadu	3.3	6.1	3.6	8.7	4.0
Pondicherry	-5.1	7.4	5.9	4.6	6.5
A & N Islands		34.0		4.8	
Gujarat	10.4	5.9	4.0	13.0	5.4
Madhya Pradesh	6.2	18.0	6.1	6.24.1	8.5
Maharashtra	6.5	13.1	6.0	13.4	7.7
Rajasthan	11.0	16.0	4.9	-5.4	10.7
Goa, Daman & Diu	3.6	6.1		-1.2	
Dadra & Nagar Haveli		16.9		-14.8	
India	10.4	10.1	5.2	6.8	6.9

Annexure Table 3.6: State-wise growth rate in total K_2O consumption in India

States	1970s	1980s	1990s	2000s	All period
Arunachal Pradesh		14.7	9.7	-2.2	
Assam	-9.0	13.8	16.7	5.6	13.4
Bihar	6.3	11.8	11.2	20.6	6.0
Manipur		15.7	13.5	-5.9	
Meghalaya		4.1	-5.4	22.9	
Mizoram		23.8	17.9	11.9	
Nagaland				7.9	
Orissa	5.6	10.5	10.6	6.6	7.7
Sikkim		3.9			
Tripura		18.3	-6.0	14.8	
West Bengal	7.9	14.6	8.1	5.5	8.6
Haryana	13.4	-10.9	15.9	17.3	2.9
Himachal Pradesh	4.4	9.8	6.8	7.7	5.9
Jammu & Kashmir	21.2	14.6	4.8	25.9	3.7
Punjab	9.4	-9.8	9.7	6.6	1.5
Uttar Pradesh	7.0	-0.9	6.4	5.97.2	3.1
Andhra Pradesh	10.0	9.0	8.8	12.8	7.6
Karnataka	5.1	7.6	5.9	10.1	6.0
Kerala	12.9	14.5	-1.6	-0.2	4.1
Tamil Nadu	-7.7	9.8	0.7	10.7	5.4
Pondicherry	10.8	5.9	-0.5	6.5	5.7
A & N Islands				-18.3	
Gujarat	21.1	3.9	3.9	15.5	6.1
Madhya Pradesh	9.7	10.4	7.1	6.6	7.3
Maharashtra	5.0	9.0	4.0	13.2	5.6
Rajasthan	6.5	-1.4	1.0	21.2	3.6
Goa, Daman & Diu	4.7	7.2	1.8	0.7	3.5
Dadra & Nagar Haveli		25.9		-23.7	
India	9.2	7.0	5.0	10.2	5.6

Annexure Table 3.7: State-wise growth rate in intensity of total fertilizer use in India

States	1970s	1980s	1990s	2000s	All period
Arunachal Pradesh			2.5	-0.8	
Assam	-4.0	10.7	18.3	6.8	10.7
Bihar	7.8	14.6	7.2	12.38.5	8.0
Manipur	11.1	15.3	9.4	-8.2	8.5
Meghalaya		1.9	2.3	0.9	
Mizoram			-0.6	15.5	
Nagaland		10.9	-6.4	-1.2	
Orissa	4.6	9.0	8.5	5.0	6.3
Sikkim			-2.4	-24.4	
Tripura	9.6	16.2	0.1	11.5	9.3
West Bengal	12.1	11.6	4.9	2.8	7.0
Haryana	12.1	10.2	3.7	2.6	7.1
Himachal Pradesh	9.0	7.4	2.9	4.3	5.3
Jammu & Kashmir	11.4	9.0	5.0	3.7	6.2
Punjab	9.6	2.5	0.5	4.1	3.7
Uttar Pradesh	12.1	5.2	4.3	2.91.2	5.6
Andhra Pradesh	10.9	10.2	4.4	7.4	6.3
Karnataka	8.6	8.1	6.0	5.0	5.6
Kerala	4.7	10.8	-0.8	2.3	3.4
Tamil Nadu	5.4	6.7	3.7	8.3	4.3
Pondicherry	6.9	7.9	2.4	10.1	6.8
A & N Islands				4.4	
Gujarat	9.8	7.3	2.6	9.6	5.7
Madhya Pradesh	4.7	14.2	3.2	8.93.2	7.6
Maharashtra	7.4	10.6	4.7	6.7	6.1
Rajasthan	9.2	10.2	4.2	4.1	7.5
Goa, Daman & Diu	6.2	3.1	2.5		
Dadra & Nagar Haveli				1.5	
India	9.4	7.8	3.9	4.6	5.7

Annexure Table 3.8: State-wise growth rate in per hectare use of N in India

States	1970s	1980s	1990s	2000s	All period
Arunachal Pradesh			3.0	2.0	
Assam	-0.5		17.3	6.6	
Bihar	8.3	14.2	6.7	13.2	8.4
Manipur	10.1	13.1	11.1	-9.7	8.5
Meghalaya		1.8	5.5	1.1	
Mizoram			-3.7	21.4	
Nagaland	4.7	8.7	-2.5	-0.6	3.2
Orissa	4.0	9.4	7.6	3.9	6.1
Sikkim			-3.0	-22.3	
Tripura	8.2	14.5	2.1	13.2	9.3
West Bengal	12.8	10.2	4.1	2.7	6.3
Haryana	10.8	8.9	3.8	3.0	6.7
Himachal Pradesh	11.6	6.7	1.4	3.4	5.5
Jammu & Kashmir	11.0	7.6	4.4	2.6	5.8
Punjab	8.3	2.7	0.6	5.9	4.1
Uttar Pradesh	12.5	5.3	3.5	1.3	5.7
Andhra Pradesh	11.7	9.5	3.4	6.6	5.9
Karnataka	9.0	6.9	6.3	3.9	5.4
Kerala	4.1	8.4	0.3	2.3	3.1
Tamil Nadu	5.6	4.7	3.9	6.8	3.7
Pondicherry	9.2	7.3	2.3	10.0	6.7
A & N Islands			0.6	4.2	
Gujarat	8.4	7.7	2.5	9.5	6.0
Madhya Pradesh	4.0	13.0	2.1	9.8	7.3
Maharashtra	9.2	10.0	4.1	4.2	6.1
Rajasthan	9.7	8.2	4.8	5.4	7.4
Goa, Daman & Diu	6.4	1.4	4.2	9.6	1.8
Dadra & Nagar Haveli			-0.5	-1.5	
India	9.5	7.2	3.6	0.8	5.2

Annexure Table 3.9: State-wise growth rate in per hectare use of P_2O_5 in India

States	1970s	1980s	1990s	2000s	All period
Arunachal Pradesh			-1.6	-4.4	
Assam	-13.3	20.1	24.2	5.8	13.4
Bihar	7.1	17.8	8.0	14.9	9.1
Manipur	16.5	24.6	1.6	-0.5	8.3
Meghalaya		1.9	-1.1	-1.9	
Mizoram			-2.1		
Nagaland		11.3	-9.2	-6.0	
Orissa	6.5	7.6	10.3	8.7	6.7
Sikkim			-1.3	-26.5	
Tripura	8.9	21.4	-3.3	7.4	9.8
West Bengal	16.4	13.9	5.5	3.0	8.5
Haryana	19.2	18.5	3.1	0.5	9.8
Himachal Pradesh	2.3	9.1	7.7	5.1	4.8
Jammu & Kashmir	14.4	14.1	8.4	3.1	7.7
Punjab	14.5	3.3	0.1	3.3	3.4
Uttar Pradesh	13.7	7.0	7.4	4.6	7.1
Andhra Pradesh	10.1	12.1	5.2	7.3	6.9
Karnataka	7.3	11.3	5.7	4.5	6.3
Kerala	2.8	10.1	-0.7	3.1	2.7
Tamil Nadu	2.6	7.0	4.2	9.4	4.8
Pondicherry	-3.3	10.7	5.1	9.4	7.5
A & N Islands			3.5	5.6	
Gujarat	10.1	7.2	2.6	9.2	5.4
Madhya Pradesh	5.4	17.2	4.8	7.0	8.3
Maharashtra	6.0	13.0	6.3	6.1	6.9
Rajasthan	9.1	16.8	3.1	8.5	9.6
Goa, Daman & Diu	5.6	4.7	-0.1		
Dadra & Nagar Haveli			-2.2	2.0	
India	9.6	10.0	4.9	5.3	6.5

Annexure Table 3.10: State-wise growth rate in per hectare use of K_2O in India

States	1970s	1980s	1990s	2000s	All period
Arunachal Pradesh			7.9	-5.0	
Assam	-11.7	11.9	15.4	8.1	12.3
Bihar	5.6	12.6	11.8	26.4	7.0
Manipur	13.4	18.2	19.1	-7.0	8.7
Meghalaya	-2.9	2.8	-8.6	18.6	-0.5
Mizoram			11.5		
Nagaland			-14.1	2.9	
Orissa	5.9	9.4	11.5	3.8	7.2
Sikkim			-1.5		
Tripura	16.7	15.2	-5.7	11.6	8.9
West Bengal	5.8	13.3	6.7	2.9	7.5
Haryana	21.1	-10.6	13.2	16.3	1.9
Himachal Pradesh	6.2	9.3	8.9	7.5	5.3
Jammu & Kashmir	7.3	14.2	0.6	29.1	4.5
Punjab	7.5	-10.8	8.3	6.9	0.4
Uttar Pradesh	6.6	-1.1	6.0	10.9	3.1
Andhra Pradesh	7.5	9.5	17.8	11.7	7.7
Karnataka	9.4	6.9	6.5	8.8	5.4
Kerala	7.2	14.4	-2.0	1.7	4.2
Tamil Nadu	7.7	10.7	1.5	10.5	5.3
Pondicherry	11.4	7.5	0.6	11.0	6.4
A & N Islands			-10.9	0.9	
Gujarat	21.1	4.6	3.1	11.8	5.9
Madhya Pradesh	7.8	9.5	5.5	16.1	7.3
Maharashtra	4.4	8.8	4.6	12.4	5.1
Rajasthan	4.6	0.8	0.0	15.2	3.3
Goa, Daman & Diu	7.7	6.1	1.5		
Dadra & Nagar Haveli			-9.3	4.9	
India	8.5	6.8	4.4	9.0	5.1

Annexure Table 3.11: State-wise fertilizer use per hectare of gross cropped area by size of holding, 1995-96

States	Marginal	Small	Semi-medium	Medium	Large	All households
Andhra Pradesh	157.6	127.4	117.6	111.2	80.6	126.2
Assam	15.5	14.4	15.1	11.9	11.4	14.5
Gujarat	294.9	164.1	115.8	80.0	41.4	114.5
Haryana	241.3	167.9	162.6	156.5	175.7	173.9
Himachal Pradesh	42.8	68.4	77.0	48.7	28.8	58.1
Jammu & Kashmir	113.7	82.8	67.4	53.8	71.4	90.3
Karnataka	82.7	37.4	61.2	52.3	41.0	60.0
Kerala	54.0	94.4	95.3	93.7	104.1	85.5
Madhya Pradesh	39.4	29.4	25.5	23.0	22.5	25.7
Orissa	49.8	38.2	36.5	35.3	29.6	39.8
Punjab	203.2	188.3	185.8	184.2	185.0	185.6
Rajasthan	51.5	46.6	40.9	26.3	17.5	31.0
Tamil Nadu	157.1	142.1	123.6	104.4	71.5	135.2
Uttar Pradesh	94.0	73.3	64.0	52.4	34.4	74.4
West Bengal	89.3	81.6	75.8	70.0	65.4	82.9
All India	103.9	82.6	75.3	68.1	51.2	77.1

Annexure Table 4.1: Central Subsidy on fertilizers: 1971-72 – 1991-2 (Pre-reforms Period)

Year	Indigenous	Imported	Total
1971-72	-	-20	-20
1972-73	-	-18	-18
1973-74	-	33	33
1974-75	-	371	371
1975-76	-	242	242
1976-77	60	52	60
1977-78	25	241	266
1978-79	172	171	343
1979-80	321	283	604
1980-81	170	335	505
1981-82	275	100	375
1982-83	550	55	605
1983-84	900	142	1042
1984-85	1200	727	1927
1985-86	1600	324	1924
1986-87	1700	197	1897
1987-88	2050	114	2164
1988-89	3000	201	3201
1989-90	3771	771	4542
1990-91	3730	659	4389
1991-92	3500	1300	4800

Source: FAI (2008)

Annexure Table 4.2: Central Subsidy on fertilizers: 1991-92 to 2007-08 (Post-reforms Period)

Year	Urea			Decontrolled P & K fertilizers	Total subsidy on all fertilizers
	Imported	Indigenous	Total		
1992-93	996	4800	5796	340	6136
1993-94	599	3800	4399	517	4916
1994-95	1166	4075	5241	528	5769
1995-96	1935	4300	6235	500	6735
1996-97	1163	4743	5906	1672	7578
1997-98	722	6600	7322	2596	9918
1998-99	333	7473	7806	3790	11596
1999-00	74	8670	8744	4500	13244
2000-01	1	9480	9481	4319	13800
2001-02	47	8044	8091	4504	12595
2002-03	0	7790	7790	3225	11015
2003-04	0	8521	8521	3326	11847
2004-05	494	10243	10737	5142	15879
2005-06	1211	10653	11864	6596	18460
2006-07	3274	12650	15924	10298	26222
2007-08	6754	16450	23204	17134	40338
2008-09	10981.28	16516.37	27497.65	48351.1	75848.75
2009-10 (e)	7800	8580.25	16380.25	33600	49980.25

Source: FAI (2008)

Annexure Table 4.3: Parity ratio between wheat and fertilizer prices, 1971-72 – 2007-08

Year		Fertilizer prices (Rs./tone) N	P2O5	K2O	Wheat support price (Rs./tone)	Unit of wheat needed to buy one unit of fertilizer N	P2O5	K2O
1971-72		2010	1860	890	760	2.64	2.45	1.17
1972-73		2080	1890	920	760	2.74	2.49	1.21
1973-74		2280	2010	1130	820	2.78	2.45	1.38
1974-75		4350	4830	2050	1050	4.14	4.60	1.95
1975-76	Prior to Dec 75	4020	4520	1970	1050	3.83	4.30	1.88
	Effective Dec 75	4020	4080	1830	1050	3.83	3.89	1.74
1976-77	16-3-1976	3800	4170	1520	1100	3.45	3.79	1.38
	8/2/1977	3590	3400	1340	1100	3.26	3.09	1.22
1977-78	14-4-1977	3590	3400	1340	1120	3.21	3.04	1.20
	12/10/1977	3370	3490	1340	1120	3.01	3.12	1.20
1978-79	11/4/1978	3370	3490	1340	1150	2.93	3.03	1.17
	29-9-1978	3370	3490	1340	1150	2.93	3.03	1.17
	23-1-1979	3370	3490	1340	1150	2.93	3.03	1.17
	10/3/1979	3150	3550	1340	1150	2.74	3.09	1.17
1979-80	11/4/1979	3150	3550	1340	1170	2.69	3.03	1.15
	21-9-1979	3150	3550	1340	1170	2.69	3.03	1.15
	12/10/1979	3350	3550	1340	1170	2.86	3.03	1.15
1980-81	w. e. f. 8-6-1980	4350	4930	1830	1300	3.35	3.79	1.41
	w. e. f. 18-3-1981	4350	4930	1830	1300	3.35	3.79	1.41
1981-82		5110	5830	2170	1420	3.60	4.11	1.53
1982-83	w. e. f. 23-5-82	5110	5830	2170	1510	3.38	3.86	1.44
1983-84		4670	5460	2000	1520	3.07	3.59	1.32
1984-85	w. e. f. 19-7-84	4670	5460	2000	1570	2.97	3.48	1.27
1985-86	Effective+ 31-1-86	5110	5830	2170	1620	3.15	3.60	1.34
1986-87	w. e. f. 29-8-86	5110	5830	2170	1660	3.08	3.51	1.31
	w. e. f. 12-12-86	5110	5830	2170	1660	3.08	3.51	1.31
1987-88	w. e. f. 27-8-87	5110	5830	2170	1730	2.95	3.37	1.25
	w. e. f. 12-11-87	5110	5830	2170	1730	2.95	3.37	1.25
1988-89		5110	5830	2170	1830	2.79	3.19	1.19
1989-90	June-89	5110	5830	2170	2150	2.38	2.71	1.01
1990-91		5110	5830	2170	2250	2.27	2.59	0.96
1991-92	Effective+ 14-8-91	6650	7570	2830	2800	2.38	2.70	1.01
1992-93	Prior to+ 25-8-92	6650	7570	2830	3300	2.02	2.29	0.86
	Effective+ 25-8-	6000	11780 to	7500	3300	1.82	3.57 to	2.27

	92		12430				3.77	
1993-94		6000	11130 to 12870	6000 to 6670	3500	1.71	3.18 to 3.68	1.71 to 1.91
1994-95		7220	12170 to 14070	6170 to 6380	3600	2.01	3.38 to 3.91	1.71 to 1.77
1995-96	Kharif +	7220	16960 to 18480	6030 to7570	3800	1.90	4.46 to 4.86	1.59 to 1.99
	Rabi +	7220	18110 to 19450	7000 to 8000	3800	1.90	4.77 to 5.12	1.84 to 2.11
1996-97	Kharif +	7220	13640 to 16180	6190 to 7170	4750	1.52	2.87 to 3.41	1.30 to 1.51
	Rabi +	7220	14920 to 16960	6620 to 7500	4750	1.52	3.14 to 3.57	1.39 to 1.58
1997-98		7960	14930	6170	5100	1.56	2.93	1.21
1998-99		7960	14930	6170	5500	1.45	2.71	1.12
1999-00	Prior to Feb. 29.00	8700	14640	6170	5800	1.50	2.52	1.06
	w. e. f. Feb. 29.00	10000	15430	7090	5800	1.72	2.66	1.22
2000-01		10000	15430	7090	6100	1.64	2.53	1.16
2001-02		10000	15430	7090	6200	1.61	2.49	1.14
2002-03		10500	16220	7430	6200	1.69	2.62	1.20
2003-04		10500	16220	7430	6300	1.67	2.57	1.18
2004-05		10500	16220	7430	6400	1.64	2.53	1.16
2005-06		10500	16220	7430	6500	1.62	2.50	1.14
2006-07		10500	16220	7430	7500	1.40	2.16	0.99
2007-08		10500	16220	7430	10000	1.05	1.62	0.74

Source: FAI (2008)

Annexure Table 4.4: Parity ratio between Paddy and fertilizer prices, 1971-72 – 2007-08

		Fertilizer prices (Rs./tone)			Paddy support price (Common) (Rs./tone)	Unit of paddy needed to buy one unit of fertilizer		
Year		N	P2O5	K2O		N	P2O5	K2O
1971-72		2010	1860	890	580	3.47	3.21	1.53
1972-73		2080	1890	920	580	3.59	3.26	1.59
1973-74		2280	2010	1130	700	3.26	2.87	1.61
1974-75		4350	4830	2050	740	5.88	6.53	2.77
1975-76	Prior to Dec 75	4020	4520	1970	740	5.43	6.11	2.66
	Effective Dec 75	4020	4080	1830	740	5.43	5.51	2.47
1976-77	16-3-1976	3800	4170	1520	740	5.14	5.64	2.05
	8/2/1977	3590	3400	1340	740	4.85	4.59	1.81
1977-78	14-4-1977	3590	3400	1340	770	4.66	4.42	1.74
	12/10/1977	3370	3490	1340	770	4.38	4.53	1.74
1978-79	11/4/1978	3370	3490	1340	850	3.96	4.11	1.58
	29-9-1978	3370	3490	1340	850	3.96	4.11	1.58
	23-1-1979	3370	3490	1340	850	3.96	4.11	1.58
	10/3/1979	3150	3550	1340	850	3.71	4.18	1.58
1979-80	11/4/1979	3150	3550	1340	950	3.32	3.74	1.41
	21-9-1979	3150	3550	1340	950	3.32	3.74	1.41
	12/10/1979	3350	3550	1340	950	3.53	3.74	1.41
1980-81	w. e. f. 8-6-1980	4350	4930	1830	1050	4.14	4.70	1.74
	w. e. f. 18-3-1981	4350	4930	1830	1050	4.14	4.70	1.74
1981-82		5110	5830	2170	1150	4.44	5.07	1.89
1982-83	w. e. f. 23-5-82	5110	5830	2170	1220	4.19	4.78	1.78
1983-84		4670	5460	2000	1320	3.54	4.14	1.52
1984-85	w. e. f. 19-7-84	4670	5460	2000	1370	3.41	3.99	1.46
1985-86	Effective+ 31-1-86	5110	5830	2170	1420	3.60	4.11	1.53
1986-87	w. e. f. 29-8-86	5110	5830	2170	1460	3.50	3.99	1.49
	w. e. f. 12-12-86	5110	5830	2170	1460	3.50	3.99	1.49
1987-88	w. e. f. 27-8-87	5110	5830	2170	1500	3.41	3.89	1.45
	w. e. f. 12-11-87	5110	5830	2170	1500	3.41	3.89	1.45
1988-89		5110	5830	2170	1600	3.19	3.64	1.36
1989-90	June-89	5110	5830	2170	1850	2.76	3.15	1.17
1990-91		5110	5830	2170	2050	2.49	2.84	1.06
1991-92	Effective+ 14-8-91	6650	7570	2830	2300	2.89	3.29	1.23
1992-	Prior to+ 25-8-92	6650	7570	2830	2700	2.46	2.80	1.05

93	Effective+ 25-8-92	6000	11780 to 12430	7500	2700	2.22	4.36 to 4.60	2.78
1993-94		6000	11130 to 12870	6000 to 6670	3100	1.94	3.59 to 4.15	1.94 to 2.15
1994-95		7220	12170 to 14070	6170 to 6380	3400	2.12	3.58 to 4.14	1.81 to 1.88
1995-96	Kharif +	7220	16960 to 18480	6030 to 7570	3600	2.01	4.71 to 5.13	1.68 to 2.10
	Rabi +	7220	18110 to 19450	7000 to 8000	3600	2.01	5.03 to 5.40	1.94 to 2.22
1996-97	Kharif +	7220	13640 to 16180	6190 to 7170	3800	1.90	3.59 to 4.26	1.63 to 1.89
	Rabi +	7220	14920 to 16960	6620 to 7500	3800	1.90	3.93 to 4.46	1.74 to 1.97
1997-98		7960	14930	6170	4150	1.92	3.60	1.49
1998-99		7960	14930	6170	4400	1.81	3.39	1.40
1999-00	Prior to Feb. 29.00	8700	14640	6170	4900	1.78	2.99	1.26
	w. e. f. Feb. 29.00	10000	15430	7090	4900	2.04	3.15	1.45
2000-01		10000	15430	7090	5100	1.96	3.03	1.39
2001-02		10000	15430	7090	5300	1.89	2.91	1.34
2002-03		10500	16220	7430	5300	1.98	3.06	1.40
2003-04		10500	16220	7430	5500	1.91	2.95	1.35
2004-05		10500	16220	7430	5600	1.88	2.90	1.33
2005-06		10500	16220	7430	5700	1.84	2.85	1.30
2006-07		10500	16220	7430	5800	1.81	2.80	1.28
2007-08		10500	16220	7430	6450	1.63	2.51	1.15

Source: FAI (2008)

Annexure Table 4.5: Share major states in urea subsidy in India: 1992-93 to 2007-08

	1992-93	1999-00	2007-08
Uttar Pradesh[7]	23.9	22.5	21.1
Punjab	11.9	10.2	9.9
Andhra Pradesh	10.5	9.9	9.7
Maharashtra	8.3	9.3	8.2
Bihar[8]	6.2	6.7	7.7
Madhya Pradesh[9]	6.1	6.0	7.4
Haryana	5.9	6.2	7.0
Gujarat	5.4	5.3	7.0
Rajasthan	4.3	5.1	5.1
Karnataka	3.9	4.8	4.8
West Bengal	5.0	5.5	4.5
Tamil Nadu	4.7	4.3	3.5
Orissa	1.6	2.1	1.7
Assam	0.2	0.6	0.8
Kerala	0.6	0.6	0.5
Jammu & Kashmir	0.4	0.4	0.4
Himachal Pradesh	0.3	0.2	0.2
Others	0.9	0.6	0.3
Coefficient of variation (%)	99.4	91.8	87.4

[7] For comparison purpose, Uttar Pradesh includes both Uttar Pradesh and Uttrakhand during 2007-08

[8] For comparison purpose, Bihar includes both Bihar and Jharkhand during 2007-08

[9] For comparison purpose, Madhya Pradesh includes both Madhya Pradesh and Chhattisgarh during 2007-08

Annexure Table 4.6: Share major states in subsidy on decontrolled P & K fertilizers in India: 1992-93 to 2007-08

	1992-93	1999-00	2007-08
Andhra Pradesh	13.2	12.4	13.5
Maharashtra	10.8	12.1	13.0
Uttar Pradesh	10.6	13.7	12.7
West Bengal	8.2	9.2	8.9
Karnataka	9.7	9.1	8.8
Madhya Pradesh	7.8	7.9	8.3
Gujarat	5.9	5.1	7.0
Tamil Nadu	9.2	7.6	6.5
Punjab	7.1	5.6	4.7
Bihar	3.3	4.2	4.1
Rajasthan	3.8	3.9	3.4
Haryana	3.9	3.6	3.4
Orissa	1.6	1.9	2.2
Kerala	3.2	1.9	1.4
Assam	0.3	0.8	1.4
Others	1.1	0.5	0.4
Jammu & Kashmir	0.3	0.3	0.3
Himachal Pradesh	0.2	0.2	0.2
Coefficient of variation (%)	70.8	74.8	75.6

Source: FAI (2008)

Annexure Table 5.1: Correlation between fertilizer consumption and food grain production (State-wise)

Range of correlation coefficient	Name of the State			
	1970s	1980s	1990s	2000s
1.0-0.7	Punjab 0.9112 Maharashtra 0.8496 Andhra Pradesh 0.7520	Uttar Pradesh 0.9676 Punjab 0.9577 West Bengal 0.9368 Madhya Pradesh 0.7537	Uttar Pradesh 0.9567 Haryana 0.9092 West Bengal 0.8363 Punjab 0.8167 Assam 0.7834 Andhra Pradesh 0.7376 Bihar 0.7286	Andhra Pradesh 0.9412 Maharashtra 0.8971 Gujarat 0.8795 Karnataka 0.8503 Tamil Nadu 0.8010 Haryana 0.7915 Orissa 0.7455 Punjab 0.7007
0.69-0.40	Haryana 0.6991 Tamil Nadu 0.6920 Uttar Pradesh 0.4934 Jammu & Kashmir 0.4902	Maharashtra 0.6500 Rajasthan 0.6095 Orissa 0.6054 Andhra Pradesh 0.5748 Assam 0.4129	Tamil Nadu 0.6774 Himachal Pradesh 0.5979 Rajasthan 0.5637 Karnataka 0.5433 Gujarat 0.4850 Madhya Pradesh 0.4828	Rajasthan 0.6518 Madhya Pradesh 0.4427
0.39-0.01	Gujarat 0.3247 Bihar 0.3178 Assam 0.2978 Himachal Pradesh 0.2298 West Bengal	Himachal Pradesh 0.3972 Gujarat 0.3840 Haryana 0.3299 Karnataka 0.3128 Tamil Nadu	Jammu & Kashmir 0.3667 Kerala 0.3344	Bihar 0.3257 Uttar Pradesh 0.1078

	0.2148 Karnataka 0.0470 Orissa 0.0400 Rajasthan 0.0092	0.2596 Jammu & Kashmir 0.1260		
(-) values	Madhya Pradesh -0.0457 Kerala -0.2722	Bihar -0.0274 Kerala -0.9529	Maharashtra -0.1165 Orissa -0.5551	West Bengal -0.1908 Assam -0.6577
All-India	0.6355	0.9220	0.8107	0.7085

Annexure Table 5.2: Correlation between fertilizer consumption and food grain yield (State-wise):

Range of correlation coefficient	Name of the State			
	1970s	1980s	1990s	2000s
1.0-0.7	Jammu & Kashmir 0.8282 Andhra Pradesh 0.7720 Punjab 0.7643 Haryana 0.7536 Maharashtra 0.7058	Kerala 0.9545 Haryana 0.9129 Punjab 0.8959 Tamil Nadu 0.8487 Madhya Pradesh 0.8462 Andhra Pradesh 0.8318 West Bengal 0.8236 Uttar Pradesh 0.8221 Assam 0.8054	West Bengal 0.8358 Assam 0.8343 Bihar 0.7948 Haryana 0.7899 Punjab 0.7809 Karnataka 0.7770 Uttar Pradesh 0.7155 Andhra Pradesh 0.7070	Andhra Pradesh 0.9225 Karnataka 0.8264 Maharashtra 0.8076 Tamil Nadu 0.7540 Orissa 0.7323 Gujarat 0.7005
0.69-0.40	Karnataka 0.6124 Gujarat 0.4418 Kerala 0.4403 West Bengal 0.4072	Bihar 0.6728 Himachal Pradesh 0.6521 Maharashtra 0.4891 Rajasthan 0.4497	Tamil Nadu 0.6634 Rajasthan 0.6115	West Bengal 0.6600 Haryana 0.6207 Punjab 0.5464 Rajasthan 0.5129 Madhya Pradesh 0.4513
0.39-0.01	Uttar Pradesh 0.3735 Himachal Pradesh 0.2387 Tamil Nadu 0.1643 Bihar 0.0671 Assam 0.0508 Rajasthan	Orissa 0.2351 Gujarat 0.1012	Madhya Pradesh 0.2499 Kerala 0.1447 Gujarat 0.1347 Himachal Pradesh 0.1111	Bihar 0.2898 Uttar Pradesh 0.2309

	0.0360			
(-) values	Orissa -0.0136 Madhya Pradesh -0.4907	Karnataka -0.1963 Jammu & Kashmir -0.0635	Maharashtra -0.1376 Jammu & Kashmir -0.4375 Orissa -0.5768	Assam - 0.4823
All-India	0.5841	0.9094	0.7245	0.7443

Annexure Table 5.3: Correlation between fertilizer consumption and food grain production (district-wise)

Range of correlation coefficient	Name of the district		
	90s	00s	90-00s
1.0-0.7	West-Bengal Maldah 0.9122 Haora 0.7796 Gujarat Gandhinagar 0.9761 Ahmadabad 0.8898 Valsad 0.8755 Rajkot 0.8502 Junagadh 0.8443 Surendranagar 0.7808 Jamnagar 0.7752 Kachchh0.7110 Maharashtra Satara 0.8232 Sindhudurg 0.7459 MP Indore 0.7586 Dhar 0.7528 Tikamgarh 0.7130 AP Kurnool 0.9432 Karimnagar 0.8397 Nalgonda 0.8304 Tamil Nadu Sivaganga 0.8239 Namakkal 0.7470 Dharmapuri 0.7461 Madurai 0.7291	Haryana Bhiwani 0.9103 Sonipat 0.8371 Hisar 0.7891 Panipat 0.7728 Gurgaon 0.7629 Yamunanagar 0.7472 Sirsa 0.7090 UP Unnao 0.8657 Sonbhadra 0.8326 Saharanpur 0.8316 Sitapur 0.8178 Pratapgarh 0.7854 Budaun 0.7691 Firozabad 0.7597 Banda 0.7540 Mirzapur 0.7537 Jhansi 0.7513 Etawah 0.7415 Sultanpur 0.7350 Shahjahanpur 0.7280 Bareilly 0.7275 Fatehpur 0.7271 Mau 0.7062 Rajashthan Alwar 0.8995 Dhaulpur 0.8799 Bharatpur 0.7607 West-Bengal Birbhum 0.9705 Nadia 0.8750 Murshidabad 0.8685 Gujarat Bhavnagar 0.8986 Mahesana 0.8803 Amreli 0.8677 Jamnagar 0.7732 Bharuch 0.7489 Rajkot 0.7456 MP Chhatarpur 0.8821 Guna 0.8363 Ujjain 0.7913 Ratlam0.7604 Karnataka Bijapur 0.9363 Gulbarga 0.7475	Haryana Bhiwani 0.7847 Hisar 0.7224 UP Unnao 0.8120 Sitapur 0.7870 Sonbhadra 0.7637 Bareilly 0.7086 Mirzapur 0.7053 WB Birbhum 0.7879 Gujarat Gandhinagar 0.9311 Mahesana 0.7556 Rajkot 0.7190 Jamnagar 0.7125 Surendranagar 0.7053 AP Kurnool 0.8922 Karimnagar 0.7392

		TN Viluppuram 0.7644	
0.69-0.40	Haryana Yamunanagar 0.5758 Sirsa 0.5339 Karnal 0.4919 Kurukshetra 0.4857 Bhiwani 0.4267 Ambala 0.4163 West-Bengal Murshidabad 0.5669 Gujarat The Dangs 0.6780 Mahesana 0.5944 BanasKantha 0.5736 Vadodara 0.5131 Surat 0.5035 SabarKantha 0.5003 MH Thane 0.6390 Jalgaon 0.5647 Akola 0.5641 Nashik 0.5354 Amravati 0.5269 Chandrapur 0.4080 MP Bhopal 0.6647 Betul 0.5939 Jabalpur 0.5717 Shajapur 0.5658 Rewa 0.5112 Dewas 0.4775 Rajgarh 0.4714 Raisen 0.4478 Ratlam 0.4351 Hoshangabad 0.4100 AP Nellore0.6839 Warangal 0.6559 Nizamabad 0.6462 Srikakulam 0.6399 Guntur 0.5879 Prakasam 0.5490 Khammam 0.5469 West Godavari 0.4874 Vizianagaram 0.4791 Karnataka Davangere 0.5832 Haveri 0.5829 Dharwad 0.5366 Gadag 0.5128 Mysore 0.4954 Tumkur 0.4296	Haryana Karnal 0.6511 Kaithal 0.6509 Rohtak 0.5450 Jind 0.5108 UP Jalaun 0.6959 Agra 0.6427 Farrukhabad 0.6410 Hardoi 0.6263 Kheri 0.6191 Pilibhit 0.6112 Varanasi 0.5863 Gorakhpur 0.5718 Azamgarh 0.5521 Etah 0.5202 Mathura 0.4842 Lucknow 0.4766 Bijnor 0.4761 Moradabad 0.4609 Deoria 0.4477 Ballia 0.4124 Rajashthan Jaipur 0.6780 Bundi 0.5603 Chittaurgarh 0.5202 Barmer 0.5111 Sikar 0.4981 West-Bengal Hugli 0.5862 Bankura 0.4354 North 24 Parganas 0.4308 Gujarat Sabar Kantha 0.6364 Vadodara 0.5703 Surendranagar 0.5511 Kachchh0.5364 Junagadh 0.4985 MH Satara 0.6404 Sindhudurg 0.5733 Nashik 0.4939 Pune 0.4822 Dhule 0.4752 MP Datia 0.6685 Sehore 0.6663 Dewas 0.6647 Vidisha 0.6404 Shivpuri 0.5885 Morena 0.5587	Haryana Sirsa 0.6766 Yamunanagar 0.5896 Jind 0.5374 Sonipat 0.5285 Rohtak 0.5279 Gurgaon 0.4979 Karnal 0.4941 Panipat 0.4416 Kaithal 0.4322 UP Firozabad 0.6804 Shahjahanpur 0.6727 Sultanpur 0.6515 Pratapgarh 0.6453 Mau 0.6369 Agra 0.6111 Etawah 0.6071 Jhansi 0.6018 Hardoi 0.6007 Banda 0.5822 Jalaun 0.5757 Budaun 0.5648 Fatehpur 0.5564 Saharanpur 0.5431 Kheri 0.5225 Pilibhit 0.5136 Gorakhpur 0.4874 Varanasi 0.4489 Moradabad 0.4384 Lucknow 0.4211 Farrukhabad 0.4201 Azamgarh 0.4119 Rajasthan Dhaulpur 0.6114 Sawai Madhopur 0.5840 Bundi 0.5529 Alwar 0.4729 Jaipur 0.4615 WB Maldah 0.6793 Murshidabad 0.5625 Hugli 0.5232 South 24 Parganas 0.5178 Koch Bihar 0.4660 Jalpaiguri 0.4631 Gujarat Kachchh 0.6047 SabarKantha 0.5674 Junagadh 0.5376 Bhavnagar 0.4742

	Tamil Nadu Erode 0.6366 Coimbatore 0.5889 Thanjavur 0.4587 Karur 0.4526	Tikamgarh 0.5565 Sagar 0.5325 Bhopal 0.5075 Rajgarh 0.4617 Shajapur 0.4527 Sidhi 0.4136 Gwalior 0.4043 AP Khammam 0.5652 Anantapur 0.5616 Krishna 0.5404 West Godavari 0.5103 Chittoor 0.4362 Karnataka Bangalore 0.6903 Dakshina Kannada 0.6427 Tamil Nadu Nagapattinam 0.5701 Nilgiri 0.4324	Vadodara 0.4125 Maharashtra Sindhudurg 0.6992 Satara 0.5225 Bhandara 0.4690 MP Ratlam 0.6158 Vidisha 0.6135 Dhar 0.5699 Tikamgarh 0.5495 Dewas 0.5315 Shajapur 0.5036 Datia 0.4980 Ujjain 0.4890 Raisen 0.4865 Sehore 0.4860 Mandsaur 0.4789 Sidhi 0.4679 Betul 0.4638 AP West Godavari 0.6915 Prakasam 0.5561 Nellore 0.5367 East Godavari 0.5273 Medak 0.5199 Warangal 0.5005 Khammam 0.4906 Karnataka Bijapur 0.5734 Mysore 0.4471 Chikmagalur 0.4324 TN Dharmapuri 0.6332 Madurai 0.5948 Nagapattinam 0.4699
0.39-0.01	Haryana Jind 0.3710 Rewari 0.3357 Kaithal 0.2931 Faridabad 0.2498 Panipat 0.2440 Sonipat 0.2123 Rohtak 0.1186 West-Bengal Hugli 0.3682 Birbhum 0.1986 Puruliya 0.1458 Koch Bihar 0.0731 South 24 Parganas 0.0587 Gujarat Amreli 0.3853 Bhavnagar 0.0398 MH Bhandara 0.3975	Haryana Faridabad 0.2610 Kurukshetra 0.1122 Ambala 0.0920 UP Meerut 0.3718 Rampur 0.2903 Hamirpur 0.2130 Gonda 0.2079 Faizabad 0.1829 Kanpur Nagar 0.1809 Muzaffarnagar 0.1192 Jaunpur 0.0887 Lalitpur 0.0544 Rajashthan Tonk 0.3621 Sawai Madhopur 0.3259 Nagaur 0.2828 Jodhpur 0.2633	Haryana Faridabad 0.3262 Kurukshetra 0.3193 Ambala 0.2270 UP Deoria 0.3870 Etah 0.3712 Ballia 0.3664 Mathura 0.3528 Bijnor 0.3488 Meerut 0.3142 Rampur 0.2580 Kanpur Nagar 0.2122 Faizabad 0.1451 Gonda 0.1152 Jaunpur 0.0974 Muzaffarnagar 0.0741 Lalitpur 0.0489 Hamirpur 0.0114 Rajasthan

	Ahmadnagar 0.3188 Sangli 0.2505 Gadchiroli 0.2158 Aurangabad 0.1471 MP Ujjain 0.3187 Panna 0.2263 Vidisha 0.1972 Damoh 0.1777 Mandsaur 0.1685 Sagar 0.1519 Seoni 0.1361 Jhabua 0.1125 Chhindwara 0.1067 Guna 0.0907 Mandla 0.0387 Bhind0.0327 AP Krishna 0.3243 East Godavari 0.3176 Visakhapatnam 0.1923 Medak 0.1822 Cuddapah 0.0962 Karnataka Uttara Kannada 0.3177 Shimoga 0.2924 Koppal 0.2309 Kolar0.1417 Bangalore Rural 0.0862 TN Nagapattinam 0.3804 Tiruvannamalai 0.3797 Nilgiri 0.3725 Perambalur 0.3683 Tirunelveli 0.3430 Ramanathapuram 0.1975 Vellore 0.0973 Theni 0.0492 Viluppuram 0.0302	Dausa 0.1757 Ajmer 0.1416 Rajsamand 0.0884 Sirohi 0.0117 West-Bengal Maldah 0.3146 South 24 Parganas 0.1195 Puruliya 0.0717 Gujarat Panch Mahals 0.3338 Ahmadabad 0.0621 Maharashtra Bhandara 0.3690 Thane 0.1849 Aurangabad 0.1736 Ahmadnagar 0.1462 Chandrapur 0.1384 Solapur 0.1154 Buldana 0.1065 Amravati 0.0967 Osmanabad 0.0960 Jalna 0.0949 Raigarh 0.0699 Ratnagiri 0.0698 Gadchiroli 0.0538 Kolhapur 0.0289 MP Dhar 0.3911 Damoh 0.3390 Satna 0.2823 Panna 0.2718 Raisen 0.2553 Jhabua 0.1934 Mandsaur 0.1562 Indore 0.0893 Seoni 0.0846 Betul 0.0754 AP Medak 0.3856 Nalgonda 0.3544 Prakasam 0.2576 Karimnagar 0.2569 Kurnool 0.1410 Nellore 0.1050 Karnataka Hassan 0.3255 Mysore 0.2541 Bangalore Rural 0.1352 Chikmagalur 0.0858 Tamil Nadu Madurai 0.2545 Dindigul 0.0733	Tonk 0.3883 Chittaurgarh 0.3375 Barmer 0.3191 Sikar 0.3086 Ajmer 0.2749 Bharatpur 0.1903 Jodhpur 0.1761 Nagaur 0.1349 Sirohi 0.1324 Dausa 0.1290 Pali 0.0070 WB Howrah 0.3586 Puruliya 0.3126 North 24 Parganas 0.1622 Bankura 0.1003 Gujarat Amreli 0.3420 Ahmadabad 0.2919 Surat 0.1257 BanasKantha 0.1127 Panch Mahals 0.0365 MH Dhule 0.3904 Akola 0.2981 Amravati 0.2865 Thane 0.2520 Nashik 0.2519 Jalna 0.1431 Aurangabad 0.1196 Kolhapur 0.0883 Osmanabad 0.0760 Raigarh 0.0176 MP Damoh 0.3663 Indore 0.3635 Morena 0.3305 Bhopal 0.3297 Seoni 0.2762 Sagar 0.2748 Rajgarh 0.2586 Chhatarpur 0.2561 Panna 0.2289 Jhabua 0.2044 Chhindwara 0.1788 Gwalior 0.0918 Guna 0.0792 Shivpuri 0.0659 Satna 0.0516 AP Nizamabad 0.3733 Guntur 0.3657 Nalgonda 0.3170 Chittoor 0.1254

		Pudukkottai 0.0690 Coimbatore 0.0268	Anantapur 0.0485 Krishna 0.0258 Vizianagaram 0.0221 Cuddapah 0.0144 Karnataka Mandya 0.3995 Dakshina Kannada 0.3923 Gulbarga 0.3728 Belgaum 0.3403 Uttara Kannada 0.2468 Hassan 0.2358 Tumkur 0.2056 Bangalore Rural 0.0366 Tamil Nadu Coimbatore 0.2567 Nilgiri 0.1682 Dindigul 0.0586
(-) values	Haryana Gurgaon -0.0243 Hisar -0.4759 West-Bengal Nadia -0.1971 Darjiling -0.4299 North 24 Parganas -0.4733 Jalpaiguri -0.5077 Bankura -0.5241 Gujarat Kheda -0.1789 Panch Mahals -0.4022 Bharuch -0.4182 MH Osmanabad -0.0029 Pune -0.0100 Wardha -0.1337 Nanded -0.1517 Buldana -0.2538 Raigarh -0.2710 Nagpur -0.2749 Ratnagiri -0.3323 Bid -0.3974 Parbhani -0.4246 Solapur -0.4353 Jalna -0.5316 Yavatmal -0.6187 Latur -0.6940 Dhule -0.7313 MP Chhatarpur -0.0741 Shivpuri -0.0812 Gwalior -0.0952 Balaghat -0.1292	Haryana Rewari -0.1506 UP Allahabad -0.0618 Bara Banki -0.0782 Ghaziabad -0.1183 Ghazipur -0.1303 Bahraich -0.1411 Kanpur Dehat -0.2024 Aligarh -0.2027 Basti -0.2059 Bulandshahr -0.6832 Rajashthan Jalor -0.0298 Baran -0.0917 Bhilwara -0.1104 Bikaner -0.1538 Pali -0.1597 Kota -0.1786 Banswara -0.3499 Jhalawar -0.5186 Udaipur -0.7658 Ganganagar -0.9869 West-Bengal Jalpaiguri -0.0417 Haora -0.2868 Koch Bihar -0.4406 Darjiling -0.5416 Gujarat Banas Kantha -0.0844 Surat -0.1327 Gandhinagar -0.3825 Kheda -0.9011 MH Jalgaon -0.0075	Haryana Rewari -0.0137 UP Ghaziabad -0.0453 Allahabad -0.0726 Bara Banki -0.0801 Ghazipur -0.1053 Bahraich -0.1535 Kanpur Dehat -0.1580 Aligarh -0.1825 Basti -0.3273 Bulandshahr -0.6215 Rajasthan Jalor -0.0008 Rajsamand -0.0289 Bhilwara -0.0874 Jhalawar -0.1265 Baran -0.1302 Bikaner -0.1783 Banswara -0.1895 Kota -0.2616 Udaipur -0.5097 Ganganagar -0.6931 WB Nadia -0.1164 Darjiling -0.6478 Gujarat Kheda -0.2239 Bharuch -0.2275 MH Gadchiroli -0.0018 Ahmadnagar -0.0459 Ratnagiri -0.0658 Chandrapur -0.0683 Buldana -0.0721 Pune -0.0726

	Satna -0.1619 Sehore -0.2230 Morena -0.3003 Sidhi -0.3154 Shahdol -0.3212 Datia -0.4026 AP Chittoor -0.0419 Anantapur -0.1855 Rangareddi -0.3216 Adilabad -0.3948 Karnataka Gulbarga -0.1624 Bangalore -0.2244 Mandya -0.3031 Bellary -0.3335 Kodagu -0.4111 Belgaum -0.6687 Raichur -0.6714 Hassan -0.6998 Chikmagalur -0.7246 Bagalkot -0.8952 Bidar -0.8984 Bijapur -0.9194 Udupi -0.9506 Dakshina Kannada -0.9745 TN Pudukkottai -0.0221 Dindigul -0.0766 Tiruchchirappalli -0.1572 Kancheepuram -0.2045 Cuddalore -0.3168 Salem -0.3435 Thiruvarur -0.3700 Kanniyakumari -0.3974 Thirpuvallur -0.7405	Bid -0.0158 Nagpur -0.0354 Akola -0.0527 Latur -0.0762 Sangli -0.1537 Nanded -0.1621 Parbhani -0.2001 Yavatmal -0.3522 Wardha -0.4673 MP Rewa -0.1299 Chhindwara -0.2153 Jabalpur -0.2341 Bhind -0.2708 Hoshangabad -0.3357 Mandla -0.4243 Shahdol -0.4874 Balaghat -0.5024 AP Warangal -0.0232 Vizianagaram -0.038 Cuddapah -0.0412 East Godavari -0.09 Visakhapatnam -0.26 Nizamabad -0.4559 Guntur -0.5028 Srikakulam -0.5495 Karnataka Tumkur -0.2232 Belgaum -0.2349 Mandya -0.2581 Shimoga -0.3039 Bidar -0.3065 Uttara Kannada -0.33 Kodagu -0.5156 Bellary -0.7335 Kolar -0.8377 Raichur -0.8921 Tamil Nadu Kanniyakumari -0.0924 Ramanathapuram -0.5558 Dharmapuri -0.62 Tiruchchirappalli -0.69 Thanjavur -0.6947 Salem -0.8463	Jalgaon -0.0842 Sangli -0.0895 Solapur -0.1507 Bid -0.1534 Latur -0.1539 Parbhani -0.1639 Nanded -0.1728 Nagpur -0.1901 Wardha -0.3202 Yavatmal -0.4750 MP Rewa -0.0753 Jabalpur -0.0796 Hoshangabad -0.0919 Balaghat -0.2043 Bhind -0.2462 Mandla -0.2922 Shahdol -0.4365 AP Srikakulam -0.0089 Visakhapatnam -0.1906 Karnataka Bangalore -0.0393 Kodagu -0.0548 Shimoga -0.0909 Kolar -0.1186 Bellary -0.4791 Bidar -0.5022 Raichur -0.6351 TN Viluppuram -0.0409 Pudukkottai -0.0443 Ramanathapuram -0.4670 Thanjavur -0.5507 Kanniyakumari -0.5660 Tiruchchirappalli -0.6457 Salem -0.6772

Haryana – 1994-2004, Uttar Pradesh – 1991-2003, Rajasthan – 1994-2003, West-Bengal – 1992-2006, Gujarat – 1996-2005, Maharashtra – 1991-2005, Madhya Pradesh – 1991-2006, Andhra Pradesh – 1993-2006, Karnataka – 1997-2004, Tamil Nadu – 1995-2005

Annexure Table 6.1: Estimated regression equation for per hectare fertilizer (N+P+K) use in India

	Coefficient	Standard error	't' value	Rank[10]
(Constant)	-212.79***	48.83	-4.36	
HYVs	0.49**	0.19	2.52	3
GIA	2.99***	0.59	5.03	1
CI	1.27**	0.47	2.70	4
Price Fertilizers	-3.96***	0.78	-5.09	2
Price Rice+Wheat	0.02	0.02	1.50	5
Credit	0.0002**	0.0001	2.81	6
Adj. R Square	0.992			
F	684.33			
D-W statistics	2.001			

*** Significant at 1 per cent; ** Significant at 5 per cent; * Significant at 10 per cent

Annexure Table 6.2: Estimated regression equation for per hectare N fertilizer use in India

	Coefficient	Standard error	't' value	Rank
(Constant)	-157.30***	29.99	-5.25	
HYVs	0.27**	0.13	2.11	4
GIA	1.55***	0.35	4.37	1
CI	1.08*	0.28	3.83	2
Price of N Fertilizer	-2.06**	0.49	-4.18	3
Price Rice+Wheat	0.01	0.01	1.30	5
Credit	0.0001*	0.00003	2.88	6
Adj. R Square	0.994			
F	831.26			
D-W statistics	1.844			

*** Significant at 1 per cent; ** Significant at 5 per cent; * Significant at 10 per cent

[10] Based on standardized coefficients (ignoring signs) given coefficients (s.d. of X_i/s.d of Y_i), where s.d. is standard deviation, X_i is i[th] explanatory variable and Y is dependent variable

Annexure Table 6.3. Estimated regression equation for per hectare P fertilizer use in India

	Coefficient	Standard error	't' value	Rank
(Constant)	-66.63	21.71	-3.07	
HYVs	0.06	0.08	0.78	5
GIA	1.10**	0.27	4.07	1
CI	0.35*	0.21	1.65	4
Price of P Fertilizer	-0.89***	0.14	-6.41	2
Price Rice+Wheat	0.01*	0.01	1.63	3
Credit	0.00002	0.00003	0.80	6
Adj. R Square	0.978			
F	224.119			
D-W statistics	1.370			

*** Significant at 1 per cent; ** Significant at 5 per cent; * Significant at 10 per cent

Annexure Table 6.4. Estimated regression equation for per hectare K fertilizer use in India

	Coefficient	Standard error	't' value	Rank
(Constant)	-4.97	13.88	-0.36	
HYVs	0.05	0.05	1.02	5
GIA	0.46**	0.17	2.68	1
CI	-0.04	0.14	-0.32	6
Price of K Fertilizer	-0.40**	0.15	-2.77	3
Price Rice+Wheat	0.004	0.004	-1.08	4
Credit	0.0001***	0.00002	4.77	2
Adj. R Square	0.944			
F	85.99			
D-W statistics	2.067			

*** Significant at 1 per cent; ** Significant at 5 per cent; * Significant at 10 per cent

Annexure Table 7.1: Classification of countries according to compound annual growth rate of N consumption

	1980s	1990s	2000s	All period
Significant +ve growth rate	Egypt 2.91 Mexico 3.30 Sri Lanka 2.99 UK 1.57 New Zealand 6.07	Egypt 3.66 USA 1.15 China 2.89 Germany 1.43	Egypt 3.54 Bangladesh 6.55 China 7.47 Pakistan 2.82	
Non-significant +ve growth rate	Brazil 2.22 Bangladesh 10.17 China 5.45 India 8.52 Japan 0.13 Pakistan 6.92 France 2.47 Australia 6.80	Mexico 0.69 Brazil 8.95 Bangladesh 5.09 India 4.68 Nepal 3.49 Pakistan 5.00 Sri Lanka 5.53 France 0.76 Australia 10.70 New Zealand 13.24	USA 0.75 Brazil 5.62 India 5.06 Japan 4.00 Sri Lanka 2.99 France 0.40 Germany 0.54 New Zealand 13.40	Egypt 13.23 Mexico 0.34 USA 2.60 Brazil 5.07 Bangladesh 3.55 China 3.60 India 1.22 Pakistan 4.90 Sri Lanka 0.26 France 0.17 UK 1.18 Australia 7.08 New Zealand 12.74
Significant -ve growth rate		Netherlands -0.93	Mexico -3.97 Nepal -4.96 Netherlands -2.00	Nepal -29.59 Germany -0.57
Non-significant -ve growth rate	USA -0.37 Netherlands -1.15	Japan -4.25 UK -0.93 Ukraine -16.44	UK -1.31 Ukraine -8.91 Australia -0.13	Japan -1.60 Netherlands -2.44 Ukraine -1.33

Annexure Table 7.2: Classification of countries according to compound annual growth rate of P consumption

	1980s	1990s	2000s	1980-2000s
Significant +ve growth rate	Egypt 6.37 China 6.61	Brazil 4.82 China 8.06	Mexico 14.05 Brazil 8.45 Bangladesh 10.55 China 4.62 Sri Lanka 4.96	Bangladesh 3.19 New Zealand 1.55
Non-significant +ve growth rate	Mexico 1.70 Bangladesh 6.29 India 12.52 Japan 0.57 Pakistan 7.60 Sri Lanka 4.90 Australia 0.38	Egypt 5.14 Mexico 2.84 USA 3.62 Bangladesh 0.79 India 7.62 Nepal 4.91 Pakistan 7.65 Sri Lanka 4.15 France 0.04 Germany 0.85 Netherlands 2.76 UK 2.29 Australia 6.24 New Zealand 2.14	Egypt 10.69 USA 2.42 India 1.08 Japan 4.26 Pakistan 3.26 Germany 3.10 Netherlands 0.64 New Zealand 0.38	Egypt 1.04 Mexico 0.26 USA 0.32 Brazil 3.26 China 6.43 India 6.24 Pakistan 5.14 Sri Lanka 0.40 Australia 1.75
Significant -ve growth rate	USA -2.30 New Zealand -4.04	Japan -3.35 Ukraine -22.70	Ukraine -23.76	UK -1.72
Non-significant -ve growth rate	Brazil -0.09 France -2.29 Netherlands -0.66 UK -0.15		Nepal -13.13 France -0.84 UK -1.12 Australia -0.48	Japan -1.43 Nepal -0.43 France -3.39 Germany -3.05 Netherlands -1.48 Ukraine -20.09

Annexure Table 7.3: Classification of countries according to compound annual growth rate of K consumption

	1980s	1990s	2000s	1980-2000s
Significant +ve growth rate	Brazil 4.74 China 11.72 India 21.71 Pakistan 11.48	Mexico 11.62 Bangladesh 6.90 China 8.21 New Zealand 3.08	Brazil 11.93 Bangladesh 11.71 China 13.26 Ukraine 41.36 Australia 4.80	India 3.84
Non-significant +ve growth rate	Egypt 22.06 Mexico 3.21 Bangladesh 9.15 Japan 0.92 Sri Lanka 3.82 France 1.56 UK 1.81 Australia 2.37	Egypt 0.56 USA 0.27 Brazil 8.34 India 2.80 Nepal 4.90 Sri Lanka 2.38 Australia 6.90	Mexico 7.54 USA 2.14 India 5.21 Japan 10.46 Pakistan 30.52 Sri Lanka 1.76 New Zealand 3.19	Egypt 5.84 Mexico 4.97 Brazil 6.26 Bangladesh 7.79 China 10.48 Nepal 0.64 Sri Lanka 0.98 Australia 3.21 New Zealand 2.43
Significant -ve growth rate	USA -1.94 New Zealand -5.06	France -2.95 Germany -2.73	Germany -2.92	Ukraine -17.42
Non-significant -ve growth rate	Netherlands -1.64	Japan -3.57 Pakistan -6.68 Netherlands -3.60 UK -0.29 Ukraine -36.18	Egypt -3.75 Nepal -9.79 France -1.50 UK -0.55	USA -0.27 Japan -1.82 Pakistan -1.76 France -2.83 Germany -3.55 Netherlands -2.88 UK -1.23