FERTILIZER SUBSIDIES

Which Way Forward?

Edited by Jikun Huang, Ashok Gulati, and Ian Gregory

IFDC

FAI
ENSURING FOOD SECURITY

Fertilizer Subsidies—Which Way Forward?

An IFDC/FAI Report

Edited by Jikun Huang, Ashok Gulati, and Ian Gregory

February 2017

Preface

Fertilizer subsidies in developing countries have been increasingly common policy interventions in recent years to increase supply and use of fertilizer and thus stimulate agricultural output and farmer income. The volatility of global food and fertilizer prices in 2007 and 2008 provided a stimulus for this resurgence in fertilizer subsidies. The multiple objectives and the rapid growth in the financial burden of subsidies and their share of the total support to agriculture have brought into question whether fertilizer subsidies are an appropriate policy intervention to meet the challenges of feeding almost 10 billion people in 2050,[1] increasing urbanization in developing countries, reducing rural poverty, and reducing environmental impacts on regional agricultural production.

Balanced and efficient fertilizer use is an essential component of increased agricultural production together with improved crop varieties, water management, land preparation, weed, disease and insect control, and sustained soil health. Harvesting and post-harvest technologies are also essential to capture and preserve increased agricultural production. The economic use of fertilizer is dependent upon the ratio of fertilizer price to crop output price and the incremental crop response to fertilizer nutrients. Fertilizer subsidies are merely transaction subsidies that impact the input/output price relationships. However, the whole supply and output value chains related to agricultural production include a multitude of services that impact fertilizer demand and use from finance to technical to processing and markets. In developed economies, fertilizer subsidies have essentially disappeared[2] and agricultural support programs, particularly crop price stabilization, crop insurance programs, area payments uncoupled from production, and support linked to environmental criteria, replaced input subsidies in the 1960s and 1970s.

The Fertiliser Association of India (FAI) and the International Fertilizer Development Center (IFDC) jointly undertook an analysis of fertilizer subsidies in five Asian countries (Bangladesh, China, India, Indonesia, and Pakistan) and four sub-Saharan countries (Malawi, Nigeria, Rwanda, and Tanzania) to understand their impact on the countries' fiscal budgets, on

---

[1] United Nations Population Fund forecast, 2015.
[2] http://www.oecd.org/tad/agricultural-policies/support-policies-fertilisers-biofuels.htm

productivity and nutrient management, and on the efficiency of fertilizer production, distribution, and consumption. Such analysis is intended to assist policymakers interested in better understanding the impact of fertilizer subsidies by documenting the diversity and effectiveness of existing subsidy programs and drawing lessons from the different regimes.

The selection of the five Asian countries reflects the different sizes of the domestic fertilizer markets—from the world's largest and second largest fertilizer nutrient markets (China and India with 28.8% and 13.5%, respectively, of the global fertilizer nutrient consumption in 2012/13) to smaller Asian markets (Bangladesh with 1.1%, Pakistan with 2.3%, and Indonesia with 2.9%) and a geographically challenging farm distribution. All of these countries participated in the "Green Revolution" from 1950 to 1970 and now have a long history of fertilizer use and fertilizer subsidy support, which were integral components of the Green Revolution. The selection also represents different levels of domestic fertilizer production and imported fertilizer dependence and the top five Asian countries with fertilizer subsidies.

Sub-Saharan Africa (SSA), in total, only accounted for 1.6% of global fertilizer nutrient consumption in 2012/13, and national markets are still very small. The selection includes the largest SSA fertilizer market (Nigeria in West Africa) and three markets in East Africa, of which two (Rwanda and Malawi) are landlocked countries that incur substantial inland freight costs for imported fertilizer. None of the SSA countries benefited from the Asian Green Revolution.

The world fertilizer market is increasingly globalized, with trade in 2012/13 accounting for 31.8% (N), 36.3% (P), and 82.1% (K) of total consumption, and reaching 181.62 million metric tons (Mt) of nutrients ($N+P_2O_5+K_2O$) in 2012/13, a 30.7% increase from 2000/01.[3] In the two years from 2007 to 2009, total world consumption of nutrients fell by 25.5% to 54.96 Mt due to the financial crisis, economic downturn, and high volatility of international prices for fertilizers and agricultural commodities. It subsequently rebounded to 181.62 Mt by 2012/13. In 2012/13, the aggregate world demand was 110.17 Mt for N, 41.1 Mt for P_2O_5, and 30.37 Mt for K_2O.

[3] http://ifadata.fertilizer.org/ucSearch.aspx

East Asian fertilizer consumption rose firmly between 2000/01 and 2012/13, and consumption of N only fell marginally in 2007/08, while that of P and K declined by 11.9% and 30.8%, respectively, in that year.

South Asian demand also expanded firmly from 2000/01 to 2012/13, and contrary to most regions, regional demand soared during the crisis period from 2007/08 to 2008/09, boosted by demand in India where farmers were protected from international price increases. Conversely, regional demand contracted in 2011/12 following revisions to India's fertilizer subsidy regime.

In SSA, after a depressed period of more than two decades following the structural adjustment programs that removed national fertilizer subsidy programs, fertilizer demand has gained momentum since 2009, albeit from a very low base. Regional consumption of fertilizer nutrients is estimated to have increased by 47% between 2000/01 and 2012/13, mainly due to increased N consumption. The region was slightly affected by the downturn in 2008/09.

It is estimated by the International Fertilizer Association (IFA)[4] that aggregate fertilizer consumption of the countries subsidizing fertilizers accounts for 54% of world fertilizer demand. The nine countries considered in this analysis represent 41% of world fertilizer demand, or almost 80% of subsidized fertilizer. Not all the fertilizer consumption in these countries is subsidized, but they represent a major portion of the global fertilizer subsidy scene.

Slightly over 50% of global fertilizer use in 2010/11 was estimated to be on cereal crops with the three main cereals, wheat, rice, and maize, each accounting for between 14% and 16% of the world total use.[5] There is considerable variation in use by crop between regions. Cereals account for 44% in East Asia, 51% in South Asia, and possibly 60% in SSA.[6] The importance of fertilizer use on cereal crops, the main staple food source for much of the developing world, is a major reason why fertilizer subsidies have been used in attempts to increase food production and food security. Initial design of fertilizer subsidies generally involved pan-territorial pricing,

[4] See Chap. 2 of this paper.
[5] Heffer P (2013) Assessment of fertilizer use by crop at the global level, 2010-2010/11. IFA, Paris.
[6] FAO; World Development Indicators (3) Cereal Yields.

allocations, and rationing. In Asia, they were successful initially at boosting fertilizer use but much less so in SSA where they were discontinued in the 1980s as a result of structural reform of national financial strategies. Many criticisms of traditional subsidies have been documented, ranging from market distortions, to crowding out, leakage, unbalanced and inefficient nutrient use, inefficiency, and unsustainable financial burdens. Many modifications to objectives, strategies, and implementation have been made by policymakers to improve effectiveness over the years. From 2000 onward, these modifications included the development of market-friendly, or "smart" subsidy programs, and following the global financial crisis of 2007/08, these expanded rapidly, especially in SSA.

The global structure of the fertilizer sector, including production, trade, and consumption, is presented in this review together with country reviews and developments of fertilizer subsidy programs in the selected countries emphasizing the period from 2000 to 2013. Lessons learned from the subsidy experiences and suggestions on the way forward are provided for each selected country together with an overall assessment of the way forward.

Table of Contents

List of Tables

List of Figures

Acronyms

ABC	ammonium bicarbonate
ACGR	annual compound growth rate
ADMARC	Agricultural Development and Marketing Corporation
ADP	Annual Development Program
AFAP	African Fertilizer and Agribusiness Partnership
AFCL	Ashugonj Fertilizer & Chemical Company Ltd.
AGRA	Alliance for a Green Revolution in Africa
AISAM	Agricultural Input Suppliers Association of Malawi
AL	Awami League
AS	ammonium sulfate
BADC	Bangladesh Agricultural Development Corporation
BARC	Bangladesh Agriculture Research Council
BCIC	Bangladesh Chemical Industries Corporation
BCR	benefit-cost ratio
BFA	Bangladesh Fertilizer Association
BIDS	Bangladesh Institute of Development Studies
BIMAS	Bimbingan Massal
BNP	Bangladesh Nationalist Party
BPS	Central Statistical Agency (Indonesia)
C	cost
CAGR	compound annual growth rate
CAN	calcium ammonium nitrate
CCP	Competition Commission of Pakistan
CIF	cost, insurance, and freight
CIP	Crop Intensification Program
CNCIC	China National Chemical Information Center
CNFA	Cultivating New Frontiers in Agriculture
COGS	cost of goods sold
CRP	ceiling retail price
CSOs	civil society organizations
CUFL	Chittagong Urea Fertilizer Factory Limited
CV	curriculum vitae
DADO	District Agricultural Development Officer
DAE	Department of Agricultural Extension

DAP	diammonium phosphate
DFID	Department for International Development
DFSMC	District Fertilizer and Seed Monitoring Committee
DoF	Department of Fertilizer
DRC	Democratic Republic of Congo
DVC	District Voucher Committee
EC Act	Essential Commodities Act
EDM	Equilibrium Displacement Model
EECA	Eastern Europe and Central Asia
EFL	Engro Fertilizer Limited
EIA	Energy Information Administration
FAI	Fertiliser Association of India
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Statistics Division of the United Nation's Food and Agriculture Organization
FCO	Fertilizer Control Order
FDI	Fertilizer Distribution Improvement
FDP	fertilizer deep placement
FFBL	Fauji Fertilizer Bin Qasim Limited
FFC	Fauji Fertilizer Company Limited
FGN	Federal Government of Nigeria
FHPD	Farm Household Panel Data
FISP	Farm Input Subsidy Program
FMP	Fused magnesium phosphate
FOB	free on board
FOR	free on road
FSFC	Federal Superphosphate Fertilizer Company
ft	feet
g	gram
G2G	Government to government
GAC	General Administration of Customs
GAMS	General Algebraic Modeling System
GCA	gross cropped area
GDN	Global Development Network
GDP	Gross Domestic Product
GES	Growth Enhancement Support

GHG	greenhouse gas
GIDC	gas input development changes
GMO	genetically modified organism
GoB	Government of Bangladesh
GoI	Government of Indonesia
GoM	Government of Malawi
GoR	Government of Rwanda
GoT	Government of Tanzania
GPP	government purchasing price
GPS	global positioning system
GST	general sales tax
ha	hectare
HDIP	Hydrocarbon Development Institute of Pakistan
HYV	high-yielding variety
IASRI	Indian Agricultural Statistics Research Institute
ICAR	Indian Council of Agricultural Research
ICT	Information and Communication Technology
IEPL	Indorama Eleme Petrochemicals Limited
IFA	International Fertilizer Association
IFDC	International Fertilizer Development Center
IFPRI	International Food Policy Research Institute
IGAN	industrial-grade ammonium nitrate
IMF	International Monetary Fund
IRG	International Resource Group
JFCL	Jamuna Fertilizer Company Limited
K	potassium
KAFCO	Karnaphuli Fertilizer Company
KCl	potassium chloride
kg	kilogram
kg/kgN	grain yields per kg of N applied
KSS	Krishi Samabay Samity (Farmers' Cooperative Society)
LC	letter of credit
LGA	Local Government Authorities
MAP	monoammonium phosphate
mBTU	million British thermal units
MC	marginal cost

MFC	Minjingu Fertilizer Company
MINAGRI	Ministry of Agriculture and Animal Resources
MK	Malawi Kwacha
MNFAL	Ministry of Food, Agriculture and Livestock
MNFSR	Ministry of National Food Security and Research
MOA	Ministry of Agriculture
MoAFS	Ministry of Agriculture and Food Security
MOF	Ministry of Finance
MOI	Ministry of Industries
MOP	muriate of potash
MRP	maximum retail price
mt	metric tons
Mt	million metric tons
MV	marginal value
MVCR	marginal value-cost ratio
N	nitrogen
NAFCON	National Fertilizer Company of Nigeria
NAIVS	National Agricultural Inputs Voucher Scheme
NASFAM	National Small Farmer Association of Malawi
NATEC	National Agricultural Technology Extension Center
NBS	nutrient-based subsidy
NBSC	National Bureau of Statistics of China
NCACF	National Coordination and Advisory Committee on Fertilizer
NCIL	Notore Chemical Industries Ltd.
NDRC	National Development and Reform Commission
NEPAD	New Partnership for Africa's Development
NFC	National Fertilizer Corporation of Pakistan
NFCL	Nagarjuna Fertilizer and Chemicals Limited
NFDC	National Fertilizer Development Centre
NFE	non-farm economic
NFML	National Fertilizer Marketing Limited
NFPCSP	National Food Policy Capacity Strengthening Program
NGFFL	Natural Gas Fertilizer Factory Limited
NGO	non-governmental organization
NMB	National Microfinance Bank
NPK	nitrogen, phosphorus, and potassium

NPRs	nominal protection rates
NPS	new pricing scheme
NRC	National Research Council
NSA	net sown area
NVSC	National Voucher Steering Committee
OPV	open-pollinated variety
P	phosphate
p.a.	per annum
PECA	Provincial Essential Commodity Act
PFP	partial factor productivity
PHC	Peshawar High Court
PKR	Pakistani Rupee (PKR 85=U.S. $1 in 2011-12)
PPI	Pakistan Press International
PT PIM	PT Pupuk Iskandar Muda
PT PKC	PT Pupuk Kujang
PT PKG	PT Petrokimia Gresik
PT PKT	PT Pupuk Kalimantan Timur
PT PUSRI	PT Pupuk Sriwijaya
PUFFL	Potash Urea Fertilizer Factory Limited
R&D	research and development
RADA	Rwanda Agricultural Development Authority
RDKK	*Rencana Definitif Kebutuhan Kelompok* (Definitive Plan of Group Needs)
RHPS	Rural Household Panel Survey
ROW	rest of the world
RPS	retention price scheme
Rs	Rupees
RUMARK	Rural Market Development Trust
RVS	Regional Voucher Secretariat
SAIN	Sustainable Agriculture Innovation Network
SFFRFM	Smallholder Farmers Fertilizer Revolving Fund of Malawi
SFRI	Soil Fertility Research Institute
Sino-Agri Group	China National Agricultural Means of Production Group Corporation
Sinochem Group	China National Chemicals Import and Export Corporation
SMS	short message service
SOE	state-owned enterprise
SOP	sulfate of potash

SP-36	superphosphate
SR	single responsibility
SRDI	Soil Resources Development Institute
SSA	Sub-Saharan Africa
SSP	single superphosphate
TAGMARK	Tanzania Agricultural Market Development Trust
TAP	Token Administration Platform or “Touch and Pay”
Tk	Bangladesh Taka
TRQ	tariff-rate quota
TSP	triple superphosphate
TSPC	TSP Complex
UAE	United Arab Emirates
UDP	urea deep placement
UFFL	Urea Fertilizer Factory Limited
UFSMC	Upazila Fertilizer and Seed Monitoring Committee
UID	unique identification number
UK	United Kingdom
UAO	Upazila Accounts Officer
UNO	Upazila Nirbahi Officer
USAID	United States Agency for International Development
VAT	value-added tax
VVC	Village Voucher Committee
WITS	World Integrated Trade Solution
WPADC	West Pakistan Agricultural Development Corporation
WTO	World Trade Organization
ZTB	Zarai Taraqiati Bank

Fertilizer Subsidies—Which Way Forward?
An IFDC/FAI Report

1 Executive Summary

The fertilizer subsidy programs reviewed exhibit, to one degree or another, various components of both fertilizer supply and demand creation subsidies. Common to all is the basic objective of increasing national staple food supply and pro-poor growth and also constantly changing implementation strategies in reaction to evolving market situations and market distortions, inefficiencies and excessive, unsustainable fiscal costs. In addition, the Chinese government has used various trade quota, tariff, and tax regulations to control supply to protect domestic production and insulate farmers from international price volatility. Regardless, not only are large subsidy budgets fiscally unsustainable, but they lead to crowding out of other often more effective support for agriculture.

The fiscal burdens of subsidies in 2011 are summarized in Table 1.1. It can be observed that fertilizer subsidies in Bangladesh and Malawi account for very large proportions of total government expenditure. In seven of the nine countries, total fertilizer subsidy expenditures accounted for between 24% and 73% of total government support for agriculture. The highest levels occur in countries with combined support for domestic fertilizer production and farm-level support, with the exception of Indonesia. The two countries with the lowest levels of fertilizer subsidy expenditure in total and as a proportion of the agriculture budget, Rwanda and Tanzania, have very focused support for fertilizer subsidies and no domestic production in Rwanda and no direct support for production in Tanzania. The small production of phosphate fertilizers in Tanzania is supported by access to the farm-level subsidized portion of the market.

Table 1.1 *Comparison of Fertilizer Subsidy Expenditures, 2011*

Country	Total Gov. Exp. (as % of GDP)	Total Gov. Exp. (U.S. $ M)	Fertilizer Subsidy (U.S. $ M)	Subsidy as % of Total Gov. Exp.
Bangladesh	9.80%	12,607	1,498	11.9%
China	22.57%	1,691,042	21,810	1.3%
India	14.30%	262,521	14,610	5.6%
Indonesia	15.00%	133,945	1,520	1.1%
Pakistan	17.60%	37,621	506	1.3%
Nigeria	6.00%	24,705	409	1.7%
Malawi	15.00%	844	148	17.5%
Rwanda	15.00%	961	10	1.0%
Tanzania	16.60%	5,624	64	1.1%
Total	12.59%	2,169,870	40,575	1.87%

Note: Error in totals can occur due to rounding.
Sources: Derived from current review papers and World Bank Database.

With the advent of commodity price volatility since 2007/08, there was a 22% increase in fertilizer subsidy costs in the nine countries since 2006 from U.S. $31.339 billion to U.S. $38.245 billion in 2011 followed by a subsequent fall as international fertilizer prices declined from 2014.With the important objective of increasing staple food-grain production, these subsidies have on average contributed to increased cereal grain yields, but arguably irrespective of efficiency in terms of benefit-cost ratios. Table 1.2 and Fig. 1.1 illustrate average grain yields per hectare (ha) from 1990 to 2013.

In the Asian countries reviewed, average grain yields increased by approximately 2.1% annual compound growth rate (ACGR) in both decades from 1990 to 2010 and in the three years from 2010 to 2013 by 2.9% per annum. In the SSA countries reviewed, the ACGR in cereal yields was 2.03% in the decade from 1990 to 2000, then increased to 4.1% between 2000 and 2010 before falling to 2.1% between 2010 and 2013. Following drought conditions in 2009, there were large average yield increases in 2010 in Tanzania and Rwanda. The yields have been sustained in Rwanda, where various other measures were taken to improve maize yields. There has been considerable variation in the growth of cereal yields among countries, with SSA countries mainly exhibiting higher growth rates from a lower base and Asian countries exhibiting slower growth from a higher base. Apart from the differences in cereal crops between the regions (SSA is essentially maize and Asia is essentially maize, rice, and wheat) and with the impact of the green revolution in Asia on average yields by 1990, total cereal production has increased in Asia

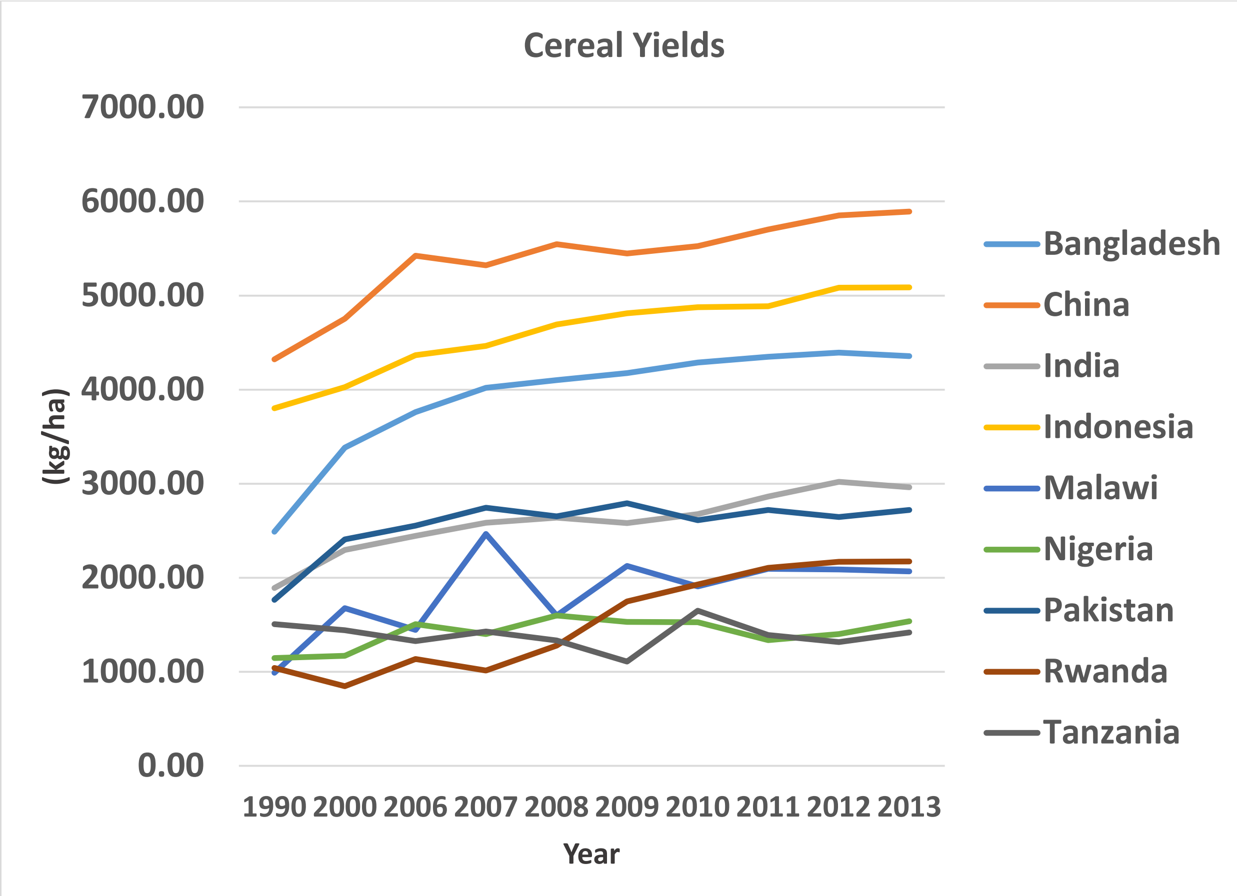
thanks to higher yields and in SSA from larger crop areas. To meet future food demand by 2050, Asian yields will need to increase at around 1.5% per year and in SSA by 2.5% per year.[7] Evidence from China and India is that fertilizer subsidy has little impact on grain production and this may in part be due to current imbalanced use of fertilizer nutrients—especially the excessive use of nitrogen relative to the other nutrients.

***Table 1.2** Cereal Grain Yields (kg/ha) for Selected Years*

Country	1990	2000	2006	2007	2008	2009	2010	2011	2012	2013	2000-2013
	(kg/ha)										ACGR
Bangladesh	2,490.6	3,384.4	3,761.4	4,020.9	4,102.5	4,176.0	4,288.3	4,348.4	4,394.1	4,357.3	3.00%
China	4,320.9	4,752.6	5,424.3	5,319.9	5,547.6	5,447.5	5,526.7	5,701.0	5,851.0	5,891.4	1.69%
India	1,891.2	2,294.2	2,446.5	2,583.3	2,637.9	2,580.8	2,676.4	2,861.8	3,020.5	2,961.6	2.65%
Indonesia	3,800.2	4,026.4	4,365.8	4,464.8	4,694.3	4,812.7	4,877.6	4,886.3	5,082.0	5,085.4	1.64%
Pakistan	1,766.4	2,407.9	2,554.0	2,744.0	2,653.7	2,790.4	2,611.1	2,722.0	2,645.4	2,722.2	2.62%
Average	2,853.9	3,373.1	3,710.4	3,826.6	3,927.2	3,961.5	3,996.0	4,103.9	4,198.6	4,203.6	2.17%
Malawi	991.5	1,675.5	1,444.7	2,467.0	1,598.7	2,124.3	1,906.9	2,094.3	2,087.1	2,068.8	4.42%
Nigeria	1,147.9	1,171.5	1,507.5	1,399.8	1,598.4	1,531.1	1,528.4	1,337.9	1,401.2	1,537.2	3.64%
Rwanda	1,042.6	848.3	1,137.9	1,013.7	1,278.1	1,747.9	1,930.1	2,106.2	2,169.5	2,171.8	4.63%
Tanzania	1,506.5	1,442.3	1,326.7	1,427.3	1,333.9	1,110.4	1,647.9	1,390.4	1,314.8	1,418.0	0.63%
Average	1,172.2	1,284.4	1,354.2	1,576.9	1,452.3	1,628.4	1,753.3	1,732.2	1,743.1	1,798.9	2.93%

Source: Created from World Development Indicators; FAO.

[7] Choudhuri S (2013) Solutions for a sustainable future. World Bank Sustainable Development Network Forum 2013.



Source: Created from World Development Indicators; FAO.

Fig. 1.1 *Cereal Yields (kg/ha) for Nine Countries, 1990-2013*

Fertilizer Subsidy Implementation

In Nigeria and all of the Asian countries reviewed except Indonesia, various domestic fertilizer production costs are subsidized to lower fertilizer prices to all farmers irrespective of whether all farmers required subsidized fertilizer. Imported fertilizers are also directly subsidized in all the countries reviewed, and China has imposed import and export quotas and tariffs to control domestic supply. These measures protect all farmers from the international price volatility and provide lower priced fertilizer to farmers. The Chinese policies were also directed toward building and modernizing the domestic manufacture of urea and diammonium phosphate (DAP). In this regard, the Chinese policies worked, and the country has been a net exporter of both urea and phosphate fertilizers since 2006/07. Administration costs are low for direct subsidy payments and price concessions to producers for natural gas, power, other inputs, and taxes. A

domestic shortage of natural gas in India and Pakistan has seen subsidy on this input partially replaced by subsidy on imported urea. When centrally subsidized fertilizer is restricted to certain farm production systems, as in Indonesia, Rwanda, Malawi, and Tanzania, and also in some countries to certain industrial uses, leakage occurs from the subsidized farm and industrial sectors to the unsubsidized farm sector, or in the case of Indonesia, to unauthorized exports.

Transportation subsidies for fertilizers are provided in China, Pakistan, and the landlocked countries of SSA (namely Rwanda and Malawi), and buffer stockholding costs in China, Nigeria, Bangladesh, and Rwanda have been subsidized when importation was under government control.

China's fertilizer industry was under a planned economy regime before the middle 1980s and total fertilizer production increased by more than 50% between 1978 and 1985. After China completed its rural institutional reform on the household responsibility system in 1984 that allocated the village-owned land to individual households, a dual-track pricing system, comprised of in-quota and out-quota prices, was introduced.

The price for in-quota fertilizer was fixed by the government and was much lower than the out-quota price that was close to the market price. Meanwhile, fertilizer retailing was gradually commercialized, and the share of out-quota fertilizers sold in market increased over time. By 1989, the out-quota fertilizers sold to farmers accounted for about 80% of the national total fertilizer (Jiang and Ling 1989). In order to have a better managed market supply and controlled price, only two state-owned companies were allowed to operate fertilizer wholesale from 1989 to 1997. In 1994 the government gave up the dual-pricing system and required all the fertilizer enterprises to apply the government reference prices with a limited range of fluctuations based on the changes in market supply and demand (so-called government-guided prices). Meanwhile, government also set a maximal price margin between wholesale and retail.

Many changes have been accompanied or matched with the fertilizer domestic marketing reform and trade policies. China used two sets of policies: (1) promoting domestic fertilizer production through subsidy and other support policies and (2) market intervention and trade restriction policies that aimed to control domestic fertilizer prices and secure adequate supply.

A formal agricultural subsidy program was started in China in 2004 in support of food security. Currently China has the largest world fertilizer subsidy program. This included an aggregate input subsidy covering fertilizers, pesticides, plastic film, and diesel fuel, plus grain, seed, and machinery subsidies. Initially the aggregate input subsidy was coupled to grain producers only. The subsidies were de-coupled in 2007 and have risen substantially since then reaching U.S. $12 billion in 2011 and $17 billion by 2014. Nearly all rural households receive the grain and aggregate input subsidy. Together with the fertilizer production subsidies (amounting to about U.S. $8 billion[8] in 2011), the total fertilizer support in China was over U.S. $21 billion in 2011. Both the production subsidies and the direct farm subsidies are currently under review. Excessive use of chemical fertilizer, N in particular, is observed in nearly all crops in China.

In India, affordable fertilizer for farmers has been central to the government's overall food security policy together with profitable returns for the fertilizer producers when delayed payments are received. This second largest market in the world had a domestic production ratio of around 90% in 2000, but this had fallen to 56% by 2011/12. Originally, the sale, price, and quality of fertilizers were regulated through the Fertilizer Control Order (FCO) and distributed through the Essential Commodities Act (EC Act) and the Movement Control Order in 1973. Later the Retention Price Scheme (RPS) was introduced in 1977 for nitrogen fertilizers and extended to phosphate fertilizers in 1979. This RPS paid subsidy on the difference between the government assessed cost of production plus a 12% return on net worth for each fertilizer plant, and the government-mandated sales price ex-factory. During numerous policy implementation changes over the past 15 years, the maximum retail price (MRP) for urea changed only marginally, although DAP and muriate of potash (MOP) MRPs increased significantly until prices were decontrolled in 2010. This policy led to an exploding fertilizer subsidy bill that reached U.S. $21 billion in 2008/09. By 2013/14 this had declined to an estimated U.S. $11 billion budget expenditure, but when delayed payments of U.S. $6 billion are taken into account, the total fertilizer subsidy cost declined marginally since the peak. In addition, the introduction of the nutrient-based pricing system in 2010 (Nutrient Based Subsidy) omitted urea from the

[8] Li Y et al. (2014) An analysis of China's fertilizer policies: impacts on the industry, food security, and the environment. Journal of Environmental Quality.

decontrolled pricing because of political economy, and this has led to rising nutrient use imbalance.

Pakistan's fertilizer production industry, initially in government hands, was progressively privatized between 1996 and 2005. However, natural gas prices and allocations to the fertilizer industry remain under government control through the Provincial Essential Commodity Act (PECA). Approximately 16% of the national natural gas supply is allocated to the fertilizer industry, where the subsidy has steadily increased from around 35% in 1995 to almost 75% in 2011 with an annual cost increase from U.S. $79 million in 1995/96 to U.S. $506 million in 2011. With a 45% increase in domestic urea capacity since 2005 and no increase in total natural gas supply, cutbacks in supply to the cement and power industries have occurred, but these have been insufficient to prevent capacity underutilization for ammonia and urea production. Since 2008, urea imports have occurred together with regular imports of DAP and MOP. Initially, all imports were made by the government through National Fertilizer Marketing Limited (NFML), a parastatal agency which was also responsible for all distribution and marketing. Subsidies on imported urea and on P and K fertilizer for the short period from 2006/07 to 2009/10 were paid based on the difference between import cost and domestic prices. With the privatization of the production companies, marketing was transferred to the private sector. Beginning in 2014, the private sector was allowed to import with NFML covering the price difference including transport and handling charges. The import and distribution subsidies peaked at U.S. $700 million in 2008/09. After removal of the P and K import subsidies and the falling international price of urea, the subsidies dropped to U.S. $506 million in 2011.

In addition to the above, the government of Pakistan intervened through its tax policy. From 2001 until 2011, urea was exempted from the general sales tax (GST) along with other agricultural inputs. It is estimated that in 2011/12 the lost revenue from the exemption on urea amounted to U.S. $363 million.

Pakistan's policies have certainly assisted in establishing a domestic urea industry and a vibrant private sector, and fertilizer use by farmers increased 14-fold between 1971 and 2014. Nutrient

imbalance because of the preferential subsidization of urea has reduced fertilizer use efficiency in a similar manner to that in China and India.

In Indonesia, as in the other Asian countries reviewed, policy is aimed at providing farmers with affordable fertilizers and also maintaining profitable operation of domestic production. Similarly to India, support for the growing domestic production industry during the 1970s and early 1980s was based on the difference between the production cost plus a fee per metric ton and the government purchasing price (GPP). Various changes were made after 1992 on the calculation of production costs, and the ceiling retail price (CRP) was also increased to reduce the subsidy cost. From 1998 until 2000, the fertilizer subsidy was discontinued under an agreement with the International Monetary Fund (IMF). In 2001 the subsidy was re-introduced with domestic urea producers subsidized with a domestic natural gas incentive, and the pan-territorial CRP was set based on estimated farm production costs and farmers' ability to pay and reflected a distributor fee of 5% and a retailer fee of 3%. The subsidized CRP applied to limited amounts of fertilizer per farmer, thereby rationing the total amount subsidized.

Before 2003 all domestic fertilizer production was sold to one state enterprise, PT PUSRI, which then distributed the subsidized fertilizer throughout Indonesia. The subsidized fertilizer was sold to retailers at the CRP minus the distributor or retailer fees. After 2003 the production subsidy for urea was changed to a natural gas subsidy, while the price subsidies continued at revised levels, and distribution responsibility was transferred to the production companies who appointed distributors and they, in turn, appointed retailers. Quotas were applied on a regional basis. Further amendments were made in 2005 and 2008 to the distribution regulations, and subsidized fertilizer is restricted to farms cultivating up to 2 hectares (ha) per season and is based on actual crop area needs. These needs are based on farmer group needs developed under the Definitive Plan of Group Needs (*Rencana Definitif Kebutuhan Kelompok* [RDKK]). Periodic shortages still occur and subsequently sales above the CRPs.

Further regulatory changes occurred in 2014 to reduce the fertilizer subsidy cost burden while stabilizing natural gas prices to urea producers and providing regional governments with authority to monitor the distribution of subsidized fertilizers through the RDKK mechanism.

Generally from 2006 to 2014 the CRP for all fertilizers increased by 50%, but the cost of goods sold (COGS) increased from 150% to 300%, resulting in the subsidy burden increasing by 409% from U.S. $336.4 million to U.S. $1.713 billion.

Fertilizer has been an essential component of Bangladesh's successful strategy to increase food-grain production and promote agricultural development since the 1950s. Initially all chemical fertilizers were imported and distributed free of cost by the Department of Agriculture. Later, publicly-owned domestic production of urea and phosphate fertilizer under the Bangladesh Chemical Industries Corporation (BCIC) supplemented imports. Inadequate arrangements and unsatisfactory progress in the program to manage inputs led to the creation of Bangladesh Agricultural Development Corporation (BADC) in 1961. As a public entity, BADC sold fertilizer to private dealers and appointed dealers in every union (the lowest administrative unit) of Bangladesh, and was solely responsible for all procurement, transportation, and storage of fertilizers for sub-districts. Fertilizers were sold by BADC to farmers at countrywide uniform, regulated prices, fixed and subsidized by the government.

The distribution and retailing of all fertilizers was gradually privatized by 1992. The progress toward the development of a competitive fertilizer marketing structure suffered a setback in 1994-95 when a severe scarcity of urea fertilizer surfaced almost all over the country occasioned by the decision to export large quantities of urea at a time when the farmers in many areas had opted for increased areas of rice cultivation in preference to other winter crops. The scarcity triggered large-scale unrest among the farmers.

In reaction to the serious urea deficit in 1995, the government appointed BCIC dealers for the distribution of urea from BCIC factories and warehouses. The government also opened 21 fertilizer warehouses in the northwest and southwest parts of the country for handling about 300,000 mt of Government of Bangladesh (GoB)-produced and -imported fertilizers. GoB reentered into fertilizer distribution through BCIC by importing urea, phosphate, and potash fertilizers from 1996 to 1997. BADC was then brought back into the fertilizer business in 2006.

Both the public and private sector now play key roles in the supply and marketing of fertilizers to farmers. The public sector is primarily concerned with (1) urea fertilizer (and to a lesser extent phosphate and potassium) supply being adequate within the country; (2) ensuring that logistics are handled in a timely manner so that farmers have access; (3) stabilizing (at a low level) prices to farmers; and (4) ensuring supply of quality fertilizers. Subsidized fertilizer prices are fixed on a national/pan-territorial basis at the importer/distributor/wholesale and retail levels. The average level of subsidization from 2005 to 2014 has been 60.2% for urea, 38.8% for TSP, and 41.0% for MOP and in total reached over U.S. $1 billion in 2013 and 2014.

In SSA, fertilizer subsidy programs range from conventional to “smart” targeted subsidies. Conventional program features include government importation and distribution of fertilizer, sales at pan-territorial subsidized prices via state-owned enterprises, and universal program availability to all farmers. So-called smart subsidies use a targeting mechanism to target poor farmers and/or crop-specific targets and ideally provide delivery of the subsidized fertilizer via the private sector input distribution system.

In spite of a growing urea and NPK production capacity, the bulk of Nigeria’s fertilizer supply is imported. Prior to 2011, imports were tendered for by the federal government through private sector importers and then consolidated in state warehouses with a 25% subsidy on the delivered cost into these warehouses. State governments and local government authorities then added a further 40-60% subsidy and distributed to all farmers via the private sector retailers. The bulk of the subsidized fertilizer benefited large farmers—considerable rent-seeking was reported at the state level, and late payments to private sector importers and retailers plagued the system. Since 2011, under the Growth Enhancement Support (GES) scheme, the federal government withdrew from fertilizer procurement and distribution and adopted a targeted subsidy program to support smaller, low income farmers. Farmers could purchase fertilizer subsidized by 40-50% from registered fertilizer retailers for use on grain crops and soybeans together with 5 kg of improved seed. Pilot targeted paper voucher programs were trialed in two states in 2009 and 2010 together with training and technical assistance to farmers, agro-dealers, and extension agents. Voucher recipient information was collected by extension agents and consolidated, and final recipient selection was made by the federal government. Beneficiaries received electronic vouchers

(e-vouchers) via a short message service (SMS) to their cell phones and exchanged the vouchers for subsidized fertilizer with an additional cash payment for the non-subsidized portion of the allocation received. The GES system was plagued by inconsistent and limited mobile phone coverage and inefficiencies in the paper-based data system. In 2014 a pilot project commenced that utilizes the Token Administration Platform (TAP). This system enables electronic data capture of farmer details and identification by extension agents at the source. Farmers are issued a TAP card, which at the authorized dealers enables identification on a tablet computer and records the subsidized purchases and agro-dealers' stock situations in real time. The system removes the limitations of cell phone availability, eliminates fraud, ensures that the subsidy is received by the intended recipients, and reduces the administration costs of a targeted voucher system.

The Malawi fertilizer market was liberalized in the 1990s and is entirely reliant on imports. Three supply channels exist: private sector importers/blenders, distributors, and retailers; the National Smallholder Farmer Association of Malawi (NASFAM), which procures from importers and distributes through its own retail stores; and the government subsidy channel, which procures via tenders from private sector importers and distributes through two parastatals—the Smallholder Farmers Fertilizer Revolving Fund of Malawi (SFFRFM) and the Agricultural Development and Marketing Corporation (ADMARC). ADMARC procures subsidized fertilizer requirements from private sector importers and distributes to regional warehouses from where the SFFRFM distributes to an extensive network of retail outlets in rural areas.

The current fertilizer subsidy program, the Farm Input Subsidy Program (FISP), was established in 2005 by the Ministry of Agriculture and Food Security (MoAFS) and is implemented by the two parastatals with some limited involvement of private sector retailers up until 2007/08. The objectives of the program are to improve national and household food security through improved access to fertilizer and improved seeds and incomes among resource-poor farmers. The program is implemented by vouchers issued to beneficiaries selected at a local village level for maize and legume growers. The fertilizer component has remained unchanged in terms of the amount and types of products subsidized, namely 50 kg urea and 50 kg NPK fertilizer, although the rate of

subsidy has increased reaching 91% by 2009. In addition, small quantities of maize and legume seeds are made available with vouchers, and there were some temporary fertilizer subsidies for tobacco, tea, and coffee producers.

Although the program has increased fertilizer availability and use along with total maize production, the cost to the government in 2014 had reached almost U.S. $150 million and represented 23% of the national budget and 42% of the agricultural development budget. In addition, recent evaluations[9] indicate crowding out of the private sector and commercial purchases of fertilizer, diversion from intended beneficiaries and poor benefit-cost ratios exist for the FISP in Malawi. Furthermore, other studies[10] indicated that contrary to FISP criteria and objectives, the selection of beneficiaries was inappropriate. Additionally, voucher redemption is complicated and time-consuming for farmers in that they have to obtain local MoAFS officials' signatures prior to voucher redemption.

In Rwanda all fertilizer requirements are imported into the landlocked country, and prior to the introduction of a subsidy in 2007, total imports remained below 10,000 mt per annum (with the exception of one year) and were mainly used on cash crops. In 2007 the Government of Rwanda (GoR) launched a national agricultural program: the Crop Intensification Program (CIP). The objectives were to raise productivity of the main food crops, boost food production, and safeguard national food self-sufficiency by creating incentives for farmers to adopt new production techniques. The program included land consolidation, crop regionalization, farmer credit facilities for fertilizer and seed, updating technical recommendations and extension services, seed subsidies, and fertilizer subsidies.

Initially the GoR procured fertilizer from neighboring country suppliers and auctioned to qualified bidders for regional distribution with a minimum floor price and pan-territorial retail prices. Successful highest price bidders then had a monopoly distribution in each region and delivered to registered agro-input dealers or farmer cooperatives. Fertilizer was purchased with a

---

[9] Dorward A, Chirwa E (2015) Crowding out diversion and benefit/cost assessments in SSA. Agr Econ 46(6); Jayne et al. Agr Econ 6(6).
[10] Chibwana C, Fisher M (2011) The impacts of agricultural inputs subsidies in Malawi (IFPRI Policy Note 5).

30% down payment and this credit facility was passed through to the retailers and selected beneficiary farmers and after harvest the credit repaid back through the system to the GoR. The beneficiary farmers were selected by the Ministry of Agriculture and Animal Resources (MINAGRI) and issued e-vouchers. The vouchers provided 50 kg of subsidized DAP or NPK and 25 kg of subsidized urea, sufficient for 0.5 ha. However, many problems arose, resulting in a late issuing of vouchers and resulting in far less than planned delivery of subsidized fertilizer to farmers.

By 2012, unpaid credit had accumulated to U.S. $20 million, and the GoR introduced fundamental changes to address this shortcoming and the very high administrative costs. In 2013 importation and auctioning were handed over to three private companies who had to arrange their own trade credit facilities, but the financial services were unable to provide credit without a government backed guarantee which was then provided by MINAGRI. Combined with the absence of vouchers, a substantial increase in subsidized fertilizer was sold probably because there was no targeting of the poorest farmers. The voucher system was discontinued in 2014.

The CIP program integrated the fertilizer subsidy with a comprehensive technical package that combined the use of improved seeds, fertilizers, and the provision of extension services to promote both the subsidy program and ensure improved farming techniques—including the recommended use of inputs and incorporating full utilization of the private sector including credit facilities.

In Tanzania, fertilizer use was subject to traditional subsidies with pan-territorial subsidized prices implemented at the import level prior to 2001. Even so, fertilizer use was very low, varying between 20,000 mt and 40,000 mt nutrients annually. The subsidies were removed in 2001 and 2002, and imports decreased to around 20,000 mt of nutrients supplemented only by domestic production of phosphate rock. A new subsidy was introduced in 2004, and imports increased to an average of 80,000 mt of nutrients per year through 2012 and reached 168,900 mt in 2013. Nitrogen use accounted for 78% of total nutrient use, phosphate use for 14.7% and potash only 6.9%. It is not clear whether this heavy emphasis on nitrogen and limited use of phosphate and potash is still appropriate for the current nutrient needs of the crops.

In 2008, the Government of Tanzania (GoT) introduced a voucher-based targeted fertilizer program, the National Agricultural Inputs Voucher Scheme (NAIVS) for maize and rice producers. The objectives were to: (a) ensure that the targeted farmers had access to inputs; (b) increase efficiency in the subsidy management process through increased clarity and transparency in the selection of farmers, allocation of input subsidies, and redeeming processes; (c) strengthen the capacity of agro-dealers to access input credits and agribusiness skills; and (d) ensure proper use of inputs for increasing crop production and productivity. Other objectives were to: (a) facilitate fertilizer use in high-potential areas; (b) offset the rising cost of fertilizers; (c) stimulate production to reduce food prices; and (d) stimulate the development of the private sector distribution network. The subsidy was 50% of the cost of the input package consisting of 50 kg of DAP or 100 kg of Minjingu mazo blend,[11] plus 50 kg urea and either 100 kg of improved maize seed or 16 kg of rice seed.

The voucher program was implemented progressively and covered 87 districts and 1.8 million farmers by 2010/11. Selection of beneficiaries was made by Village Voucher Committees advised by District Voucher Committees comprised of representatives of farmer groups, agro-dealers, and civil society organizations. Strict criteria are applied to beneficiaries; namely, the farmer should be living in the village and be a full-time farmer growing maize and rice; the farmer should not own more than 1 ha of land; the farmer should be willing to use the provided inputs on these crops and undertake the recommended agricultural practices; and the farmer should be willing and able to pay for 50% of the market price of the fertilizers. Priority was given to female-headed households and households that had not used any, or very little, fertilizer and improved seeds to grow these crops over the last five years. Vouchers were issued for three years, after which the farmers were expected to have benefited sufficiently to continue using inputs at commercial prices. The 3,000 agro-dealers involved had to undergo business training and redeem the submitted vouchers through the National Microfinance Bank, which was provided funds from the Ministry of Agriculture. Meanwhile, the extension service conducted extensive demonstrations for farmers on improved crop production systems.

[11] Minjingu mazo blend consists of a blend of Minjingu phosphate rock and urea with an analysis of 10-25-0.

With no credit facilities incorporated into the program, not all targeted beneficiaries can participate because they are unable to meet the 50% cash cost of the program and often sell their vouchers to other farmers or to agro-dealers. Also as the program expanded considerable delays in agro-dealer reimbursements occurred straining their working capital positions. Overall the program has been successful in increasing the use of fertilizer and extending and improving the number and capacities of private agro-dealers. However, there are reported deficiencies in the operations of Village Voucher Committees and District Voucher Committees which have resulted in poor selection of beneficiary farmers and agro-dealers, late voucher distribution, and inadequate monitoring.

The Way Forward

The experiences with fertilizer subsidies in the reviewed countries suggest that considerable changes need to be made in their scope and implementation for more cost-effective measures to realize lower food production costs, achieve sustainable food security, and improve small farmer incomes. This applies to both the general production subsidies prevalent in countries with well-established fertilizer manufacturing industries as well as to the "smart" subsidy programs prevalent in SSA.

Overall the fiscal costs of input subsidy programs are neither sustainable nor efficient, although they have clearly promoted increased food production, and they have greatly assisted establishment of the fertilizer manufacturing sector in countries with adequate natural resources. A more diverse public expenditure on investments in agricultural research and development, extension services, irrigation, transport, and rural infrastructures and rural service industries can be more beneficial to rural and national development. However, subsidies are highly demonstrable actions and popular with politicians and farmers (voters) alike. Political considerations evidently ensure longevity and create long-term subsidy-dependent farmers. In Asia, particularly, the implementation of subsidies has been biased toward nitrogen fertilizer use, creating imbalanced nutrient application and subsequent reduction in crop responses to nitrogen, overfertilization with nitrogen, and subsequent soil and environmental degradation. Pro-poor

targeting of subsidies has not been effectively implemented in SSA with some exceptions such as those in Kenya.[12] Diversion and crowding out have remained consistent problems.

Recommendations provided for the reviewed countries are summarized below, and then overall recommendations are provided for the way forward.

Bangladesh: Fertilizer subsidies have been an essential component of Bangladesh's successful strategy to increase staple food-grain production and promote agricultural development. However, the existing subsidy program has flaws. Along with a substantial reduction in subsidies and the diverting of resources to more productive investments in agriculture, nutrient-based subsidies (which include all fertilizers opposed to urea only) should be adopted. This action would encourage balanced plant nutrition and reduced use of nitrogen. As in a number of countries, the user subsidy available to all farmers should be targeted to smallholders. Finally, strong fertilizer quality monitoring is needed at storage and distribution points to ensure quality control of fertilizers.

China: Past supply subsidies and trade interventions have greatly assisted in developing a more than adequate domestic supply industry which may now be integrated into global fertilizer trade without seasonal restrictions and penalties so that offsets can be implemented by removing natural gas, electricity, and transportation subsidies (a process already agreed to and under implementation). The user subsidy, currently available to all farmers, should be restricted to defined poorer farmers and applied to encourage balanced nutrient use and reduced nitrogen application rates, where N fertilizer is clearly overused. The seasonal inventory subsidies should also be considered for reduction or removal. The reduced subsidy levels would release public funding for other rural agricultural investments and possibly direct cash transfers to the poorest farmers.

India: The highly subsidized domestic urea production industry, with 30 plants, exhibits highly variable production and feedstock costs and supplies urea at approximately one-third of current

[12] Mason et al. (2015) The effects of Kenya's "smarter" input subsidy program on crop production, incomes and poverty (Policy Brief No. 11). Egerton University, Tegemeo Institute of Agricultural Policy and Development.

world market prices. This subsidization cannot be sustained. Decontrol of the industry is recommended together with secured and increased supply of natural gas and standardized natural gas pricing for the 26 gas-based plants. The decontrol and subsidy removal recommended would be implemented over a three- to five-year period with a one-time capital grant to the firms to assist them in adjustment. It is estimated that 10 to 14 of the plants will be economically unviable at prevailing international pricing norms including all four of the naphtha feedstock-based plants, which are currently planned to be converted to natural gas feedstock once pipeline access is completed. It is estimated that total domestic production of urea will fall and an additional 3 Mt of urea will need to be imported. Decontrol and removal of all subsidies will create a threefold increase in urea prices for farmers. Compensation is suggested at Rs 5,000/ha for small and marginal farmers below 2 ha and Rs 4,000/ha for the other 15% of farms to be held steady for three years, allowing a gradual accommodation of the transition to market prices. Whether this will be politically acceptable is debatable, but the move to market pricing will reduce the imbalance and overuse of urea which is having no discernable impact on grain production. Inclusion of urea in the nutrient-based subsidy during the transition or linking all fertilizer subsidies to the soil health might also be considered.

Indonesia: Improvements to the existing fertilizer subsidy system are recommended to reduce the budgetary cost and divert more public funds to supporting crop insurance, paddy rice support, and improvement in agricultural infrastructures.

Specific recommendations include improved effectiveness in determining the allocation of subsidized fertilizer which would reduce the distribution cost component of the COGS, simplifying the distribution process by reducing the number of distribution units. This would reduce the gap between the CRP and the COGS. The Ministry of Agriculture has a target of reducing the gap from 50% to 20%.

Other ideas being discussed include diverting the fertilizer subsidy to farmers with more than 2 ha who are more likely to produce marketable surplus than smaller farmers which will contribute to strengthening national food security. Currently farmers use basal fertilizers for paddy production with the same ratio of N, P, and K, namely 15-15-15. The recommended ratio

is 15-10-10, and if farmers adjusted the ratio this would save on foreign currency imports and fertilizer subsidy. The use of direct subsidies to farmers utilizing vouchers in Indonesia is considered by some to be constrained by the low level of farmer education and the validity of farm-level data. Others believe that the RDKK could be intensified to support direct farmer subsidization.

Pakistan: Based on an elaborate and scientifically based simulation model, removal of the natural gas subsidy and the GST exemption for urea simultaneously would decrease fertilizer prices at the farm-gate, have a positive impact on crop production, and could positively benefit farmers if trade is freely allowed. This liberalization would not cost the government substantially but would require secure natural gas supply to the ammonia/urea plants.

SSA: Fertilizer subsidies will continue to be an inescapable feature of agricultural policy in SSA for the foreseeable future. This longevity brings the risk of creating additional subsidy-dependent farmers, weakening the prospect of commercializing the smallholder sector. In addition, SSA fertilizer use and subsidy programs are generally not based on current soil analysis and fertilizer trial results. As a result, recommendations and restrictive approved fertilizer product regulations require urgent updating. There are clear trends also evolving, namely:

- There will be a trend toward using e-vouchers to deliver inputs and a movement away from paper vouchers. However, while some governments will prioritize national food security and hence eliminate targeting instead of making the subsidy available to whoever can afford to pay the cash top-up amount, many governments will continue to use vouchers to target poor farmers, particularly if subsidies provide an important source of political mileage.
- Subsidy programs will expand their portfolio beyond fertilizers and seeds to include extension services, credit, irrigation, and linkages to output markets.
- There are a number of fertilizer production and blending initiatives ongoing in SSA. Given the dominant role of subsidy programs in many countries in SSA, a future trend could be increased linkages between subsidy programs and fertilizer blending companies, as is the case in Tanzania.

- Subsidy programs will see a greater role for the private sector in importation and distribution as governments shift their focus toward improving the purchasing power of smallholder farmers.

Moving Forward

There are obvious differences between the established fertilizer sectors in both supply and demand sides between the major Asian markets and SSA. In Asia, plagued by inefficient use of nitrogen fertilizer and huge public fertilizer subsidy costs, it is time to rationalize and provide fertilizer subsidies only for those farmers who need assistance and to fully commercialize and rationalize the production industry. The long history of fertilizer use and awareness by farmers of the role of fertilizer in improving crop performance is offset by policy-induced market distortions that have created inefficient use of subsidized fertilizer. In SSA, fertilizer use by farmers—especially smallholders—is still at the early stage of development due to a multitude of reasons, and soil fertility is being eroded. Promotion of efficient fertilizer use by farmers and rural infrastructure needs, including supply chain efficiencies and assistance to resource-poor farmers unable to afford fertilizer at commercial price levels, are still basic needs.

Nearly all of the countries reviewed (exceptions being Indonesia, Tanzania, and Rwanda) essentially have stand-alone fertilizer subsidy programs when agricultural, rural, and national development require a holistic package of support interventions. In all the countries reviewed, not all farmers require the cost of fertilizer to be subsidized, but little effort is being made to identify the poorest or whether the poorest smallholder farmers benefit from fertilizer and other input subsidies.

The identification problem is also beset by political economy, and generally the fertilizer subsidy policies have no exit strategies.

Targeted subsidies offer a means to address many of these issues, but the implementation has to be much improved to ensure accurate targeting, delivery of benefits, and monitoring of these at farm and national level. Commercialization of the production industries in Asia introduced over a fixed time period of three to five years will substantially increase the cost of fertilizers for

farmers, especially for urea in India. This will help in rationalizing balanced fertilizer use and rates. Smallholder farmers requiring short-term assistance to accommodate the cost increases need to be identified based on their financial resources and on favorable economics of fertilizer-crop price ratios. Pro-poor support objectives which might involve direct cash transfers will still require individual identification and accurate and timely monitoring of their financial conditions.

The rapidly developing technology for e-vouchers provides a way in which to identify and target highly specified beneficiaries for fertilizer subsidy and other input support. Generalized targeting specifications such as “farmers with less than 2 ha” have to be avoided. “No fertilizer purchase in the past two years” or “unable to afford a top-up payment” and “female head of household” are examples of more specificity. In addition, targeted support programs should have a clear exit strategy based on the time provided for the beneficiaries to adopt improved farming technologies and graduate out of the support programs.

The experience in Malawi where government control of subsidized fertilizer distribution and delivery to farms disastrously crowded out a fairly vibrant and developing private sector should be avoided.

Specific objective targeting and exit strategies will control the endless fiscal burden of fertilizer subsidies, allowing more holistic interventions and investments. Few of the existing subsidy programs have included access to credit, and where this was the case in Rwanda, the results proved to be disastrous. Trade credit requirements by the private sector can be passed through to farmers at the retail level. This transfers risk to farmers, and the risk level for individual farmers arises from their ability to manage crops well and on weather conditions. Climate-induced crop failure leads to credit failure, and more attention should be paid in targeted subsidy programs to crop insurance programs for smallholder farmers as is being tried in Indonesia. Additionally, the need for good quality extension services advice to farmers on all aspects of crop production will have a positive impact on reducing farm-level risk.

Governance and political commitment to effectively target well-defined objectives aimed at only those farmers who require assistance may well be the key requirement for moving forward.

2 Fertilizer Use and Supply Trend and Outlook at the Global and Regional Levels

Patrick Heffer and Michel Prud'homme
International Fertilizer Association (IFA)

2.1 Abstract

Aggregate fertilizer consumption of the countries subsidizing fertilizers accounts for about 54% of world demand; therefore, the importance of analyzing fertilizer demand and supply dynamics in those markets vs. the rest of the world cannot be overstated.

This chapter analyzes the trend since the beginning of the century, the current situation, and the outlook to 2018/19 for world and regional fertilizer demand and supply. The regional analysis focuses on East Asia, South Asia, and SSA, the three target regions of the publication. The authors also address the global and regional evolution of fertilizer use efficiency and effectiveness.

2.2 Fertilizer Use

2.2.1 Evolution of Global and Regional Fertilizer Consumption Between 2000/01 and 2012/13

World fertilizer consumption increased steadily between 2000/01 and 2007/08, by 23%, rising from 137.0 to 168.4 million metric tons (Mt) of nutrients ($N+P_2O_5+K_2O$). In 2008/09, world consumption contracted by 8%, to 155.4 Mt, due to the economic downturn and financial crisis. Consumption of nitrogen (N) was much less impacted (-2%) than that of phosphate (P) and potassium (K), which fell by 12% and 20%, respectively. World demand started to rebound in 2008/09, to reach 178.9 Mt by 2012/13, i.e., a 15% increase over this four-year period (Fig. 2.1). Between 2000/01 and 2012/13, aggregate world fertilizer consumption rose by 31%. Nitrogen recorded the strongest growth (+33%, to 109.1 Mt N), followed by K (+30%, to 28.7 Mt K_2O) and P (+25%, to 41.1 Mt P_2O_5).

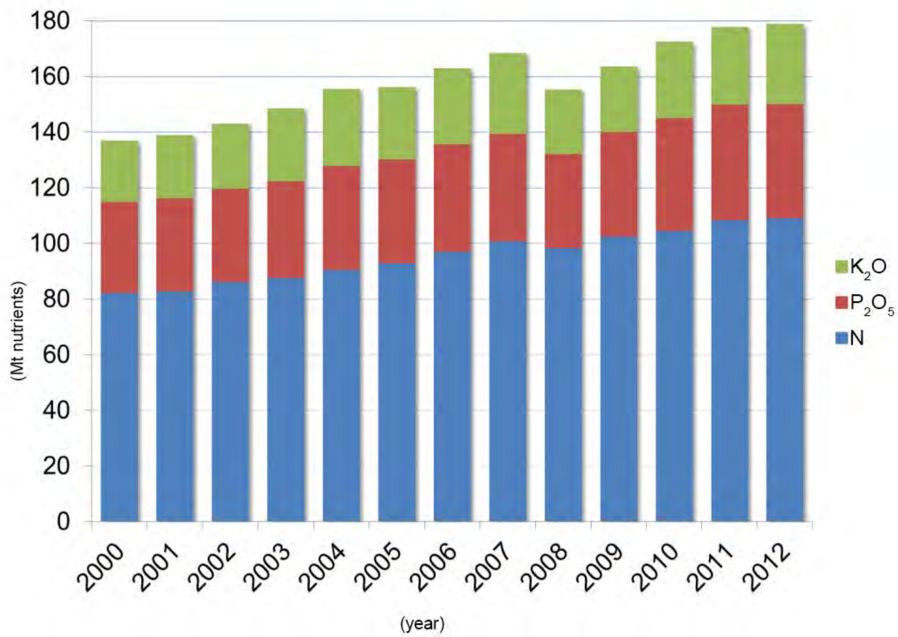


Fig. 2.1 *Global Fertilizer Consumption (Mt nutrients) (IFA 2014a)*

Aggregate fertilizer consumption in East Asia rose firmly between 2000/01 and 2012/13, from 46.2 to 68.5 Mt (+48%). Demand for K fertilizers grew much faster (+75% to 10.3 Mt) than for the other nutrients, boosted by fast expanding oil palm cultivation in Indonesia and Malaysia. Demand for N and P fertilizers rose more modestly: +47%, to 43.1 Mt for N, and +38%, to 15.2 Mt for P. Consumption of N fertilizers dropped only marginally during the downturn in 2008/09, while that of P and K declined by 11 and 24%, respectively, on that year.

South Asian fertilizer demand also expanded firmly since the turn of the century: +47%, to 31.5 Mt in 2012/13. The strongest increase was recorded for P fertilizers: +53%, to 8.0 Mt, followed by N (+46%, to, 21.0 Mt) and K (+40%, to 2.5 Mt). Contrary to most regions, regional demand surged during the world economic crisis: between 2007/08 and 2008/09, boosted by India where fertilizer subsidies protected farmers against international price fluctuations, regional demand expanded by 8%, with increases of 13% for P and 19% for K. In contrast, regional demand started to contract in 2011/12 following the revision of the fertilizer subsidy regime in India. In the two campaigns following 2010/11, regional demand dropped by 8%.

Since 2009, after a depressed period of more than two decades following the structural adjustment programs, demand growth in SSA is gaining momentum (Fig. 2.2). Between 2000/01 and 2012/13, regional consumption is estimated to have increased by 47%, to 2.9 Mt. Nitrogen fertilizers accounted for most of the expansion (+75%, to 1.8 Mt). Demand for P and K fertilizers rose only modestly during that period: +20%, to 0.7 Mt for P, and +10%, to 0.4 Mt for K. Regional demand was little affected by the downturn in 2008/09: an 18% increase in N demand offset drops of 1% and 7% in P and K demand, respectively.

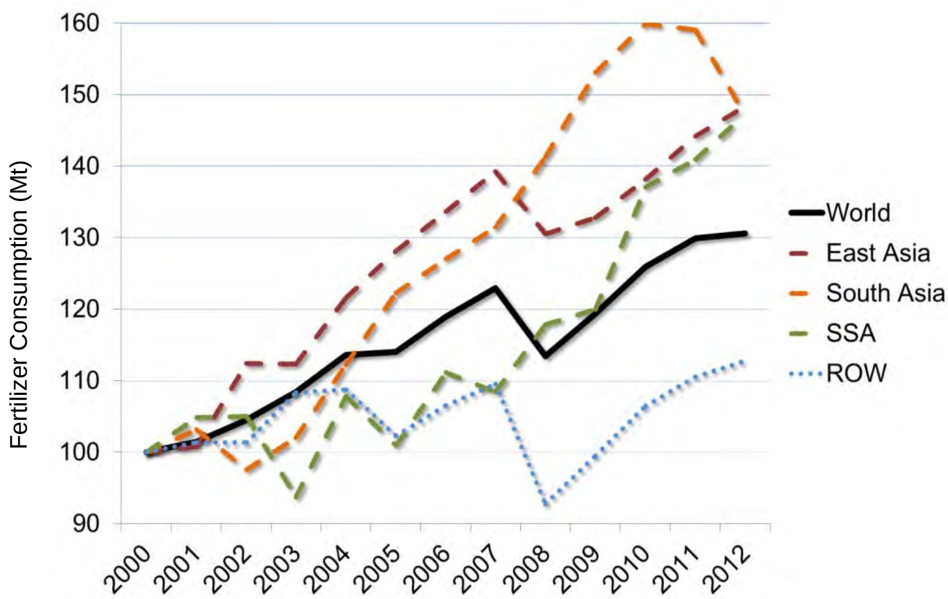


Fig. 2.2 *Relative Evolution of World and Regional Fertilizer Demand (2000 = 100) (Adapted from IFA [2014a])*
ROW: rest of the world

2.2.2 Evolution of the Product Mix Between 2000/01 and 2012/13

The world fertilizer market, which is increasingly globalized, has been moving toward high-grade (high-nutrient concentration), easy-to-transport products, namely urea for the N market, ammonium phosphates for the P market, and potassium chloride (or MOP) for the K market. The share of urea in the world N fertilizer market increased from 49% to 56% between 2000/01 and 2012/13. During the same period, consumption of ammonium phosphates sharply increased, and their share of the world P market jumped from 41% to 60%, while the K market share of potassium chloride increased from 61% to 66%.

In East Asia, urea's share of regional N consumption rose from 60% to 65% in 2012/13. The contribution of ammonium phosphates to total P consumption more than doubled, from 32% to 69%. In contrast, with the fast expansion of the East Asian market for complex NPK fertilizers, the share of potassium chloride dropped from 75% to 61%.

The product mix by nutrient family evolved only marginally in South Asia, between 2000/01 and 2012/13. In 2012/13, urea represented 83% of regional N consumption, ammonium phosphates 64% of P consumption, and potassium chloride 70% of K consumption.

The market in SSA is more diversified than in Asia, with a greater market share held by complex NPKs. Nevertheless, the leading commodity fertilizers have increased their share of regional consumption: between 2000/01 and 2012/13, urea rose from 37% to 42%, DAP from 32% to 42%, and MOP from 17% to 35%.

2.2.3 Global and Regional Fertilizer Consumption in 2012/13

2.2.3.1 Fertilizer Consumption by Region

Total world fertilizer consumption in 2012/13 is estimated at 178.9 Mt nutrients, with 109.1 Mt for N, 41.1 Mt for P, and 28.8 Mt for K. Aggregate demand is dominated by five regions, which, together, accounted for nine-tenths of the global market in 2012/13: East Asia represented 38% of the total, followed by South Asia (18%), North America (13%), Latin America (11%) and West Europe (9%). The remaining 11% are shared between the following regions in order of market size: Eastern Europe and Central Asia (4.0%), Africa (2.8%), West Asia (2.3%) and Oceania (1.6%). If Africa is split between North and South of the Sahara, SSA accounted for 1.6% of world demand and North Africa for 1.2%.

East Asia largely dominates world N, P, and K fertilizer consumption, with market shares of 36% to 40% depending on the nutrient. In the case of South Asia, the situation is more contrasted with the region accounting for 19-20% of world N and P consumption vs. only 9% of world K consumption. The contribution of SSA to world consumption is marginal, between 1% and 2% for the three nutrients. The rest of the world (ROW) represented 40% of world consumption in the case of N fertilizers, 42% in the case of P, and 54% in the case of K (Fig. 2.3).

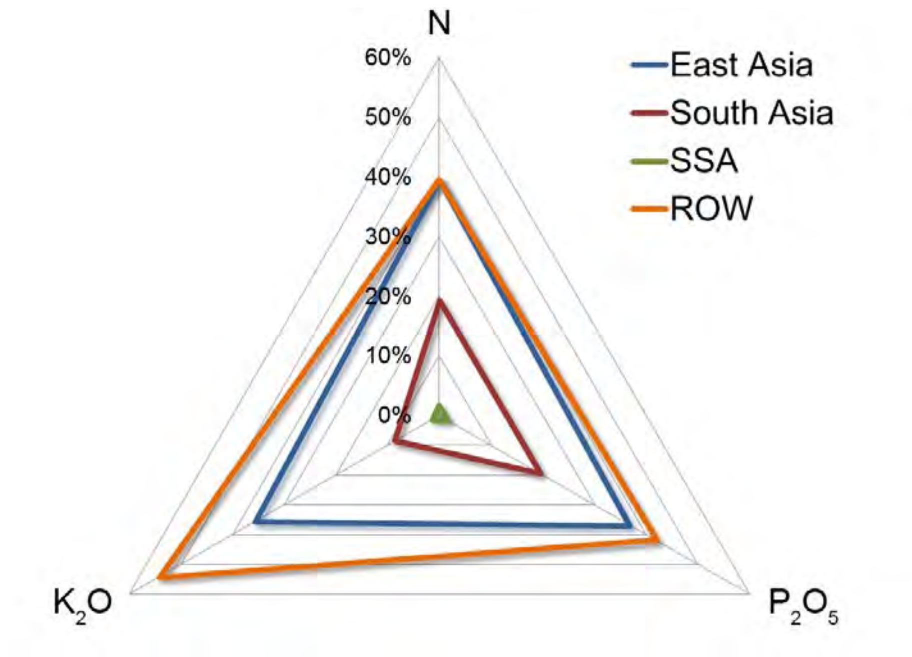


Fig. 2.3 *Contribution of East Asia, South Asia, SSA, and the ROW to World N, P, and K Fertilizer Consumption in 2012/13 (IFA 2014a)*

Altogether, countries subsidizing fertilizers[13] account for approximately 54% of world fertilizer consumption. This proportion is much higher for N and P (58% and 55%, respectively) than for K (37%). Some countries such as Indonesia subsidize fertilizers used by smallholder farmers only. Therefore, it can be assessed that approximately half of the fertilizer applied to crops globally is subsidized in some way. In the case of SSA, where an increasing number of countries have recently introduced fertilizer subsidy schemes, it is estimated that, in 2012-13, countries subsidizing fertilizers accounted for more than 60% of aggregate regional consumption.

2.2.3.2 World Fertilizer Use by Product

Urea dominated the world N fertilizer market, with a 56% share in 2012/13. Ammonium nitrate and calcium ammonium nitrate together accounted for 9% of the market. Nitrogen solutions

[13] These include Bangladesh, China, Egypt, India, Indonesia, Morocco, Pakistan, Russia, and about 20 countries in Sub-Saharan Africa (Burkina Faso, Burundi, Chad, Djibouti, Ethiopia, Ghana, Kenya, Lesotho, Malawi, Mali, Mozambique, Namibia, Nigeria, Senegal, Rwanda, Seychelles, Sudan, South Sudan, Tanzania, and Zambia). Countries such as Malaysia and Mexico subsidize a small proportion of their fertilizer market, targeting smallholder farmers.

(mostly urea ammonium nitrate) had a 5% market share. Ammonia directly applied to the soil accounted for 4% of the world market. The N share of ammonium phosphates accounted for 7% of the market, and the N share of NPK compounds for another 9%. Other straight N fertilizers collectively represented 9% of the market.

The P fertilizer market is dominated by ammonium phosphates, which accounted for 60% of world fertilizer consumption in 2012/13. Single superphosphate (SSP) and triple superphosphate (TSP) had a market share of 10% and 6%, respectively. The P fraction of NPK compounds represented 20% of the world market. The remaining 4% were split between other straight P fertilizers, other NP and PK compounds, and direct phosphate rock applications.

Potassium chloride (or MOP) is the leading K fertilizer product, with a 66% market share in 2012/13. The K share of NPK compounds represented another 26% of the world market. The remaining 8% was composed of potassium sulfate, NK and PK compounds, and other straight K fertilizers.

2.2.3.3 Global and Regional Fertilizer Use by Crop

The latest estimates of fertilizer use by crop relate to the 2010/11 campaign (Heffer 2013). Total fertilizer applications to cereals in that campaign amounted to 87.5 Mt nutrients, i.e., slightly over half (50.8%) of world fertilizer utilization. The three main cereals – wheat, rice, and maize – each accounted for 14% to 16% of the world total. Fertilizer use on the other cereals represented 4.6% of the world total. Oil crops accounted for 11.0% of world fertilizer consumption (19.0 Mt), with market shares of 3.9% for soybean, 2.0% for oil palm, and 5.2% for the other oilseeds. Fiber crops (mostly cotton), sugar crops (mostly sugarcane), and roots and tubers (mostly potatoes) received 4.1%, 4.2%, and 3.0%, respectively, of global fertilizer applications. Fruits and vegetables together accounted for 15.1% of world fertilizer uses. The other crops received the remaining 11.7%.

Cereals accounted for a larger share of world fertilizer N consumption (55%) than P (49%) and K (37%). Because of the impact of soybean, oilseeds have a higher contribution to P (15%) and K (20%) consumption than to N uses (7%). Fruits and vegetables, sugar crops, and oil palm are

major consumers of K fertilizers, and they account for 17%, 8%, and 7% of world demand, respectively.

The relative contribution of the different crop categories to total fertilizer consumption varies widely between regions, as illustrated by Fig. 2.4. For instance, cereals account for 44% of regional fertilizer consumption in East Asia and 51% in South Asia. In South Asia, rice alone accounts for 30% of total fertilizer uses. In contrast, fruits and vegetables receive 27% of the fertilizer applications in East Asia vs. 15% in South Asia.

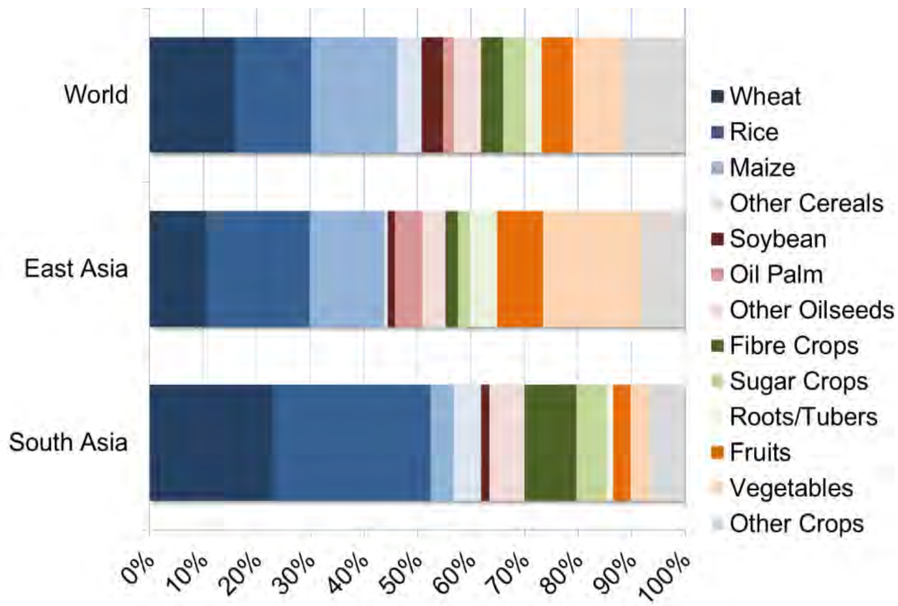


Fig. 2.4 *Relative Contribution of the Main Crop Categories to Global and Regional Fertilizer Consumption in 2010/11 (Heffer 2013)*

(Data based on China, Indonesia, Vietnam, Malaysia, Thailand, and Philippines for East Asia, and on India, Pakistan, and Bangladesh for South Asia; no estimates are available for Sub-Saharan Africa.)

2.2.4 Outlook to 2018/19 for World and Regional Fertilizer Demand

Global consumption in 2013/14 was estimated at 184 Mt nutrients, a 5 Mt year-on-year increase. World consumption is seen rising for all nutrients, reaching 112.2 Mt for N, 41.7 Mt for P, and 30.2 Mt for K (Heffer and Prud'homme 2014).

The medium-term outlook for agriculture remains favorable overall. Positive market fundamentals are expected to boost fertilizer use in the years to come. World demand would rise on average by 2.1% per annum (p.a.) between 2012/13 (the base year) and 2018/19. For the first time ever, aggregate global demand would exceed 200 Mt. Demand for K fertilizers would expand faster (2.5% p.a., to 34 Mt) than that for N (2.1% p.a., to 120 Mt) and P (1.9% p.a., to 46 Mt).

Among the three focus regions of the study, the highest growth rates are forecast in SSA (3.6% p.a.), where volumes are still very low while the cultivated land area is expanding steadily and several countries have started subsidizing fertilizers to stimulate domestic consumption. Demand is seen as progressively rebounding in South Asia (3.3% p.a.), assuming transition to a more effective fertilizer subsidy regime, while East Asian demand growth would continue to decelerate (+2.6% p.a.) as China's N and P fertilizer demand reaches a plateau. Demand expansion in the rest of the world would be modest (+1.3% p.a.). At the regional level, the bulk of the increase in demand would come from Asia and, to a lesser extent, from Latin America. South Asia, East Asia, and SSA are forecast to account for 25%, 31%, and 4%, respectively, of the global increase in demand between 2012/13 and 2018/19.

Compared to the previous 12 years, trends for the 2012/13-2018/19 period show a progressive deceleration of N demand growth, while P demand would continue to expand linearly and K demand growth would gain momentum. The decline in N demand growth is driven by N use efficiency gains in developed countries and, more recently, in China.

2.2.5 Fertilizer Use Efficiency and Effectiveness

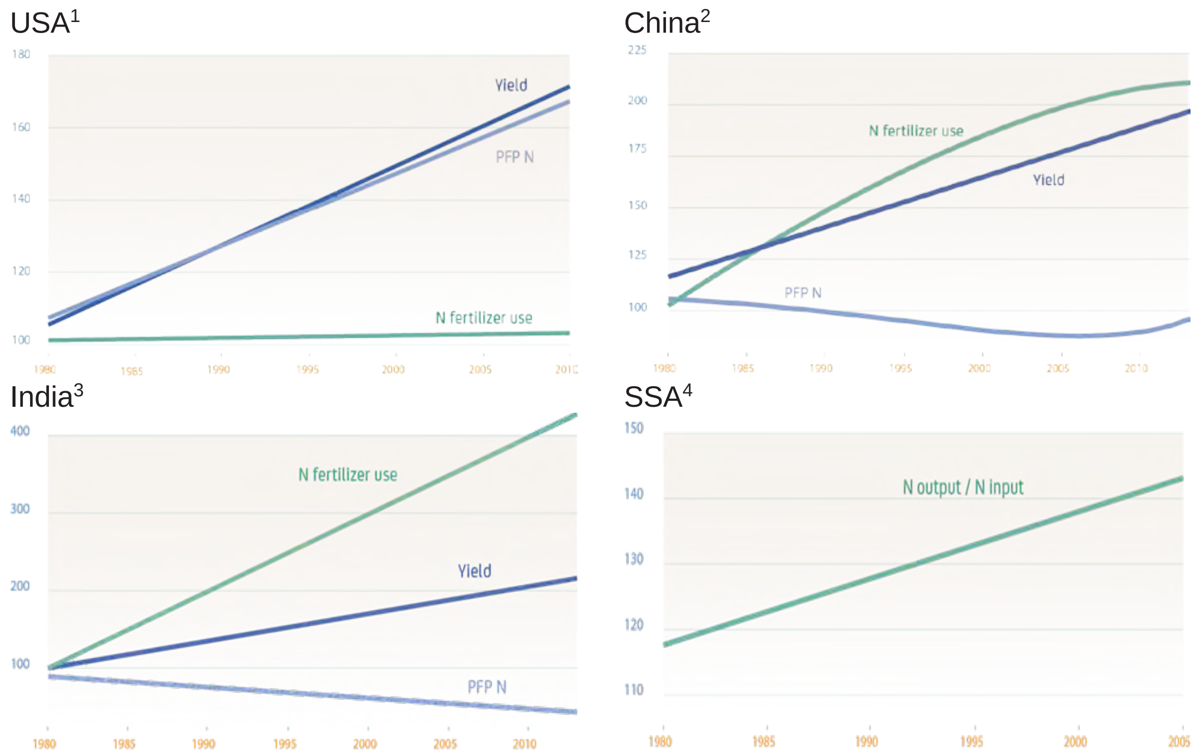
2.2.5.1 Nutrient Use Efficiency Trends

Nutrient use efficiency is an indicator of nutrient management performance. It is an expression of the efficiency of uptake by crops of the applied nutrients in a crop production system. Improving nutrient use efficiency optimizes farming productivity and profitability and reduces risks of nutrient losses to the environment. Monitoring nutrient use efficiency is particularly relevant for N and P sources (both organic and inorganic), because N and P losses can have detrimental impacts on air, water, and soil quality and on biodiversity.

Nutrient use efficiency can be measured by Partial Factor Productivity (PFP) (kg harvested product/kg nutrient applied) and output/input ratio (kg nutrient in harvested product/kg nutrient applied) among other indicators. With respect to data availability, these two calculations of nutrient use efficiency are more easily actionable and scalable than other measurement options.

Nitrogen is the macronutrient with the highest risk of leakage to the environment. Nitrogen use efficiency trends vary widely between regions and countries because of the diversity of soils, crops, climate, farmers' access to technology and knowledge, and policy priorities. The following regional trends are observed (Fig. 2.5):

- In the U.S., N use efficiency (expressed as PFP for fertilizer-N applied to maize) has undergone steady improvement over the past three decades, driven by the adoption of fertilizer best management practices (application of the right nutrient source at the right rate, at the right time, and in the right place). Similar trends are observed in other developed countries, e.g., for N fertilizer applied to wheat in West Europe and to rice in Japan.
- In China, N fertilizer consumption has been increasing faster than cereal yield gains, due to the government's national objective of achieving self-sufficiency in grains. This has led to a steady deterioration of the use efficiency of fertilizer N applied to cereals. With the government's new focus on resource efficiency, N use efficiency has improved in recent years.
- In India, N fertilizer applications to cereals are still increasing faster than cereal yields, resulting in declining N use efficiency. This trend can be explained by a fertilizer subsidy regime that has contributed to unbalanced and inefficient fertilizer use.
- In SSA, farmers use less than 10 kg of nutrients per hectare, less than one tenth of the world average, which results in greater amounts of N being taken up by crops than what is being applied in the fields (i.e., unsustainable ratios above 100%), causing widespread soil nutrient depletion, land degradation, and low agricultural productivity.



[1] Maize yield, N fertilizer applications to maize, and PFP for fertilizer-N applied to maize in the USA (1980 = 100).
[2] Cereal yield, N fertilizer applications to cereals, and PFP for fertilizer-N applied to cereals in China (1980 = 100).
[3] Cereal yield, N fertilizer applications to cereals, and PFP for fertilizer-N applied to cereals in India (1980 = 100).
[4] Output/input ratio (%) for total crop production in Sub-Saharan Africa.

***Fig. 2.5** Nitrogen Use Efficiency Trends in Different Parts of the World (IFA 2014b)*

As far as P use efficiency is concerned, losses to the environment occur mostly through soil and particulate matter erosion. In absence of significant erosion losses, the efficiency of fertilizer-P use is often high when evaluated over an adequate time scale—at least a decade (Syers et al. 2008).

2.2.5.2 Fertilizer Use Effectiveness

Nutrient use efficiency is an important, but not a sufficient, indicator of nutrient management. For sound interpretation, it is important that any monitoring of nutrient use efficiency be combined with a set of complementary indicators reflecting nutrient effectiveness, such as crop yield and soil nutrient levels.

In the perspective of a world reaching more than 9 billion people by 2050, and the need to alleviate persistent hunger, which still affects more than 800 million people, nutrient

management shall ensure continuous increase of agricultural production. The latest projections by the Food and Agriculture Organization of the United Nations (FAO) show that feeding that many people would require raising overall food production by some 60% between 2005 and 2050 in absence of changes to current biofuel mandates (FAO 2012). This shall be done while mitigating environmental impacts of farming in general, and nutrient management in particular. Agricultural intensification using fertilizer best management practices is therefore a desirable and necessary goal. The alternative—agricultural extensification—means increased conversion of natural habitats to farmland, biodiversity loss, and a significant increase in global greenhouse gas emissions. Improving fertilizer use efficiency is critical, but it must not be pursued to the detriment of agricultural yields.

Figure 2.6 illustrates that the region with the lowest fertilizer application rates (SSA) is the region with the highest yield gap (difference between average farm yield and attainable yield), and this low crop productivity is closely correlated to the prevalence of hunger. It is also associated with quick deforestation and related loss of biodiversity and emissions of greenhouse gases.

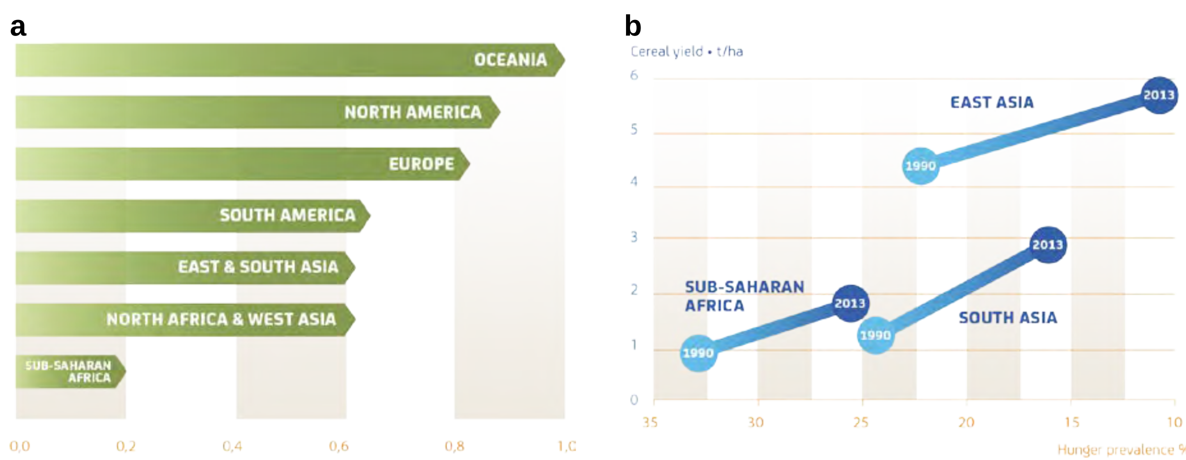


Fig. 2.6 *(a) Yield Gap (ratio between actual yields and attainable yields) for Maize and (b) Relation Between Prevalence of Hunger and Cereal Yield from 1990 to 2013 (IFA 2014c)*

East and South Asia are performing better than SSA, with a lower yield gap and a smaller proportion of their population that is undernourished. The yield gap in Asia remains however quite substantial compared to developed countries. Bridging the yield gap requires access to

technology and knowledge and enabling policy that will facilitate adoption of best farming practices, including fertilizer best management practices. In this respect, implementation of sound fertilizer subsidy policies could play an essential role to trigger faster transition toward more sustainable practices, with special focus on greater fertilizer use in SSA and more efficient use in East and South Asia.

2.3 Fertilizer Supply

Access and adequacy of fertilizers and raw materials supply are driven by market demand and resource endowment. Globally, there are sufficient available resources to meet the world's nutrient requirements for several centuries. On a smaller time scale, the development of capacity to produce adequate supply in order to meet world demand is driven by a range of factors that include geological and resources competitive advantages, conducive investment and procurement policies, access to financing and best available technologies, and growing domestic or neighboring markets.

Over the period from 2000 to 2013, global supply was more than adequate to meet global demand, with the notable exception of 2007/08 when the emergence of a food crisis led to a spike in the demand of fertilizers, which was barely met from existing supply. Beyond 2008, global nutrient consumption was adequately supplied, but many companies and established producers embarked in 2008 on capacity development projects in virtually every fertilizer-consuming and -producing country.

2.3.1 Production and Trade—Global Trends

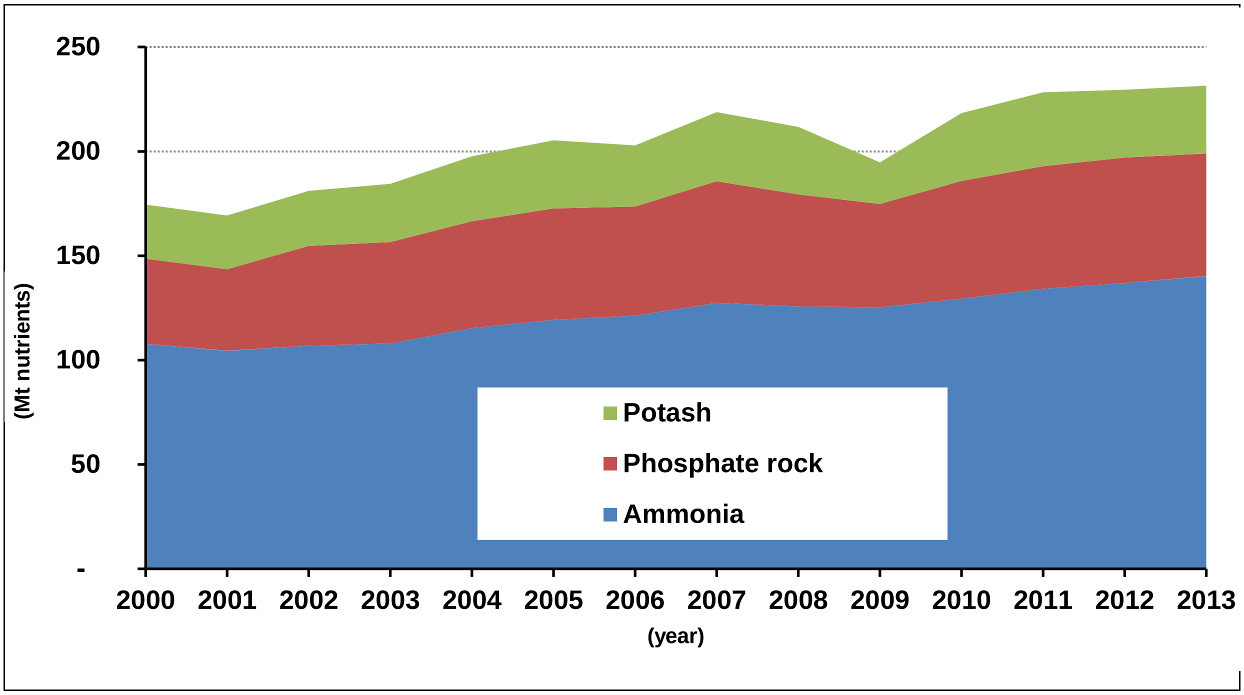


Fig. 2.7 World Nutrient Production (Mt nutrients) (IFA 2014d)

Between 2000 and 2013, global nutrient production expanded one-third to 232 Mt of nutrients, with half of this growth driven by rising nitrogen production (Fig. 2.7). Over this decade, global phosphate rock production grew by an overall 44%, compared with ammonia (+30%) and potash (+26%).

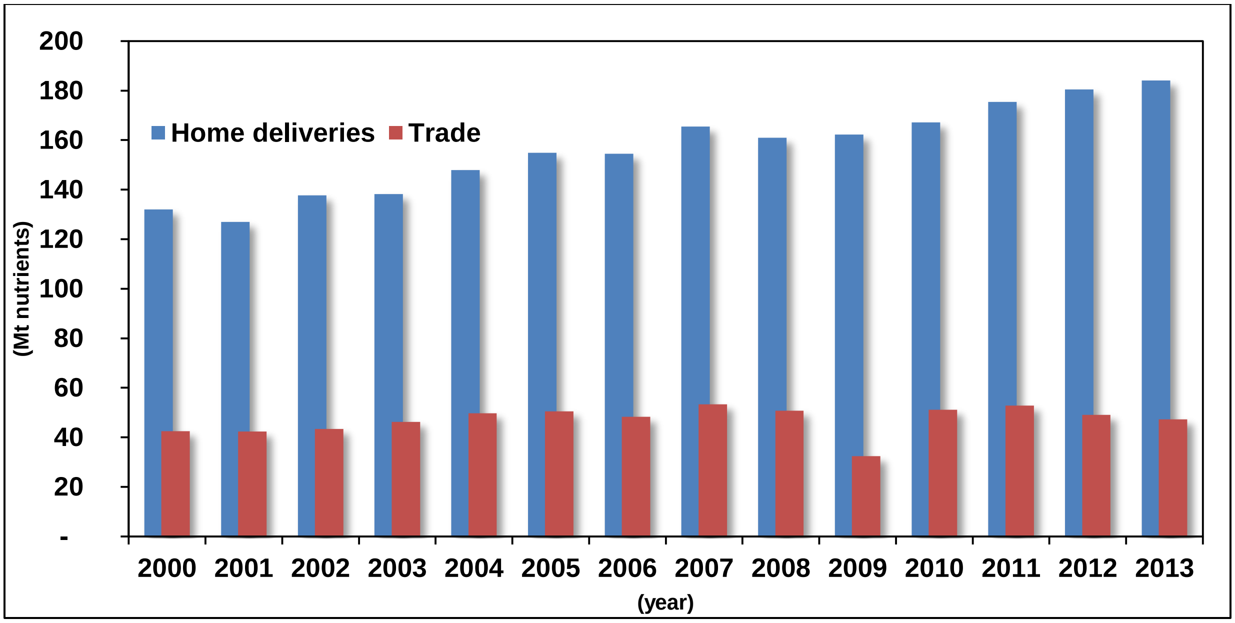


Fig. 2.8 *World Nutrient Sales (Mt nutrients) (IFA 2014d)*

The main sales feature that emerged during this period was the contradiction between the steadiness of global trade and a sustained expansion of domestic deliveries (Fig. 2.8). Global trade rose at an average annual growth rate of 0.9%, compared with domestic sales growing at 3% p.a. This reflects the increase of downstream capacity where raw materials (phosphate rock, ammonia and potash) are produced in combination with a rapid development of domestic capacity in key consuming countries. China, Indonesia, Vietnam and Pakistan are good examples of this development.

Table 2.1 *Global Production and Sales: Urea, DAP, and MOP, 2000 and 2013 (Mt products) (IFA 2014d)*

		2000	2013	*CAGR* %*
Urea	Production	107	170	*4%*
	Trade	26	45	*5%*
	Domestic sales	81	125	*4%*
DAP	Production	25	34	*3%*
	Trade	13	14	*1%*
	Domestic sales	12	20	*5%*
Potash	Production	43	55	*2%*
	Trade	34	42	*2%*
	Domestic sales	9	13	*4%*

*CAGR: Compound Annual Growth Rate.

When comparing mainstream fertilizer products, global urea trade grew in parallel with domestic sales, both expanding at an average growth rate of 3-4% p.a. between 2000 and 2013. DAP domestic sales expanded at a rate of 5% p.a., while global trade grew by 1% p.a., emphasizing the important contribution of China in expanding its domestic sales and reducing its reliance on imports. Potash sales followed a similar trend as DAP, with domestic sales growing at 4% p.a., compared with global trade at 2% p.a.; however, in the case of potash, global trade contributes to the majority of sales, with 75% share of total sales. This would reflect the higher sensitivity of potash export sales to global economic and trade downturns.

2.3.2 Regional Fertilizer Production

Global urea production is dominated by East Asia due to the large urea capacity prevailing in China and, to a lesser extent, in Indonesia. East Asia accounts for 45% of global urea production, followed by South Asia (17%) where India and Pakistan are the main producers. Urea production in India and Pakistan expanded steadily over the past decade, growing 20% and 16%, respectively. However, urea production has remained constrained by shortfalls in the supply of natural gas. Urea production in SSA is confined to one country, Nigeria, where urea production resumed in 2009 after being idled for close to a decade; this sub-region accounts for less than 0.2% of global output.

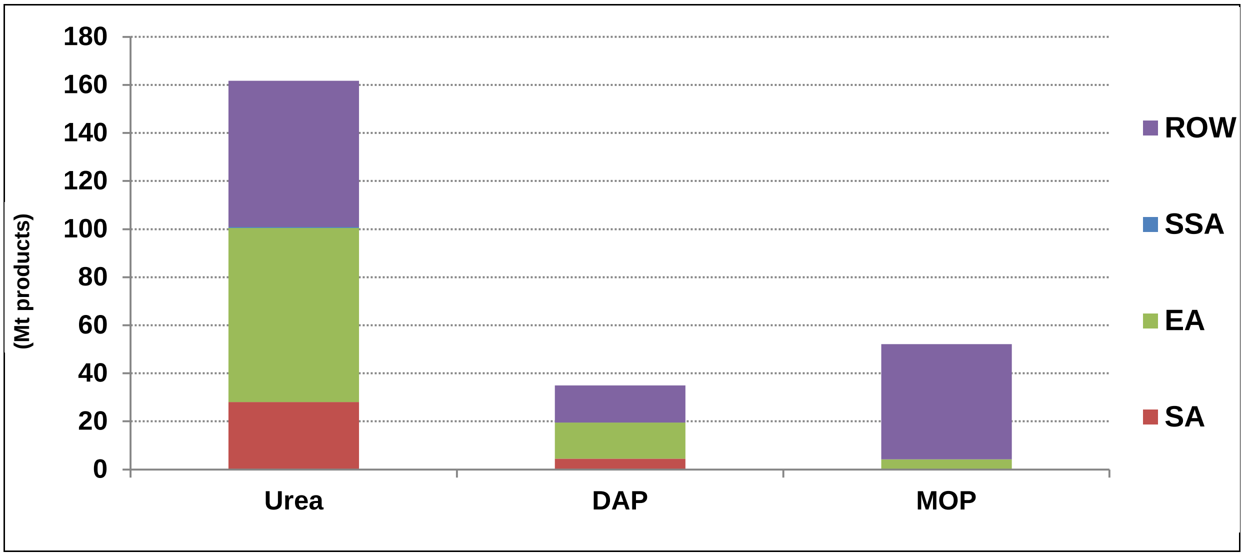


Fig. 2.9 Regional Fertilizer Production in 2012 (Mt products) (IFA 2014d)

Global DAP production is also dominated by East Asia, due to the prevalence of China. There is limited DAP production in East Asia outside China, which accounts for 43% of global DAP output. South Asia, notably India and Pakistan, contributes 13% of world output. India's DAP output is conditioned by domestic demand and the arbitrage between DAP domestic production and imports; DAP annual output in India has fluctuated between 3.5 Mt and 5.5 Mt over the past decade. Sizable production of DAP emerged after 2004 in Pakistan, following the completion of new DAP facilities; annual production is close to 0.7 Mt. DAP production in SSA occurs sporadically in Senegal and accounts for a mere fraction of global output.

Potash production is relatively absent in the three targeted regions, with only East Asia (China) extracting potash at an increasing rate since 2001. East Asia now accounts for 8% of global output. There is no primary potash production in South Asia and SSA.

2.3.3 Regional Trade

Between 2002 and 2012, East Asia became self-reliant in urea supply, as China shifted from a significant import reliance position in the late 1990s to become a dominant exporter by 2006 (Fig. 2.10). China is the world's largest urea exporter, with a 16% share of global urea exports. South Asia has become heavily reliant on imports. This situation is mostly prevalent in India, due to its limited domestic capacity against growing use driven by a favorable subsidy regime on urea. Urea trade in SSA shows two resilient features: a sustained deficit and relatively low import demand.

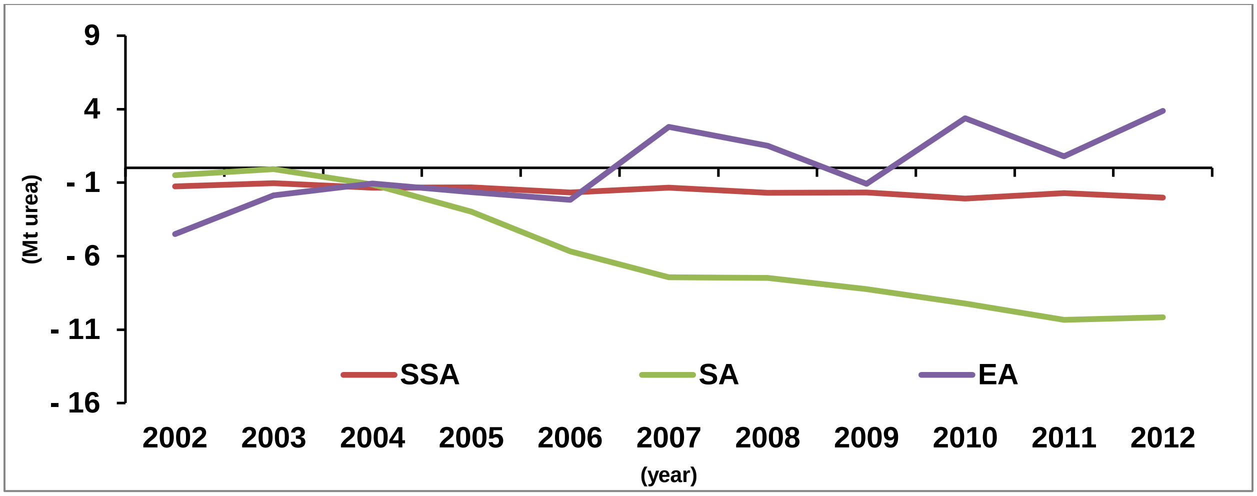


Fig. 2.10 *Net Regional Urea Trade (Mt urea) (IFA 2014d)*

DAP trade in East Asia is similar to that of urea. East Asia became self-reliant in DAP supply in 2007 and emerged as a prominent world exporter by 2009, as China expanded DAP domestic capacity (Fig. 2.11). East Asia contributed 4 Mt, or 28% of world DAP trade, in 2012. In South Asia, growing DAP consumption in India resulted in a rapid increase of import demand; India was the world's largest importer of DAP with a 40% share of global trade in 2012 (6 Mt). DAP trade in SSA has shown steady import volumes. Only two countries account for the bulk of imports: Nigeria and Ethiopia.

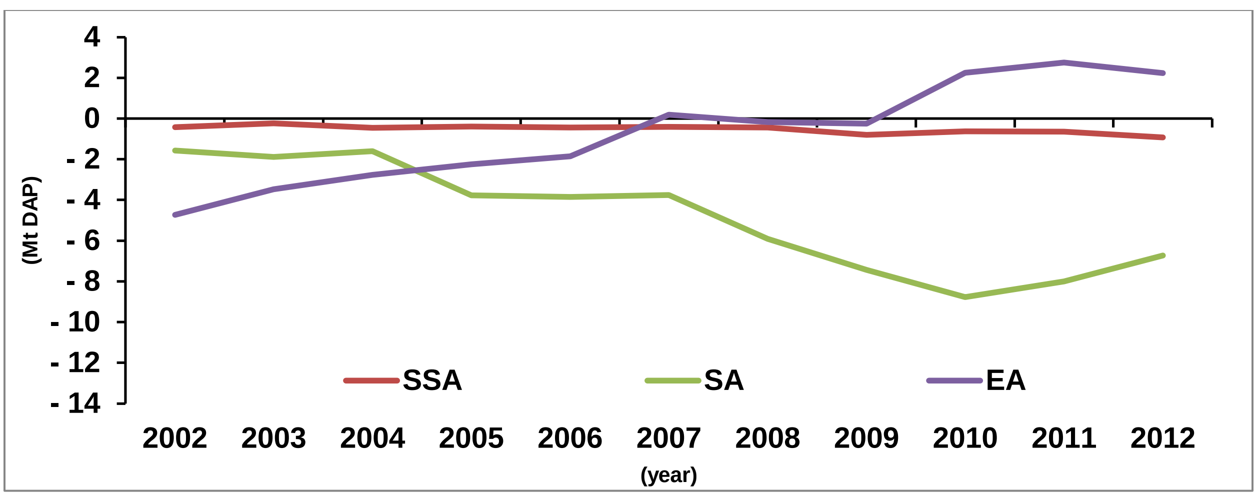


Fig. 2.11 *Net Regional DAP Trade (Mt DAP) (IFA 2014d)*

The three targeted regions are deficient in potash supply and heavily rely on imports to meet their respective domestic requirements (Fig. 2.12). MOP trade in East Asia showed great fluctuations dictated by commercial contractual considerations, and domestic potash production has been on the rise since 2000 in China. Annual imports in this region usually ranged between 12 and 15 Mt MOP. With no production in South Asia and SSA, both regions rely on imports. South Asia's demand is dominated by India, where potassium use is impacted by policy changes in the subsidy regime and by international prices. In recent years, MOP imports in South Asia varied between 3.6 Mt and 6.6 Mt. Consumption and imports of MOP in SSA are still anecdotal, with less than 0.4 Mt of MOP imports annually since 2002. MOP is mostly imported in South Africa, and to a lesser extent, Mali and Côte d'Ivoire.

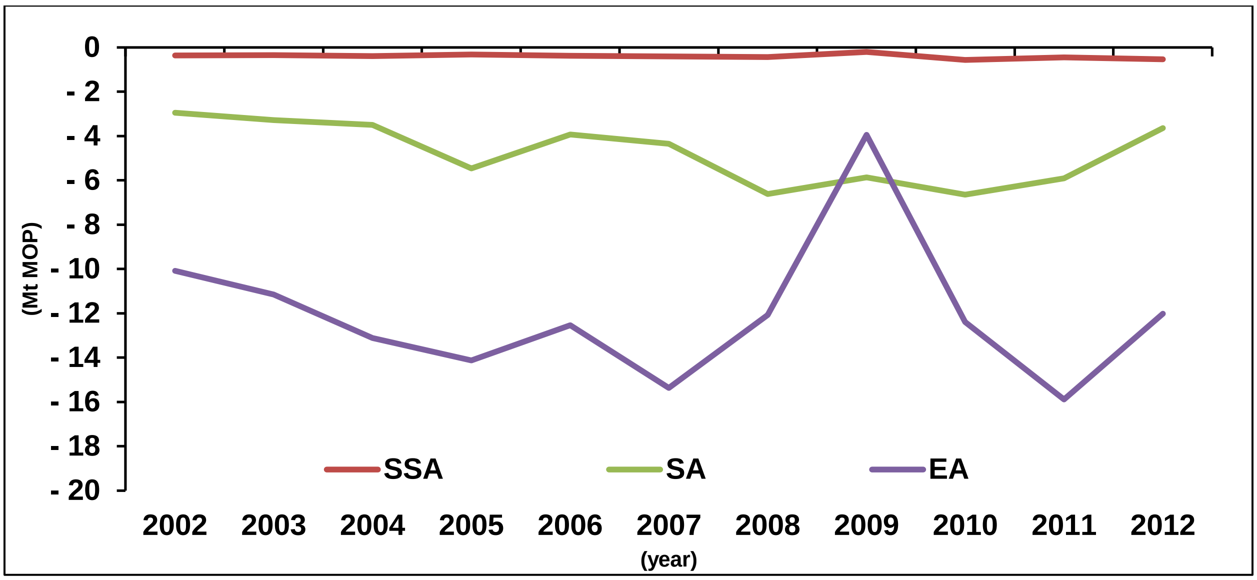


Fig. 2.12 *Net Regional MOP Trade (Mt MOP) (IFA 2014d)*

2.3.4 Capacity—Global Outlook

Between 2013 and 2018, global capacity of fertilizer products, intermediates, and raw materials will potentially increase by 146 Mt, representing an overall growth of 18% over 2013. Assuming that all planned projects are realized according to companies' announced schedules, expansions of capacity would occur in all segments over 2013 capacity: nitrogen, +18%; phosphates, +13%; and potash, +22%.

Close to 200 new units are projected to come onstream between 2013 and 2018 worldwide, in addition to 30 projects related to phosphate rock mining. On the basis of current capital cost for new units and mines, the industry would invest nearly U.S. $110 billion between 2013 and 2018 and would create more than 40,000 direct and 60,000 indirect jobs during this period.

2.3.4.1 Urea

Table 2.2 *Global Urea Capacity by Region (Mt urea) (Prud'homme 2014)*

	2013	2014	2015	2016	2017	2018
Western Europe	6.7	6.7	6.7	6.7	6.7	6.7
Central Europe	4.2	4.2	4.3	4.4	4.4	4.4
Eastern Europe & Central Asia	16.6	17.3	18.2	18.2	18.9	18.8
North America	11.2	11.2	11.9	15.5	16.7	16.7
Latin America, Caribbean	6.6	7.4	8.7	10.4	10.4	10.4
Africa	7.9	10.2	11.5	12.8	17.2	17.2
West Asia	22.2	22.2	23.3	23.3	24.4	25.6
South Asia	33.4	33.4	35.1	35.1	35.0	35.0
East Asia	94.4	98.0	104.5	110.2	110.2	109.2
Oceania	0.6	0.6	0.6	0.6	0.6	1.1
World	203.8	211.2	224.8	237.2	244.5	245.1

Note: Error in totals can occur due to rounding.

IFA estimates that between 2014 and 2018, about 60 new urea units would come onstream, of which 25 would be located in China. Global urea capacity would increase by a net 41 Mt between 2013 and 2018 (+20%), to reach 245 Mt in 2018 (Table 2.2). This corresponds to a CAGR of 3%.

On a regional basis, three regions will account for three-quarters of the overall capacity growth during the period from 2014 to 2018. East Asia would contribute 36% of the net increase of capacity, followed by Africa (22%) and North America (13%). The other regions will contribute at various levels: Latin America (9%), West Asia (8%), and Eastern Europe and Central Asia (EECA) (5%). Little changes are seen in the remaining regions.

On the basis of historical operating rates, global urea supply (effective capacity) is estimated at 216 Mt in 2018 (Table 2.3), growing at a projected average annual rate of 3.8% over 2013. Over the next five years, the supply and demand projections show a potential surplus of 13 Mt in

2018, equating to 6% of potential supply. The potential surplus will remain relatively stable over the period from 2014 to 2015, followed by an upward correction in 2016-17 and stability thereafter.

2.3.4.2 Phosphoric Acid and Processed Phosphates

IFA estimates that global capacity would increase by 7.2 Mt over 2013, to 61.5 Mt phosphoric acid (P_2O_5) in 2018. Between 2013 and 2018, a total of 30 new acid units are currently planned for completion, of which two-thirds will occur outside China, notably in Morocco and Saudi Arabia. The other main capacity additions will come from Jordan, Indonesia, and Brazil.

Global capacity of processed phosphates in 2018 is projected at 47.7 Mt P_2O_5 expanding 5.1 Mt over 2013. Global capacity of DAP will reach 31 Mt P_2O_5 (67 Mt DAP) in 2018, with the bulk of the increase occurring in three countries: Morocco, Saudi Arabia, and China. While capacity additions have been attributed to DAP, several of the new units will have the flexibility of producing NPK compounds, TSP, MAP, and MAP-based fertilizers. Projects that are specifically dedicated to DAP are planned in Saudi Arabia, China, Vietnam, and India.

Table 2.3 *Global Phosphoric Acid Capacity by Region (Mt P_2O_5) (Prud'homme 2014)*

	2013	2014	2015	2016	2017	2018
Western Europe	0.6	0.6	0.6	0.6	0.6	0.6
Central Europe	0.9	0.9	0.9	0.9	0.9	0.9
Eastern Europe & Central Asia	4.9	4.9	5.0	5.0	5.0	5.1
North America	9.6	9.6	9.3	9.3	9.3	9.3
Latin America, Caribbean	2.8	2.8	2.8	2.8	2.8	3.8
Africa	8.4	8.9	9.8	10.3	10.3	10.3
West Asia	3.7	4.3	4.3	4.3	5.8	5.8
South Asia	2.2	2.2	2.4	2.4	2.4	2.4
East Asia	20.5	20.9	22.1	22.6	22.8	22.9
Oceania	0.6	0.6	0.6	0.6	0.6	0.6
World	54.3	55.6	57.7	58.6	60.4	61.5

Note: Errors in total can occur due to rounding.

Global potential supply of phosphoric acid in 2018 was estimated by IFA at 52 Mt P_2O_5, increasing by an overall 6.7 Mt over 2013 and representing an average growth rate of 3.0% p.a.

Taking into account phosphoric acid consumption in all uses and processing losses, the global demand of phosphoric acid is forecast to grow at an annual rate of 2% over 2013, to reach 48 Mt P_2O_5 in 2018. The global phosphoric acid supply/demand potential conditions show a stable potential balance in the short term, followed by a moderate increase in 2015. As new capacity projects are commissioned between 2016 and 2018, the supply/demand balance would show the emergence of slightly larger potential surpluses. Assuming that all projects are realized on schedule and a gradual ramp-up of new capacity, the potential balance may expand to 4.3 Mt P_2O_5 by 2018, representing 8% of potential supply, compared with historical ratios of 6% in 2012 and 12% in 2009.

2.3.4.3 Potash

Close to 20 expansion projects are planned for completion between 2014 and 2018. Of these, only three are Greenfield projects. Global potassium capacity is forecast to reach 60.8 Mt potash (K_2O) in 2018, representing a capacity increment of 11 Mt or a growth rate of 4.4% p.a. (Table 2.4). Two-thirds of the world's capacity increase will occur in Canada and Russia. China will account for a 12% share of the capacity increment, followed by Belarus (4%). On a product basis, the bulk of new potash capacity will be in the form of MOP, rising 17 Mt to 97 Mt MOP in 2018.

Table 2.4 *Global Potash Capacity by Region (Mt K_2O) (Prud'homme 2014)*

	2013	2014	2015	2016	2017	2018
Western Europe	5.6	5.6	5.5	5.5	5.5	5.6
Eastern Europe & Central Asia	14.6	14.9	15.2	15.5	18.6	18.8
North America	18.2	18.6	21.7	23.2	23.5	23.6
Latin America, Caribbean	1.9	1.9	1.9	1.9	1.9	1.9
West Asia	4.0	4.0	4.0	4.0	4.0	4.0
East Asia	5.3	5.6	6.4	6.7	6.7	6.9
World	49.6	50.5	54.7	56.7	60.3	60.7

Note: Error in totals can occur due to rounding.

Assuming maximum operating rates between 2014 and 2018 at 83%-86% of nameplate capacity, global potassium supply would have the potential to reach 51.4 Mt K_2O in 2018. Global demand

of potassium was projected at 38.3 Mt K_2O in 2018, equating to an average annual growth rate of 3.0% over 2013.

Between 2013 and 2018, global potash demand would grow by an overall 15%, while supply would expand by 22%. There would be adequate potential supply to meet the forecast increase in demand. The potential global potash supply/demand conditions over the next five years show a moderate expansion of the potential surplus between 2013 and 2016, growing to 10.6 Mt K_2O in 2016; this level would equate to 22% of potential surplus over supply. The potential surplus may then expand to 13 Mt K_2O in 2018, assuming the realization of planned projects. The acceleration of the potential surplus results from the combination of new capacity from large projects that were initiated in 2010-12 and a slowdown in the growth of potash demand.

2.3.5 Regional Capacity Overview

2.3.5.1 Sub-Saharan Africa

This region is fertile ground for capacity investments, thanks to its rich natural resources. Beyond South Africa, this region is now seen as the new investment/development frontier, where many fertilizers and mining projects are under consideration, in the form of South-South partnerships or Direct Foreign Investments from large fertilizer producers in developed countries.

Only Nigeria currently produces urea, but new capacity is seen emerging in the near term in coastal countries of West Africa and East Africa that are endowed with abundant natural gas reserves. Countries where current nitrogen projects are being assessed include Nigeria, Gabon, Ghana, and Côte d’Ivoire. However, the prospect for further development may prevail in other natural gas-rich countries such as Angola, Botswana, Cameroon, Democratic Republic of Congo (DRC), Namibia, Equatorial Guinea, Mozambique, Rwanda, Zimbabwe, and South Africa. By 2018/19, SSA may emerge as one of the world’s largest urea-exporting regions, considering the number of announced projects in Nigeria alone, where at least eight new ammonia/urea complexes are under consideration (Table 2.5). In Gabon, a Greenfield ammonia/urea complex, with a capacity of 1.3 Mt urea, is under construction with completion planned in 2017.

Table 2.5 Capacity Developments in Sub-Saharan Africa (Mt products) (Prud'homme 2014)

	2013	2018	Growth %
Urea	0.5	5.8	1,060%
DAP	None		
Potash	None		

Prospects for developing potash and phosphate mines have also emerged in recent years, especially in DRC, Ethiopia, Eritrea, and Angola on potash, and in the DRC, Tanzania, Uganda, Mali, Namibia, and Guinea Bissau on phosphate rock (but not on DAP).

However, constraints on financing, poor infrastructure, uncertain regulatory framework, and economic and political considerations have dampened the development of several projects and have extended their completion beyond the planned schedule. No significant developments are seen in processed phosphate capacity (DAP) in the near term.

On potash, several companies have embarked on large development projects, with nameplate capacity ranging between 0.5 Mt and 2 Mt MOP. Most potassium deposits that are under consideration comprise carnallitic potash ore formations, notably for those projects located in DRC, Eritrea, and Ethiopia. For most of these projects, the proposed extraction process is solution mining, despite the limited knowledge and expertise available onsite of this mining method.

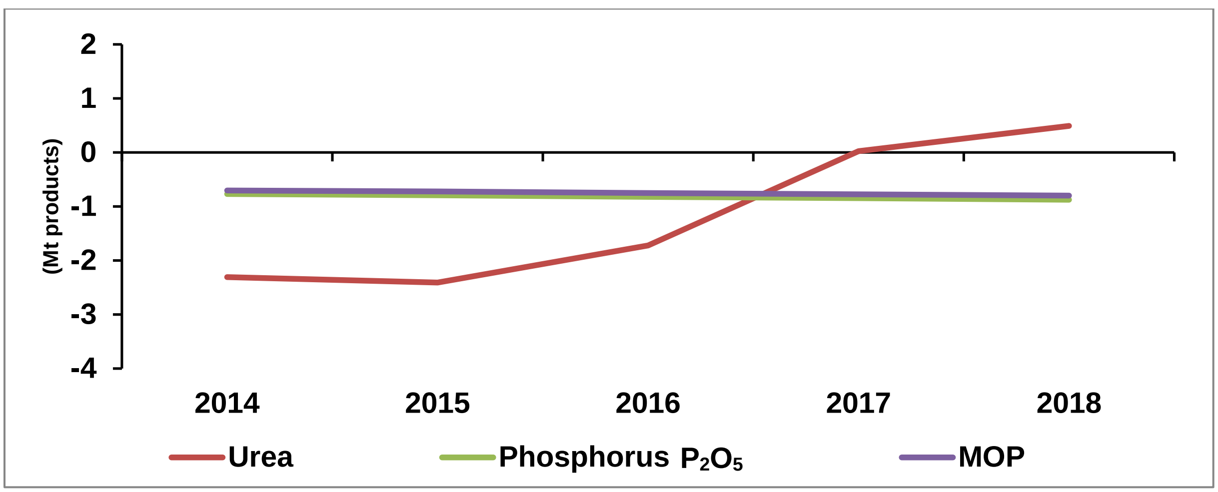


Fig. 2.13 Net Regional Trade—Sub-Saharan Africa (Mt products) (Prud'homme 2014)

On a net trade basis, this sub-region will show a resilient deficit on MOP and phosphorus over the next five years. Longer term potash developments would permit this region to become self-sufficient and emerge as a significant source of potash export. In the shorter term, huge incremental capacity for urea will translate into potential exportable surplus, unless significant urea consumption developments take place (Fig. 2.13).

2.3.5.2 South Asia

This region is, and will remain, the world's largest import hub of phosphate and nitrogen products, due to growing demand and lack of economic reserves of potassium and phosphate. A chronic shortage of natural gas supply and regular curtailments have been constraining the urea industry's ability to invest in new indigenous nitrogen capacity. Marginal nitrogen capacity development is seen in South Asia over the next five years, notably in India and Bangladesh. No large projects are foreseen on phosphate or potash (Table 2.6).

In South Asia, urea is mainly produced in India, Pakistan, and Bangladesh, but these countries are, and may likely remain, highly reliant on imports to meet their respective domestic needs. In India, domestic urea production contributed 75% of the total needs, estimated at 30 Mt in 2013/14. Several announced Greenfield projects have been postponed beyond 2018, and only one project is scheduled for startup in 2014. By 2018, India's urea capacity would be close to 25 Mt. In the case of Pakistan, while there is sufficient installed capacity to meet domestic annual requirements, a chronic shortfall in the supply of natural gas has dampened utilization rates below 80% of nameplate capacity and constrained output. As such, Pakistan has imported significant volumes of urea over the past three years. In Bangladesh, urea capacity would expand to 3.4 Mt in 2015/16, as a result of the construction of a new 0.6 Mt urea facility that will replace a smaller and older plant. However, Bangladesh will remain a net urea importing country in the near term, until significant improvements are seen in its natural gas sector.

Table 2.6 *Capacity Developments in South Asia (Mt products), (Prud'homme 2014)*

	2013	2018	Growth %
Urea	33.4	35	5%
DAP	4.1	4.3	5%
Potash	None		

DAP production mostly occurs in India and, to a lesser extent, in Pakistan and Bangladesh. A few capacity projects are planned in India, raising total DAP capacity to 8 Mt by 2018; however, this level remains short of India's domestic requirements, estimated at 10-12 Mt p.a. in the near term. India will likely remain the world's largest DAP importer in the near term, with potential DAP imports ranging between 4 and 6 Mt p.a. No capacity changes are foreseen in the near term in Bangladesh and Pakistan; both countries will likely continue to import DAP, in the range of 0.4 to 1 Mt p.a.

No potash projects are under development in South Asia. This region will continue to show annual deficits that will be entirely fulfilled through imports of potassium-bearing products. In 2018, potassium imports in this region would exceed 4 Mt K_2O, equivalent to nearly 7 Mt MOP.

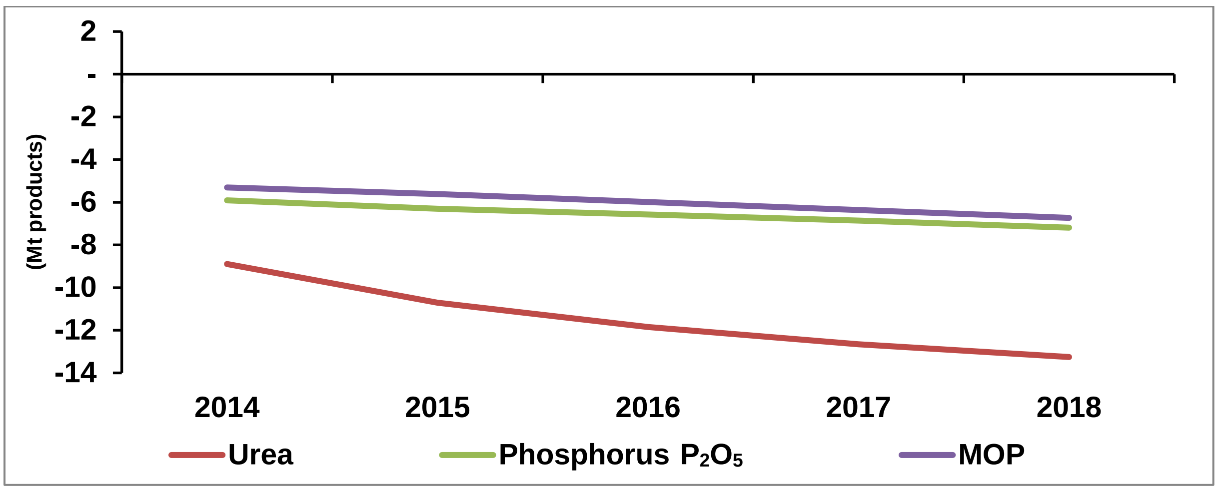


Fig. 2.14 *Net Regional Trade—South Asia (Mt products) (Prud'homme 2014)*

South Asia will remain a nutrient deficit region, with sizable potential import requirements growing over the next five years. The imbalance in nutrient application between nutrients may favor rising urea imports against potassium (MOP) and phosphorus fertilizers, unless the subsidy regime is altered. In case of accrued demand for phosphorus (P) and potash (K) nutrients, their deficits would expand and lead to larger imports in the near term (Fig. 2.14).

2.3.5.3 East Asia

Developments in this region could be subdivided into two groups: China and Southeast Asia.

China’s production capacity in all nutrients continues to expand, despite resilient overcapacity in the nitrogen and phosphate sectors. Chinese N and P producers will face consolidation and restructuring on the domestic front, notably in the small-sized plant nitrogen segment. Investment in new capacity in large-sized urea plants continues to prevail in China, especially in coal-rich provinces and in spite of the resilient overcapacity in the Chinese urea sector. According to the 2014 IFA capacity survey, China’s urea capacity will grow 2.7% p.a. over the next five years, reaching 94 Mt in 2018.

Between 2013 and 2018, China’s DAP capacity is projected to increase 0.9 Mt to 9.0 Mt P_2O_5 in 2018; overall China’s processed phosphate fertilizer capacity would grow 1.2% p.a. over the next five years. However, with relatively static phosphate fertilizer consumption in the near term, China will remain a net exporter of DAP. In 2013, China was the world’s third largest potash-producing country, with a 10% share of world potash capacity. Future capacity developments will focus on MOP and sulfate of potash (SOP), bringing capacity to 8.4 Mt MOP in 2018.

Table 2.7 *Capacity Developments in East Asia (Mt products) (Prud’homme 2014)*

	2013	2018	Growth %
Urea	94.4	110.2	17%
DAP	8.3	9.3	12%
Potash	7.4	9.0	22%

In Southeast Asia, capacity is being expanded in the nitrogen segment, mainly in Indonesia and Vietnam. Indonesia and Malaysia are among the largest urea-producing and -exporting countries in this region. Indonesia’s urea capacity is projected to expand 30%, to reach 10.6 Mt in 2018. In Malaysia, a new 1.1 Mt facility is under construction. By 2018, urea capacity in Malaysia would then double to 2.4 Mt. In Vietnam, a few projects will add new urea capacity over the next five years. With a total urea capacity exceeding 3 Mt in 2018, Vietnam will become self-sufficient. Southeast Asia will gradually move toward self-sufficiency and would, in the long run, become a net urea-exporting region (Table 2.7).

The nitrogen industrial segment, mostly for industrial-grade ammonium nitrate (IGAN), continues to expand in this sub-region, with new capacity in Indonesia and Vietnam.

No major developments are seen on DAP, besides a new 0.3 Mt unit in Vietnam in 2017. In the short term, DAP imports may likely decline in this region. No other DAP projects are seen in the near term, but a few new NPK compound units are under development in Indonesia. On potash, several new mines have been completed in Laos since 2011, but production is constrained with technical and logistic issues. No other developments are seen in the near term, but some additional exploration activities are anticipated in Thailand and Laos.

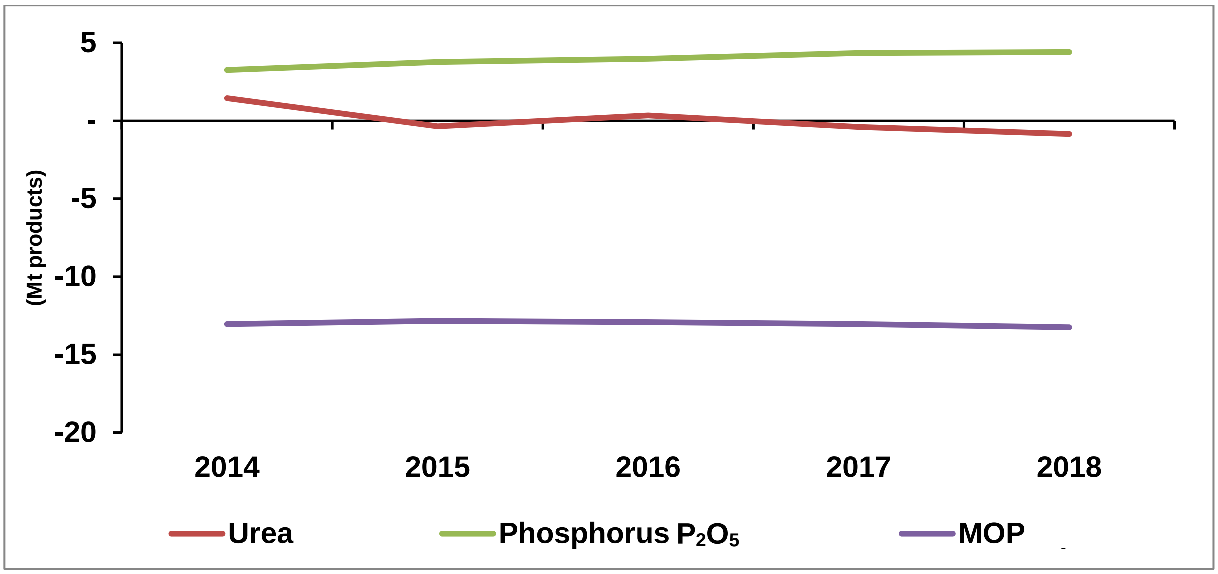


Fig. 2.15 Net Regional Trade—East Asia (Mt products) (Prud'homme 2014)

East Asia will see a rising phosphorus surplus, notably due to the increase in P capacity in China. Potassium (MOP) may show a stable, if not growing, deficit notwithstanding capacity expansions in China, and possibly in Laos. Urea may shift from a current surplus to a near balanced position, as a result of fast-growing industrial demand in China (Fig. 2.15). However, new urea capacity in Indonesia and possibly in Vietnam may add to a potential surplus in the longer term.

References

Food and Agriculture Organization of the United Nations (FAO) (2012) World agriculture towards 2030/2050—the 2012 revision. FAO, Rome

Heffer P (2013) Assessment of fertilizer use by crop at the global level, 2010-2010/11. International Fertilizer Association (IFA), Paris

Heffer P, Prud'homme M (2014) Fertilizer outlook 2014–2018. IFA, Paris

IFA (2014a) IFADATA. Retrieved from http://ifadata.fertilizer.org/ucSearch.aspx

IFA (2014b) Nitrogen use efficiency in different parts of the world. IFA, Fertilizer Facts, Paris

IFA (2014c) Fertilizers are crucial for closing the yield gap. IFA, Fertilizer Facts, Paris

IFA (2014d) IFA production and international trade statistics. IFA, Paris

Prud'homme M (2014) Fertilizers and raw materials global supply, 2014-2018. IFA (report restricted to the members of IFA), Paris

Syers JK, Johnston AE, Curtin D (2008) Efficiency of soil and fertilizer phosphorus: reconciling changing concepts of soil phosphorus behavior with agronomic information, FAO Fertilizer and Plant Nutrition Bulletin 18. FAO, Rome

Annex Table 2.1 *World and Regional Fertilizer Demand, 2000/01 to 2018/19*

		2000/01 (Mt)	2012/13 (Mt)	*Av. Annual Growth Rate (%/y)*	2018/19 (Mt)	*Av. Annual Growth Rate (%/y)*
World	N	82.1	109.1	*2.4*	119.8	*2.1*
	P_2O_5	32.8	41.1	*1.9*	46.2	*1.9*
	K_2O	22.1	28.8	*2.2*	34.2	*2.5*
	Total	137.0	178.9	*2.2*	200.3	*2.1*
East Asia	N	29.3	43.1	*3.3*	46.2	*2.6*
	P_2O_5	11.0	15.2	*2.7*	15.7	*2.0*
	K_2O	5.9	10.3	*4.8*	11.9	*4.0*
	Total	46.2	68.5	*3.3*	73.8	*2.6*
South Asia	N	14.4	21.0	*3.2*	24.4	*3.0*
	P_2O_5	5.2	8.0	*3.6*	9.7	*3.5*
	K_2O	1.8	2.5	*2.9*	4.1	*4.7*
	Total	21.4	31.5	*3.3*	38.2	*3.3*
SSA	N	1.0	1.8	*4.8*	2.4	*4.7*
	P_2O_5	0.6	0.7	*1.5*	0.9	*2.4*
	K_2O	0.4	0.4	*0.8*	0.5	*1.7*
	Total	2.0	2.9	*3.3*	3.7	*3.6*
ROW	N	37.3	43.2	*1.2*	46.8	*1.3*
	P_2O_5	16.0	17.3	*0.6*	20.0	*1.2*
	K_2O	14.1	15.6	*0.8*	17.8	*1.3*
	Total	67.4	76.0	*1.0*	84.6	*1.3*

SSA: Sub-Saharan Africa; ROW: Rest of the world.

3 Bangladesh

Ishrat Jahan
International Fertilizer Development Center

3.1 Introduction

Crop agriculture, and particularly food-grain production, is the major driving force of the Bangladesh economy. It directly impacts rural livelihood opportunities and poverty reduction. Agriculture and agricultural-related non-farm economic (NFE) activities drive an economy largely dependent on agricultural production for creation of employment opportunities for the rural population. About 84% of the 15 million farm families are small marginal farmers with no more than 1 ha of land (GoB 2013).

Rice is the principal staple food in Bangladesh, occupying about 78% of the total cropped land (Gob 2013), and by far the most important food crop, with an average annual production of 34 Mt (Gob 2014). The majority of farm households grow rice crops. *Boro* (dry) rice is planted in January-February and harvested in April-May. Some grow *Aus* (wet) rice in March-April and harvest in June-July, while the third growing season is August-September for *Aman* (wet) rice, which is harvested in November-December. Farmers engage in at least two cropping seasons in a year, and in a few places, three seasons are the norm. All these require rigorous land preparation using power tillers, draft animal, and modern agricultural inputs, such as seed-fertilizer-irrigation.

Crop diversification is occurring in some areas with positive results in maize and vegetable production. Maize in particular has been important as a livestock feed. Improved soil nutrient management, supported by irrigation and quality seed, is the key component of the Government of Bangladesh (GoB)'s strategy to improve yields on a sustainable basis. In the fertilizer sector, there has been little progress in technology introduction to improve soil nutrient management. In the past years, increased attention has been given to urea deep placement (UDP) technology[14] to

[14] UDP involves point placement of a large fertilizer pellet (up to 3.4 grams [g] by weight) near the root zone of the plant. This reduces fertilizer N losses and increases crop uptake efficiency of the fertilizer and is an environmentally friendly technology.

improve the efficiency of urea fertilizer. This technology has been validated at the research and field level to improve rice yields with improved nutrient uptake efficiency. On average, farmers are realizing up to 20% yield increase with 30-35% less use of fertilizer (IFDC 2008).

Given a relatively fixed amount of land, the expansion of rice production depends on an interrelated package of improved seed-fertilizer-irrigation technologies and government policies leading to increased output per hectare of land. The pre-condition is usually the provision of lower cost agricultural inputs to farmers and better farm-gate prices for outputs. The GoB is seeking to promote more growth and stability for the crop sector—not only for the dominant rice crop, but also for other cash and industrial crops. Therefore, increasing agricultural production is essential and remains a constraint in agriculture and rural development.

3.2 The Fertilizer Sector

Fertilizer has been an essential component of Bangladesh's successful strategy to increase food-grain production and promote agricultural development. The contribution that fertilizer has had in Bangladesh's efforts toward agricultural development and food-grain self-sufficiency is well documented. The chemical fertilizers used in Bangladesh include macronutrients such as nitrogen (N mainly from urea), phosphorus (P_2O_5), and potassium (K_2O from muriate of potash [MOP]). The use of phosphate now mainly comprises triple superphosphate (TSP) and diammonium phosphate (DAP). Secondary and micronutrients include mainly sulfur (S), zinc (Zn), and boron (B).

The use of fertilizer in Bangladesh dates back to the 1950s. Initially all chemical fertilizers were imported and distributed free of cost. The Department of Agriculture (now Ministry of Agriculture [MOA]) was responsible for their promotion and distribution. Inadequate arrangements and unsatisfactory progress in the program to manage inputs led to the creation of Bangladesh Agricultural Development Corporation (BADC) in 1961. As a public entity, BADC sold fertilizer to private dealers and appointed dealers in every union (the lowest administrative unit) of Bangladesh, and BADC was responsible solely for all procurement, transportation, and storage of fertilizers for sub-districts formerly called Thanas and now Upazilas. Fertilizers were

sold to farmers at countrywide uniform, regulated prices fixed and subsidized by the government.

Fertilizer supply until 1962 was from import sources only. Later, fertilizer supply emerged from two sources in Bangladesh (i.e., import and local production). The first urea factory went into commercial production on July 1, 1962.

The distribution of all fertilizers was gradually withdrawn from BADC to the private sector since 1992. This was done through policy reforms, training of private sector dealers, farmers, and continuous monitoring of the fertilizer sector under the Fertilizer Distribution Improvement (FDI) projects funded by the United States Agency for International Development (USAID) and implemented by the International Fertilizer Development Center (IFDC) from 1979 through 1994. The new system of fertilizer distribution worked satisfactorily for a number of years. The system, among others, rested on adequate and timely availability of fertilizers at the distributor level with minimal interference from the government.

The progress toward the development of a competitive fertilizer marketing structure suffered a setback in 1994-95, prior to the *Boro* rice season, when a severe scarcity of urea fertilizer surfaced almost all over the country. The scarcity resulted from the decision to export large quantities of urea at a time without knowledge that farmers in many areas had opted for *Boro* rice cultivation in preference over other winter crops. The farmers' preference in all likelihood was influenced by the increase in rice prices following the failure of *Aman* crop in 1994 and reduction of urea price by the government. The choice for larger *Boro* cultivation generated a demand for large quantities of urea, which could not be met owing to the earlier exports. The scarcity triggered large-scale unrest among the farmers.

Although the marketing of phosphates and potash fertilizers has been allowed to continue by the private sector dealers, urea has not been left entirely with the private sector. In reaction to the serious urea deficit in 1995, the government appointed Bangladesh Chemical Industries Corporation (BCIC)[15] dealers for the distribution of urea. At present, there are about 5,300 GoB-

[15] A parastatal organization of GoB under the Ministry of Industries managing all domestic fertilizer factories.

appointed BCIC dealers, who are only allowed to lift urea fertilizer from BCIC factories and warehouses. The government also opened 21 fertilizer warehouses in the northwest and southwest parts of the country for handling about 300,000 mt of GoB-produced and -imported fertilizers. GoB reentered into fertilizer distribution through BCIC by importing urea, phosphate, and potash fertilizers from 1996 to 1997.[16] BADC was brought back into fertilizer business in 2006.

Both the public and private sector now play key roles in the supply and marketing of fertilizers to farmers. The public sector is primarily concerned with (1) urea fertilizer (and to a lesser extent phosphate and potassium) supply being adequate within the country; (2) ensuring that logistics are handled in a timely manner so that farmers have access; (3) stabilizing (at a low level) prices to farmers; and (4) ensuring supply of quality fertilizers. Fertilizer prices are fixed (national/pan-territorial basis) at the importer/distributor/wholesale and retail levels and subsidized to encourage farmer use.

Private sector participation in the Bangladesh fertilizer market occurs at all levels, with the exception of urea fertilizer imports. The private sector, along with the government agency BADC, imports phosphate and potassium fertilizers. Both are involved in wholesale activities. The private sector is entirely responsible for retail sales.

A series of government decisions and orders regulate the following: (1) the quantity and types of fertilizers that the private sector can import and procure from the local factories; (2) fertilizer prices at the import, factory, and retail levels; (3) the number of dealers and retailers that can engage in the fertilizer business; and (4) geographic locations where dealers can operate.
Due to the numerous controls and market interventions by the government at all levels, the private sector is, in effect, being "managed" by the government.

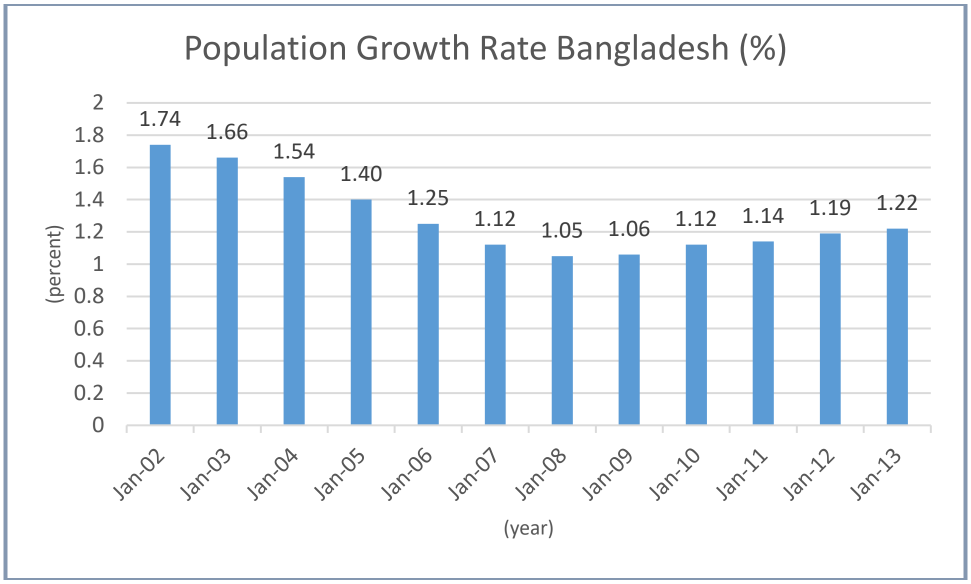
The net effect of the government's influence on the fertilizer supply and marketing system is significant. In broad terms, the combined influence of the government controls (via a policy framework that is based on the "Essential Commodities Act(s)" and a series of periodically

[16] GoB financial year starts from July and ends in June.

issued “control orders”) acts to: (1) allocate supply to individual importers/distributors/retailers; (2) reduce the role of prices in stimulating efficiency in resource allocation and market development; (3) restrict the development of extended dealer networks that will improve farmers’ access; and (4) regulate the supply of fertilizers to individual farmers through an allocation system.

There is no private sector incentive to engage in market development activities such as technology promotion and farmer education. It is clear that the GoB places a high priority on providing farmers timely access to fertilizers. It devotes considerable resources and attention to administering the market. Prima facie, the fertilizer market appears to function as a market-oriented system. In reality, it is a controlled market with essentially little (if any) private sector decision-making participation that can potentially improve cost and performance efficiency and stimulate market development.

Despite the influence of the GoB in the fertilizer sector, the success of Bangladesh’s policies to produce more food and become self-sufficient in food-grain production is well demonstrated by the fact that food-grain production in Bangladesh grew at an annual average rate of 3.25% over the last 14-year period 2000-14 (Annex Table 3.1), while population grew at an annual rate of 1.05% to 1.74% from 2002 to 2013 (Fig. 3.1). Key factors contributing to this success were the rapid adoption of high-yielding variety (HYV) seeds, the increased use of fertilizers and to a lesser extent, improvements in irrigation.



Source: World Bank (2014) World Bank Indicators—Bangladesh Population, *Accessed on September 11, 2014, at http://www.tradingeconomics.com/bangladesh/population-growth-annual-percent-wb-data.html*.

Fig. 3.1 *Annual Population Growth Rate in Bangladesh (2002-13)*

3.2.1 Fertilizer Production, Imports, and Consumption

3.2.1.1 Fertilizer Production

All of the urea, TSP, and DAP factories are state owned and operated as companies under the overall management and supervision of BCIC. In addition to the above, a multinational company called Karnaphuli Fertilizer Company (KAFCO) has been installed. BCIC holds about 42% share in this company. This factory is entirely an export-oriented company, and it started commercial production in 1995. The production capacity of KAFCO was 575,000 mt and is currently 675,000 mt. Although KAFCO was originally set up to export, since 1996 KAFCO has supplied a sizable portion of its urea production to BCIC for domestic use every year and from 2012 has been supplying its entire urea production to BCIC. Later, two DAP factories were established to improve the supply of phosphate fertilizers. The details of different factories are presented in Table 3.1.

Although BCIC is installing a new urea factory (Shahajala Fertilizer Company) with a nameplate capacity of 580,000 mt this will replace the oldest factory, Natural Gas Fertilizer Factory Limited (NGFFL). The prospect of expanding new urea production units is not bright, as there are

competing demands for natural gas for energy production. It is debatable, however, whether the use of natural gas for energy production makes more economic sense than for production of fertilizer.

Table 3.1 *Fertilizer Producers in Bangladesh Supplying the Domestic Fertilizer Market*

Sl. No	Name of Factory/Location	Product	Year of Construction	Annual Capacity (mt)
1	Natural Gas Fertilizer Factory Ltd. (NGFFL)/Sylhet	Urea	1961	106,000
		AS		12,000
2	Urea Fertilizer Factory Ltd. (UFFL)/Ghorashal	Urea	1970	469,000
3	Ashugonj Fertilizer & Chemical Company Ltd. (AFCL)	Urea	1981	528,000
4	Potash Urea Fertilizer Factory Ltd. (PUFFL)/Ghorashal	Urea	1985	95,000
5	Chittagong Urea Fertilizer Factory Ltd. (CUFL)/Chittagong	Urea	1987	561,000
6	Jamuna Fertilizer Company Ltd. (JFCL)/Jamuna	Urea	1991	561,000
7	Karnaphuli Fertilizer Company (KAFCO)	Urea	1995	675,000
Total urea production capacity for in-country consumption				2,995,000
7	TSP Complex (TSPC)/ Chittagong	TSP	1974	100,000
		SSP		120,000
8	Diammonium Phosphate (DAP)/Chittagong	DAP 1	2006	240,000
		DAP 2	2006	240,000

Source: BCIC.

The Bangladesh fertilizer industry is old-aged. Four of the ammonia/urea complexes were commissioned more than 30 years ago. The most modern plants, Jamuna Fertilizer Company Ltd. (JFCL) and the Chittagong Urea Fertilizer Factory (CUFL), are both more than 20 years old. Despite a total production capacity of 2.995 Mt/year of urea (equal to over 100% of annual urea use), only 0.839 Mt of urea was produced in 2013-14, yielding a (calculated) capacity utilization rate of 36% (Annex Table 3.2).[17] The annual fertilizer production growth rate decreased by 6.05% over the last 14 years. This is due to various factors, including some outdated process

[17] Natural gas is the key raw material used in ammonia/urea production and is made available through the Ministry of Energy at ~U.S. $3/1,000 ft^3.

technologies, interruptions in the supply of natural gas (feedstock for all of the nitrogen plants), and the poor condition of some factories. In 2013-14, the government (through BCIC) imported and purchased from KAFCO 1.73 Mt of urea—a sixfold increase from a level of 0.30 Mt in 2000-01.

The Bangladesh phosphate fertilizer industry includes two complexes. The TSP/SSP complex, which was constructed more than 40 years ago, has a capacity of 100,000 mt/year of TSP and a separate line with a capacity of 120,000 mt of SSP.[18] The two DAP units have a total capacity of 480,000 mt/year. The phosphate industry is based on imported phosphoric acid and ammonia from KAFCO. Operating rates are very low due to technical and power constraints. In 2013-14, TSP and DAP production totaled only 86,000 mt and 48,000 mt, respectively (Annex Table 3.2). SSP production and use has been banned by the GoB due to adulteration by mixing TSP and SSP in the distribution chain.

3.2.1.2 Fertilizer Import

Bangladesh now imports all major fertilizers: urea, TSP, DAP, and MOP to meet the demand shortfall. Due to low production of fertilizers from the domestic factories, GoB heavily relies on import of all fertilizers.

During the five-year period from 2000-01 to 2004-05, urea imports averaged less than 600,000 mt/year. After 2005-06 urea import averaged 1.1 Mt. In 2010-11 imports went up to 1.81 Mt, and in 2013-14 urea import totaled 1.73 Mt. The import data reported in Annex Table 3.2 include urea supplied by KAFCO for the domestic market. Despite the recent (2006) commissioning of the DAP complex, the reliance on imports of finished phosphate fertilizers (i.e., TSP and DAP) has not declined. In 2011-12, DAP and TSP imports totaled 1.13 Mt, and in 2013-14 it was about 1.0 Mt. Bangladesh imports 100% of its potassium fertilizer requirements; in 2011-12 and 2012-13, imports of MOP totaled 643,000 mt and 787,000 mt, respectively. However, it went down to 382,000 mt in 2013-14.

[18] There is no production of SSP due to the government ban on SSP since 2007/08 and not reported in this paper.

The government, through BCIC, is responsible for all urea fertilizer importation. This is due to the priority attention to ensure that urea is readily available to rice farmers. BCIC international procurement transactions for urea during the past two years are shown in Table 3.2. BCIC imports urea through two main channels: (1) Government to Government (G2G) and (2) Tender. Import through the G2G process is from Qatar, Saudi Arabia, and UAE, and import of urea through tender mostly comes from China. As for an example, in 2013-14 FY BCIC imported 0.83 Mt G2G and 0.567 Mt through tender.

Both the public and private sector are allowed to import phosphate and potassium fertilizers. The government-owned BADC and members of the private sector Bangladesh Fertilizer Association (BFA)[19] import TSP, DAP, and MOP based on anticipated sales levels. BADC imports TSP primarily from North African producers, specifically Tunisia and Morocco. BFA members import TSP and DAP mainly from China and MOP from Belarus and Russia.[20]

In order to accommodate the farm-price subsidy for fertilizers imported by the private sector, the GoB policy is to provide private sector importers a direct reimbursement of fertilizer import costs. The reimbursement amount is calculated on a case-by-case basis and is determined by a review of all import procurement documents. Payments are made to importers for the variance between (1) the cost they incur (i.e., import procurement cost) plus an importer's margin and (2) the official government-mandated purchase price. The system of allowing importers to recover their full import costs plus a margin encourages private sector participation in fertilizer importation. At the same time, this approach may allow inefficiencies in the procurement process by virtue of the assurance of full cost recovery and an agreed-upon margin.

3.2.1.3 Fertilizer Consumption

Almost all farmers in Bangladesh use fertilizers in crop production, and small quantities of fertilizer urea are used in fish ponds. Fertilizer sales by product and year from 2000-01 to 2013-14 are shown in Annex Table 3.2. On a product basis, total fertilizer sales reached a new record in 2013-14 at 4.27 Mt of products. During the last 14-year period from 2000-01 to 2013-14, the

---

[19] BFA was created at the initiative of FDI II project implemented by IFDC.
[20] It would be appropriate to fully assess the relative import efficiency of BADC vis-à-vis the BFA members.

volume of sales of fertilizer products grew at an annual rate of 2.88% from 2.73 Mt in 2000-01 to 4.27 Mt in 2013-14. Most of this growth was due to the rapid increase in the consumption of phosphate and potassium fertilizers. Consumption of potassium fertilizer increased by more than four times, while that of phosphate fertilizers increased 2.5 times over this period. The most rapid growth in consumption of phosphate and potassium fertilizers in general, occurred during the 2010-14 period. Overall annual growth rate is 6.71% and 9.23% for phosphate and potash fertilizers, respectively, during the 2010-14 period. In the case of urea, growth in consumption is substantially smaller at 0.66%. The more rapid growth of phosphorus and potassium use compared to nitrogen consumption is clearly illustrated in Fig. 3.2. The shift in consumption for the last six to seven years positively improved the balanced application of major plant nutrients (N, P, and K) and, possibly, soil fertility and crop yields.

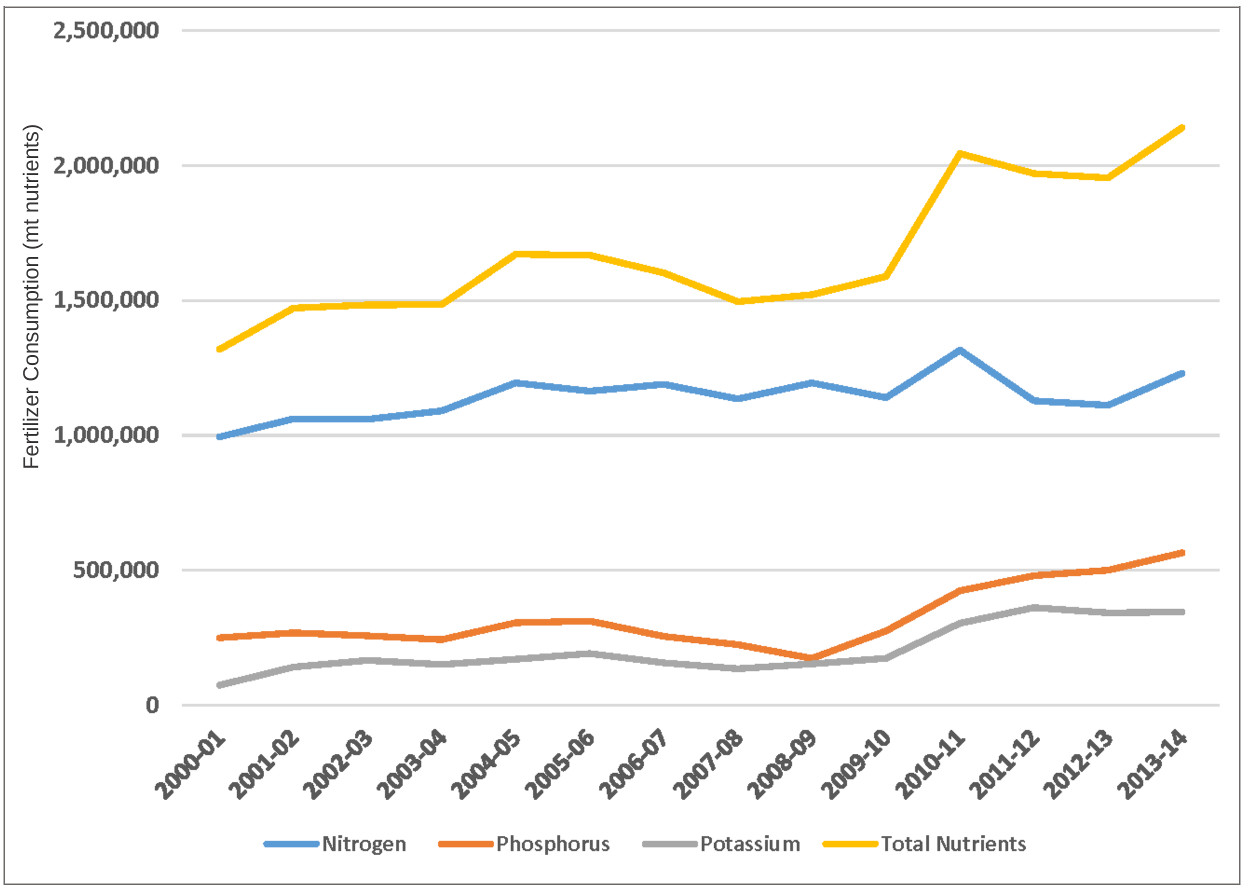


Fig. 3.2 *N, P_2O_5, and K_2O Sales Growth (2000-14)*

During the past 14 years, annual fertilizer consumption has ranged from 1.319 Mt of nutrients in 2000-01 to 2.14 Mt in 2013-14 as presented in Annex Table 3.3. The $N:P_2O_5:K_2O$ ratio is viewed as an important indicator of the relative balance of nutrients used by farmers. In 2000-01, the $N:P_2O_5:K_2O$ ratio was 10:2.5:0.7 and it improved to 10:4.6:2.8 in 2013-14.

The relative stability in year-to-year fertilizer use over the past 14 years, particularly in 2007-08 when international market prices quickly increased to record levels, reflects the heavy role of the GoB in the fertilizer market. In particular, three demand-influencing factors acted to "insulate" Bangladeshi farmers from the large fluctuations that occurred in the global fertilizer market: (1) a general and widespread farmer awareness of the need for fertilizers to achieve higher yields; (2) the stability of a timely supply of fertilizer to farmers; and (3) retail price stability as local prices are subsidized and a stable fertilizer crop/price ratio. All three demand-influencing factors are a direct consequence of the government's emphasis on improved food security, increasing farmer incomes, farmers' education, and fertilizer supply management and price control.

3.2.1.4 Buffer Stock

The GoB, through BCIC and BADC, maintains a buffer stock for urea. Decisions on the national buffer stock are made by the four committees, the MOA, Ministry of Industries (MOI), BCIC, and BADC. That includes the quantity of fertilizer to be held in inventory, the timing of release/replenishment of the stock and monitoring. Both BCIC and BADC are the agencies that manage the physical inventory and associated buffer stock logistics.

3.2.1.5 Registration of Dealers/Retailers

The Bangladesh Fertilizer Association (BFA), established in 1994, is a non-profit active trade association with 7,000 members including private sector fertilizer dealers, importers, and manufacturers of NPK, SSP, micronutrient, and organic fertilizers. BFA is represented on different government committees related to policymaking and agricultural development activities. Membership includes both BCIC-registered dealers and other registered fertilizer dealers.

As previously noted, only BCIC-licensed dealers are allowed to procure fertilizers from BCIC factories and from the BADC warehouses. There are approximately 5,500 BCIC-licensed dealers, of which 4,700 are currently active in the business. Three committees are involved in determining the number of dealers and approving authorized dealers to receive a license. The MOA approves the number of dealers and the individual dealers by district and Upazila (sub-district). The MOI provides a directive to BCIC to issue the license to the MOA-approved dealers.

Dealer licenses are rarely revoked. However, if a dealer is determined to be in violation of providing farmers high-quality fertilizer or if BCIC lifting requirements (stipulated quantities by month) are not met, BCIC, under directive of the MOI, may cancel a dealer's license to procure from BCIC.

BCIC licensing does not apply to non-BCIC fertilizers. Private importers may import phosphate and potassium fertilizers and sell the same through their own channels including the use of either BCIC-/BADC-licensed dealers or non-BCIC-licensed dealers, albeit their performance as per the MOA-approved national demand forecast is closely monitored to assure farmer access in each union. BADC currently sells from its warehouses to some 1,500 non-BCIC-licensed dealers.

A key policy issue in this regard is whether market development at the micro (retail) level should be under control of the government or of the dealers who are dealing fertilizers at the district level. The other policy issue is development of farm-level marketing enterprises, wholly owned and managed by the farmers. Attempts to introduce farmer-led marketing enterprises for fertilizer distribution at the retail level, introduced during 1968 through Union Agricultural Committees (Krishi Samabay Samity [KSS], failed and were never revived.

Based upon government approval, the number of sales agents/retailers allowed per BCIC-licensed dealer was recently increased from three to nine. That means that each of the active 4,700 BCIC-licensed dealers has up to nine retailers, thus creating some 45,000 retail points of sale. In many cases the location of dealers is not demand-driven. The number of dealers cannot increase unless approved by the government.

Fertilizer allotments to retailers are based on the decisions of five government entities—starting with the Department of Agricultural Extension (DAE) and the upazila-level committee. The government target is one dealer per union. The BCIC-licensed dealers typically operate on a “rule of thumb” that 50% of their allotment is channeled to retailers. In reality, there is some conflict at this level in the value chain as the retailers are in competition based upon price with the dealers.

3.2.2 Fertilizer Market Outlook

As indicated previously, Bangladesh’s fertilizer market structure reflects the political sensitivity associated with ensuring that farmers have affordable and timely access to fertilizers. While both the public and private sectors have key roles, the marketing system is essentially an administered system (Figs. 3.3 and 3.4). In order to assess the annual demand of different fertilizers, the GoB has formed four committees at different levels. These committees are:

- Upazila Fertilizer and Seed Monitoring Committee (UFSMC)
- District Fertilizer and Seed Monitoring Committee (DFSMC)
- Committee on Assessment of Fertilizer Demand and Preparations of Procurement Plan, headed by the Secretary of the Ministry of Agriculture (MOA)
- National Coordination and Advisory Committee on Fertilizer (NCACF)

It is noteworthy that the fertilizer marketing system in Bangladesh is essentially a physical distribution system, with primary emphasis on logistics management. The government, in effect, “administers” the system through various policy-related actions, with decision-making authority on matters related to fertilizer allocation, wholesale distribution, retail dealer networks, prices, and the product mix. The various marketing-related functions, wherein government involvement occurs, are shown in Table 3.4.

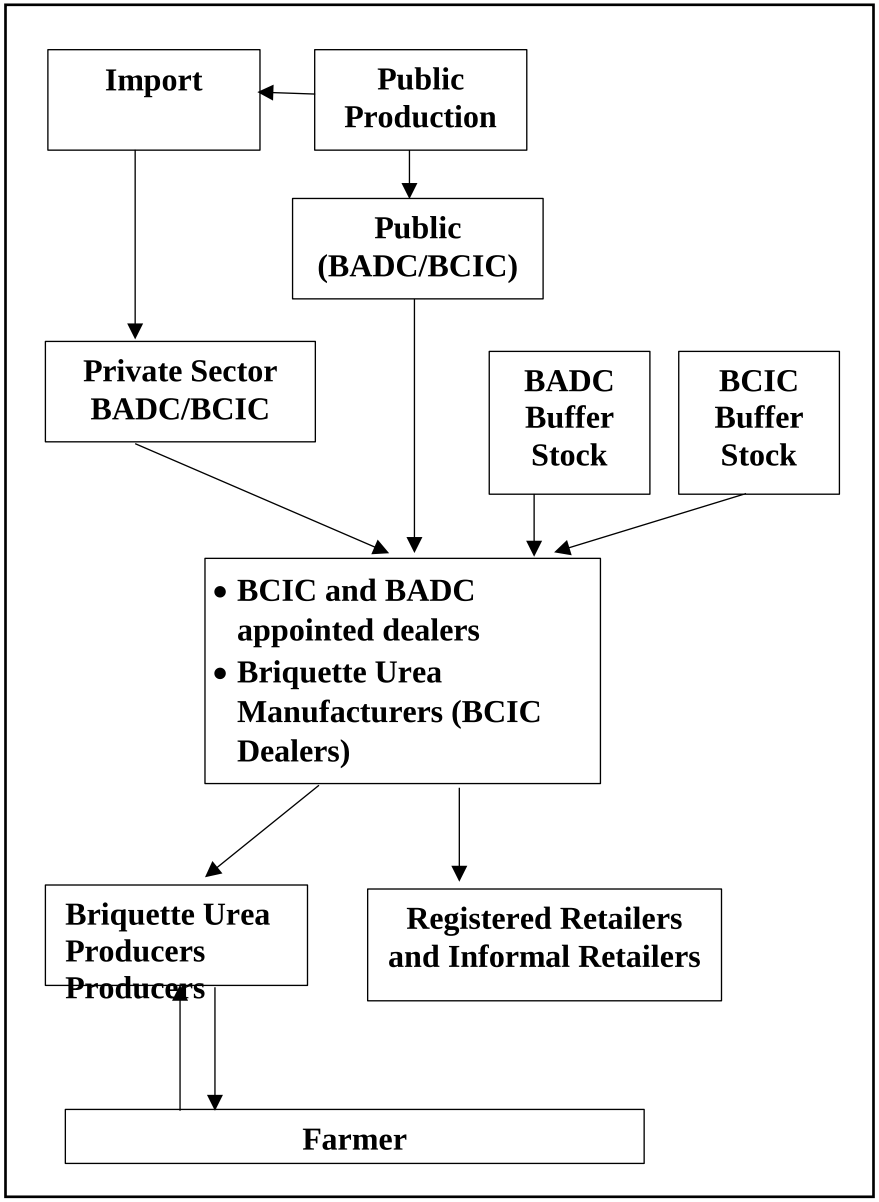


Fig. 3.3 Physical Flow of Fertilizer

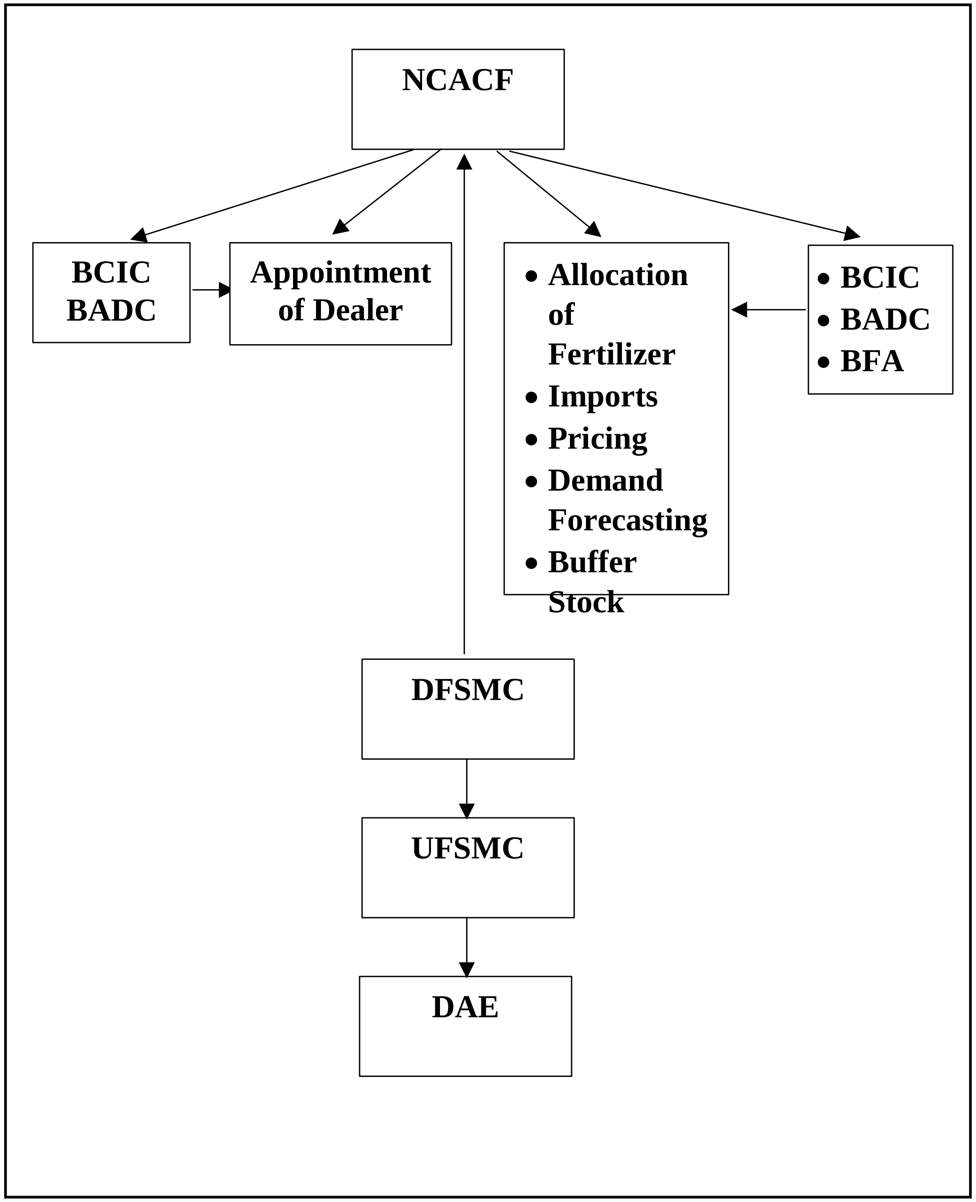


Fig. 3.4 Decision-Making Process/Control Mechanism

The government develops an annual demand forecast by season. It involves a “bottom-up approach,” starting with the DAE agricultural officers making estimates of farmer needs at the block,[21] Upazila and district levels. Each of the two fertilizer committees at the field level are involved with the NCACF (BFA is also represented in this committee), which is responsible for the national demand forecast. It is then submitted to the MOA for final approval.

However, annual fertilizer demand is not being estimated using the basic concept such as price of fertilizer, price of output (crop), farmers income, prices of other inputs and other parameters of production technology. The fertilizer demand is fixed based on agronomic requirement. The administration sets the requirements. But fertilizer demand and fertilizer requirement are two different concepts. Fertilizer requirement, often referred to by the policymakers as “potential demand,” is the assessment of fertilizer need based mainly on the information of total arable land under different crops in different seasons, cropping intensity, possibility of using HYVs by farmers, and the fertilizer dose recommended by the agricultural scientists for a particular crop and agroecological zone. Therefore, there remains a significant gap between fertilizer demand and fertilizer requirement. There is a need for forecasting fertilizer demand professionally for fertilizer policy design and implementation in Bangladesh.

Table 3.2 *Government Ministries/Organizations Involved in Fertilizer Sector Decision-Making/Performance of Supply and Marketing Functions*[a]

Entity	Production	Import	Buffer Stock	Dealer License	Demand Forecast	Dealer Allotment	Pricing	Sub-Dealer Allotment	Promotion	Farmer Allotment
MOA	x	x	x	x	x	x	x	x	x	x
MOI	x	x	x	x		x	x			
MOF	x	x	x				x			
BCIC	x	x	x	x		x	x			
BADC		x	x			x				
DAE			x		x	x		x	x	x
UFSMC			x	x	x	x	x	x		x
DFSMC			x	x	x	x	x	x		x
NCACF	x	x	x	x	x	x	x	x		x

a. In addition to the government ministries, BCIC, BADC, and various committees mentioned here, a number of other government influences may be felt through entities such as the Bangladesh Standard Testing Institute and the Bangladesh Agricultural Research Council (BARC), as well as various acts and laws.
Source: IFDC (2010).

[21] Block refers to the smallest administrative subdivision, comprising between one and three villages.

The NCACF, headed alternately by the Minister of Agriculture and Minister of Industries, is the apex body mandated to finally decide the demand (requirements) estimates for fertilizers. The structure presented in Fig. 3.5 indicates that this committee is aided by another committee headed by the Secretary, MOA. This Secretary committee is again aided by Fertilizer Monitoring Cell, DAE field estimates, and 33 officials from MOA deputed to collect field-level information/data.

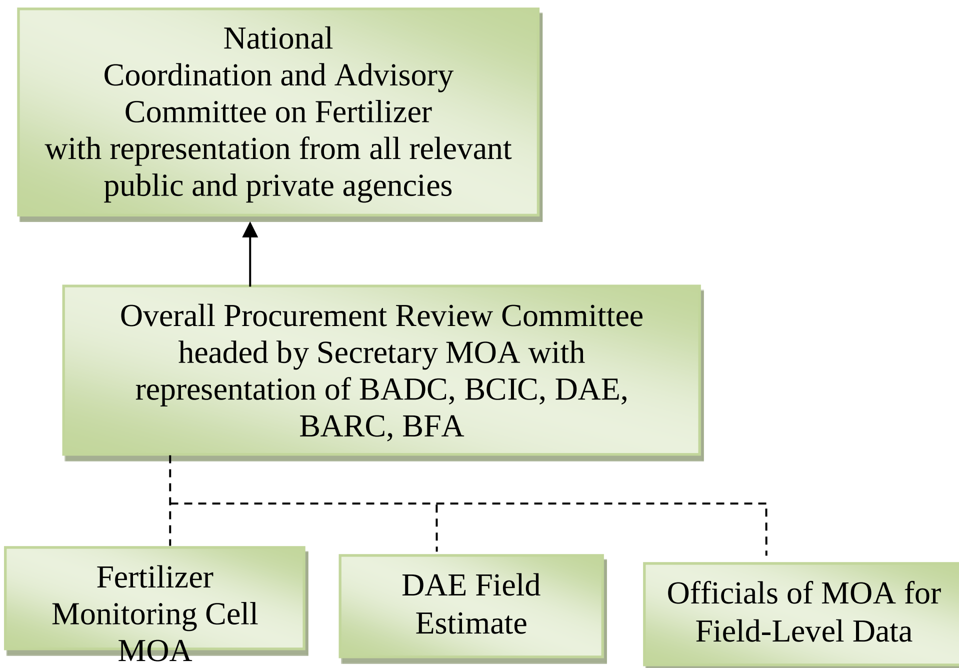


Fig. 3.5 Structure and Process of Demand (Requirement) Estimation of Fertilizer

Once the annual requirements are finalized, estimates for the import procurement program are done separately by the yearly procurement review meeting headed by the Secretary, who advises NCACF on the issue. In recommending demand estimates, the following steps are being followed:

- The process of demand estimation starts in April each year. The process begins with determining the possible closing stock of the present year.
- Present year's stock on April 1 - Past year's sale during (April + May + June) = Possible Stock on July 1.

- Field data from Fertilizer Monitoring Cell of MOA are considered in addition to data from BCIC, BADC, and BFA.
- MOA officials (33) are deputed to 64 districts. They send daily fertilizer (urea, TSP, DAP, and MOP) stock reports for each district as per field monitoring format of MOA.
- DAE sends estimated consumption requirement (crop, livestock, and fisheries) data by district and by month for the next year during March-April of the present year.
- Yearly Procurement Review Committee, headed by the Secretary MOA and including heads of agencies, accepts or rejects or calls for justification of quantity for yearly demand presented for recommendation.
- NCACF takes final decision on the recommendation of Yearly Procurement Review Committee.
- Unsold stock is accounted for in next year's opening stock. The agencies believe that quality remains good even if fertilizer is stored in warehouses over a year. This is not the whole truth, as reports are published about quality-deteriorated and adulterated fertilizers being sold in the market, mostly in national newspapers, every year.

Some consultants/projects estimate demand of fertilizer to provide guidance to the government and also the industry, but ultimately the government decides on the annual fertilizer demand based on the above procedures.

3.2.2.1 Fertilizer Outlook for 2020

One study projected the outlook for fertilizer requirement for three products—urea, TSP, and MOP through 2020 (Basak 2010).[22] This study used four scenarios for estimating fertilizer requirements. The first estimate is based on average **rice production data** for the incremental population using actual rice production from 1999-00 to 2008-09 and then used the **recommended fertilizer dose** for the three rice crops. The second estimate is based on **trend line analysis changing the three rice season production data** and then used the **recommended dose of fertilizer** for the three rice crops. The third estimate is based on average **rice production data** for the incremental population using actual rice production from 1999-2000 to 2008-09 and

[22] Basak JK (2010) Future fertilizer demand for sustaining rice production in Bangladesh: a quantitative analysis. Unnayan Onneshan.

then used the **actual fertilizer dose** for the three rice crops. The fourth estimate is based on **trend line analysis changing the three rice season production data** and then used the **actual dose of fertilizer** for the three rice crops. The estimates are provided in Table 3.3.

Table 3.3 *Projected Demand Estimates of Major Fertilizers, 2020*

Estimates Scenario	Population in Million number	Rice Production (Mt)	Fertilizer Demand 2020 (Mt)		
			Urea	TSP	MOP
1 (Average)	191.65	44.87	2.58	1.44	1.13
2 (Changing)	191.65	44.87	2.56	1.40	1.13
3 (Average)	191.65	44.87	2.00	0.46	0.36
4 (Changing)	191.65	44.87	1.96	0.46	0.36

Note: Total rice production remained the same but the share of three season data (*Boro, Aman,* and *Aus*) changed.

The estimates provided in Table 3.3 appear more realistic in the case of scenarios 1 and 2 compared with the actual sales of fertilizers in Annex Table 3.2.

The forecast value of apparent demand for urea, phosphate, and MOP fertilizers is estimated using the growth rates computed in Annex Table 3.2 for the next five years 2015-16 through 2019-20. The fertilizer outlook for these periods is presented in Table 3.4. However, these estimates should be viewed as conservative projections that should be evaluated and revised every year. Use of urea is projected to decrease because of the urea deep placement (UDP) technology promotion and other improved management practices. On the other hand, use of phosphate and potassium fertilizers will increase if the current price at farm level is maintained.

Table 3.4 *Projected Demand of Major Fertilizers from 2015-16 to 2019-20*

Estimates Scenario	Fertilizer Demand (Mt)			
	Urea	Phosphates	MOP	Total
2015-16	2.55	1.08	0.59	4.22
2016-17	2.56	1.14	0.62	4.32
2017-18	2.58	1.19	0.65	4.42
2018-19	2.53	1.30	0.69	4.52
2019-20	2.47	1.46	0.75	4.68

3.3 Fertilizer Management

The domestic marketing system for fertilizers is essentially a physical distribution system, with few farmer-oriented services (e.g., technical advisory services, convenient access) that are typical of progressive markets. The dominant role of the government is evident in such key areas as demand forecasting and physical distribution planning, setting prices on a pan-territorial basis, making allocations to dealers, and directly influencing various aspects of logistics management. The government's dominant role constrains private incentive for market development activities, including providing improved services to farmers. The current fertilizer policy framework is inconsistent with market-led growth in the fertilizer market.[23]

3.3.1 Nutrient Use Ratio

About five years ago, heavy reliance on nitrogenous fertilizer coupled with poor plant nutrition management, lack of complementary inputs, declining soil fertility, and weak marketing and distribution systems emerged as major impediments to improving the effectiveness of fertilizer use in Bangladesh. Due to lack of efficiency and effectiveness in fertilizer use, the sustainability of fertilizer use has also come under question. The high imbalance in (N:P:K) fertilizer application was an important element of plant nutrition mismanagement. But this situation has been improving.

Varied soil characteristics and cropping practices by geographic area render it difficult to establish an overall "target" of N:P:K ratio. Based on the official *Fertilizer Recommendation Guide* and the approximate cropping pattern, the average national N:P:K ratio should be approximately 10:3.1:4.8. Farmers were not replenishing the soil phosphorus and potassium removed in crop production prior to 2010. This was due to three main factors, as follows:

[23] The fertilizer market in Bangladesh has experienced three periods of major change. Prior to 1982, essentially all fertilizer distribution functions were performed by the government. During 1982-95, under the Fertilizer Distribution Improvement (FDI-I and II) projects financed by USAID and implemented by IFDC, fertilizer market reform occurred and the government withdrew from all fertilizer marketing activities with the GoB's role changing to one of maintaining a pro-market-oriented policy framework and regulatory functions. From 1995 to date, due to various events and the political sensitivity of fertilizer availability, the government gradually re-engaged in controlling the market.

- Farmers can easily see the effect of nitrogen use in crop growth; it is less visible in the case of other nutrients.
- Until 2008-09, the government pricing policy was to price urea fertilizer at less than one-half of the price of phosphate and potassium fertilizers.
- Although most farmers use fertilizers, many do not fully understand the importance of balanced fertilizer use to restore and maintain soil fertility.

The GoB and particularly the MOA are aware of the need to improve the phosphorus and potassium levels in the soil and are taking action to encourage farmers to improve the efficiency of nitrogenous fertilizer by promoting UDP technology and improving soil nutrient management. Improved farmer education, through the DAE, and the fertilizer pricing policy are central components of the MOA strategy to change farmers' fertilizer use practices. The GoB reduced the price of potassium even lower than urea fertilizer and that of phosphate fertilizers close to the urea price.

The GoB policy of lowering the price of P and K fertilizers and improving the efficiency of urea through UDP led to improved sales of phosphate and potassium fertilizers and more judicious application of urea. This resulted in the improvement of the N:P:K ratio from 10:1.5:1.3 in 2008-09 to 10:4.6:2.8 in 2013-14 (Annex Table 3.3). While the use of phosphate fertilizers improved more than the recommended rate, use of potassium fertilizer still needs to be improved.

3.3.1.1 Seasonality of Use

Bangladeshi farmers can potentially harvest three rice crops per season; the average cropping intensity exceeds two. As a result of favorable agro-climatic conditions, fertilizer use occurs throughout the year, with the major cropping seasons overlapping in various parts of the country. Most fertilizer is used during the *Boro* season (December-March) on irrigated rice, other grains, and vegetables. Substantial (but less) amounts are used in the *Aus* (April-July) and *Aman* (July-November) seasons.

3.3.1.2 Fertilizer Use by Crop

Data on fertilizer use by crop in Bangladesh reported by IFA for 2010/11 (Annex Table 3.4) show that rice accounts for 83% of N use, 78% of P_2O_5 use, and 80% of K_2O use (IFA 2013).

Maize, wheat, and vegetables are increasingly being planted and account for much of the remaining fertilizer use. An earlier estimate of FAO in 1998 confirms that rice constitutes the major share of fertilizer use at more than 80% of the total use. See Annex Table 3.5 for more details.

3.3.1.3 Product Mix

The number of fertilizer products used in Bangladesh is limited by regional standards. As indicated earlier, urea, DAP, TSP, and MOP are the main fertilizer products used. As indicated in Annex Table 3.2, farmers applied between 3 and 4 Mt of fertilizer products annually. The highest use was in 2013-14.[24]

The product mix is largely (over 95%) comprised of commodity-type products with a high nutrient content.[25] In general, the current product mix provides the most economical source of plant nutrients available in the form of “dry” fertilizers. As the cropping pattern changes and crop diversification occurs, it will be important to extend the product mix to better accommodate crop- and soil-specific nutrient requirements. This should include increased attention to use of secondary and micronutrients needed to improve yield quality and quantity.

The fertilizer product mix available to farmers in Bangladesh is controlled by the government. A list of approved fertilizer products is issued by the government and periodically updated. For example, single superphosphate (SSP) with an annual use level of over 170,000 mt was banned from sale in Bangladesh in 2009.[26] The list of approved products was expanded to include NPK fertilizer products in the late 1990s, both imported compounds and domestic bulk blends. Six nutrient grades are currently on the list of approved NPK fertilizers. The most popular grade is 8-20-15-5; it is intended for use in high-yield rice varieties in the *Boro* season. Since 2005, the use of NPK products has averaged about 110,000 mt/year—less than 4% of the total market.

---

[24] Preliminary data indicate farmers used 4.266 Mt of fertilizer products in 2013-14.

[25] Urea (46-0-0); DAP (18-46-0); TSP (0-46-0); MOP (0-0-60).

[26] SSP is an effective fertilizer with multiple nutrients that contains phosphate and sulfur. However, it is similar in appearance to TSP. GoB banned the sale of SSP due to frequent complaints by farmers that some unscrupulous dealers were selling SSP under the name of TSP.

Blended NPK fertilizer quality control (e.g., consistency in nutrient content of various grades and product uniformity in physical characteristics) is an issue of growing concern.[27]

3.3.1.4 Promotion

Promotion of soil fertility management is being done by specific development assistance projects and via various government entities. Due to the various government controls on the market (e.g., fertilizer supply to dealers, price, and dealer networks), there is little incentive for private sector participation in fertilizer promotion and farmer education.

Two government bodies, the Soil Resource Development Institute (SRDI) and DAE, are responsible for promoting soil fertility management improvement. Promotional activities for fertilizer products, appropriate use practices, and use benefits are quite limited and are mainly comprised of direct DAE interaction with farmers. Other government organizations such as the Bangladesh Agricultural Research Council (BARC) and SRDI are also involved in providing information that is used by DAE to improve farmer education on the status of Bangladeshi soils.

3.4 Description of Fertilizer Subsidy Program

3.4.1 Objectives of the Program

Fertilizer subsidy results from the twin policy objectives of GoB: (1) keeping grain prices low to ensure availability of food to all, particularly the poor segments of the society and (2) keeping prices of food grain high enough to ensure sufficient incentives for farmers to grow food grain. The policy mix that is commonly followed is three-pronged: (1) fertilizer supply subsidization, (2) demand input subsidization through fertilizer sales subsidization, and (3) output price stabilization strategies such as domestic procurement, open-market sales, and food imports by public sector organizations.

The fertilizer subsidy in Bangladesh is linked with the "Green Revolution" in the 1960s when food-grain production was increased with the advent of improved agricultural input use (seed-fertilizer-irrigation). Since the independence of Bangladesh, rice production has increased

[27] The quality of fertilizers being manufactured at the NPK plants should be assessed; attention to improved quality control to guarantee farmers are receiving the specified nutrient content that is needed.

threefold, whereas population has increased twofold, thus per capita availability of rice in the country has increased. During the early stage of chemical fertilizer use, the government regularly controlled this market and provided subsidies to both wholesalers and retailers to keep the prices of major fertilizers—urea, TSP, and MOP—more affordable to farmers. This was carried out with a view to encourage use of chemical fertilizer, which was mostly unfamiliar to farmers during the early stage of the "Green Revolution." Later, subsidies for fertilizer lost credibility on the logic that by then farmers had become familiar with different categories of fertilizers and their implications. Currently the objectives of providing subsidy on major fertilizers are mainly economic and political.

The economic reason for providing subsidy is essentially to create higher demand for fertilizer at lower prices, which in turn will increase food-grain production. The higher production of food grain will lead to food-grain self-sufficiency and keep the prices of the staple food grain low, ensure food security, and decrease vulnerability to high import prices on the world market.[28]

There are also political objectives for providing a subsidy for fertilizer. The democratically elected government is required to meet its election pledges for providing food grain at lower prices. As Bangladeshi people are net buyers of rice, it may be politically costly for the government not to be able to keep rice prices low.

3.4.2 Evolution of Fertilizer Policy and the Subsidy Regime Over Time in the Context of Food Security Goals

The fertilizer pricing system is complex, with an element of subsidy at all levels in the value chain. A very significant factor in the government decision on fertilizer prices is the price of rice. Emphasis is on maintaining a favorable rice-to-fertilizer price relationship, so that farmers are encouraged to increase yields with improved use of fertilizers. The government provides subsidy

[28] Many economists argue that subsidy is an "*inefficient*" allocation of resource in the sense that farmers pay a lower price for fertilizer compared to the world price of fertilizer, and thereby have more incentive to use too much fertilizer. But a counter argument is that market imperfections such as constraints on access to credit make it difficult for poor farmers to purchase high cost fertilizers. Therefore, the subsidy may not be necessarily introducing inefficiency, but may be considered as a corrective measure to address the imperfections in the agriculture sector of Bangladesh.

and determines price at three levels: (1) the ex-factory, (2) buffer stock, and (3) farm-gate prices. Explanations are as follows:

- ***Ex-Factory and Buffer Stock Level*****—**BCIC is the sole domestic manufacturer of basic fertilizers.[29] BCIC receives a substantial subsidy at all levels—a preferential nitrogen feedstock (natural gas) price for the BCIC factories and a less than full recovery of other operating and capital costs.[30] BCIC also receives a subsidy on imported urea fertilizers, with the MOI providing the difference between actual import costs, and the MOI-approved dealer lifting (wholesale) price. Also at the ex-factory and buffer stock level, BADC and the private sector importers receive a subsidy on imports. The difference between a "benchmark" international fertilizer market price for imports and the farm-level price (less the allowed margin) is reimbursed to the importer by the government.[31] There is typically a delay of two to three months from the time the importer applies for a repayment of the import subsidy until the government effects the payment.
- ***Farm-Gate Level*****—**Dealers are allowed to procure urea, DAP, TSP, and MOP from either BCIC or at the BADC buffer stock level at fixed prices, regardless of the quantity lifted and the season of lifting. The cost of subsidizing imported fertilizers varies with the international price.

Market liberalization is closely linked with pricing policy. Fertilizer prices were subsidized since the beginning of chemical fertilizer use in Bangladesh in the early 1950s. In the early 1980s, with the recommendation of fertilizer distribution improvement (FDI) projects implemented by IFDC, the GoB implemented policies to gradually eliminate all subsidies on fertilizer. This gradual approach prevented abrupt change that would have caused confusion in the fertilizer market. As a result of this policy change, fertilizer prices increased progressively. This resulted in a reduction of the subsidy cost to the GoB from about U.S. $72 million in 1980-81 to U.S. $18

---

[29] There are several small NPK fertilizer formulators and producers of organic/inorganic fertilizer products. However, BCIC is the sole producer of basic fertilizer intermediates and finished fertilizers. BCIC is also the only importer of fertilizer raw materials needed for basic fertilizer production (e.g., phosphate rock and S).

[30] The fertilizer factories in Bangladesh are varied in age and many are inefficient in terms of production efficiency owing to outdated technology and repair needs. The phosphate plants are based upon imported basic raw materials.

[31] The benchmark international market price for DAP, TSP, and MOP is set by the government based upon import prices that prevail with the initial import price realized by BADC and the private sector at the onset of the *Boro* season. The benchmark price then applies to all subsequent imports, meaning importers may enjoy more or less profit, depending upon their success in achieving prices that are below the benchmark price. The frequency of revising the benchmark price is not well established other than it is seasonal.

million in 1986-87. This policy was remarkable in that increased prices did not cause sharp decreases in fertilizer consumption. Although there was no subsidy on urea fertilizer from 1985 to 1986, the subsidy on TSP and MOP continued.

Continuing the subsidy on TSP and MOP involved price regulation and administrative intervention, which was inconsistent with the development of a free and competitive market. Moreover, in addition to the budgetary burden and allocation inefficiency, the existence of the subsidy constrained the GoB in conducting important policy reforms to realize the gains from internationally competitive imports. Therefore, in the process of privatization of fertilizer procurement, marketing, and distribution, subsidies were also removed for TSP and MOP. This process began in August 1991 and was completed in December 1992. From January 1993, fertilizer was procured from domestic public sector factories or through imports on a full-cost basis and distributed by the private sector through wholesale and retail markets to the farmers.

From 1997-98, the GoB introduced a subsidy for urea fertilizer in the form of a trade gap being provided to BCIC for imported fertilizers. BCIC started importing 500,000 to 700,000 mt of urea annually from 1996 to 1997 to meet the demand of the country. In 2007-08, more than 1 Mt of urea was imported. Imported urea is being sold to the BCIC-appointed dealers at the same price as the ex-factory price, and the difference between the sale price to dealers and the import price of urea is being provided to BCIC as a subsidy in addition to a gas subsidy being provided to urea factories. The reason for providing a subsidy is that the import price is much higher than the ex-factory price. However, due to the huge subsidy, especially on urea, the GoB opted for increasing use efficiency of this fertilizer through expansion of UDP technology. See Box 1 for more details on the progress of UDP technology from the research report of the Global Development Network (GDN).

Box 1. Urea Deep Placement in Bangladesh

The normal practice of applying broadcasted urea results in significant losses to the atmosphere and surface and groundwaters.

In order to improve the efficiency of fertilizer use, the farmers have adopted urea deep placement (UDP) bringing an increase in yields of at least 25% above a conventionally fertilized crop. The technique also reduces fertilizer costs.

Since 2007, around 6,000 extension workers and 2 million farmers have been trained in UDP. According to the International Fertilizer Development Center (IFDC), per farm income among those trained has increased by an average of U.S. $116 per year, and the country has saved an estimated U.S. $21 million through more efficient fertilizer use.

Source: Mujeri MK, et al. (2012) Improving the effectiveness, efficiency and sustainability of fertilizer use in South Asia. GDN, Research Paper 8, p. 37.

The GoB has re-introduced a subsidy for phosphate and potash fertilizers at the rate of 25% to 40% of landed import prices in the form of trade gap being provided to the GoB organizations (BADC and BCIC) and private dealers for imported fertilizers in view of the rise in the international price of these fertilizers in 2004-05. The subsidy rate, however, increased up to 75%.

The international procurement prices, the subsidized price at dealers' level, the percent of subsidy and maximum prices at the farm level for the four major products (namely urea, TSP, DAP, and MOP) are presented in Appendices 3.1-3.4. In the case of urea, the subsidy ranged between 27% and 78% from 2000-01 to 2013-14. For TSP, DAP, and MOP, in 2004-05 to 2013-14, the subsidy ranged from 19% to 59%, 17% to 59%, and 20% to 73%, respectively. The differences between subsidy rates are mainly due to variations in international prices and exchange rates.

Appendix Table 3.5 further shows the subsidy amount paid by government for both urea and non-urea fertilizers. Over the period from 2002-03 to 2013-14, the subsidy amount increased from U.S. $17 million in 2002-03 to more than U.S. $1 billion. Until 2008-09, urea accounted for a major share of the subsidy amount, while from 2009 to 2010, the share of non-urea fertilizer subsidy increased considerably. This was mainly due to the fact that the GoB reduced the price

of non-urea fertilizers to promote two policies related to (1) improving the efficient use of fertilizer by promoting UDP technology and (2) improving the balanced use of fertilizer to maintain soil fertility which, according to experts, had been diminishing.

3.4.3 Characteristics and Implementation Modalities of the Current Subsidy Program

Fertilizer subsidies have long been a contentious issue between development partners and the government. Beginning in the 1970s to 1980s, development partners directly aided subsidizing inputs through grants and concessional loans to BADC through various agreements. Throughout the 1970s and 1980s, except in 1974, there was no crisis of funds from external sources. Since the 1990s, the key development partners suggested that output price support should be resorted to as a more effective measure for agricultural growth. However, throughout this period and until the first part of the 1990s, some key multilateral and bilateral development partners continued assistance. Phosphate and potassium fertilizers were entirely funded through grant/loan assistance. The sale price was not on a full-cost basis, and neither was it for urea, in which Bangladesh was self-sufficient. During the late 1980s, the development partners took a two-pronged strategy to develop the input market: (1) by complete removal of subsidy and (2) putting in the new fertilizer marketing system, meaning gradual withdrawal of the public sector from input marketing. This was effected through some externally funded projects for which contributions of funds were made by some bilateral and multilateral aid-giving agencies.

These agencies also requested past governments to adjust gas prices given at a subsidized rate (i.e., less than international prices for BCIC factories). They also pressed for a trader role of the private sector in the import of urea. The government did not agree to such an approach as Bangladeshi farmers, because of poverty, could not afford to buy inputs at full-cost pricing.

The issue of transfer of subsidy to the private sector for import and sale of TSP and MOP resulted as a compromise formula. The public perception of the line of reasoning adopted by the development partners was that it is a dual policy that is being followed in respect to Bangladesh in that (a) the developed countries pay a staggering amount annually to their farmers and (b) under the World Trade Organization rules, the least-developed countries are entitled to provide subsidy to the farmers to the extent of 10% of the agricultural output value.

In the ultimate analysis, the problem is not the removal of the subsidy burden, but whether the intended subsidy reaches the farmers to enable them to reduce the cost of production and thereby earn a better income. Subsidies to inputs such as fertilizers were reintroduced by the government led by Awami League (AL) in 1996 to the extent of Tk 1 billion, which was later raised to Tk 4 billion. The succeeding government led by Bangladesh Nationalist Party (BNP) further increased it. For a long time, BFA in NCACF complained that the new modalities of transfer of the fertilizer subsidy for TSP and MOP involved unusual delay, as it had to be centrally determined by MOA and MOF based on reports from DFSMC. See Box 2 for a summary of procedures involved in distribution and payment of subsidies to importers for importing non-urea fertilizers.

The above situation, as affirmed by BFA, tends to indicate that the time lag has since been substantially reduced. The decision-making process and structure to recommend the subsidy amount have also been further streamlined. At present, such recommendations are being made by a committee led by the Secretary, MOA. BFA is represented in the committee. Since subsidy payments for inputs have now been expanded to inputs other than fertilizers to include diesel for irrigation, it has led the government to introduce what is known as the Input Distribution Card for “real” farmers. Evidence indicates that about 30 million of such cards have been printed, but complete distribution is yet to be finished. By this device, MOA hopes to get around the problem of subsidy not directly reaching the farmers in the field as the price of fertilizers, as well as diesel, are centrally fixed by NCACF.

Box 2. Summary of Procedures Involved in Distribution and Payment to Importers of Imported Non-Urea Fertilizers

The procedures involved in private sector fertilizer import procurement are significantly cumbersome as described below. The procedures contribute to higher costs to both importers and to the government through a series of inspections/verifications and allowances paid to importers for storage and bank costs that accrue due to the time involved in the payment clearance process.

- ✓ Importer opens letter of credit (LC) and informs MOA with a copy of the LC.
- ✓ When cargo arrives at outer anchor of the port, importer informs MOA. MOA assigns a serial number of that imported stock.
- ✓ MOA informs DAE of cargo arrival. DAE collects a sample while the ship is in the outer anchor and sends to a specified laboratory for analysis. If the analysis is per specification, then DAE issues a release letter for unloading.
- ✓ Upon receiving DAE clearance, the importer unloads the fertilizer from the vessel and places it in temporary storage.
- ✓ After storing the fertilizer, the importer informs MOA. MOA asks the inspection committee to physically verify that the product is in storage and gives clearance for sale.
- ✓ MOA, on receiving clearance, allots the fertilizer districtwide through a committee chaired by Deputy Governor, Bangladesh Bank or by the Co-Chairman, Additional Secretary, MOA. On receipt of the allotment, the DFSMC divides the total supply and assigns allotments for transfer from importer to BCIC dealers.
- ✓ BCIC dealers, upon receipt of allotment quantities, take delivery of fertilizer from the importer on payment or on mutual understanding between the buyer and seller.
- ✓ Taking delivery of the fertilizer, the dealer stores its stocks and informs the Upazila Nirbahi Officer (UNO) and the Upazila Accounts Officer (UAO). The UNO and UAO give a certificate of arrival and allow the dealer to sell among the retailers/farmers of his territory. Deputy Commissioner Office also certifies the action to pay the importers and sends it to MOA with a copy to importer.
- ✓ MOA verifies the documents and authorizes the Accountant General Office for payment. Importer (after several persuasions) receives payment.
- ✓ In most cases, dealers help the importers to get the needed clearance certificate from the upazila and district.

Provision of Benefit for Importers

1. Three percent profit is allowed on the gross cost.
2. Thirteen percent bank interest on the cost for four months is allowed.
3. Two months warehouse rent at Tk 2/mt is allowed.
4. Government is paying the trade gap between the government-fixed price and total gross cost.
5. The subsidy amount is released on the basis of all audited documents.

Source: BFA.

3.5 Evaluation of Impacts/Results of the Current Subsidy Program

3.5.1 *Fertilizer Accessibility*

One of the most contentious issues surrounding the fertilizer subsidy is how much of what is paid actually finds its way to the farmers and how much is drawn by the fertilizer industries/BCIC/BADC and other participants in the distribution process. There has always been a debate about the issue of real beneficiaries of these subsidies. Some studies show that the average price paid by large farmers is lower, and the price paid for urea fertilizer starts to decline as farm size increases (Asaduzzaman and Islam 2008). This is because the large farmers purchase more quantity for their lands, while the small farmers purchase less quantity for their very small land areas. Another study cites a joint IFDC/BARC farm-level survey to show that the small farmers do pay higher prices than the medium and large farmer, but the difference is not large enough to suggest that the small farmers do not enjoy the benefit of subsidy at all (Osmani 1985). The limitation of these studies, however, is that they only consider the full price of fertilizer. Apart from the nominal price (administered or otherwise), there are other costs in obtaining fertilizers, for example, transaction costs. The farmer has to go to the dealer on specified days; they may have to wait for a long time. When these costs are accounted for, it may well turn out that the marginal and small farmers pay more for a unit of fertilizer as compared with the rich farmers. Sometimes local political leaders influence the dealers to purchase more fertilizers which may favor large farmer demand. Equally important is that farmers may have to purchase fertilizers at a higher price through non-BCIC-registered dealers because of the influence of extension officers attempting to increase fertilizer demand in their areas. The extension officers are important personnel monitoring the distribution and sale of fertilizers at the field level all over the country. Therefore, non-price factors also play a role in having access to fertilizers.

3.5.2 *Fertilizer Availability*

The fertilizer subsidy is a complex issue as indicated earlier in the report. Although no major fertilizer crisis emerged after 1994-95, farmers frequently complain of the product quality and underweight fertilizer bags. Since 2008-09, no reports of short supply have been reported except

during hartals.[32] Farmers have always reported about an adequate supply of all fertilizers since 2008-09. Annex Table 3.6 provides information on the end stock of fertilizers.

3.5.3 Agricultural Productivity, Farmers' Income, and Nutrient Management Performance

The fertilizer subsidy system in operation in Bangladesh affects the efficiency, effectiveness, and sustainability of fertilizer use. It is evident that unbalanced use of fertilizers was a common and serious concern until 2007-08, and it improved thereafter. The relatively high subsidies given to urea, compared with TSP, DAP, and MOP, led to unbalanced fertilizer use, which depressed yields and adversely affected soil fertility. Fig. 3.2 shows how fertilizer use has changed in Bangladesh since 2000-01, resulting in a rapid increase in the use of urea while the use of other fertilizers remained almost constant until 2007-08. Since 2008-09, the scenario changed in favor of other fertilizers.[33] The yield rate of rice has also improved with improvements in the balanced use of fertilizers as shown in Table 3.5. Yield increased by 16% over a period of six years. Because of the increase in yield, farmers' incomes also increased.

Table 3.5 *Rice Area, Production, and Yield*

Year	Rice		
	Area in ha (million ha)	Production (Mt)	Yield (mt/ha)
2007-08	10.58	28.93	2.73
2008-09	11.28	31.32	2.78
2009-10	11.36	32.26	2.81
2010-11	11.36	33.54	2.91
2011-12	11.53	33.89	2.94
2012-13	11.53	33.81	2.93

Source: Bangladesh Bureau of Statistics.

3.5.4 Fertilizer Market Development and Private Sector Participation, Implications for Businesses, and Subsidy Procedures

Fertilizer sales developed in Bangladesh at an average annual growth rate of 2.88%, from 2.73 Mt in 2000-01 to 4.27 Mt in 2013-14.

[32] When an opposition party calls for a general strike, shutting down all businesses and transportation movement.
[33] See Sect. 3.1 for detailed information on nutrient use.

Both the public and private sectors now play key roles in the supply and marketing of fertilizers to farmers. The public sector is mainly involved in the production and importation of urea, DAP, TSP, and MOP fertilizers, while the private sector is involved in the importation of these fertilizers except urea.[34]

In general, the method of subsidy payment is unnecessarily complicated and highly bureaucratic in Bangladesh. It passes through different committees as indicated earlier. Each committee works at its own pace, which delays subsidy payments. See Box 2 for detailed procedures for payment of the fertilizer subsidy to the private sector.

3.5.5 Fiscal Implications for Government Budgets

The burden of fertilizer subsidies on the government budget is gradually increasing. A huge amount of subsidy has been disbursed over the last 10-12 years. The GoB makes subsidy payments through its revenue budget. Previously the subsidy was budgeted through the annual development program (ADP). After reintroduction of the subsidy on fertilizers in 1996-97, it has been paid from the revenue budget. The subsidy burden, both on the total agriculture and country budgets, is increasing over a period of time. The share of the subsidy to the agriculture budget increased from 10% in 2002-03 to 73% in 2012-13 over a period of 11 years. The total agriculture expenditure was U.S. $2.06 billion in 2012-13, of which $1.50 billion was paid as fertilizer subsidy. Similarly, the share of subsidy to the country budget has been increasing. During the same period, the share of the fertilizer subsidy increased from almost zero to 7% of the total country's budget, which was U.S. $20.20 billion. The fiscal burden of the GoB will continue to increase if fertilizer demand continues to expand and if the international price of fertilizers rises. See Appendix Table 3.6 for more details.

The fertilizer subsidy is a preferred means to achieve food-grain productivity. However, the merits of the fertilizer subsidy should be considered in the broader context of developmental objectives such as the risk of returns, adoption of new technologies, and macroeconomic feasibility of instituting a subsidy regime.

[34] See Sect. 3.2 for detailed information.

3.6 Lessons Learned and Expected Changes to the Subsidy Regime

In Bangladesh, the main challenge is to maintain steady growth in crop yields in the face of diminishing marginal returns to agricultural inputs. Farmers can improve their net returns from agriculture with lower cost inputs and enhanced efficiency of input use.

Bangladesh cannot meet its demand for fertilizer from domestic production alone. Although it has sufficient urea capacity installed, it does not have the technical efficiency nor an adequate supply of natural gas to significantly increase current operating rates. Its capacity to meet demand from domestic production has steadily declined since 2000-01 when 32% of all fertilizers were imported. The share of imports has gone up to 76% in 2013-14. MOP is entirely imported. Although Bangladesh has two DAP plants, they hardly contribute to meeting the rapidly rising local demand. Moreover, the deficit is a localized problem. In a field study, for instance, it has been reported that the total requirement of urea, TSP, and MOP was 4,650 mt, 583 mt, and 588 mt in one of the Upazilas of Bangladesh in 2008-09, but the supply was reported to be only 85%, 18%, and 21%, respectively (Alam 2009). In the case of TSP and MOP, the short supply was mainly due to very low stock available in the country. Also the GoB was concerned that, through some parts of the coastal belt, fertilizers were smuggled into Myanmar.

In Bangladesh, the need for realistic forecasting of demand for fertilizers is apparent. The overestimation of demand leads to high inventory carrying costs, deterioration in the quality of fertilizers due to prolonged storage under high humidity conditions, and liquidity problems. On the other hand, underestimation of demand results in situations of fertilizer scarcity and a rise in fertilizer prices paid by farmers, thus leading to lower agricultural production due to inadequate quantities of fertilizers applied to the crops. This brings out the need to adopt appropriate methodologies for fertilizer demand assessment in Bangladesh. It is important to recognize that reliable fertilizer demand forecasting is the first step toward planning for their adequate and timely availability. Whereas a short-term demand assessment meets the immediate fertilizer requirements, medium- and long-term demand forecasts become essential as tools for planning for the future.

The economic reason for providing a fertilizer subsidy lies in the fact that it encourages farmers to produce more food grains. The economic reason for not providing a subsidy for fertilizer lies in the argument that this is an inefficient allocation of resources in the sense that farmers pay a lower price for fertilizer compared to the world price of fertilizer, thereby having less incentive to judiciously use fertilizer. Yet the counterargument to not providing a subsidy is that, farmers are constrained by low access to credit and liquidity and would find it difficult to purchase fertilizer without a "subsidy." In this situation, they would be using suboptimal amounts of fertilizers. Therefore, the "subsidy" is not about introducing "inefficiency" in an "efficient" environment, but may be considered as a "correcting device" to address issues of imperfections in the Bangladesh agriculture sector.

The present system of fertilizer distribution and subsidy payment involves huge administrative cost to sustain the policies and controls. An alternative could be direct payment to farmers. But managing/overseeing direct payment to millions of farmers would involve huge costs as well. It may also be difficult to ensure that direct transfer of a subsidy to millions of farmers would actually be used by farmers for purchasing fertilizer without significant leakages. If the subsidy is not used for fertilizer, agricultural production would be decreased. A major problem is that local agricultural extension staff are preoccupied with managing and controlling fertilizer distribution at the union level, and thus their primary responsibility of providing agricultural extension support to farmers is seriously hindered. There is clearly scope to improve the current system.

The existing fertilizer subsidy policy, although having a positive impact in Bangladesh, is not free from flaws. Along with a substantial reduction of subsidies and diverting resources to more productive investments in agriculture, nutrient-based subsidies (where all fertilizers—including urea—would be treated the same way) could be adopted. Moreover, steps should be taken to create a national database of farmers that will allow better targeting of fertilizer subsidies.

Recently, the GoB introduced a card system[35] to ensure supply of subsidized fertilizer to all farmers according to the size of their farms.

According to many farmers and fertilizer briquette producers, adulterated fertilizers, especially urea and MOP, have penetrated the markets of Bangladesh. In order to restrict adulteration, quality testing and ensuring quality control mechanisms at different levels need to be strengthened along with taking necessary actions against persons involved in fertilizer adulteration. Strong monitoring is needed at storage and distribution points to check for the adulteration of fertilizers.

Due to lack of proper extension services, the farmers are usually not aware of the best methods of applying fertilizer. Recently improved fertilizer application techniques are gaining popularity among the Bangladeshi farmers. Some farmers are moving away from the common practice of surface broadcasting urea on rice, which may result in large nitrogen losses, to UDP, which reduces nitrogen losses due to volatilization, denitrification, and floodwater runoff by 30%, allowing farmers to realize a 15-18% increase in yields. Reducing nutrient losses is a critical step toward improving soil fertility and agricultural productivity and reducing negative impacts on the environment.— Improving the efficiency of fertilizer use is of paramount importance and needs particular attention in Bangladesh. Assuming advances in appropriately scaled mechanism, FDP adoption of fertilizer deep placement (FDP) technology (including UDP) for lowland rice would significantly increase fertilizer use efficiency (especially N) and reduce associated costs.

FDP technology has an important role to play in improving agricultural productivity and reducing dependence on imported urea. The pace and extent of FDP technology diffusion will be impacted by various fertilizer market-related factors. One important factor is that urea briquettes are, for now, developing outside of the government-mandated fertilizer marketing system. While there is dependence on the BCIC dealer and union-level retail dealers for urea supply, and the fertilizer briquette dealers must operate within the parameters of the broad government policies

[35] Since subsidy payments for inputs have now been expanded to inputs other than fertilizers to include diesel for irrigation, it has led the government to introduce what is known as the Input Distribution Card for “real” farmers. Evidence indicates that about 30 million of such cards have been printed but distribution is not completed.

that influence and regulate private sector behavior, there are no government orders that directly pertain to urea briquettes.

While the objective of this analysis does not extend beyond assessment of the fertilizer policies that directly impact the fertilizer briquette market, there are actions that would enhance market performance within the fertilizer briquette market and open a window of opportunity to achieve broader-based fertilizer policy reform. The key areas wherein policy reform is needed to support the sustainability of FDP technology in Bangladesh are as follows.

- **Remove barriers to market entry at the retail level:** Urea briquette producers who are not fertilizer dealers are legitimate actors in the fertilizer market. It is important that attention be given to recognize fertilizer briquette producers as legitimate businesses with legal entitlement to apply for and be granted a license to operate fertilizer briquette businesses in Bangladesh. Opening the fertilizer market to any private sector firm (either male or female owned) that seeks to properly register and operate a fertilizer retail point of sale will improve farmer access and create opportunities for improved efficiency. It will allow fertilizer briquette dealers to operate within the policy guidelines and facilitate private sector investment on the basis of market demand.
- **Relax price controls at the retail level:** Relaxation of price controls at the retail level is necessary to achieve increased efficiency in the fertilizer market. It will encourage price determination on the basis of supply and demand and afford retailers the flexibility to engage in competition through promotion, offering services and pricing that will build demand on a systemic basis. The policies of setting the lifting (wholesale) price and predetermining gross margins directly conflict with systemic, market-led development. There is no incentive for the private sector to develop the market through farmer education to improve use efficiency. The only incentive is to improve efficiency in logistics management, thereby increasing the net returns from engaging in the fertilizer value chain. It would appear that the current pricing policy provides an incentive to the private sector for *cost containment and short-term profit maximization*, as opposed to *investment for long-term market growth and improved services to farmers to build the market*. The latter is fundamental to systemic market development.

- **Discontinue the fertilizer allocation system at the retail level:** The current fertilizer allocation system does not reflect market realities; it constrains potential benefits to farmers. Dealer appointments are not based upon geographic centers of demand, and the allocation system does not reflect farmer demand. It is a supply push approach that is more reflective of a command system. The current system discourages dealer network development to provide farmers more convenient access and encourages transaction costs that are non-beneficial to farmers. Allowing retailers to procure and sell fertilizers on the basis of market demand is necessary for efficiency in meeting demand and overall market development. The "allotment system" and "pricing policy" create unintended flaws in the value chain system. The "allotment system" essentially means that dealers can only receive and sell a stated quantity of fertilizers. Market growth and the associated benefits of "economy of scale" are thwarted. The GoB-authorized increase in the number of dealers at the union level (i.e., from three per union to nine per union) was not market/demand driven. The selection of retail dealers is made by government committees at the union level. BCIC dealers and retail-level dealers are, in effect, in a degree of competition for sales to farmers. In the meantime, several thousand unlicensed dealers have emerged and are also buying from the BCIC-licensed dealers.

In a broader context, the fertilizer marketing system in Bangladesh "functions" due to a heavy commitment by (and cost to) the GoB in administering the market. In addition to the aforementioned policy reform measures that would be beneficial, significant policy-related regulations constrain market operations at the importer and distributor/wholesaler levels.

In a relatively small and marginal farmer-dominated agriculture, the availability of credit is an important factor which constrains fertilizer demand, especially demand for fertilizer briquettes needed for FDP technology, and its optimal use at the farm level. The provision of credit in the right amount and at the right time through local and specialized banks and microfinance institutions is necessary for promoting balanced use of fertilizer/FDP technology.

To better understand the fertilizer subsidy policy issues, there is need for further detailed investigation taking into account the following:

- The efficiency of BCIC monopoly import procurement for urea.

- Full assessment of the relative import efficiency of BADC, vis-à-vis the BFA members for non-urea fertilizer.
- Production cost and efficiency of different factories.

References

Alam S, et al. (2009) Input marketing and management system in relation to food security in coastal region of Bangladesh, NFPCSP. Final Report CF No. 11/07, Dhaka

Asaduzzaman M, Islam N (2008) Distribution of benefits of diesel subsidy to farmers and its effectiveness (mimeo). Bangladesh Institute of Development Studies (BIDS), Dhaka

Basak JK (2010) Future fertilizer demand for sustaining rice production in Bangladesh: a quantitative analysis. Unnayan Onneshan

GoB (2013) Statistical Yearbook of Bangladesh 2012. Bangladesh Bureau of Statistics, Statistics and Informatics Division

GoB (2014) Bangladesh Economic Review 2014 (Bangla). Ministry of Finance, 94. Accessed on September 6, http//www.mof.gov.bd/en/index.php?option=com

IFA (2013) Assessment of fertilizer use by crop at global level, 2010-2010/11

IFDC (2008) An assessment of project impact: expansion of urea deep placement technology in 80 upazilas of Bangladesh

IFDC (2010) Market development in fertilizer sector of Bangladesh (Inception Report on Fertilizer Market Assessment).

Mujeri MK, et al. (2012) Improving the effectiveness, efficiency and sustainability of fertilizer use in South Asia. GDN, Research Paper 8, p. 37.

Osmani S (1985) Pricing and distribution policies for agricultural development in Bangladesh. BIDS 13(3-4):1-40

Annex Table 3.1 *Food-Grain Production by Year (2000-01 through 2013-14) in '000 mt*

Year	Rice	Wheat	Maize	Total
2000-01	25,085	1,673	10	**26,768**
2001-02	24,300	1,606	64	**25,970**
2002-03	25,190	1,507	117	**26,814**
2003-04	26,189	1,253	241	**27,683**
2004-05	25,156	976	356	**26,488**
2005-06	26,530	735	522	**27,787**
2006-07	27,318	740	899	**28,957**
2007-08	28,931	850	1,346	**31,127**
2008-09	31,317	850	730	**32,897**
2009-10	32,257	969	887	**34,113**
2010-11	33,541	970	1,552	**36,063**
2011-12	33,889	995	236	**35,120**
2012-13	33,814	1,255	2,178	**37,247**
2013-14	34,265	1,281	2,236	**37,782**
Annual Growth Rate	***3.09%***	***-2.43%***	***34.38%***	***3.25%***

Source: Ministry of Agriculture (2014).

Annex Table 3.2 *Production, Import, and Sale of Major Fertilizers by Year (2000-01 through 2013-14) in '000 mt*

Year	Production				Import				Total Production + Import				Sale			
	Urea	Phosphate	MOP	Total	Urea	Phosphate	MOP	Total	Urea	Phosphate	MOP	Total	Urea	Phosphate	MOP	Total
2000-01	1,883	68	-	**1,951**	302	489	123	**914**	2,185	557	123	**2,865**	2,121	490	124	**2,734**
2001-02	1,545	66	-	**1,611**	522	429	248	**1,199**	2,068	494	248	**2,810**	2,247	528	233	**3,009**
2002-03	2,057	65	-	**2,122**	286	446	278	**1,010**	2,342	511	278	**3,132**	2,247	497	271	**3,015**
2003-04	1,986	67	-	**2,053**	235	460	272	**967**	2,221	527	272	**3,020**	2,324	451	240	**3,015**
2004-05	1,878	54	-	**1,932**	567	447	249	**1,263**	2,446	501	249	**3,195**	2,523	451	220	**3,194**
2005-06	1,730	56	-	**1,787**	836	547	291	**1,674**	2,566	603	291	**3,461**	2,451	545	255	**3,251**
2006-07	1,817	50	-	**1,867**	749	464	295	**1,508**	2,566	514	295	**3,375**	2,515	534	280	**3,329**
2007-08	1,475	127	-	**1,602**	1,170	261	225	**1,656**	2,645	388	225	**3,258**	2,763	499	298	**3,560**
2008-09	1,280	53	-	**1,333**	1,416	305	234	**1,955**	2,696	358	234	**3,288**	2,533	193	85	**2,811**
2009-10	1,056	109	-	**1,165**	1,488	524	320	**2,332**	2,544	633	320	**3,497**	2,409	569	275	**3,253**
2010-11	909	103	-	**1,012**	1,814	791	367	**2,972**	2,723	894	367	**3,984**	2,655	922	507	**4,084**
2011-12	933	113	-	**1,046**	1,294	1,133	643	**3,070**	2,227	1,246	643	**4,116**	2,296	1,044	603	**3,943**
2012-13	1,027	48	-	**1,075**	1,314	871	787	**2,972**	2,341	919	787	**4,047**	2,247	1,088	571	**3,906**
2013-14	839	134	-	**973**	1,731	988	382	**3,101**	2,570	1,122	382	**4,074**	2,462	1,228	576	**4,266**
Annual Growth Rate	***-6.70%***	***4.00%***		***-6.05%***	***16.00%***	***6.30%***	***8.60%***	***10.97%***					***0.66%***	***6.71%***	***9.23%***	***2.88%***

Source: Ministry of Agriculture, September 1, 2014.

Notes: 1. Phosphates include only TSP and DAP.

2. Error in totals can occur due to rounding.

Annex Table 3.3 *Fertilizer Consumption, Status of NPK Use, 2000-14*[a]

Year	N					P_2O_5					K_2O			Total Nutrients	$N:P_2O_5:K_2O$ Ratio
	Urea	DAP	AS	NPKS	Total N	TSP	DAP	SSP	NPKS	Total P_2O_5	MOP	NPKS	Total K_2O		
	(t of nutrient)														
2000-01	975,704	16,214	2,734	-	994,652	183,737	41,435	24,946	-	250,118	74,273	-	74,273	1,319,043	10:2.5:0.7
2001-02	1,033,814	22,866	4,217	1,107	1,062,005	184,673	58,435	22,883	2,472	268,463	139,949	2,009	141,958	1,472,426	10:2.5:1.3
2002-03	1,033,620	21,962	2,100	2,236	1,059,918	172,560	56,125	23,855	4,992	257,531	162,372	4,056	166,428	1,483,877	10:2.4:1.6
2003-04	1,069,077	16,200	1,890	3,870	1,091,037	166,060	41,400	26,640	8,640	242,740	144,000	7,020	151,020	1,484,797	10:2.2:1.4
2004-05	1,160,762	25,329	1,174	7,740	1,195,005	193,213	64,730	30,768	17,280	305,991	156,231	14,040	170,271	1,671,267	10:2.6:1.4
2005-06	1,127,630	26,100	1,327	9,460	1,164,517	200,776	66,700	23,470	21,120	312,066	174,402	17,160	191,562	1,668,146	10:2.7:1.6
2006-07	1,156,900	20,700	1,260	10,750	1,189,610	156,400	52,900	21,960	24,000	255,260	138,000	19,500	157,500	1,602,370	10:2.1:1.3
2007-08	1,104,000	18,000	5,040	8,600	1,135,640	138,000	46,000	21,600	19,200	224,800	120,000	15,600	135,600	1,496,040	10:2.0:1.2
2008-09	1,173,000	4,140	6,300	11,180	1,194,620	138,000	10,580	-	24,960	173,540	133,200	20,280	153,480	1,521,640	10:1.5:1.3
2009-10	1,106,760	24,480	-	8,772	1,140,012	193,200	62,560	-	19,584	275,344	157,800	15,912	173,712	1,589,068	10:2.4:1.5
2010-11	1,157,300	53,000	-	-	1,210,000	224,556	135.444.	-	-	360,000	319,600	-	319,600	1,889,900	10:3.2:2.3
2011-12	1,056,160	72,540	-	-	1,128,700	294,860	185,380	-	-	480,240	361,800	-	361,800	1,970,740	10:4.3:3.2
2012-13	1,033,620	78,120	-	-	1,111,740	300,840	199,640	-	-	500,480	342,600	-	342,600	1,954,820	10:4.5:3.1
2013-14	1,132,520	97,740	-	-	1,230,260	315,100	249,780	-	-	564,880	345,600	-	345,600	2,140,740	10:4.6:2.8

Source: IFDC. (2011). Bangladesh Fertilizer Market Assessment: Implications Relative to the Accelerating Agriculture Productivity Improvement (AAPI) project in Bangladesh, p 7. For Year 2010-11, source IFA (2014) and for years 2011-12 to 2013-14 calculated by author from Annex Table 3.2 only from urea, DAP, TSP, and MOP. Other figures are not available.

a. All reference to the nutrient content of fertilizers is based upon oxide rather than elemental. To convert oxide to elemental for phosphorus and potassium fertilizers, multiply the nutrient content (oxide basis) by 0.436 and 0.83, respectively.

Note: Error in totals can occur due to rounding.

Annex Table 3.4 *Bangladesh Fertilizer Nutrient Use by Crop, 2010-11 ('000 mt)*

	Total	Rice	Wheat	Maize	Other Cereals	Soybean	Palm Oil	Other Oil Crops	Fiber Crops	Sugarcane	Roots and Tubers	Fruit	Vegetables	Other Crops
N	1,210	1,004	13	12	0	0	2	10	18	12	24	36	36	41
P_2O_5	360	281	8	4	0	0	1	9	4	5	7	11	11	21
K_2O	191	153	3	2	0	0	1	4	2	6	4	6	6	6
Total NPK	**1,761**	**1,438**	**24**	**18**	**0**	**0**	**4**	**23**	**24**	**23**	**35**	**53**	**53**	**68**
N	**% of Total**	82.98%	1.07%	0.99%	0.00%	0.00%	0.17%	0.83%	1.49%	0.99%	1.98%	2.98%	2.98%	3.39%
P_2O_5		78.06%	2.22%	1.11%	0.00%	0.00%	0.28%	2.50%	1.11%	1.39%	1.94%	3.06%	3.06%	5.83%
K_2O		80.10%	1.57%	1.05%	0.00%	0.00%	0.52%	2.09%	1.05%	3.14%	2.09%	3.14%	3.14%	3.14%
Total NPK		**81.66%**	**1.36%**	**1.02%**	**0.00%**	**0.00%**	**0.23%**	**1.31%**	**1.36%**	**1.31%**	**1.99%**	**3.01%**	**3.01%**	**3.86%**

Source: IFA. (2013). Assessment of fertilizer use by crop at global level, 2010-2010/11.

Annex Table 3.5 *Statement on Area and Consumption of Fertilizers by Crop During 1998 in Bangladesh*

Crop	Area ('000 ha)	Area %	Consumption of Nutrient/ha			Consumption as Nutrient (in '000 mt)			Consumption as Product (in mt)			Percentage of Consumption		
			Rate N	Rate P	Rate K	Cons N	Cons P	Cons K	Urea	TSP	MOP	Urea	TSP	MOP
Rice	10,117	76.9	72	15	10	728	152	101	1,580,671	329,319	168,954	82.7	75.8	63.7
Wheat	882	6.7	45	10	8	40	9	7	86,127	19,139	11,790	4.5	4.4	4.4
Maize	24	0.2	30	10	8	1	0	0	1,562	521	317	0.1	0.1	0.1
Cane	172	1.3	85	69	72	15	12	12	31,725	25,758	20,675	1.7	5.9	7.8
Pulses	625	4.7	5	2	-	3	1	-	6,792	2,713	-	0.4	0.6	-
Fibers	525	4.0	92	23	54	48	12	28	104,811	26,214	47,345	5.5	6.0	17.9
Groundnut	580	4.4	50	15	8	29	9	5	62,930	18,879	7,749	3.3	4.3	2.9
Fruits	14	0.1	40	12	10	1	0	0	1,194	369	234	0.1	0.1	0.1
Other Roots	142	1.1	75	20	15	11	3	2	23,111	6,163	3,557	1.2	1.4	1.3
Cotton	43	0.3	70	47	51	3	2	2	6,467	4,340	3,624	0.3	1.0	1.4
Banana	39	0.3	60	15	12	2	1	0	5,056	1,259	785	0.3	0.3	0.3
Total	13,162	100	624	238	248	880	200	159	1,910,446	434,673	265,029	100	100	100

Source: FAOSTAT.

Note: 1. Area is expressed in '000 ha; Area % = percentage of area dedicated to respective crop on which farmers apply fertilizers. Rate is expressed in kg nutrients/ha. Consumption, i.e., area multiplied by application rate, is expressed in '000 mt. Year: 1998.
2. Error in totals can occur due to rounding.

Annex Table 3.6 *Production, Import, and Sale of Major Fertilizers by Year (2000-01 through 2013-14) in '000 Mt*

Year	Total Production + Import				Sale				End Stock			
	Urea	Phosphate	MOP	Total	Urea	Phosphate	MOP	Total	Urea	Phosphate	MOP	Total
2000-01	2,185	557	123	**2,865**	2,121	490	124	**2,735**	64	67	(1)	130
2001-02	2,068	494	248	**2,810**	2,247	528	233	**3,008**	(116)	33	14	(69)
2002-03	2,342	511	278	**3,131**	2,247	497	271	**3,015**	(20)	47	22	49
2003-04	2,221	527	272	**3,020**	2,324	451	240	**3,015**	(123)	123	53	53
2004-05	2,446	501	249	**3,196**	2,523	451	220	**3,194**	(201)	173	82	54
2005-06	2,566	603	291	**3,460**	2,451	545	255	**3,251**	(86)	231	118	263
2006-07	2,566	514	295	**3,375**	2,515	534	280	**3,329**	(35)	211	133	309
2007-08	2,645	388	225	**3,258**	2,763	499	298	**3,560**	(153)	100	60	7
2008-09	2,696	358	234	**3,288**	2,533	193	85	**2,811**	10	265	209	484
2009-10	2,544	633	320	**3,497**	2,409	569	275	**3,253**	145	329	254	728
2010-11	2,723	894	367	**3,984**	2,655	922	507	**4,084**	213	301	114	628
2011-12	2,227	1,246	643	**4,116**	2,296	1,044	603	**3,943**	144	503	154	801
2012-13	2,341	919	787	**4,047**	2,247	1,088	571	**3,906**	238	334	370	942
2013-14	2,570	1,122	382	**4,074**	2,462	1,228	576	**4,266**	346	228	176	750

Note: Assuming there was no carry-over stock from 2009 to 2010. Although this is not true, GoB always keep stocks at least for next three months so that no problem arises in terms of availability of fertilizers to farmers.

Appendix Table 3.1 *Subsidized Price of Urea Fertilizer by Year (2000/01-2013/14)*

Year	Sale ('000 mt)	Procurement Price ($/50-kg bag)	Dealers Price ($/50-kg bag)	Subsidy ($/50-kg bag)	% of Subsidy	Maximum Retail Price for Farmers ($/50-kg bag)
2000-01	2,121	9.79	4.63	5.16	53%	5.56
2001-02	2,247	9.25	4.35	4.89	53%	5.22
2002-03	2,247	8.85	4.32	4.53	51%	5.18
2003-04	2,324	11.15	4.24	6.91	62%	5.09
2004-05	2,523	15.09	4.07	11.02	73%	4.89
2005-06	2,451	14.62	3.73	10.89	75%	4.47
2006-07	2,515	16.76	3.62	13.14	78%	4.35
2007-08	2,763	22.27	7.29	14.98	67%	4.37
2008-09	2,533	29.79	13.08	16.71	56%	8.72
2009-10	2,409	17.88	13.01	4.87	27%	8.67
2010-11	2,655	27.09	12.65	14.44	53%	8.43
2011-12	2,296	28.49	11.38	17.11	60%	7.59
2012-13	2,247	22.94	11.26	11.68	51%	7.51
2013-14	2,462	22.96	8.76	14.21	62%	5.00

Source: Ministry of Agriculture and BCIC, September 1, 2014.
Note: Procurement price includes international price including freight + U.S. $50 for in-country transportation cost.

Appendix Table 3.2 *Subsidized Price of TSP Fertilizer by Year (2004/05-2013/14)*

Year	Sale ('000 mt)	Procurement Price ($/50-kg bag)	Dealers Price ($/50-kg bag)	Subsidy ($/50-kg bag)	% of Subsidy	Maximum Retail Price for Farmers ($/50-kg bag)
2004-05	337	13.76	8.45	5.31	39%	10.07
2005-06	380	15.10	10.79	4.31	29%	12.28
2006-07	393	15.29	10.97	4.33	28%	12.41
2007-08	402	25.55	20.41	5.14	20%	21.87
2008-09	175	60.98	49.42	11.56	19%	50.87
2009-10	432	23.46	15.90	7.56	32%	17.34
2010-11	591	30.12	15.46	14.67	49%	16.86
2011-12	641	34.11	13.91	20.20	59%	15.17
2012-13	654	33.78	13.76	20.01	59%	15.01
2013-14	685	30.09	13.76	16.33	54%	15.01

Source: Ministry of Agriculture and BCIC, September 1, 2014.
Note: Procurement price includes international price including freight + U.S. $50 for in-country transportation cost.

Appendix Table 3.3 Subsidized Price of DAP Fertilizer by Year (2004/05-2013/14)

Year	Sale ('000 mt)	Procurement Price ($/50-kg bag)	Dealers Price ($/50-kg bag)	Subsidy ($/50-kg bag)	% of Subsidy	Maximum Retail Price for Farmers ($/50-kg bag)
2004-05	114	18.79	12.22	6.57	35%	13.85
2005-06	165	18.90	12.30	6.60	35%	13.79
2006-07	141	20.61	14.12	6.48	31%	15.57
2007-08	97	33.11	26.02	7.09	21%	27.48
2008-09	18	78.81	65.41	13.40	17%	66.86
2009-10	137	33.58	21.68	11.90	35%	23.13
2010-11	331	34.11	17.56	16.55	49%	18.97
2011-12	403	38.53	15.80	22.73	59%	17.07
2012-13	434	34.51	15.64	18.87	55%	16.89
2013-14	543	34.51	15.64	18.87	55%	16.89

Source: Ministry of Agriculture and BCIC, September 1, 2014.
Note: Procurement price includes international price including freight + U.S. $50 for in-country transportation cost.

Appendix Table 3.4 Subsidized Price of MOP Fertilizer by Year (2004/05-2013/14)

Year	Sale ('000 mt)	Procurement Price ($/50-kg bag)	Dealers Price ($/50-kg bag)	Subsidy ($/50-kg bag)	% of Subsidy	Maximum Retail Price for Farmers ($/50-kg bag)
2004-05	220	13.90	8.55	5.35	38%	10.18
2005-06	255	13.68	9.97	3.71	27%	11.46
2006-07	280	14.81	11.17	3.64	25%	12.62
2007-08	298	22.18	16.76	5.42	24%	18.22
2008-09	85	53.37	42.88	10.49	20%	44.33
2009-10	275	35.02	23.85	11.17	32%	25.29
2010-11	507	24.98	9.13	15.85	63%	10.54
2011-12	603	30.95	8.22	22.73	73%	9.48
2012-13	571	17.86	8.13	9.72	54%	9.38
2013-14	576	17.86	8.13	9.72	54%	9.38

Source: Ministry of Agriculture and BCIC, September 1, 2014.
Note: Procurement price includes international price including freight + U.S. $50 for in-country transportation cost.

Appendix Table 3.5 *Actual Subsidy Amount Paid by Year (2000/01-2013/14)*

Year	Crop Sector Subsidy Budget (Million Taka)	Actual Subsidy Paid (Million Taka)			Exchange Rate (Taka/U.S. $)	Actual Subsidy Paid (Million U.S. $)		
		Urea	Non-Urea	Total		Urea	Non-Urea	Total
2000-01				-	53.9592	-	-	-
2001-02				-	57.4347	-	-	-
2002-03		964		964	57.9000	17	-	17
2003-04		1,448		1,448	58.9353	25	-	25
2004-05		6,619	165	6,784	61.3939	108	3	111
2005-06	11,000	7,678	3,042	10,719	67.0797	114	45	160
2006-07	11,411	7,345	3,482	10,827	69.0318	106	50	157
2007-08	39,000	31,557	3,800	35,357	68.6018	460	55	515
2008-09	57,850	42,735	8,028	50,763	68.8012	621	117	738
2009-10	49,500	19,788	21,002	40,790	69.1848	286	304	590
2010-11	57,000	25,715	30,710	56,425	71.1719	361	431	793
2011-12	70,000	23,297	46,243	69,539	79.0963	295	585	879
2012-13	120,000	48,244	71,459	119,704	79.9326	604	894	1,498
2013-14	90,000	34,015	52,412	86,427	79.9326	426	656	1,081

Source: Fertilizer Subsidy Amount from Ministry of Agriculture, BCIC, and BFA, September 1, 2014.

Notes: 1. Subsidy budget includes fertilizer, rebate on electricity/diesel for irrigation, and support for sugarcane production. Data on separation of supply subsidies and demand subsidies for fertilizer have not been made available.

2. Error in totals can occur due to rounding.

Appendix Table 3.6 *Percent of Subsidy Against Agriculture Budget and Total Government Budget by Year (2000/01-2012/13)*

Year	Amount in Local Currency (Million Taka)			Exchange Rate (Taka/U.S. $)	Amount (Million U.S. $)			Percent of Fertilizer Subsidy to:	
	Fertilizer Subsidy	Agriculture Budget	Total Country Budget		Fertilizer Subsidy	Agriculture Budget	Total Country Budget	Agriculture Budget	Total Country Budget
2000-01	NA	10,384	368,130	53.9592	-	192	6,822	0%	0%
2001-02	NA	9,309	367,820	57.4347	-	162	6,404	0%	0%
2002-03	964	9,708	407,410	57.9000	17	168	7,036	10%	0%
2003-04	1,448	10,948	452,070	58.9353	25	186	7,671	13%	0%
2004-05	6,784	24,640	534,350	61.3939	111	401	8,704	28%	1%
2005-06	10,719	27,787	575,430	67.0797	160	414	8,578	39%	2%
2006-07	10,827	34,410	633,280	69.0318	157	498	9,174	31%	2%
2007-08	35,357	65,792	763,770	68.6018	515	959	11,133	54%	5%
2008-09	50,763	81,032	872,710	68.8012	738	1,178	12,685	63%	6%
2009-10	40,790	73,797	1,040,470	69.1848	590	1,067	15,039	55%	4%
2010-11	56,425	94,863	1,171,950	71.1719	793	1,333	16,466	59%	5%
2011-12	69,539	161,554	1,401,500	79.0963	879	2,042	17,719	43%	5%
2012-13	119,704	164,282	1,614,630	79.9326	1,498	2,055	20,200	73%	7%

Source: 1. Fertilizer Subsidy Amount from Ministry of Agriculture, BCIC, and BFA, September 1, 2014.
2. Budget for agriculture from Bangladesh Economic Survey 2007 (Bangla), p. 218 and Bangladesh Economic Review 2014 (Bangla), pp. 300-303.
3. Exchange rate by year from Bangladesh Economic Review 2014 (Bangla), p. 336.

Note: All are actual figures. NA = not available.

4 China

Jikun Huang and Cheng Xiang

Center for Chinese Agricultural Policy
Chinese Academy of Sciences

4.1 Introduction

Fertilizer has played an important role in increasing crop production in every country, but the problems arising from its use differ largely among developed and developing countries. In developed countries, the overuse of chemical fertilizers was common in the 1970s and 1980s, but environmental regulations and agricultural policy reforms resulted in improvements in nutrient management that facilitated reducing or not increasing fertilizer use (SAIN 2010). The problem in most developing countries, particularly in Africa, often has been the underuse of fertilizer due to marketing and credit constraints affecting affordability at the farm level, deficient infrastructure, and lack of performing distribution chains (Odhiambo and Magandini 2008; Takashi and Ayumi 2010).

China, however, is one of the exceptions, as the underuse of fertilizer is not a problem. After the release of the modern semi-dwarf crop varieties and improvement in irrigation in the 1970s, fertilizer consumption has significantly increased. As early as 1980, China's per hectare fertilizer application for crop production had already surpassed the average fertilizer use of developed countries (Heisey and Norton 2007). By 2000, fertilizer use per hectare in crop production reached 280 kilograms (kg)—nearly three times the world average (Sonntag et al. 2005). Moreover, while total crop area increased by only about 5% in 2000-12 (NBSC 2013), it is estimated that the total chemical nitrogen (N), phosphate (P), and potash (K) fertilizers (in nutrient content) use increased by 48%, 63%, and 102%, respectively, over the same period (Appendix Table 4.1-Appendix Table 4.3).

The excessive use of fertilizer, N fertilizer in particular, is observed in nearly all crops and has been well-documented in literature. Numerous studies have estimated the use of N fertilizer exceeded the amount recommended by scientists by a range of 20-60% in grain (Chen et al.

2006; Huang et al. 2012; Jia et al. 2013) and even more in vegetable production in China (He et al. 2009). This intensive use of fertilizers has raised serious concerns about environmental consequences. For example, nitrate and phosphorus pollution occurred in nearly all major lakes, rivers, and groundwater of most areas where chemical fertilizers were employed (Zhu and Chen 2002). Overuse of fertilizer also resulted in soil acidification that could negatively affect agricultural productivity (Guo et al. 2010). Moreover, it was estimated that emissions from N fertilizer production, transportation, and application alone accounted for nearly 30% GHG emissions in agriculture in 2007—equivalent to 5% of China's total GHG emissions (SAIN 2010).

Several studies sought to understand the reasons for the excessive use of chemical fertilizers in China's crop production. While some indicated that low-quality fertilizer contributed to overuse of chemical fertilizer (without any empirical proof), most studies argued that farmers' lack of knowledge on efficient use of fertilizer, poor extension service, small-scale farming, and rising off-farm employment (or rising wages) were major reasons (Peng et al. 2006; Hu et al. 2007; Huang et al. 2008; Jia et al. 2013; Jia et al. 2014). All studies agreed that training farmers on efficient use of chemical fertilizer would significantly reduce N fertilizer use. More recently, claims that the government's significant subsidies on fertilizer production and use are the primary reasons for excessive use (Ge and Zhou 2012; Li et al. 2013).

Surprisingly, little work has been conducted to examine the impacts of policies, particularly fertilizer subsidy policy, on the fertilizer market. The overall goal of this study is to provide a better understanding of the nature of China's fertilizer market and distortions likely caused by fertilizer subsidy and other policies. Specifically, this paper aims to answer the following questions: What is the general trend in fertilizer production, consumption, and trade? How have subsidy and other policies in the fertilizer sector evolved over time? What are the implications of fertilizer subsidy policy in the government budget? How have fertilizer-related policies distorted fertilizer price and consequently fertilizer production and consumption?

This study shows how China has developed its fertilizer sector using various supporting policies and market interventions. Since the 1990s, China has become the largest fertilizer producer and

consumer in the world. In each stage of fertilizer development, an aggregate package of policies was applied to deal with the major issues of that period. Substantial domestic fertilizer production and consumption subsidies were provided in the past decade. However, despite the sector being highly subsidized, the domestic and international markets were nearly integrated in the early 2000s, which was significantly different from the highly protected fertilizer market of the 1980s and 1990s.

The benefit to fertilizer producers from subsidies has been offset by their losses from fertilizer export restrictions. Moreover, while the aggregate inputs subsidy program, which includes fertilizer subsidy for farmers, has become the largest agricultural subsidy program in China, this subsidy is decoupled from grain production and fertilizer consumption; thus, the program has not resulted in distortion of farmers' production decisions (Huang et al. 2011). While the recent policy package worked as a whole and achieved the government's policy goal of ensuring national food security, the cost to the national budget has been huge and presents long-term sustainability issues. There are better policy options and cost-effective measures to lower production cost and achieve national food security. The good news is that China is now planning to reform its current fertilizer subsidy and trade-distorting policies.

The following narrative introduces: the trends of fertilizer production, consumption, and trade; evolution of fertilizer policy and the subsidy regime; and impacts of these policies. From the impacts perspective, consideration is given to the overall impact of the fertilizer policy and subsidy regime, the overall impact on fertilizer, the impact of the aggregate input subsidy to farmers on their fertilizer use, and the overall policy impacts on fertilizer prices or market distortions. The chapter concludes with a discussion on lessons learned and the way forward.

4.2 Overview of China's Fertilizer Situation

4.2.1 Total Chemical Fertilizer Production, Trade, and Consumption

The chemical fertilizer sector was in an infant stage prior to China's rural reforms, initiated in 1978. Annual production of chemical fertilizer in total nutrient content was only about 100,000 mt nutrients ($N + P_2O_5 + K_2O$) in the 1950s and 1.2 Mt in the 1960s (NBSC 2010).[36]

[36] All amounts discussed in Sect. 4.2 are on the basis of nutrient (N, P_2O_5, and K_2O) content.

Meaningful production of fertilizer was initiated by the Green Revolution after new cereal varieties responsive to fertilizer application were released. By 1978, when China started its rural economic reform, total fertilizer production reached 8.8 Mt (Table 4.1). On average, domestic fertilizer production provided about 58 kg/ha in 1978 (NBSC 2010).

Table 4.1 *Fertilizer Production, Consumption, and Trade in China, 1978-2012 (Mt nutrients)*

	Production	Apparent Consumption			Import	Export
		Total	Industry	Farm		
1978	8.8	10.7	0.0	10.7	1.9	0.0
1980	12.6	15.4	0.0	15.4	2.7	0.0
1985	13.5	16.9	0.2	16.7	3.4	0.0
1990	18.8	26.8	0.4	26.4	8.0	0.0
1995	25.0	35.1	0.6	34.4	10.5	0.4
2000	29.2	34.7	1.1	33.6	6.7	1.2
2005	42.7	48.4	4.4	44.0	7.7	1.9
2010	54.8	51.0	4.4	46.7	3.9	7.6
2012	59.5	54.6	7.9	46.7	4.0	8.8

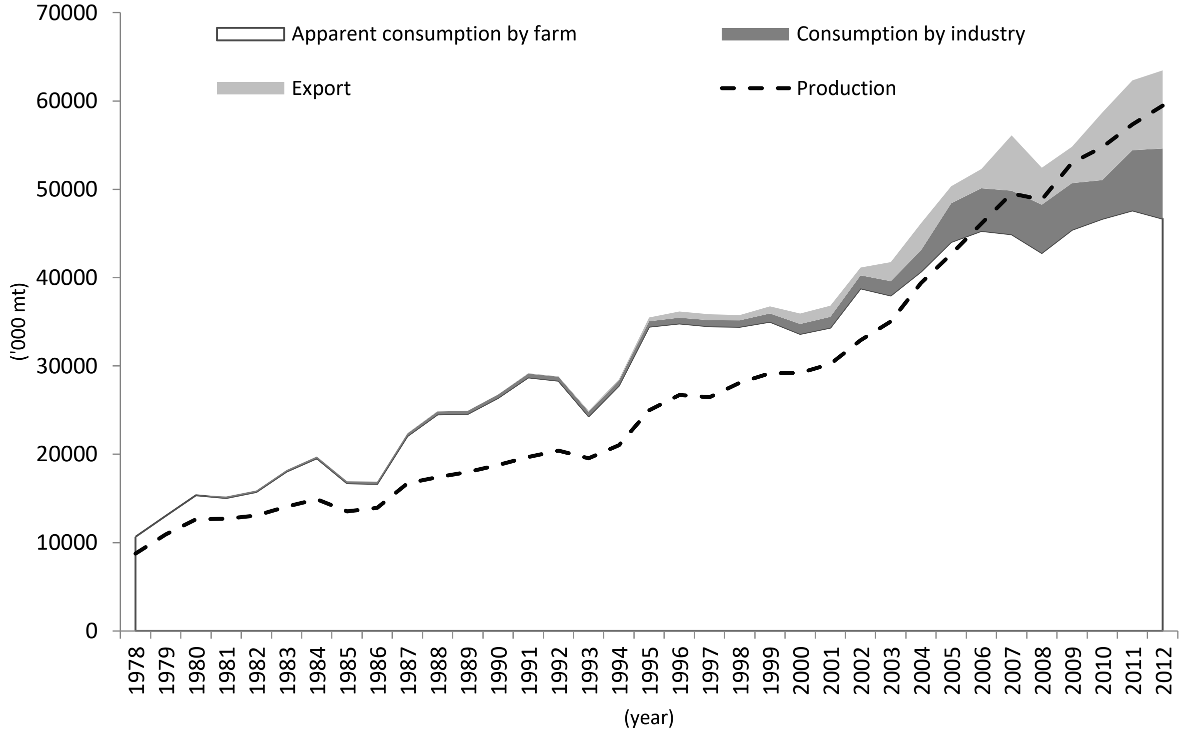
Note: Figures are given in term of nutrients N, P_2O_5 and K_2O by aggregating the data in Appendix Table 4.1 through Appendix Table 4.3. Detailed sources of data are also presented in the notes of Appendix Table 4.1 through Appendix Table 4.3.

The scale and growth of fertilizer production have been impressive in the past three-and-a-half decades in China. Production reached 18.8 Mt in 1990, more than double from 1978 (Table 4.1). By 2000, fertilizer production growth had increased to 29.2 million, a 55% increase over 1990 (Table 4.1). China has been the world's largest fertilizer producer since 1992 (IFA 2014).[37] The most substantial increase in production occurred after 2000. Chemical production doubled again during 2000-12, reaching 59.5 Mt in 2012 (Table 4.1), accounting for 31% of global fertilizer production (IFA 2014).

Despite the rapid growth of domestic fertilizer production, China also significantly increased fertilizer imports to meet the growing domestic demand for crop production. Between 1978 and 1995, the increase in chemical fertilizer production was accompanied with significant, and even faster, growth of fertilizer imports. Imports increased from 1.9 Mt in 1978 to nearly 8 Mt in 1990

[37] This is measured in total nutrients of N, P_2O_5, and K_2O based on the IFA database, 2014: http://ifadata.fertilizer.org/ucSearch.aspx.

and reached its peak at 10.5 Mt in 1995 (Table 4.1). The share of imports in total domestic consumption was raised from 18% in 1978 to about 30% in 1995.



Source: Appendix Table 4.1 through Appendix Table 4.3.

Fig. 4.1 *Chemical Fertilizer Production, Consumption, and Trade in China, 1978-2012 (1,000 mt, measured in total nutrients of N, P_2O_5, and K_2O)*

Continued and accelerated growth of fertilizer production since the late 1990s has shifted China from a major fertilizer importer to a net fertilizer exporter of nitrogen and phosphate fertilizers in recent years. Imports decreased from more than 10 Mt in 1995 to 6.7 Mt in 2000, and to 4 Mt in 2012 (Table 4.1). Meanwhile, China started significant fertilizer exports; annual exports increased from less than 1 Mt in the late 1990s to nearly 9 Mt in 2012. Domestic production exceeded total consumption after 2008 (Fig. 4.1), and by 2012, fertilizer exports accounted for about 15% of domestic production and net exports (export-import) reached 8%.

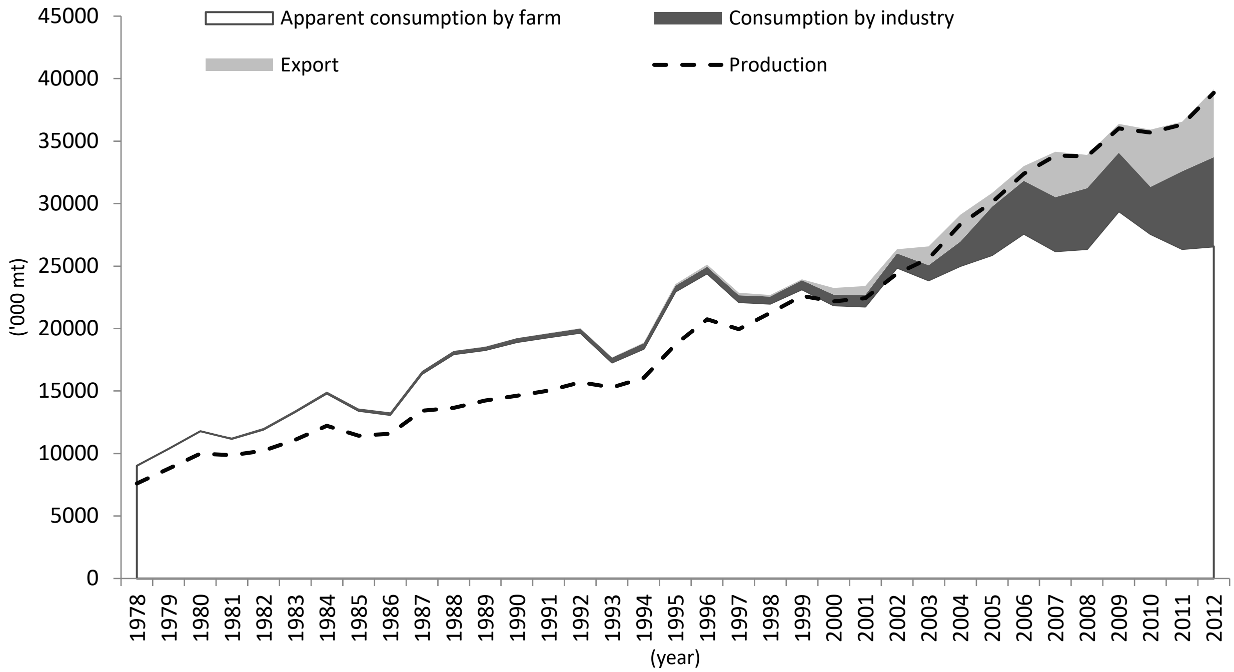
The rising trend of domestic production implies that total fertilizer consumption also increased significantly in China, in particular before the mid-2000s. In less than 30 years, total consumption increased by more than 3.5 times, from 10.7 Mt in 1978 to 48.4 Mt in 2005 (Table

4.1). Indeed, China has become the largest total fertilizer-consuming country since 1989 (IFA 2014). Since 2005, the growth of fertilizer consumption on farms has slowed down with most of the increase in fertilizer consumption coming from industry use since 2010.[38] By 2012, it is estimated that industry consumption of fertilizer accounted for 15% of total consumption, while the other 85% was for farm use (Table 4.1). On a per hectare crop basis, the average Chinese farmer applied 162 kg of chemical fertilizer in 2012, which was about 3.1 times the world average in the same year (FAO 2014).[39]

4.2.2 Production, Trade, and Consumption of Nitrogen, Phosphate, and Potash

The evolution of N fertilizer supply and demand shows China's increasing ability to meet its growing demand for N fertilizer and the changes in China's role in the international market (Fig. 4.2). For the entire period of 1978-2012, the average annual growth rate of China's N fertilizer production reached 4.5%, which was 1 percentage point higher than average annual growth of N fertilizer consumption (3.5%, estimated based on the data in Appendix Table 4.1). Rising N fertilizer production shifted China from importing 4.6 Mt annually in 1990-91 to a net exporter in 2003. Most of the imported products are compound fertilizers (Appendix Table 4.4). By 2012, the production of N fertilizer reached nearly 39 Mt, of which 5.4 Mt was exported (Appendix Table 4.1). Within N fertilizer, the composition of products has also changed significantly. Ammonium bicarbonate (ABC) had the largest share of production before the mid-1990s, with an average share of 57% in the 1980s and 53% in the early 1990s (Appendix Table 4.4). But urea has taken over as the top N fertilizer product since 1997. Compound N fertilizer production reached a significant level only in the past 10 years. In 2012, the shares of urea, other N straight fertilizer, compound fertilizer, and ammonium bicarbonate were 67%, 11%, 15%, and 8%, respectively (Appendix Table 4.4).

[38] Fertilizers for industrial consumption are mainly nitrogen and potash (Zhang et al. 2013).
[39] This is measured in total consumption of N, P_2O_5, and K_2O (measured in nutrients) divided by total crop harvested areas based on the FAO database (2014): http://faostat3.fao.org/download/.



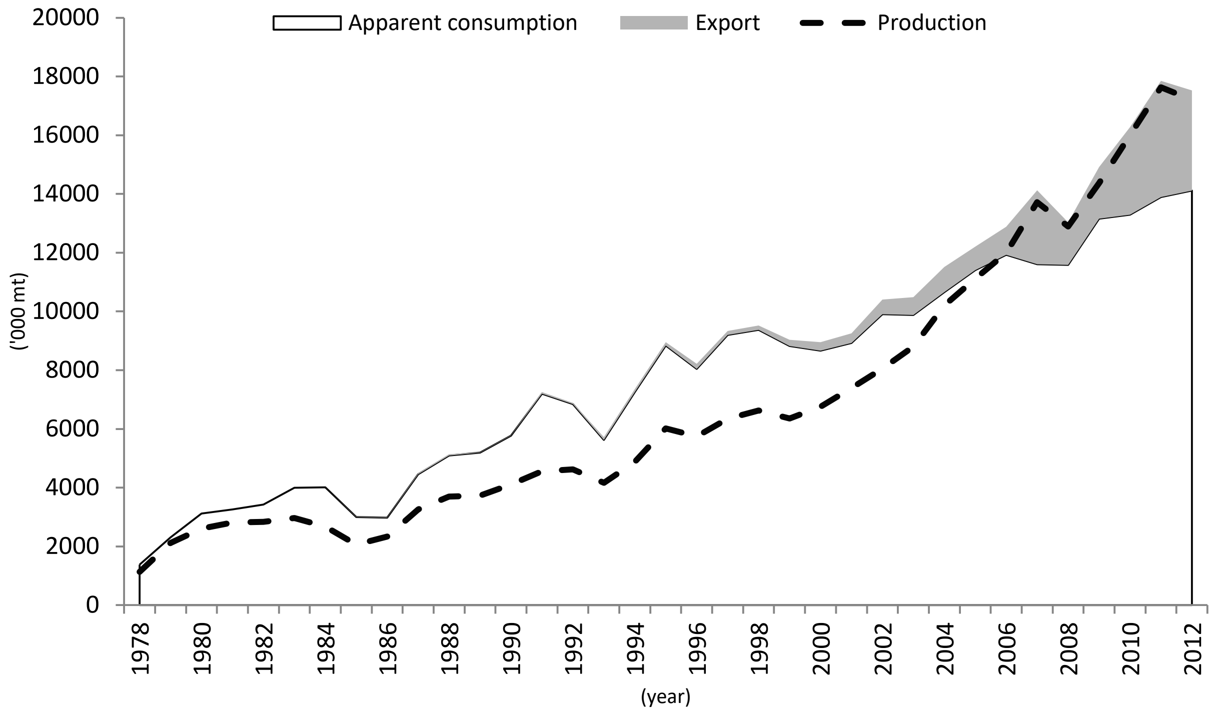
Source: Appendix Table 4.1.

Fig. 4.2 *Nitrogen Fertilizer Production, Consumption, and Export (1,000 mt) in 1978-2012 in China, on the Basis of N Nutrient Content*

In the past three-and-a-half decades, the growth rates of production, trade, and consumption of P fertilizers in China show a similar story as that of N fertilizers (Fig. 4.3). Due to much lower production levels in the late 1970s, P fertilizer production has grown at an even higher rate than N. Phosphorus fertilizer production recorded an average annual growth rate of 6.7% between 1978 and 2012, which was 1.3 percentage points higher than its consumption growth rate estimated at 5.4% (Appendix Table 4.2). Consequently, China shifted from a net importer of P fertilizer to a net exporter in 2006. Foreign dependence on P fertilizer imports fell from about 30% in the 1990s to a mere 3% in 2005 (Appendix Table 4.2). The composition of P fertilizer production has also changed significantly over time. Single superphosphate (SSP) accounted for more than 70% of P fertilizer production before the early 1990s, the rest being primarily Fused Magnesium Phosphate (FMP) (Appendix Table 4.5). The growth of P fertilizer production in China since the late 1990s was mainly from DAP and MAP.[40] By 2012, DAP and MAP each

[40] In fact, most MAP was used for NPK compounds fertilizer production.

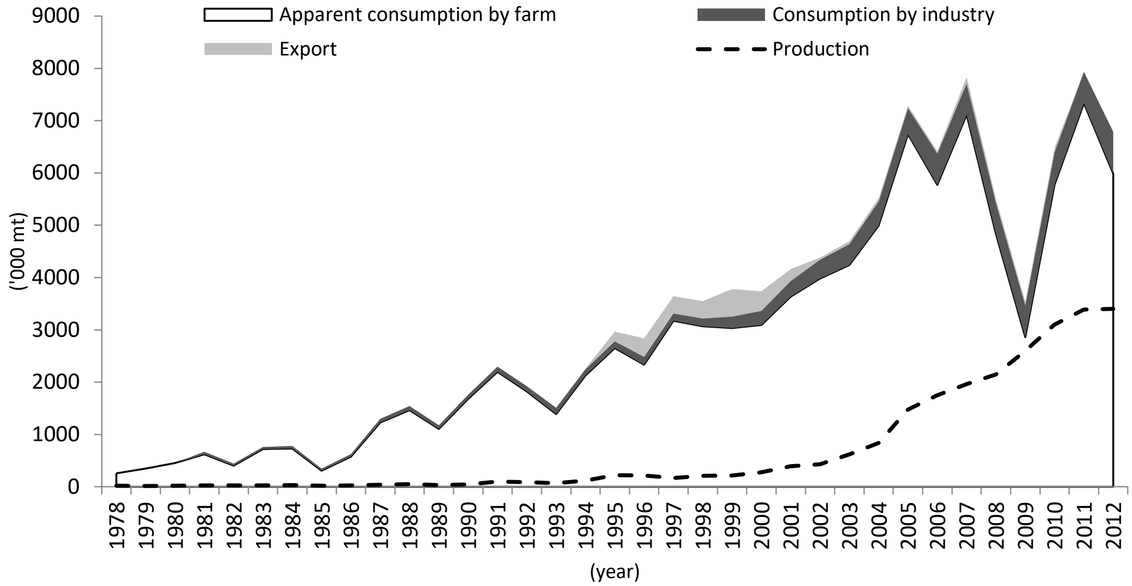
accounted for more than 36% of total P fertilizer production, while SSP and other compound fertilizer each had a share of about 11% of P fertilizer production.



Source: Appendix Table 4.2.

Fig. 4.3 *Phosphate Fertilizer Production, Consumption, and Export (1,000 mt) in 1978-2012 in China, on the Basis of P_2O_5 Nutrient Content*

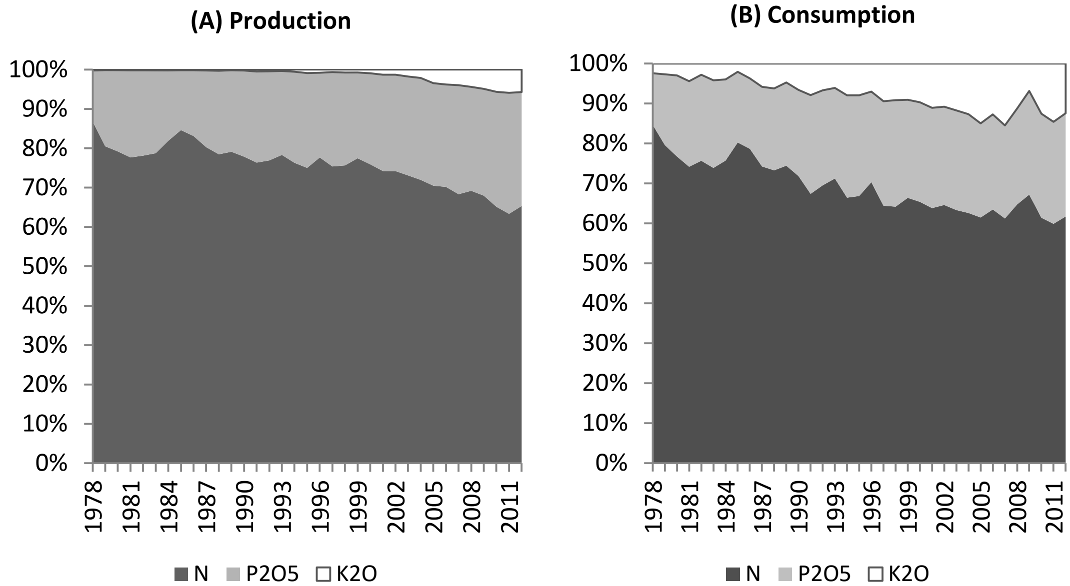
Constrained by its lack of potassium (K) mineral resources, China mainly depends on imports to meet potash consumption requirements. Total production of K fertilizer never reached 1 Mt before 2004 (Fig. 4.4 and Appendix Table 4.3). From 2005 to 2012, domestic K fertilizer production increased from 0.8 Mt to 3.4 Mt as a result of the developments of potassium-brine deposits in Qinghai Province and in Xinjiang Autonomous Region. Major products produced are muriate of potash (MOP) and potassium sulfate (Appendix Table 4.6). The recent significant increase in domestic production has largely reduced China's dependence on the international market for its growing demand. The foreign dependence ratio has declined from nearly 100% in the late 1990s to about 50% in 2012 (Appendix Table 4.3). Nearly all imported K fertilizer is MOP (Appendix Table 4.6).



Source: Appendix Table 4.3.

Fig. 4.4 *Potash Fertilizer Production, Consumption, and Export (1,000 mt) in 1978-2012 in China, on the Basis of K_2O Nutrient Content*

The different growth rates in the production and trade for N, P, and K fertilizers have resulted in significant changes in fertilizer production and consumption in China (Fig. 4.5). In general, production has been dominated by N fertilizer. It accounted for more than 80% of total chemical production in the middle 1980s, but its share has gradually decreased to about 65% in recent years. On the other hand, P and K fertilizer production continue to rise, reaching about 30% for P fertilizer and 6% for K in 2012 (Fig. 4.5). Changes in fertilizer consumption have been more significant than that of production due to the nature of fertilizer imports. In general, the structure of NPK consumption has been improving over time. While China may still be deficient in potassium application, it has over-application of N and P (Yang and Sun 2008).

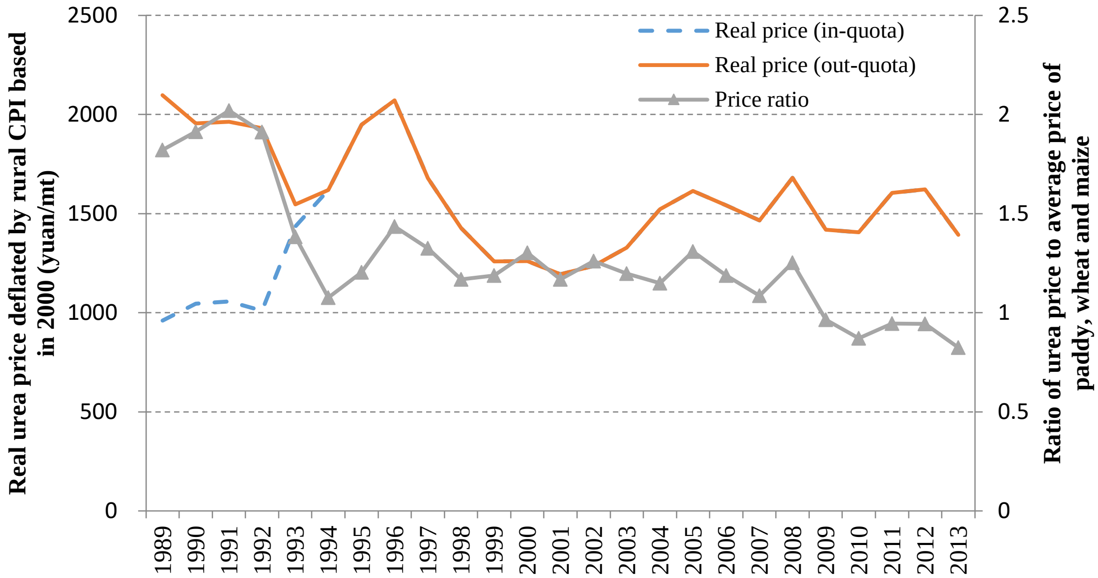


Source: Appendix Table 4.1 through Appendix Table 4.3.

Fig. 4.5 *Composition of Chemical Fertilizer Production and Total Apparent Consumption in China in 1980, 1990, 2000, and 2010*

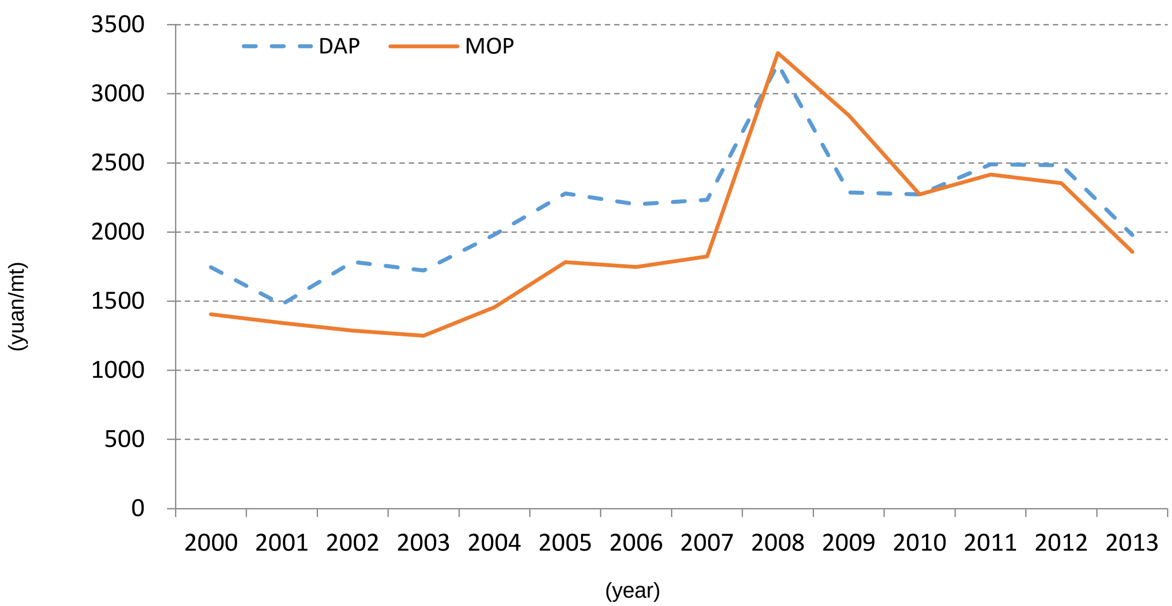
4.2.3 Fertilizer Price Trends

The trends of fertilizer prices differ by type of fertilizers (Figs. 4.6 and 4.7). In spite of large fluctuation, the urea real price presented a long-term falling trend until the middle 2000s and then held at about 1,500 Yuan/mt (Fig. 4.6 and Appendix Table 4.7). Because real grain price had been increasing since the early 2000s, the ratio of urea and grain price decreased even more in the past decade. The trends of DAP and MOP prices differed somewhat from urea. The real prices of both DAP and MOP had been rising gradually until 2007-08 when they peaked at a significantly higher price than urea. Since 2007-08, prices of both fertilizers have gradually decreased (Fig. 4.7). The significant increase in the prices of DAP and MOP in 2007-08 was obviously associated with the global food crisis and significant rises of both food and fertilizer prices in the international market. If excluding data in 2007-09, the price ratio of MOP to grain fluctuated at about 1.3 since the early 2000s, but the price ratio of DAP to grain has been lower in recent years that than in the early 2000s (Fig. 4.8).



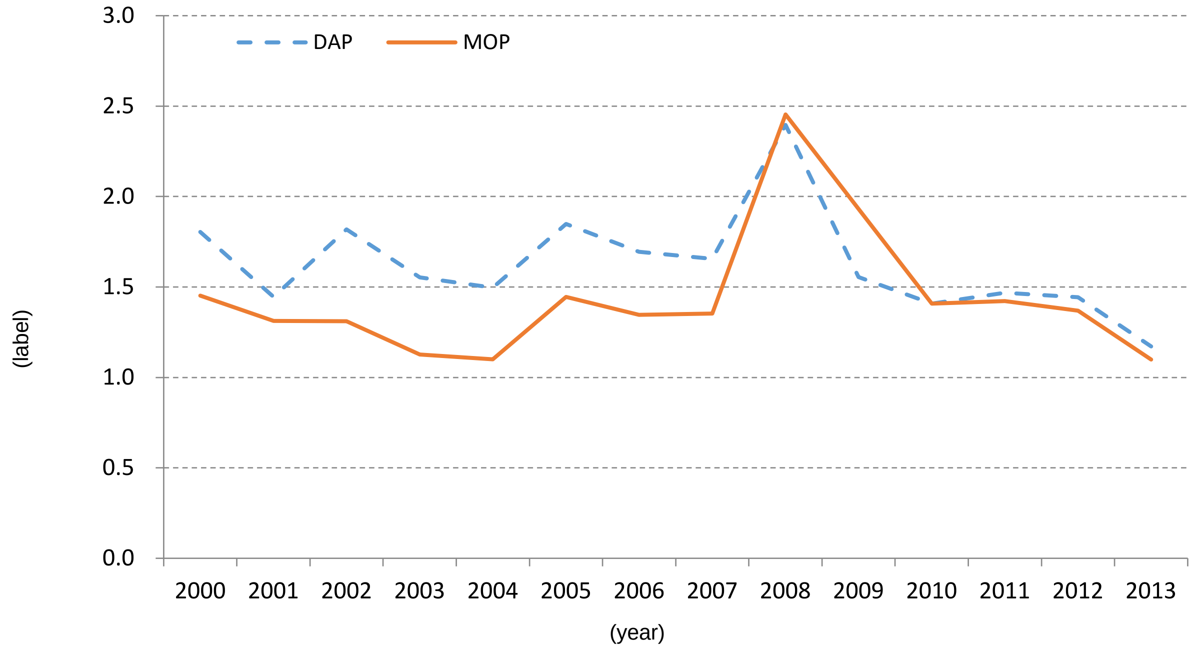
Notes: Grain prices are farm-gate procurement prices and are from NDRC (1990-2014). Urea prices are wholesale prices, and detail sources are provided in Appendix Table 4.8. The rural consumer price index from NBSC (2014) is used to deflate urea price series.

Fig. 4.6 *Real Urea Prices and the Ratio of Urea to Grain Prices in China, 1989-2013*



Sources: The rural consumer price index is from NBSC (2014). The sources of DAP and MOP prices are provided in Appendix Table 4.9 and Appendix Table 4.10.

Fig. 4.7 *Real Prices (Yuan/mt) of DAP and MOP in China, 2000-13 (deflated by rural CPI based in 2000)*



Source: See Appendix Table 4.7.

Fig. 4.8 *Ratio of DAP and MOP Price to Average Price of Paddy, Wheat, and Maize in China, 2000-13*

4.3 Evolution of the Fertilizer Policy and Subsidy Regime

Ensuring national food security is the number one goal of China's agricultural policy. Of the various measures to improve the national food security, increased fertilizer use in crop production has been considered by the nation's leaders as one of the major measures. Therefore, the overall goals of national policy in the fertilizer sector are to increase availability of fertilizer largely through domestic production on the supply side, and to provide incentives for farmers to apply more fertilizer to improve land productivity on the demand side.

To achieve the above goals, China has used a number of policy instruments in different stages of fertilizer development. This section reviews major policies governing fertilizer supply and demand and their likely implications for production, trade, and price. While China's fertilizer policy has evolved over several decades, only a brief discussion on the policies before the late 1990s is provided. Our major discussions are focused on the fertilizer subsidy policies and distortive effects in the most recent 15 years.

4.3.1 Fertilizer Market Reform

China's fertilizer industry was under a planned economy regime before the middle 1980s. Similar to pesticides, machinery, and other inputs, the production, distribution, trade, and consumption of fertilizers were arranged strictly according to the central plan. A unified price was applied nationwide. By the mid-1980s, government's investment in the fertilizer industry made up almost half of its total investment in the petrochemical industry (Zhang et al. 2013). Total fertilizer production increased by more than 50% between 1978 and 1985 (Fig. 4.1). During the same period, China also imported fertilizers, about 20% of total consumption, under the central plan. On the other hand, rural de-collectivization or institutional reform that allocated land equally to all households in each village was initiated in 1978 and was nearly completed in 1984. Under this new production system (household rather than collective production), farmers could make their own production decisions. They could sell their grain and other products in the market at higher prices after they fulfilled their obligations of selling a certain amount of their output to the government (or procurement quota) at lower prices. Farmers could decide on the use of fertilizer and other inputs in crop production. The previously planned economic regime of the fertilizer sector found it difficult to meet farmers' different demands for fertilizers. Planned allocation of fertilizers to millions of farmers became impossible.

The first market reform in the fertilizer sector was initiated in 1985 by introducing a dual-track pricing system. After China completed its rural institutional reform on the household responsibility system in 1984 that allocated the village-owned land to individual households, the dual-track pricing system, comprised of in-quota and out-quota prices (Fig. 4.6 and Appendix Table 4.8), was introduced to agricultural output and input, including fertilizer. The price for in-quota fertilizer was fixed by the government and was much lower than the out-quota price that was close to the market price. Meanwhile, fertilizer retailing had been gradually commercialized, and the share of out-quota fertilizers sold in market had also increased over time. By 1989, the out-quota fertilizers sold to farmers accounted for about 80% of the national total fertilizer (Jiang and Ling 1989). In order to have a better managed market supply and controlled price, only two state-owned companies (the Sino-Agri Group and the Supply and Marketing Cooperatives) were allowed to operate fertilizer wholesale from 1989 to 1997.

With the overall acceleration of marketing reform in the early 1990s, China has implemented several fertilizer market reforms since 1994. In 1994 the government gave up the dual-pricing system and required all the fertilizer enterprises to apply the government reference prices with a limited range of fluctuations based on the changes in market supply and demand (so-called government guided prices). Meanwhile, government also set a maximal price margin between wholesale and retail. For example, this price margin was about 10% in 1994 (Ding 1996). After 1998, nearly all price restrictions or regulations on domestic fertilizers were phased out. The reform has brought substantial growth of the fertilizer production during 1998-2012 (Fig. 4.1). Rising fertilizer production also resulted in a significant fall in the real fertilizer price in the late 1990s (Fig. 4.6).

4.3.2 Major Subsidy and Other Support Policies on Domestic Fertilizer Industry

Parallel to market reform, the support policies for China's fertilizer industry also have evolved over time. Many changes were accompanied or matched with the fertilizer domestic marketing reform and trade policies. Given the importance of fertilizer for national food security and the profitability of farmers' crop production, China used two sets of policies: (1) promoting domestic fertilizer production through subsidy and other support policies and (2) market intervention and trade restriction policies that aimed to control domestic fertilizer prices and secure adequate supply (Tables 4.2 and 4.3). But in each stage of fertilizer development, the policy package differs. In the early stage, to promote domestic production, both domestic support policies and market intervention were in favor of domestic production. In the late stage, to prevent the rise of fertilizer price, the domestic support policies for the fertilizer industry have been used to offset the industry's loss from the fertilizer export restrictions.

Table 4.2 Subsidies and Policy Supports for Domestic Fertilizer Industry in China, 1998-2014

	1998-2000	2001-2003	2004-2007	2008-2012	2013-2014
Electricity[1]	Preferential price and exemption of electricity construction funds policy started in the planned economy period and stopped in 2012				Gradually phasing out the preferential price policy in 2013-18
Natural gas[2]	Preferential price policy started in the planned economy period and stopped in 2012				Phasing out the preferential price policy by 2015
Rail transport[3]	Preferential price and the exemption of railway construction funds since 1998				
Off-season reserve			Subsidized loans for fertilizer reserve implemented since 2004		
VAT (13%)					**All exemptions removed September 2015[4]**
Urea		Full rebate in 2001, half rebate in 2002, no rebate in 2003	Half rebate after paid tax in 2004 and then full exemption since 2005		
DAP				Full exemption since 2008	
MAP	Full exemption since 1998				
Potash fertilizer	VAT fully rebated since 1995 except for 2001-02 when VAT was fully exempted				
NPK compound	Full exemption for NPK compound fertilizer since 1994				
Other nitrogen and phosphate fertilizer		Full exemption since 2001			

[1] The subsidies on electricity use are mainly implemented for small- and medium-sized fertilizer manufacturing plants.
[2] The subsidies on natural gas use are only useful for nitrogen fertilizer enterprises.
[3] The subsidies on rail transport are only for domestic fertilizers used in agricultural production.
[4] The VAT exemption policy was implemented in September 2015 and is considered as one of the major efforts to achieve the national policy goal of zero growth of fertilizer consumption by 2020.

Table 4.3 Fertilizer Import and Export Policies in China, 2000-14

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009-2014
Import										
(i) VAT (13%)										
Urea	13% started in 1997									
DAP	13% started in 2000								Full exemption since 2008	
Potash fertilizer and NPK compound	Full exemption									
(ii) TRQ (Mt)										
Urea			1.30	1.80	2.30	2.80	3.30 in 2006-14			
DAP			5.67	5.95	6.25	6.56	6.90 in 2006-14			
NPK compound			2.84	2.98	3.13	3.29	3.45 in 2006-14			
(iii) Tariff										
Urea, DAP, and NPK compound	About 11% until 2001		4% in-quota tariff and 50% out-of-quota tariff in 2002-05				1% in-quota tariff and 50% out-of-quota tariff since 2006			
Main potash fertilizer	3% started in 2000 and continued until 2005						1% since 2006			
Export										
(i) VAT										
Urea and DAP	Partial exemption before 2001, full exemption in 2001-02, partial exemption in 2003				No exemption since 2004					
Main potash fertilizer	Partial exemption in before 2001, full exemption in 2001-02, partial exemption in 2003-05						No exemption since 2006			
(ii) Tax										
Urea						Tax imposed since 2005				
DAP								Tax imposed since 2007		
MAP									Tax imposed since 2008	
Main potash fertilizer and NPK compound										Tax imposed since 2009

Major support policies included the preferential taxation policy, the subsidy for transportation, electricity and other inputs, and the storage subsidy (Table 4.2). Taxation privilege is implemented through rebate or exemption of the value-added tax (VAT). The transportation subsidy mainly includes discounted railway freight rates for both fertilizer products and their raw materials. Electricity and other input subsidies include preferential prices for electricity consumption and raw materials use such as coal and natural gas and the exemption of electricity construction funds.[41] The storage subsidy is made through subsidized loans for off-season reserve.

Among four major categories of support policies for the domestic fertilizer industry, the preferential VAT policy was the largest support policy in terms of budgetary outlays. This policy includes exemption or rebate of VAT (13%). It has covered nearly all fertilizer products from their production to wholesale and retail. But this policy differs by types of fertilizers and over time, due to their supply situation in the domestic market. The preferential VAT policy was first started on NPK compound fertilizers in 1994 and then gradually expanded to potash fertilizers in 1995, MAP in 1998, urea in 2005 and DAP in 2008. The sequence of the fertilizer products included in the preferential VAT policy is consistent with their supply and demand situation in China. For example, NPK compound fertilizer and potash fertilizer were included as the first group of fertilizers for full exemption or full rebate of VAT because of the large imbalances of the supply and demand of these two types of fertilizers in mid-1990s in China. In implementing the preferential VAT policy, there were slight differences among the types of fertilizers. Full exemption or full rebate policy has been implemented for P and K fertilizers, but urea had mainly enjoyed half of VAT rebate policy before 2005 and full exemption of VAT thereafter (Table 4.2). The benefit to fertilizer manufacturers from the preferential VAT policy has been substantial. If the value added in the fertilizer production accounted for about 60% of output values (Zhang et al. 2007), this implies that the manufacturers have gained about 7.8% (60*13%) of gross value of its total output in recent years. Zhang et al. (2007) estimated that the benefit to fertilizer manufacturers from the preferential VAT policy was 16 billion Yuan in 2005, which was about 6.6% of the gross value of the national fertilizer products in the same year (CNCIC 2006). In a recent study, Li et al. (2013) estimated an 8% of gross value of the national fertilizer

[41] Government phased out coal subsidy for fertilizer production in 1994.

products benefited to the fertilizer manufacturers during 2004-10. In September 2015 all VAT exemptions for fertilizers were removed.

The second largest support policy for the fertilizer industry is the subsidy on transportation for fertilizers.[42] This policy has been implemented for a few decades. Based on several policy documents on the fertilizer transportation prices released by the Ministry of Railway, the rate of the fertilizer transportation subsidy ranged from nearly 60% of freight in the early 2000s to about 40% in recent years. Li et al. (2013) estimated that annual subsidy on railway transportation reached about 8.1 billion Yuan in 2003-10.[43] This amount of subsidy was equivalent to about 2.5% of the total output value of fertilizers in the 2000s, but this share has been falling gradually, to about 1-1.5% in 2010-11.

Electricity and natural gas subsidies also have been implemented for several decades, but these policies are expected to be gradually phased out in the coming years. The electricity subsidy started more than 50 years ago. In the 2000s, fertilizer manufacturers generally paid two-thirds of the average electricity price for the industries that were not subsidized. The subsidy on natural gas started in the 1980s, but only a small portion of nitrogen fertilizer manufacturers benefit from this policy because the production of ammonia in China mainly uses coal rather than natural gas as the major raw material. The gas-based ammonia accounted for only 22.6% in the entire synthetic ammonia capacity in 2012 (Zhang et al. 2013). In addition, fertilizer manufacturers also enjoyed more stable electricity and natural gas prices as decided by the National Development and Reform Commission (NDRC), thus avoiding short-run electricity price hikes. Because the costs of electricity and natural gas account for only a small share of the total cost of fertilizer production, these two subsidies together are less than 1% of the total output value of the whole fertilizer industry in recent years. A recent study showed that the annual electricity subsidy for fertilizer production was about 1-2 billion Yuan since the early 2000s (Li et al. 2013). With oversupply of N and P fertilizers since the mid-2000s, the pressure to eliminate the electricity

[42] Begun in the late 1990s, the transportation subsidy has been applied for domestic chemical fertilizers used on agricultural production. However, it has been excluded for both imported fertilizers and fertilizers for industrial uses.

[43] The average official exchange rate was 8.28 Yuan per U.S. $ in 2003 and 6.77 in 2010.

and gas subsidies has been growing, and China has decided to gradually phase out the electricity subsidy policy between 2013 and 2018 and eliminate the natural gas subsidy.

The seasonal buffer stock fertilizer reserve subsidy, introduced in 2004, is a new subsidy program aimed to balance the supply and demand of fertilizers between peak and off-peak demand seasons. The reserve is managed by the government's designated enterprises/companies that purchase fertilizers, mainly urea and DAP, in the off-season and sell in peak season. The reserve is purchased using the loans on which interest is paid by the government for six months. In the 10-year implementation of the reserve subsidy, off-season reserves of fertilizer products increased from 8 Mt in 2004 to 18 Mt in 2013—the latter was about 20% of the total production of urea and DAP in 2013. The government's annual budget for this fertilizer reserve program has been about 1 to 1.5 billion Yuan in recent years. Given the excess capacity in nitrogen and phosphate fertilizer production, whether this policy should be continued has been debated.

4.3.3 Evolution of Fertilizer Trade Policy

Fertilizer trade policy is an integral part of China's fertilizer policy package which changed over time as China's fertilizer policy package has evolved. On the import side, balancing domestic fertilizer production and imports or the trade-off between consuming domestically produced fertilizer with a higher price and increasing total consumption through importing cheaper fertilizer have been key factors affecting fertilizer import policy. To accomplish these objectives, China has primarily depended on the state trading measure to manage its imports in most periods in the past. The import tariff policy has never been an important measure affecting fertilizer imports, and the export policy became relevant in the past decade when China shifted from being an importer to an exporter of N and P fertilizers, especially following the 2007-08 fertilizer crisis. Balancing domestic supply and demand and maintaining stable fertilizer prices have been the key factors affecting export policy. Both export promotion and restriction policies have been implemented in different periods since the early 2000s.

4.3.3.1 Fertilizer Import Policy

China has used state trading, import quotas, VAT, tariffs, and managing price to regulate fertilizer imports. However, the role of each measure has changed over time. In general, import

policy evolved toward a more liberalized one. But for potash, the major imported fertilizer in China, some extent of import monopolization still exists.

While state trading is a major factor for China's fertilizer imports, competition has also been occurring, though it has traveled a winding path. To manage fertilizer imports, the "Sinochem Group", a state-owned enterprise (SOE), was established in 1950. Sinochem is the largest company in the international trade of chemical fertilizer in China. To introduce competition, China also provided all provincial corporations (provincial SOEs) with agricultural inputs and licenses to import fertilizers in the 1980s and early 1990s. However, the rising number of importers challenged the existing trade management system and monopoly power; a short-run recentralization for fertilizer imports occurred from 1994 to 1998, when Sinochem Group once again became the only company that could import fertilizers. With China's deepening economic reform since the late 1990s, fertilizer import policy was forced to reform by allowing the "Sino-Agri Group," the largest SOE trading company in domestic agricultural inputs, to engage in fertilizer import since 1998. In the interim, China also started to apply quantitative import restrictions on all fertilizers, but after joining the World Trade Organization (WTO) in 2001, further liberalization has been introduced. Numerous trade companies, both SOEs and private companies, were given licenses to import N and P fertilizers after 2001. However, for potash fertilizer, there are still only 10 companies that have import licenses. They include Sinochem Group, Sino-Agri Group, and eight non-SOE companies.

The VAT and tariffs are the other major trade measures, and their effects on fertilizer imports varied in different periods and by products (Table 4.3). Implementation of VAT policy has mainly depended on domestic production and demand. For example, for potash fertilizers and NPK compound fertilizers, the most deficit fertilizers in China, the government has never imposed any VAT. On the other hand, a 13% VAT was first applied on imported urea in 1997 and DAP in 2000. With the significant increase in domestic urea production and China becoming a net urea exporter after the early 2000s, the VAT policy for urea has never been exempted. However, exemption of VAT for imported DAP has been effective after 2008, two years after China shifted from a net importer to a net exporter of P fertilizers.

The fertilizer import tariff was implemented in the late 1990s, but it has never become a significant trade policy (Table 4.3). Before China joined the WTO, fertilizer tariffs were quite low. After China joined WTO, imports of urea, DAP, and NPK compound fertilizers have been subject to a tariff-rate quota (TRQ) regime, replacing quantitative import restrictions. Under the TRQ regime, the in-quota tariff was 4% between 2002 and 2005 and 1% since 2006 (Table 4.3). The above quota tariff has been maintained at 50% during the whole period. Because imports of all fertilizers under the TRQ have never exceeded the import quota, the above quota tariffs have not been applied. For potash fertilizer, the tariff was only 3% before China joined WTO in 2001, and there has been no import quantitative restriction after 2001. A 3% tariff was maintained from 2002 to 2005 and then reduced to 1% since 2006 (Table 4.3).

It is worth noting that the price of imported fertilizer in the domestic market often differed from the actual cost of the import (cost, insurance, and freight [CIF] plus the VAT, tariff free on board [FOB] and other costs at port). Before 1993, the prices for selling imported fertilizers at port were fixed at the domestic ex-factory price. The government would provide financial support for the losses if the import cost surpassed the domestic ex-factory price. If the imported cost was lower than the domestic ex-factory price, the revenue was taken by the government. After 1993, reform in managing the price of imported fertilizer has undergone four steps: (1) between 1993 and 2000, imported fertilizers were sold in the domestic market priced at the real import costs plus 1% profit (or price margin); (2) between 2000 and 2006, the imported DAP and compound fertilizers were allowed to set a price matching the domestic ex-factory price plus or minus 1.7% (while the rules to set the price of imported potash fertilizers remained the same, the price margin rose to 1.7%); (3) between 2006 and 2009, the rules for setting the imported DAP and compound fertilizers were applied to potash fertilizer but with 3% of price flexibility; and (4) after 2009, except for potash fertilizers, price regulations on imported fertilizer have been eliminated.

4.3.4 Fertilizer Export Policy

Two major measures have been used on fertilizer exports, viz., VAT and tax. Before 2015, in general, the export policies had moved toward more restriction (Table 4.3). The change of export policies has mainly taken place after 2004 when China had increasing concerns over national

food security and after the fertilizer price hike in 2007-08 (Figs. 4.6 and 4.7). But export policies were irrelevant before 2000 because China had suffered from a deficit of supply for nearly all types of fertilizers, and China had no comparative advantage in the global fertilizer market.

While VAT exemption had been applied for domestically produced fertilizer, only partial or no exemption of VAT had been applied for fertilizer exports (Table 4.3). With rising real prices of fertilizers since the early 2000s, no exemption of VAT was implemented for the exports of N and P fertilizers since 2004 and K fertilizers after 2006.

In the meantime, China started to implement export taxes and other export restrictions since mid-2005 (Table 4.3). Export taxes were first applied to N fertilizer (e.g., urea) in 2005. The imposition of export restrictions was enhanced during the global food crisis period of 2006-08 when both international and domestic fertilizer prices increased significantly (Appendix Figs. 4.1-4.3). Consequently, China also began to levy additional export taxes on DAP in 2007 and then on MAP in 2008. With the continuous rise of fertilizer prices, in an effort clearly designed to restrain all fertilizer exports, all fertilizer products were subject to a 100-150% export levy from April 2008 to the end of the year. Since 2009, a formal export tax has been imposed on potash and NPK compound fertilizers despite their not being exportable products.

Export taxes are complicated because they differ not only by product but also by seasons and years. In general, exports were almost prohibited during the peak demand season and were allowed only during the offseason in 2008-13. With China's excess capacity in nitrogen and phosphate fertilizer production, export restrictions are expected to be relaxed in the coming year. For example, in the cases of urea and DAP in 2010-12, the off-season export tax was set at 7% only if the export price was lower than the benchmark price set by the government. Otherwise it was calculated using the following formula: (1.07-benchmark price/FOB)*100%. But during the peak season, the export tax was set at 110%.[44] After the rising trend of fertilizer prices stopped in recent years (Appendix Figs. 4.1-4.3), the off-season export tax was reduced to 2% for urea and

[44] The off-season and peak season differ among fertilizer products due to seasonal demand in crop production. For urea in 2010, the off-season is in January, July to mid-September, and the middle of October through December. The peak season is in February through June and the middle of September to the middle of October.

to 5% for DAP in 2013. Meanwhile, the peak-season tariff was lowered to 77% and 80% for both urea and DAP. The export tax was further reduced in 2014. During peak season, the export tax was set at 15% *ad valorem* on top of the off-season tariff which is at 40-50 Yuan/mt. Similar export tax schedules have also been applied to MAP, potash fertilizers, and NPK compound fertilizers.

4.3.5 Agricultural Aggregate Input Subsidy Policy

Rising fertilizer prices and concern about food security, together with significantly increased government revenues in China, have facilitated China's initiation of an agricultural subsidy program. A formal agricultural subsidy program was started in 2004. Since then its budget has increased substantially. Currently, major subsidies in the order of their budget sizes are aggregate input subsidy, machinery subsidy, seed subsidy, and direct grain production subsidy (Table 4.4). Initially, an aggregate input subsidy was aimed to cushion grain producers from increases in prices of agricultural inputs such as fertilizers, pesticides, plastic films, and diesel. However, because of difficulty in implementing this policy based on actual grain production and amount of inputs used by farmers, nearly all rural households receive grain and aggregate input subsidies based on the amount of contracted land recorded in the late 1990s (Huang et al. 2011). So subsidies are mostly being given to the land contractor, not the tiller.[45] Given the nature of implementing the subsidy, the policy should be considered as a direct payment supporting farmers' incomes. Budgetary transfers for this program have constantly been increasing. Overtime, the aggregate input subsidy has been rising from 12 billion Yuan in 2006 to 107.1 billion Yuan (about U.S. $17 billion) in 2014 and has become the most important single budgetary transfer supporting the agriculture sector.

[45] Each farmer has a bank account opened by the government for transferring any subsidy or income from government. The subsidies are normally transferred early in the year.

Table 4.4 Major Agricultural Subsidies in China (billion Yuan) in 2004-14

Year	Aggregate Inputs	Grain	Seed	Machinery
2004	0	11.6	2.9	0.1
2005	0	13.2	3.9	0.3
2006	12	14.2	4.2	0.6
2007	27.6	15.1	6.7	2.0
2008	48.2	15.1	8.0	8.3
2009	71.6	15.1	15.5	13.0
2010	83.5	15.1	20.4	14.5
2011	86.0	15.1	22	17.5
2012	107.8	15.1	22.4	21.5
2013	107.1	15.1	19.9	21.8
2014	107.1	15.1	21.4	17.0

Sources: Data are based on the reviews of policy documents from the Ministry of Finance.

Accompanying the rising agricultural subsidies are the debates on whether these subsidies have achieved their policy goals. There is a consensus among scholars that agricultural subsidies lead to improved rural household incomes (Xiao 2011; Huang et al. 2011). They also demonstrated that there were no significant statistical differences in the amount of agricultural subsidies obtained by different income groups of farmers. However, the empirical evidence on the effect of subsidies on grain production shows that there is very little impact (Du et al. 2010) or no impact (Huang et al. 2011). For example, based on a national representative survey, Huang et al. (2011) showed that agricultural subsidies did not distort producers' decisions in terms of grain area or agricultural input use and therefore did not affect agricultural production because the subsidies are decoupled from grain production or purchase of agricultural inputs.

4.4 Overall Policy Impacts on Fertilizer Market Distortions

4.4.1 Measuring the Distortions

To measure overall impacts of policies on fertilizer market distortions, the differences between domestic wholesale prices and international prices at the border (Nominal Protection Rates [NPRs])[46] were examined. Because there are many fertilizers produced, consumed, and traded, the focus was on major products such as urea for nitrogen fertilizer, DAP for phosphate fertilizer,

[46] The NPR is calculated by the following formula. For exportable product, NPR = (Pd – Px)/Px *100%; for importable product, NPR= (Pd – Pm)/Pm * 100%, where Pd is domestic wholesale price, Px is export price at border (FOB) and Pm is import price at border (CIF).

and MOP for potash fertilizer. The distortion measures estimated in this study represent aggregate impact of a wide range of policy instruments including subsidy policies as they are designed to be an integrated part of whole policy package, used in China on domestic fertilizer prices and, hence, on fertilizer production, consumption, and trade. Although it cannot explicitly disentangle the effect of fertilizer subsidy policy from other policies on domestic fertilizer prices, the presentations in the previous sections can help make appropriate judgments on the likely impact of China's fertilizer subsidy program.

The time period covered in this study is 1989-2013 for urea and 2000-13 for DAP and MOP. Data before 1994 for urea are interesting because the effects of the dual-track pricing policy on the market distortion can be examined. Unfortunately, the analysis could not be done before 2000 for DAP and MOP because of a lack of price data.

4.4.2 Data

The data used to estimate NPRs in this study are from a number of sources, depending on the products analyzed. For urea, the wholesale prices are from CNCIC, but these are only available during 2003-13. The wholesale prices of urea in 1989-2002 were estimated based on the correlation between the wholesale and retail prices that have much longer recorded data by NDRC (1990-2003). For DAP, the wholesale price was estimated using the retail prices and an average price margin between wholesale and retail in 2000-03.[47] Data are from the National Agricultural Technology Extension Center (NATEC) of MOA. For MOP, the wholesale prices in 2006-13 are from CNCIC, and the wholesale prices in 2000-05 are estimated based on the growth rate of MOP market retail prices over the same period; the data on the later period are from NATEC of MOA. The FOB and CIF prices are mainly from the General Administration of Customs (GAC) of China. For urea, the CIF was calculated by dividing the import values by import quantity (NBSC 1990-2014). Official exchange rates are from NBSC (2014).The FOB or CIF were chosen for analysis depending on the nature of trade and trade policy. For urea, China became a net exporter from a net importer in 1997 (Appendix Table 4.4); thus, CIF was used for 1989-97, and FOB was used for 1997-2013. In the early 2000s, China imported a large amount of DAP, but exports have exceeded imports since 2007. So CIF is used for 2000-06 and FOB for

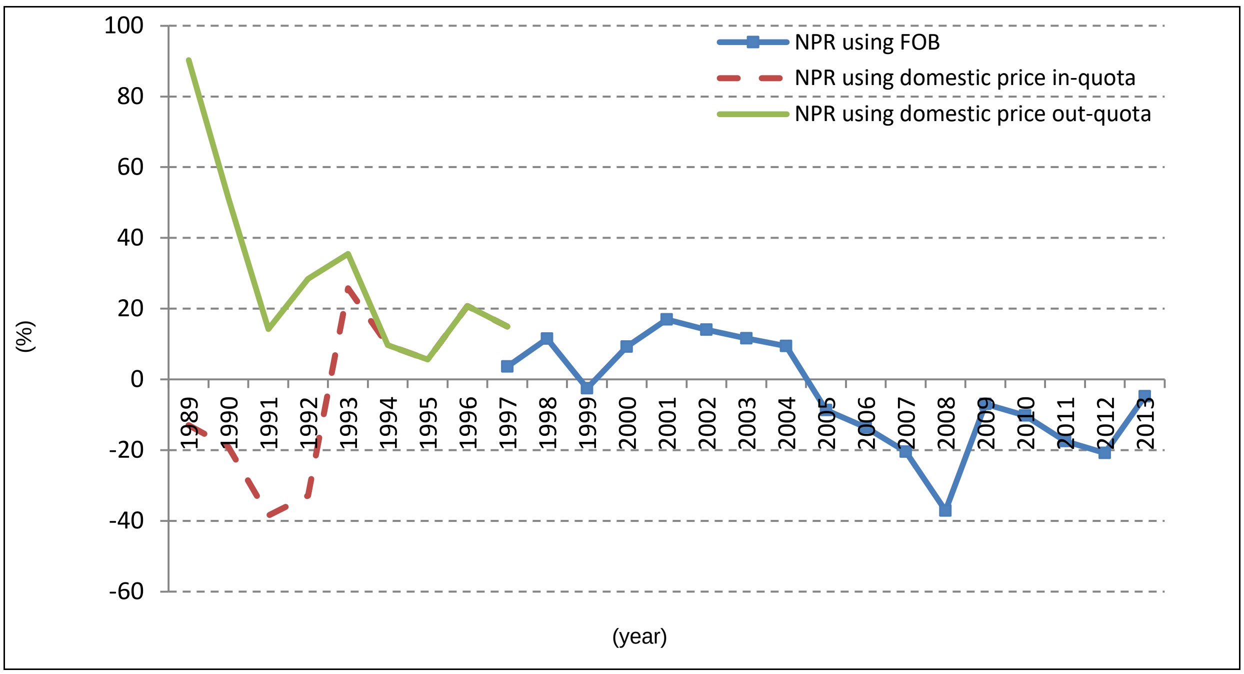
[47] The average price margin was set at 5.5% (Zhang et al. 2013).

2006-13. CIF was used only for the analysis of MOP because China has been one of the biggest importers of potash fertilizers in the world.

Detailed data to estimate NPRs for urea, DAP, and MOP and the results are summarized in Appendix Tables 4.7-4.9.

4.4.3 Results

As discussed in the previous section, the major policy shifts and large rise and fluctuation of fertilizer prices have occurred since the mid-2000s. The changing trends of NPRs for urea, DAP and MOA are presented in Figs. 4.9, 4.10, and 4.11.



Source: Appendix Table 4.8.

Note: CIF is used for 1989-1997 and FOB is used for 1997-2013.

***Fig. 4.9** Nominal Protection Rates (%) of Urea in China, 1989-2013*

Source: See Appendix Table 4.9.

Note: CIF is used for 2000-06 and FOB is used for 2006-13.

Fig. 4.10 *Nominal Protection Rates (%) of DAP in China, 2000-13*

4.4.3.1 Distortions to Fertilizer Domestic Market Before the Mid-2000s

The distortions to the urea market in China before the mid-2000s are characterized by three important features (Fig. 4.7). First, the NPR measures show that the fertilizer trade policy or the whole policy packages offered high rates of protection to Chinese domestic urea markets in the late 1980s and 1990s. In 1989, the market price of urea in China was more than 80% higher than the international price of fertilizer (CIF, China's port). Although the NPRs fell significantly in 1990 and 1992, they were positive and stayed at about 10-20% in 1992-2004, which implies that fertilizer producers (or manufacturers) received strong incentives from China's policy intervention through higher market prices. This policy on its own would not have been consistent with providing cheaper fertilizer to farmers for crop production. It was, however, consistent with a policy of developing domestic fertilizer industry since it encouraged greater urea production by keeping out imports with import tariffs and quotas and keeping domestic prices high. Second, the results also show that the distortion had presented a general falling trend, indicating the domestic urea market was gradually integrating into the international market. Thirdly, the domestic marketing policies, mainly the dual-track pricing system, compensated the farmers. They were working in the opposite direction to fertilizer trade policies in terms of their effects on both

fertilizer producers and farmers. The negative values of the NPRs show how the in-quota urea price offered incentives to farmers to produce their crops in 1989-92 (Fig. 4.9).

The cases of DAP and MOP (Figs. 4.9 and 4.10) tell similar stories as that of urea. For both products, during 2000-05, they were always net imported products, and the markets were generally protected. The protection provided incentives for the domestic DAP and MOP producers to raise their production, but farmers paid higher prices than the farmers abroad. While the market price of DAP in China had varied around the world price, positive NPRs had decreased from an average of about 18% in 2000-02 to less than 7% in 2003-06 (Fig. 4.10 and Appendix Table 4.9), indicating the distortions had decreased in 2000-06. A more significant decline in NPRs occurred for MOP in the mid-2000s—from about 40% in 2000 to 13% in 2005 (Fig. 4.11).

4.4.3.2 Distortions to the Fertilizer Domestic Market After the Mid-2000s

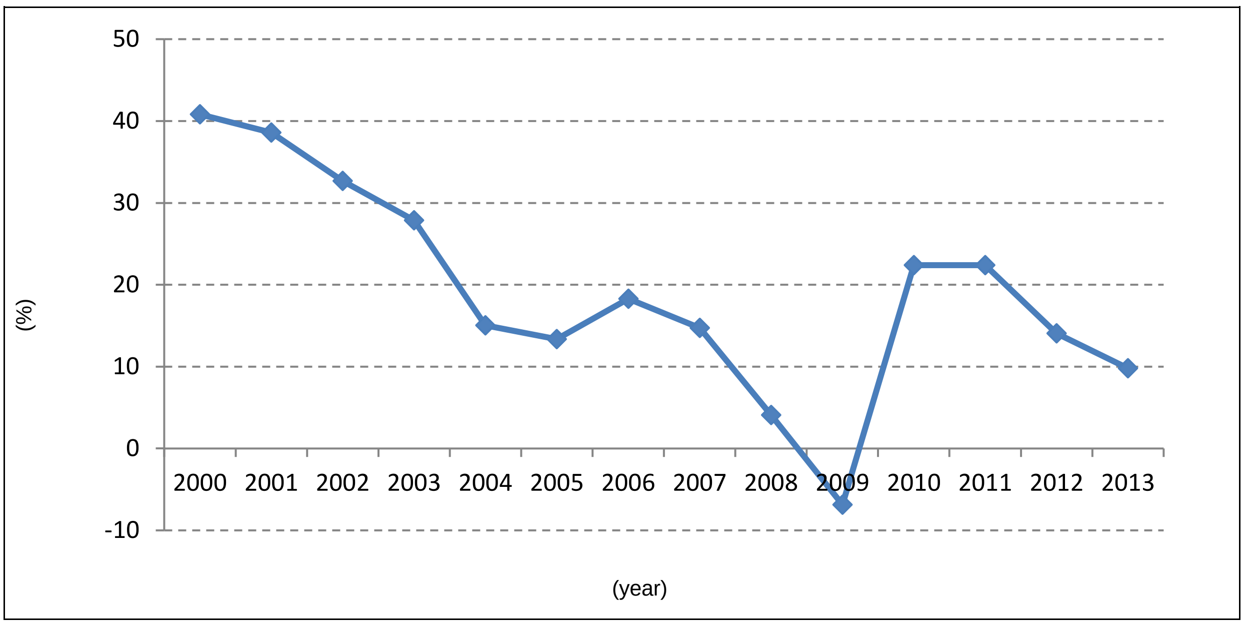
After the mid-2000s, the distortions analysis shows that the NPRs for the three products changed significantly (Figs. 4.8, 4.9, and 4.10). Several special features can be observed during 2006-13, including the large fluctuation of NPRs, a generally continuous fall in the protections and movement from protected to unprotected markets for urea and DAP.

For urea and DAP, the NPRs fell to values below zero after 2005 and reached a negative value of 37% and 41%, respectively, in 2008. The significant fall in NPRs in this period can be largely explained by the following two facts. First, the rapid price hike in the international market between 2005 and 2008. The international urea price at the Chinese border (FOB at port in China) increased from U.S. $236/mt in 2005 to U.S. $479/mt in 2008, more than doubling within three years (Appendix Table 4.8). The international prices for DAP increased even more: FOB increased from U.S. $291/mt in 2006 to U.S. $973/mt in 2008, more than tripling within two years (Appendix Table 4.8). Second is the strong response of China’s leaders to the global food crisis, as well as the rapid rise of international fertilizer prices. In this period, border measures, especially fertilizer export restrictions, successfully mitigated the price transmission from the global market. In 2005-08, domestic urea and DAP prices in nominal terms increased by only

18.6% (from 1,764 Yuan/mt to 2,092 Yuan/mt) and 60.8% (from 2,489 Yuan/mt in 2005 to 4,003 Yuan/mt in 2008), respectively (Appendix Tables 4.7 and 4.8).

However, as international fertilizer prices fell after the global food crisis or at the beginning of the global financial crisis, the gaps between domestic and international prices of urea and DAP fell. In 2010-13, average NPRs were -13% for urea and -4% for DAP and can be explained by China's continuous fertilizer export restriction policy after the global food crisis.

While the overall trend of NPRs for MOP was similar to those for urea and DAP, the negative protection of MOP appeared only in 2009 (Fig. 4.11). The average NPR remained at 17% in 2010-15. This suggests there could be other interventions in selling imported potash.[48]



Source: See Appendix Table 4.10.

***Fig. 4.11** Nominal Protection Rates (%) of MOP in China, 2000-13*

Last but not least, by 2013, the values of NPRs for all three fertilizers suggest that the current market is only slightly distorted. The NPRs of both urea and DAP were only -5% in 2013.

[48] There are two major potash import companies (Sinochem Group and Sino-Agri Group) in China.

4.5 Concluding Remarks and Lessons for Future Reform

This study shows how China has developed its fertilizer sector using various supporting policies and market interventions. The fertilizer industry has achieved impressive results: rising from an infant industry in the 1970s to become the world's largest since 1989 as well as a major net fertilizer exporter in recent years. To increase domestic fertilizer production and ensure reasonable fertilizer price for farmers, China has implemented different policy packages in different stages of the fertilizer sector's development. Each policy package was designed to deal with the major issues encountered in each stage of fertilizer production and consumption.

In the early stage of reform period from the mid-1980s to the mid-1990s, lack of domestic fertilizer supply was a fundamental problem. The policy package included investment in the fertilizer industry and import restrictions through state trading for border control plus the dual-track pricing system for farmers in domestic market. This policy obviously resulted in high protection of domestic fertilizer production and hurt farmers. On the other hand, the dual-track pricing policy was able to partly offset the disincentive of higher market fertilizer prices to farmers.

In the later stages of reform periods, rising fertilizer prices, instability of the fertilizer market, and recent concerns over national food security and farmers' incomes have become the major problems. Fertilizer policies have changed accordingly. The most recent policy package includes interventions on both the supply and demand sides. On the supply side, the fertilizer industry has been heavily subsidized to reduce the cost of fertilizer production, so as to reduce the rising fertilizer price pressure. On the other hand, the industry also has been penalized by restricting its fertilizer exports to stabilize and mitigate the likely rapid hike of domestic prices. On the demand side, the aggregate agricultural input, mainly fertilizer, subsidy program has been implemented since 2004. The total amount of this subsidy is substantial.

Interestingly, despite huge amounts of subsidies in both fertilizer production and consumption in the past decade, the overall impact of the government's policy intervention has been very moderate. Indeed, the results show that China's fertilizer industry has moved gradually from being highly protected to being market-driven with its prices close to the international market

prices. The average rate of nominal protection was -10% for urea and only -5% for DAP in 2010-13. Supply side intervention policies, incentives for production and restrictions on export, have offset each other, a trade-off policy designed by the policymakers. On the demand side, the subsidy has been decoupled from grain production and fertilizer consumption and therefore did not distort the market. Every farmer receives the subsidy regardless of income level. The nature of subsidies for farmers implies that it has no impact on fertilizer use. For N and P fertilizer markets, they have shifted from the protected to unprotected ones as their domestic prices were lower than international prices in the recent years. Recent lower N and P fertilizer prices might partially explain farmers' overuse of fertilizer in recent years, along with other factors previously noted (Hu et al. 2007; Huang et al. 2008, 2012; Jia et al. 2014; He et al. 2006).

While the national goal of fertilizer industry development has been achieved with the policies designed by the central government, the current industry subsidy and aggregate input subsidy have significant implications for the government's budget. Whether the current policy package could be sustainable is also questionable. With the rising integration of domestic and international markets, oversupply of domestic nitrogen and phosphate fertilizers due to production increases and the nation's new leaders' initiative to strengthen overall market-oriented economic reforms, the policymakers in the fertilizer sector should consider these as great opportunities and introduce timely reforms to the fertilizer policy to reduce or phase out current fertilizer production and consumption subsidy programs.

There are better options available to improve national food security and farmers' incomes. Previous studies have shown that public investments in agricultural technology, irrigation, and rural infrastructure are the most effective ways to improve China's food security and reduce poverty (Fan et al. 2004). If the current subsidy budget for both the fertilizer industry and agriculture could be used for agricultural productivity enhanced investment (e.g., agriculture research and development, irrigation, and other rural infrastructure), agricultural extension and training farmers to improve fertilizer management and direct income transfer for the poor (rather than all) farmers, better outcomes could be expected—China's food security would be better ensured; incomes of the poor in farming and rural income equity would be further improved; and the environmental consequences of fertilizer overuse could be largely mitigated. Of course, if the

fertilizer industry subsidy program would be phased out, as a trade-off, fertilizer export restrictions also would be eliminated. As a result, a more integrated Chinese and international fertilizer market would likely emerge in the coming years.

Fortunately, recent policy debates and changes are encouraging. The fertilizer industry has started to agree to the elimination of the subsidy if the fertilizer export restriction could be simultaneously eliminated. The current market and political environments for deepening reforms in the fertilizer industry are also better now than at any time in the past. Indeed, there are several initial market-oriented reforms. The subsidy for natural gas for fertilizer manufacturers was planned to be eliminated by 2015. The electricity subsidy will be gradually phased out between 2013 and 2018. The extent of fertilizer subsidy has also fallen slightly. Moreover, nitrogen fertilizers and phosphate fertilizer export restrictions (e.g., export tax in both peak and off-peak seasons) were reduced in 2013-14. While these moves are in the right direction, China should take a much bolder step to reform the industry, as the reform is consistent with the national goals of ensuring food security, increasing farmers' incomes, sustainable agricultural development, and a better preserved environment. However, with the proposed reforms, the new challenge will be on how to deal with potentially large international market price fluctuations in the future, which is an issue that needs further study.

References

Chen X, Zhang F, Römheld V, Horlacher D, Schulz R, Böning-Zilkens M, Wang P, Claupein W (2006) Synchronizing N supply from soil and fertilizer and N demand of winter wheat by an improved N_{min} method. Nutrient Cycling in Agroecosystems 74(2):91-98

China National Chemical Information Center (CNCIC) (2006) China chemical industry yearbook. CNCIC, Beijing

Ding J (1996) Overview of fertilizer price policy in recent China. Price: Theory & Practice 4:18-19 (in Chinese)

Du H, Zhang M, Chen C (2010) The confusion and solutions of China's new agricultural subsidy system: Rational reflection of its six years' practice. China Soft Science 7:1-7 (in Chinese)

Fan SG, Zhang LX, Zhang XB (2004) Reforms, investment, and poverty in rural China. Economic Development and Cultural Change 52(2):395-421.

FAO (2014) FAO database. Retrieved from http://faostat3.fao.org/download/

Ge J, Zhou S (2012) Does factor market distortions stimulate the agricultural non-point source pollution? A case study of fertilizer. Issues in Agricultural Economy 3:92-98 (in Chinese)

Guo JH, Liu XJ, Zhang Y, Shen JL, Han WX, Zhang WF, Christie P, Goulding KWT, Vitousek PM, Zhang FS (2010) Significant acidification in major Chinese croplands. Science 327(5968):1008-1010

He FF, Jiang RF, Chen Q, Zhang F, Su F (2009) Nitrous oxide emissions from an intensively managed greenhouse vegetable cropping system in northern China. Environmental Pollution 157(5):1666-1672

He, H, Zhang L, Li Q (2006) Farmer's fertilizer use and agricultural non-point pollution. Journal of Agrotechnical Economics 6:2-10 (in Chinese)

Heisey, PW, Norton GW (2007) Chapter 53: Fertilizers and other farm chemicals. In: Evenson R, Pingali P (eds) Handbook of Agricultural Economics, Volume 3, Elsevier, pp. 2741-2777

Hu R, Cao J, Huang J, Peng S, Huang J, Zhong X, Zou Y, Yang J, Buresh RJ (2007) Farmer participatory testing of standard and modified site-specific Nitrogen management for irrigated rice in China. Agricultural Systems 94(2):331-340

Huang JK, Hu RF, Cao JM, Rozelle S (2008) Training programs and in-the-field guidance to reduce China's overuse of fertilizer without hurting profitability. Journal of Soil and Water Conservation 63(5):165A-167A

Huang J, Xiang C, Jia X, Hu R (2012) Impacts of training on farmers' Nitrogen use in maize production in Shandong, China. Journal of Soil and Water Conservation 67(4):321-327

Huang J, Wang X, Zhi H, Huang Z, Rozelle S (2011) Subsidies and distortions in China's agriculture: evidence from producer-level data. Australian Journal of Agricultural and Resource Economics 55(1):53-71

IFA (2014) IFA database. Retrieved from http://ifadata.fertilizer.org/ucSearch.aspx

Jia XP, Huang JK, Xiang C, Hou LK, Zhang FS, Chen XP, Cui ZL, Bergmann H (2013) Farmer's adoption of improved nitrogen management strategies in maize production in China: An experimental knowledge training. Journal of Integrative Agriculture, 12(2):364-373

Jia X, Huang J, Xiang C, Powlson D (2014) Reducing excessive Nitrogen use in Chinese wheat production through knowledge training: What are the implications for the public extension system? Agroecology and Sustainable Food Systems 39:189-208

Jiang R, Ling L (1989) Fertilizer market and price in China. Prices Monthly 12:5-11 (in Chinese)

Li YX, Zhang WF, Ma L, Huang GQ, Oenema O, Zhang FS, Dou ZX (2013) An analysis of China's fertilizer policies: Impacts on the industry, food security, and the environment. Journal of Environmental Quality, 42(4):972-981

National Bureau of Statistics of China (NBSC) (2010, 2013, 2014). China statistical yearbook. China Statistics Press, Beijing

National Development and Reform Commission (NDRC) (1990–2003) Price yearbook of China. Editorial office of Price yearbook of China, Beijing

NDRC (1990–2014) National agricultural production cost and return collection.China Statistics Press, Beijing

Odhiambo JJO, Magandini VN (2008) An assessment of the use of mineral and organic fertilizers by smallholder farmers in Vhembe district, Limpopo province, South Africa. African Journal of Agricultural Research 3(5):357-362

Peng S, Buresh RJ, Huang J, Yang J, Zou Y, Zhong X, Wang G, Zhang F (2006) Strategies for overcoming low agronomic nitrogen use efficiency in irrigated rice systems in China. Field Crops Research 96(1):37-47

SAIN (2010) UK-China Sustainable Agriculture Innovation Network: Policy Brief 1. Retrieved from http://www.sainonline.org/English.html

Sonntag BH, Huang J, Rozelle S, Skerritt JH (2005) China's agricultural and rural development in the early 21st century. CCICED Task Force, Australian Centre for International Agricultural Research

Takashi Y, Ayumi A (2010) Fertilizer policies, price, and application in East Africa (GRIPS Discussion Paper 10-24). National Graduate Institute for Policy Studies, Tokyo

Xiao Q (2011) The study and statistical evaluation of the agricultural subsidy policy. EBM Org Comm

Yang L, Sun B (2008) China's farmland ecosystem: Nutrient cycling, balance and management. Science Press, Beijing

Zhang W, Gao L, Ma J, Ma W, Xu X, Zhang F (2007) Evaluation on the reform effectiveness of fertilizer industry policy in China. Phosphate & Compound Fertilizer 22(1):5-9 (in Chinese)

Zhang W, Zhang F, Li Y, Huang G, & Wu L (2013) Research report for China's fertilizer development. China Agricultural University Press, Beijing (in Chinese)

Zhu, ZL, Chen DL (2002) Nitrogen fertilizer use in China—Contributions to food production, impacts on the environment and best management strategies. Nutrient Cycling in Agroecosystems 63(2):117-127

Appendix Tables

Appendix Table 4.1 *Nitrogen Fertilizer Production, Trade, and Consumption in China in 1978-2012, on the Basis of N Nutrient Content*

	Production (1,000 mt)[1]	Import (1,000 mt)[1]	Export (1,000 mt)[1]	Consumption by Industry (1,000 mt)[2]	Apparent Consumption by Farm (1,000 mt)[3]	Foreign Dependence Ratio (%)[4]
1978	7,604	1,422	0	0	9,026	16
1979	8,805	1,563	0	0	10,368	15
1980	9,993	1,794	0	0	11,787	15
1981	9,857	1,430	0	120	11,287	13
1982	10,219	1,815	0	130	12,034	15
1983	11,094	2,365	0	140	13,459	18
1984	12,221	2,728	0	150	14,949	18
1985	11,440	2,157	0	180	13,597	16
1986	11,588	1,700	0	200	13,288	13
1987	13,423	3,179	7	220	16,596	19
1988	13,653	4,566	10	250	18,209	25
1989	14,240	4,315	2	280	18,553	23
1990	14,637	4,597	7	300	19,227	24
1991	15,029	4,600	3	320	19,626	23
1992	15,705	4,311	5	350	20,011	22
1993	15,298	2,392	22	380	17,668	13
1994	16,058	2,806	48	430	18,816	15
1995	18,731	4,834	129	480	23,436	20
1996	20,736	4,373	178	500	24,931	17
1997	19,939	2,935	209	550	22,665	12
1998	21,258	1,429	118	580	22,569	6
1999	22,603	1,328	71	710	23,860	5
2000	22,175	1,067	522	850	22,720	2
2001	22,427	977	710	920	22,694	1
2002	24,412	1,941	347	1,110	26,006	6
2003	25,614	958	1,494	1,220	25,078	-2
2004	28,339	778	2,150	1,940	26,967	-5
2005	30,095	755	1,091	3,870	29,759	-1
2006	32,379	618	1,187	4,220	31,810	-2
2007	33,844	304	3,631	4,330	30,517	-11
2008	33,782	116	2,662	4,860	31,236	-8
2009	36,009	356	2,294	4,670	34,070	-6
2010	35,678	246	4,580	3,760	31,344	-14
2011	36,323	221	3,946	6,220	32,598	-11
2012	38,861	286	5,432	7,140	33,715	-15

a. Data on fertilizer production and trade are from IFA.
b. Industry consumption data are from China Nitrogen Fertilizer Industry Association.
c. Estimated using the following formula: Production + Import – Export – Industry consumption. The apparent consumption by farm mainly includes those used in crop and fishery production, but the latter is very minimal.
d. Estimated using the following formula: (Import-Export)/Total Consumption.

Appendix Table 4.2 *Phosphate Fertilizer Production, Trade, and Consumption in China in 1978-2012, on the Basis of P_2O_5 Nutrient Content*

	Production (1,000 mt)[a]	Import (1,000 mt)[a]	Export (1,000 mt)[a]	Apparent Consumption (1,000 mt)[b]	Foreign Dependence Ratio (%)[c]
1978	1,133	246	0	1,379	18
1979	2,117	190	0	2,307	8
1980	2,607	512	0	3,119	16
1981	2,808	450	0	3,258	14
1982	2,836	588	0	3,424	17
1983	2,966	1,030	0	3,996	26
1984	2,669	1,342	0	4,011	33
1985	2,058	953	12	2,999	31
1986	2,332	660	14	2,978	22
1987	3,258	1,230	32	4,456	27
1988	3,692	1,447	44	5,095	28
1989	3,728	1,477	12	5,193	28
1990	4,114	1,669	13	5,770	29
1991	4,555	2,700	57	7,198	37
1992	4,622	2,263	40	6,845	32
1993	4,168	1,555	97	5,625	26
1994	4,872	2,485	102	7,255	33
1995	6,017	2,936	114	8,839	32
1996	5,747	2,470	174	8,043	29
1997	6,342	2,993	135	9,200	31
1998	6,629	2,892	148	9,373	29
1999	6,360	2,674	211	8,823	28
2000	6,759	2,194	289	8,664	22
2001	7,393	1,861	328	8,926	17
2002	8,056	2,348	498	9,906	19
2003	8,806	1,680	607	9,879	11
2004	10,200	1,314	857	10,657	4
2005	11,121	1,085	799	11,407	3
2006	11,998	886	956	11,928	-1
2007	13,720	404	2,517	11,607	-18
2008	12,891	143	1,450	11,584	-11
2009	14,374	541	1,757	13,158	-9
2010	15,998	278	2,982	13,294	-20
2011	17,631	220	3,957	13,894	-27
2012	17,209	316	3,410	14,115	-22

a. Data on fertilizer production and trade are from IFA.
b. Estimated using the following formula: Production + Import – Export. The apparent consumption by farm mainly includes those used in crop and fishery production, but the latter is very minimal.
c. Estimated using the following formula: (Import-Export)/Apparent Consumption.

Appendix Table 4.3 *Potash Fertilizer Production, Trade, and Consumption in 1978-2012 in China, on the Basis of K_2O Nutrient Content*

	Production (1,000 mt)[a]	Import (1,000 mt)[a]	Export (1,000 mt)[a]	Consumption by Industry (1,000 mt)[b]	Apparent Consumption by Farm (1,000 mt)[c]	Foreign Dependence Ratio (%)[d]
1978	21	236	0	0	257	92
1979	16	333	0	0	349	96
1980	20	435	0	0	455	96
1981	24	647	0	50	671	96
1982	25	419	0	40	444	94
1983	29	733	0	40	762	96
1984	32	750	0	50	782	96
1985	23	325	0	40	348	93
1986	24	602	0	50	626	96
1987	40	1,260	0	70	1,299	97
1988	54	1,491	0	80	1,545	97
1989	32	1,145	0	70	1,177	97
1990	46	1,715	0	80	1,761	97
1991	98	2,200	0	100	2,298	96
1992	91	1,832	0	100	1,923	95
1993	70	1,449	9	120	1,511	95
1994	117	2,144	12	120	2,249	95
1995	223	2,745	186	130	2,782	92
1996	218	2,620	353	150	2,485	91
1997	170	3,474	330	140	3,314	95
1998	213	3,337	331	150	3,219	93
1999	218	3,563	526	220	3,255	93
2000	275	3,463	374	270	3,364	92
2001	395	3,768	227	300	3,936	90
2002	430	3,953	41	360	4,342	90
2003	620	4,076	56	400	4,640	87
2004	840	4,679	63	460	5,456	85
2005	1,475	5,811	44	500	7,242	80
2006	1,750	4,667	45	600	6,372	73
2007	1,967	5,867	120	600	7,714	75
2008	2,148	3,360	75	600	5,433	60
2009	2,600	940	70	610	3,470	25
2010	3,101	3,384	86	620	6,399	52
2011	3,390	4,548	4	600	7,934	57
2012	3,402	3,390	5	800	6,787	50

a. Data on fertilizer production and trade are from IFA.
b. Industry consumption data are from Potash Branch of China National Inorganic Salts Industry Association.
c. Estimated using the following formula: Production + Import – Export – Industry consumption. The apparent consumption by farm mainly includes those used in crop and fishery production, but the latter is very minimal.
d. Estimated using the following formula: (Import-Export)/Total Consumption.

Appendix Table 4.4 *Product Structure of N Fertilizer Production and Trade in China in 1981-2012, on the Basis of N Nutrient Content (%)*

	Production[a]				Import[b]			Export:[b] Urea
	Urea	ABC	Other N Straight	Compound	Urea	Other N Straight	Compound	
1981	32	52	16	0	85	7	8	0
1982	31	55	14	0	83	2	15	0
1983	30	58	12	0	83	1	16	0
1984	31	59	10	0	74	1	25	0
1985	36	55	10	0	80	0	20	0
1986	37	54	9	0	80	0	20	0
1987	34	58	8	0	81	0	19	0
1988	31	60	8	0	86	1	13	0
1989	33	59	8	0	85	1	14	0
1990	33	58	8	1	82	3	15	0
1991	35	56	8	1	70	5	25	0
1992	39	52	8	1	80	6	14	9
1993	40	51	8	1	69	5	26	4
1994	42	48	8	2	51	5	44	39
1995	43	48	6	3	66	6	27	17
1996	44	48	6	2	61	9	30	50
1997	50	41	7	3	54	3	43	63
1998	55	35	6	3	4	1	96	46
1999	60	32	5	4	2	0	98	30
2000	59	22	14	5	0	0	100	88
2001	58	23	14	6	0	18	82	81
2002	58	22	13	7	18	13	70	55
2003	58	21	13	7	6	13	81	83
2004	58	18	16	8	2	18	80	85
2005	62	18	11	9	4	40	56	67
2006	61	16	12	10	3	64	33	57
2007	64	15	9	12	0	28	71	68
2008	65	15	10	10	0	9	91	76
2009	67	12	10	11	6	0	94	68
2010	64	11	12	13	2	0	97	71
2011	64	9	14	13	0	0	100	45
2012	67	8	11	15	25	1	75	66

a. Nitrogen fertilizer product data are from China Nitrogen Fertilizer Industry Association.
b. Import and export data are from CNCIC.

Appendix Table 4.5 Product Structure of P Fertilizer Production and Trade in China in 1981-2012, on the Basis of P_2O_5 Nutrient Content (%)

	Production[a]						Import[b]				Export:[b] DAP
	SSP	FMP	Other P_2O_5 Straight	DAP	MAP	Other Compound	P_2O_5 Straight	DAP	MAP	Other Compound	
1981	72	28	0	0	0	0	30	50	0	20	
1982	72	28	0	0	0	0	43	47	0	10	
1983	73	27	0	0	0	0	28	61	0	11	
1984	72	28	0	0	0	0	30	0	0	70	
1985	78	22	0	0	0	0	25	0	0	75	
1986	75	24	0	1	0	0	59	0	0	41	
1987	73	26	0	1	0	0	22	0	0	78	
1988	71	28	0	1	0	0	31	0	0	69	
1989	73	25	1	1	1	0	30	0	0	70	
1990	71	24	2	1	2	1	35	0	0	65	0
1991	70	22	2	2	2	1	29	0	0	71	0
1992	71	21	2	2	3	1	5	0	0	95	2
1993	74	17	3	3	3	1	2	0	0	98	30
1994	69	18	3	3	6	2	1	92	0	8	14
1995	65	20	3	3	6	4	0	92	0	7	
1996	67	14	3	5	8	3	0	81	4	15	12
1997	65	14	3	5	10	2	0	83	2	16	
1998	67	11	4	6	10	2	0	86	1	13	21
1999	57	11	6	7	14	4	0	86	1	13	21
2000	56	9	4	10	12	9	0	83	0	17	30
2001	50	10	4	13	14	10	0	80	0	19	51
2002	46	8	4	15	16	11	0	82	1	17	51
2003	44	7	4	18	16	11	0	74	2	24	49
2004	41	5	5	20	19	10	0	73	4	24	42
2005	35	4	5	21	23	12	0	65	5	30	53
2006	29	3	5	23	26	14					36
2007	25	2	5	23	31	14	1	54	2	44	41
2008	25	2	6	29	29	10	11	30	1	58	33
2009	22	2	5	34	27	10	8	48	1	43	68
2010	16	1	5	33	34	10	10	50	4	35	69
2011	13	1	6	35	36	9	0	20	0	80	56
2012	11	1	3	36	37	11	16	25	0	59	72

a. Data of phosphate fertilizer products are from China Phosphate Fertilizer Industry Association.
b. Import and export data are from CNCIC.

Appendix Table 4.6 *Product Structure of K Fertilizer Production and Trade in China in 2006-12, on the Basis of K_2O Nutrient Content (%)*

	Primary Production[a]			Import[b]			Export:[b] MOP
	MOP	Potassium Sulfate	Other	MOP	Potassium Sulfate	Compound	
2006	100	0	0	91	3	7	59
2007	100	0	0	95	2	4	18
2008	95	3	3	98	2	0	44
2009	80	15	6	86	3	11	85
2010	82	15	3	98	2	0	64
2011	77	20	3	98	2	0	55
2012	79	20	2	97	2	1	96

a. Data on phosphate fertilizer products are from Potash Branch of China National Inorganic Salts Industry Association.
b. Import and export data are from CNCIC. MOP export is mainly re-export.

Appendix Table 4.7 *Price of Major Fertilizer Products and Grain (Yuan/mt) and the Ratio of Fertilizer Price to Average Price of Paddy, Wheat, and Maize in China, 1989-2013*

	Fertilizer Price[a]			Grain Price[b]			Price Ratio		
	Urea (Out-quota)	DAP	MOP	Paddy	Wheat	Maize	Urea	DAP	MOP
1989	1,055			619	631	500	1.8		
1990	1,027			583	609	438	1.9		
1991	1,055			571	599	421	2.0		
1992	1,087			586	663	486	1.9		
1993	990			809	730	603	1.4		
1994	1,279			1,423	1,130	964	1.1		
1995	1,809			1,642	1,509	1,340	1.2		
1996	2,074			1,612	1,620	1,145	1.4		
1997	1,724			1,388	1,402	1,077	1.3		
1998	1,449			1,338	1,331	1,076	1.2		
1999	1,260			1,132	1,207	874	1.2		
2000	1,260	1,745	1,404	1,035	1,058	856	1.3	1.8	1.5
2001	1,203	1,488	1,353	1,074	1,050	967	1.2	1.4	1.3
2002	1,241	1,791	1,292	1,028	1,025	912	1.3	1.8	1.3
2003	1,354	1,757	1,275	1,201	1,128	1,055	1.2	1.6	1.1
2004	1,626	2,118	1,557	1,596	1,489	1,161	1.1	1.5	1.1
2005	1,764	2,489	1,947	1,553	1,380	1,111	1.3	1.8	1.4
2006	1,710	2,440	1,938	1,613	1,432	1,268	1.2	1.7	1.3
2007	1,713	2,611	2,132	1,704	1,512	1,495	1.1	1.7	1.4
2008	2,092	4,003	4,100	1,902	1,655	1,450	1.3	2.4	2.5
2009	1,761	2,839	3,528	1,982	1,848	1,640	1.0	1.6	1.9
2010	1,807	2,921	2,921	2,360	1,980	1,872	0.9	1.4	1.4
2011	2,183	3,388	3,285	2,691	2,079	2,121	0.9	1.5	1.4
2012	2,262	3,461	3,280	2,761	2,166	2,223	0.9	1.4	1.4
2013	1,997	2,838	2,662	2,730	2,356	2,176	0.8	1.2	1.1

a. Fertilizer prices are wholesale prices; detail sources are provided in Appendix Tables 4.8-4.10.
b. Grain prices are farm-gate procurement prices and are from NDRC (1990-2014).

Appendix Table 4.8 *Urea Wholesale Price, International Price, and the Nominal Protection Rates in China, 1989-2013*

	Wholesale Price (Yuan/mt)[a]		International Price (U.S. $/mt)		Exchange Rate	NPRs (%)		
	In-quota	Out-quota	FOB[b]	CIF[c]	(Yuan/U.S. $)[d]	(2)&(3)	(1)&(4)	(2)&(4)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1989	483	1,055		147	3.77		-13	90
1990	549	1,027		142	4.78		-19	51
1991	568	1,055		174	5.32		-38	14
1992	568	1,087		154	5.51		-33	28
1993	919	990		127	5.76		26	36
1994		1,279		135	8.62			10
1995		1,809		205	8.35			6
1996		2,074		207	8.31			21
1997		1,724	201	181	8.29	4		15
1998		1,449	157		8.28	12		
1999		1,260	156		8.28	-3		
2000		1,260	139		8.28	9		
2001		1,203	124		8.28	17		
2002		1,241	131		8.28	14		
2003		1,354	147		8.28	12		
2004		1,626	180		8.28	9		
2005		1,764	236		8.19	-9		
2006		1,710	248		7.97	-14		
2007		1,713	283		7.60	-20		
2008		2,092	479		6.95	-37		
2009		1,761	277		6.83	-7		
2010		1,807	297		6.77	-10		
2011		2,183	410		6.46	-17		
2012		2,262	452		6.31	-21		
2013		1,997	339		6.19	-5		

a. Wholesale urea prices in 2003-13 are from CNCIC. Its prices in 1989-2002 are estimated based on the growth rate of urea market retail prices over the same period, the data on the latter are from NDRC (1990-2003).
b. FOB data at China's border are from the GAC.
c. CIF data at China's border are calculated by dividing total urea import values with urea import quantity. Data are from NBSC (1990-2014).
d. Data of exchange rate are from NBSC (1990-2014).

Appendix Table 4.9 *DAP Wholesale Price, International Price, and Nominal Protection Rates in China, 2000-13*

	Wholesale Price (Yuan/mt)[a]	International Price (U.S. $/mt)[b]		Exchange Rate (Yuan/U.S. $)[c]	NPRs (%)	
		FOB	CIF		FOB	CIF
2000	1,745		173	8.28		22
2001	1,488		170	8.28		6
2002	1,791		173	8.28		25
2003	1,757		195	8.28		9
2004	2,118		257	8.28		0
2005	2,489		284	8.19		7
2006	2,440	291	275	7.97	5	11
2007	2,611	367		7.60	-6	
2008	4,003	973		6.95	-41	
2009	2,839	354		6.83	17	
2010	2,921	451		6.77	-4	
2011	3,388	566		6.46	-7	
2012	3,461	556		6.31	-1	
2013	2,838	482		6.19	-5	

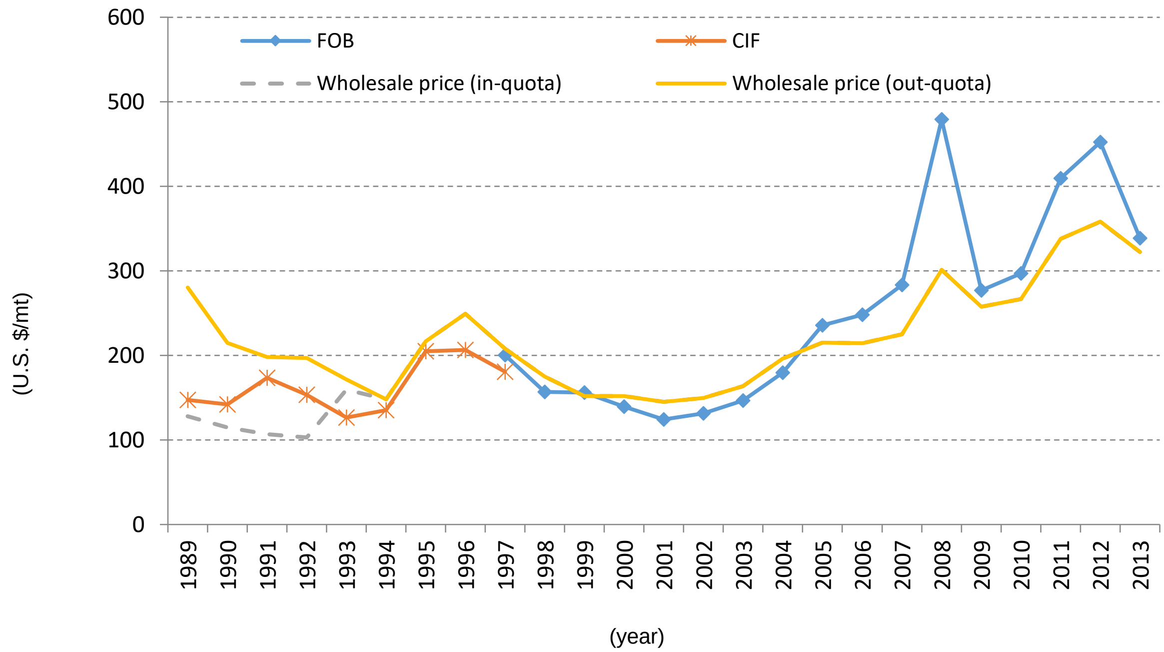
a. Wholesale prices are estimated by multiplying the retail DAP prices with a factor of 0.945 in order to account for the price margin between wholesale market at border and average national retail prices. The retail prices are from NATEC, MOA of China.
b. The price FOB and CIF at China's board are from GAC.
c. Data of exchange rate are from NBSC (2014).

Appendix Table 4.10 *MOP Wholesale Price, CIF, and Nominal Protection Rates in China, 2000-13*

	Wholesale Price (Yuan/mt)[a]	CIF (U.S. $/mt)[b]	Exchange Rate (Yuan/U.S. $)[c]	NPRs (%)
2000	1,382	119	8.28	41
2001	1,331	116	8.28	39
2002	1,271	116	8.28	33
2003	1,255	119	8.28	28
2004	1,532	161	8.28	15
2005	1,916	206	8.19	13
2006	1,938	206	7.97	18
2007	2,132	244	7.60	15
2008	4,100	567	6.95	4
2009	3,528	555	6.83	-7
2010	2,921	353	6.77	22
2011	3,285	416	6.46	22
2012	3,280	455	6.31	14
2013	2,662	391	6.19	10

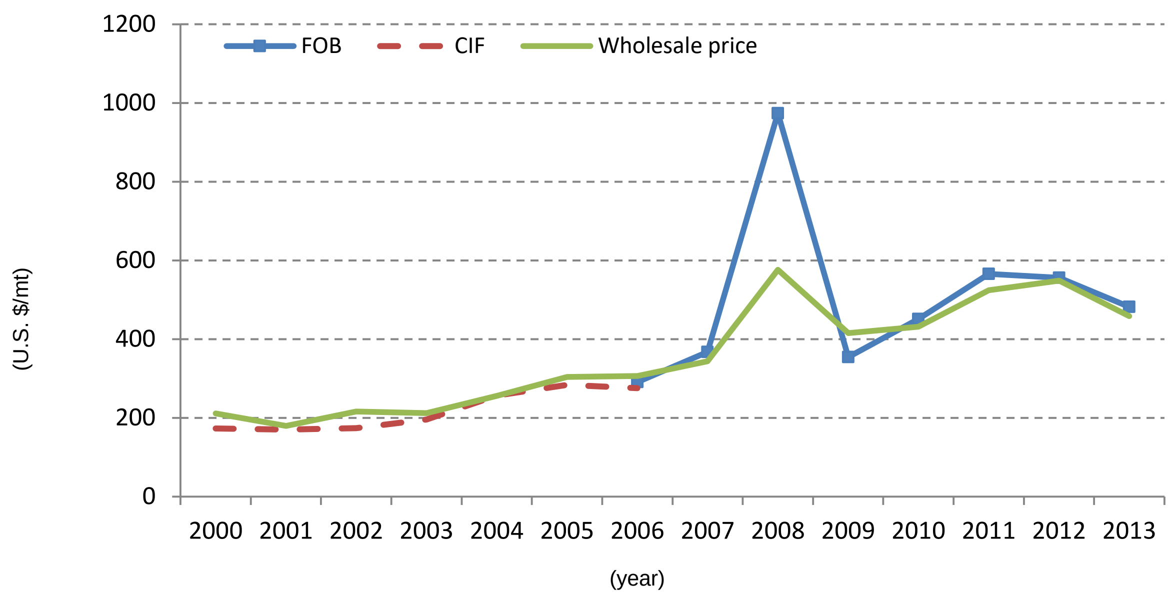
a. Wholesale MOP prices in 2006-13 are from CNCIC. Its prices in 2000-05 are estimated based on the growth rate of MOP market retail prices over the same period, the data on the latter are from NATEC, MOA of China.
b. CIF data at China's board are from GAC.
c. Data of exchange rate are from NBSC (2014).

Appendix Figures



Source: Appendix Table 4.7.

Appendix Fig. 4.1 *Urea FOB, CIF, and Wholesale Prices (U.S. $/mt), 1989-2013*



Source: Appendix Table 4.8.

Appendix Fig. 4.2 *DAP FOB and Wholesale Prices (U.S. $/mt), 2000-13*

Source: Appendix Table 4.9.

Appendix Fig. 4.3 *MOP FOB and Wholesale Prices (U.S. $/mt), 2000-13*

5 India

Ashok Gulati[49]

5.1 Backdrop

India is currently the second most populous country, after China, with more than 1.25 billion people (17.5% of world population). It is likely to surpass China by 2028, with more than 1.46 billion people, and finally may stabilize around 1.6 billion by 2050 (UN population database and projections, revised in 2012). In comparison with its population, India's agriculture area and freshwater resources are pitiably low—less than 4% of global resources. This results in tremendous pressure on India's natural resources to produce enough food, livestock feed, and fiber for its growing population.

India has roughly 400 million people living today in urban areas, and this is expected to rise to 600 million by 2030. To house them properly, India has to create "a Chicago a year" until 2030. In the next 15 years or so, per capita incomes are expected to rise by 5-6% per annum. Given that an average household is still spending almost 45% of its expenditure on food (2011, NSS data), this rising income, coupled with rising urbanization, is going to create even more pressures on land and water resources.

So, this is the biggest challenge of feeding India, but it is also an opportunity for business to perform in a manner that is economically profitable and environmentally sustainable in the long run. The way forward obviously lies in using agricultural research and development (R&D) and extension through better seeds and better farming practices, including precision farming, to raise productivity not only per unit of land but also per unit of water. Given the current level of agro-technologies, fertilizers have to play a critical role in this endeavor of feeding India, along with high-yielding (HYV/hybrids/genetically modified organisms [GMOs]) seeds and increasing irrigation cover.

---

[49] My sincere thanks to Satish Chander, Director General, Fertiliser Association of India, and Charlotte Hebebrand, Director General, International Fertilizer Association, with whom I had the benefit of intense discussions on this subject, and for their very useful comments on an earlier draft of this paper.

This paper is focused on the issue of fertilizer subsidies in India, how they have evolved over time, and where they stand now. Fiscal implications of these subsidies are obviously of great concern. But in our attempts to address the issue, we also look at the impact of these subsidies on production, consumption, and trade of fertilizers and consequently on grain production and the degree of self-sufficiency in basic staples (rice and wheat) that this subsidy regime in fertilizers may have helped to achieve. But in the end, the central purpose of this paper is to explore the way forward that can achieve better utilization of fertilizers and thus have a higher impact on grain production, at lower cost to the treasury. After all, the art of policymaking is to achieve your objectives at lowest possible costs, both financially and environmentally.

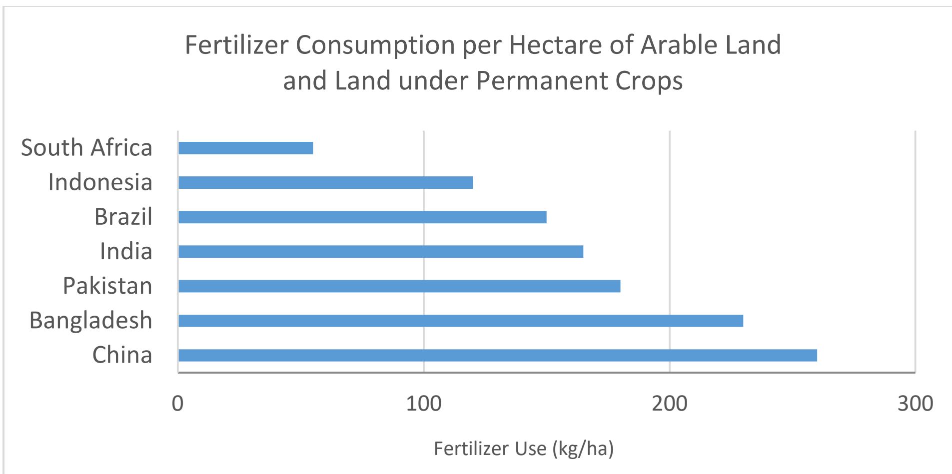
Accordingly, this paper is organized as follows: Sect. 5.2 traces the pattern of fertilizer consumption, production, and trade in India, especially since 2000. Sect. 5.3 dwells on the key issue of fertilizer subsidies, and at places it is juxtaposed against other major variables in India. This section also describes briefly the pricing policy of fertilizers which has led to this level of fertilizer subsidies. In Sect. 5.4, the probable perverse impact of these subsidies on the imbalanced use of nitrogen (N), phosphorus (P) and potash (K) is explored, as is how subsidized fertilizers (especially urea) are leading to its suboptimal uses. Finally, Sect. 5.5 delineates the possible ways forward, ranging from total decontrol of the fertilizer sector to sustained increases in urea prices, which are likely to give better results in terms of efficiency and growth, than the current system.

5.2 Consumption, Production, and Trade of Fertilizers

Globally, India is the second largest consumer of fertilizers, next to China. In terms of nutrients ($N+P_2O_5+K_2O$), in 2011 India consumed about 28 Mt, in relation to China at about 50 Mt, the United States at about 20 Mt, and Brazil at about 12 Mt. However, on per hectare of arable land basis, India’s fertilizer consumption (165 kg per hectare [kg/ha] in 2011) is still below several countries in the region; for example, China was at 260 kg/ha, Bangladesh at 228 kg/ha, and Pakistan at 180 kg/ha. Brazil with 147 kg/ha and the United States with 126 kg/ha use lower levels of fertilizer compared to India, as they have huge land mass in relation to their populations. Higher doses of fertilizer consumption reflect the intensification of agriculture.

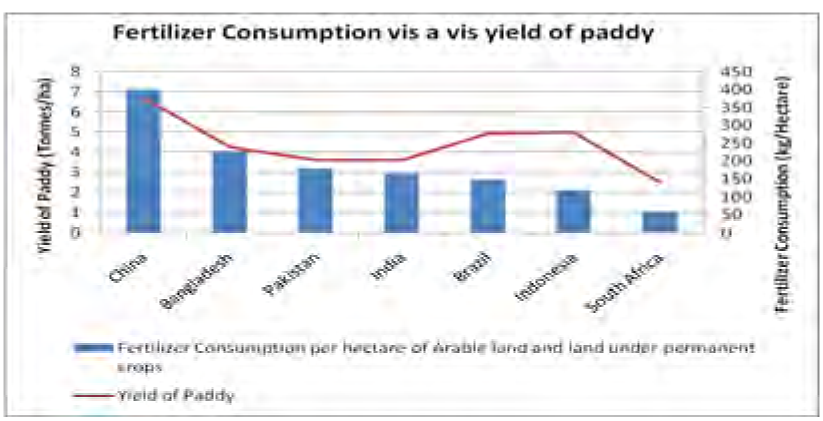
Figure 5.1 gives this picture more vividly. The impact of higher per hectare consumption of fertilizers is reflected on the respective yields of prime crops in those countries. China, for example, has more than double India's per hectare consumption of fertilizers and 1.8 times India's yield of paddy (Fig. 5.2).

However, India's consumption of fertilizers on a per hectare basis has significantly improved over the years. Figure 5.3 gives the evolution of this rising consumption of fertilizers on a per hectare of gross cropped area (GCA) basis, which has increased from a meager 34 kg/ha in 1981-82, to 90 kg/ha in 2000-01, and to 140 kg/ha in 2011-12.



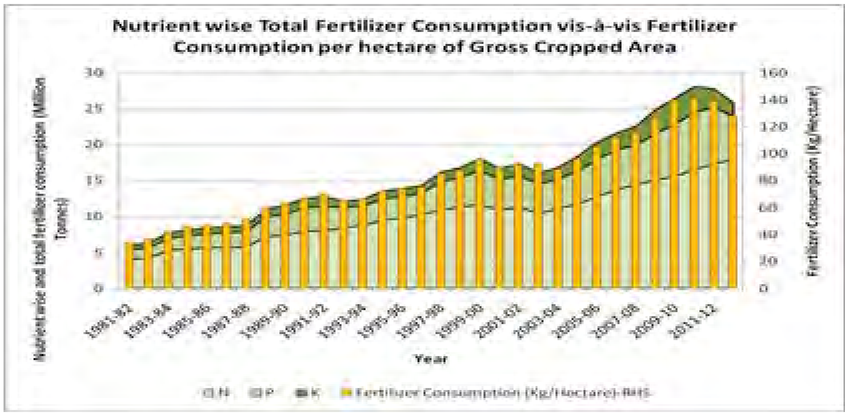
Source: FAO for the year 2011.

Fig. 5.1 Fertilizer Consumption per Hectare of Arable Land (selected countries, kg/ha, 2011)



Source: FAO for the year 2011.

Fig. 5.2 Fertilizer Consumption and Paddy Yields (selected countries, kg/ha, 2011)



Source: Fertilizer Statistics (2012-13).

Fig. 5.3 *Evolution of Fertilizer Consumption in India (kg/ha of GCA)*

The rising consumption of fertilizers in India has been met partly by domestic production, especially urea, and partly by imports. Almost the entire amount of potash fertilizers (K_2O) is imported, while in the case of phosphate fertilizers (P_2O_5), India imports both phosphate rock and finished phosphate fertilizer. In the case of urea, at the beginning of the 2000s, India was largely self-sufficient, but now even in nitrogenous fertilizers, India is importing significant quantities. Overall, the dependency on imports has increased (Fig. 5.4).

Source: Annexure VI, Annual report 2013-14, Department of Fertilizer, Ministry of Chemicals and Fertilizers, Government of India.

Unit: in Lakh Mt (10 lakhs equal one million).

Fig. 5.4 *Production and Imports of Fertilizers (Lakh Mt)*

It is interesting to note that in the early 2000s, the self-sufficiency ratio of fertilizers hovered around 90%, but it fell to 56% by 2011-12. In absolute terms, imports went up from 2.1 mt in 2000-01 to more than 10 mt during 2008-09 to 2011-12, before coming down to about 7 mt by 2013-14.

This is also a period when the Indian fertilizer industry has seen only limited expansion of existing urea plants, leading to increased dependency on imports. One of the various reasons behind this lackluster performance of the Indian fertilizer industry is the uncertainty of policy, especially of fertilizer pricing and subsidy, and difficulties in obtaining subsidy payments due from the government. Also, there is a question about how globally competitive the Indian urea industry could be, given that India does not have ample resource endowments of gas (India is a net importer of gas), and that gas pricing cannot be as low as in Gulf countries. This would beg the question: What is the marginal cost of domestic production vis-à-vis the option of imports? This is one of several questions to be discussed in detail in the following sections.

5.3 Fertilizer Pricing and Subsidy in India

With the onset of the green revolution in India in the late 1960s, and its consequent spread in the 1970s, the importance of fertilizers increased as the new seeds were very responsive to higher

doses of fertilizers. So, providing fertilizers to farmers in a timely manner and at affordable prices became central to the government's overall food policy and food security concerns. For this reason, the sale, price, and quality of fertilizers have been regulated through the Fertilizer Control Order (FCO) under the Essential Commodities Act (EC Act). The distribution of fertilizers was also regulated through the Movement Control Order in 1973. The oil shocks of the 1970s (1973-74, 1977-79), however, created a huge uncertainty about the pricing of fertilizers. It was in the wake of this oil/gas price volatility, and the need to have a stable price regime for fertilizers, that the Marathe Committee was set up to find ways to bring greater certainty in the fertilizer sector. It was on the recommendations of this Marathe Committee that the government introduced the Retention Price Scheme (RPS) for nitrogenous fertilizers in November 1977, which was subsequently extended to phosphate and other complex fertilizers as of February 1979. Under this scheme, the difference between the retention price (cost of production as assessed by the government and subject to certain efficiency norms, plus 12% post tax return on net worth, plus a distribution margin and freight) and the statutorily notified sale price was paid as subsidy to each urea plant. The RPS did attract new investments in the fertilizer sector, enhancing production and availability in the country. The cumulative nutrient capacity (N+P) created increased from 2.5 Mt during the 4^{th} Five-Year Plan (1969-73) to 11 Mt by 1991-92. But the system also came under a lot of criticism for being cost-plus in nature, leading to "gold plating" of some plants and not providing enough incentives for increasing efficiency and lowering costs. While the costs of producing fertilizers were high and rising, the price for farmers lagged way behind, leading to rising fertilizer subsidy bills. The economic crisis and subsequent reforms of July 1991 exposed this issue of the ballooning fertilizer subsidy creating pressures on fiscal deficit. The economic reforms of 1991 created a major debate on fertilizer pricing and subsidy, which led to a 30% increase in urea prices in one go. A Joint Parliamentary Committee was set up to address this issue in 1992, which recommended freeing up of DAP and MOP prices, but brought down the price of urea by 10%. This led to imbalanced fertilization of soil, skewed in favor of urea since its price remained relatively low. To overcome this situation, the government announced ad hoc concessions in DAP and MOP prices to cushion the impact of the price rise and, of course, to encourage balanced fertilization. In 1997, the government started indicating country-wide uniform maximum retail prices (MRP) for DAP and MOP. The MRPs of

phosphate and potash fertilizers were revised on February 28, 2002, which continued up to March 31, 2010, in the cases of DAP and MOP, at which point they were revised again.

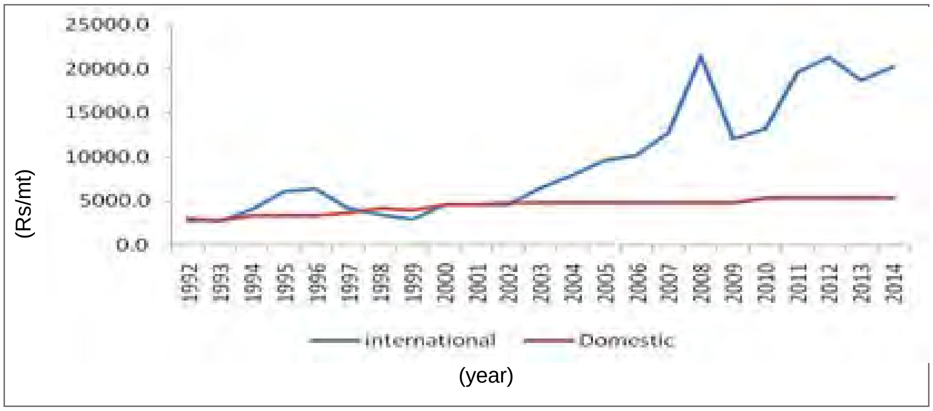
Urea prices were under RPS until 2003. After that a new pricing scheme (NPS) was introduced in three stages and, until now, stage III is prevalent. Although under NPS, urea prices have been increased, they did not increase as much as the MRP of DAP and MOP. This difference increased to a striking level in 2010 after the nutrient-based subsidy (NBS) policy was introduced, and again, urea was kept outside its purview.

During the last 15 years, the price of urea increased only marginally (from Rupees [Rs.] 4,600/mt in 2000-01 to Rs 5,360/mt in 2013-14) while the prices of DAP and MOP have experienced meteoric rise, especially since 2010-11. The MRP for DAP increased from Rs 9,950/mt in 2009-10 to Rs 25,184/mt in 2013-14; and of MOP increased from Rs 5,055/mt to Rs 17,972/mt over the same period. Obviously, this created a huge imbalance in the use of fertilizers, skewed in favor of urea.

Over all the years, from 1977 to 2014, only marginal change was made in the RPS for urea, moving from plant-specific to group-specific costing norms, groups being created on the basis of feedstock and vintage of different urea plants. As of the first quarter of 2014, there were 30 urea plants in operation in the country, and their retention prices (excluding sales taxes) ranged from U.S. $164/mt to U.S. $773/mt. We will discuss more about these in the section on a decontrol scenario later in this paper. Suffice it to say that over all these years, fertilizer pricing in India, especially of urea, has been heavily controlled. Several expert committees had been set up in the past to review the situation. Most of them recommended rationalization of fertilizer prices, the need to reduce subsidies and even a gradual move toward a market-based system. But the political economy has not moved in that direction, presumably due to the coalition nature of the government during most of this period. As a result, while the costs of production of fertilizers at home or of imports have been rising, the prices for the farmers have lagged behind. Thus, fertilizer subsidies have swelled at a very fast rate, especially since 2000-01, putting increasing pressures on the fragile fiscal situation.

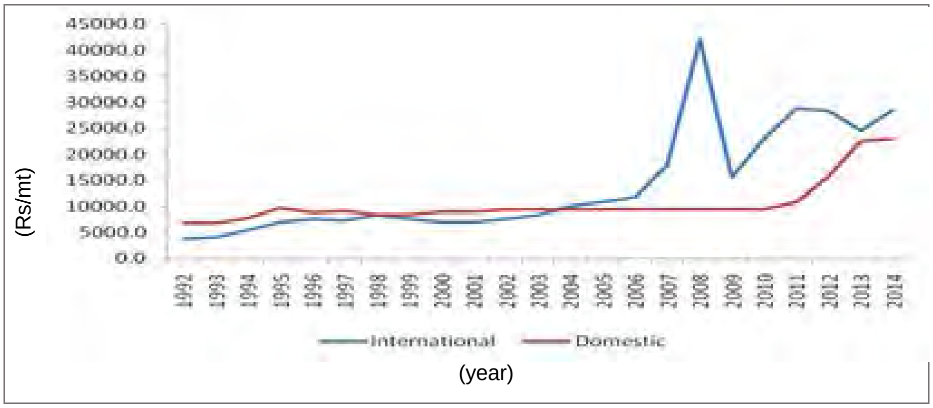
Figures 5.5 and 5.6 show domestic prices of urea and DAP vis-à-vis global prices in local currency (Rs/mt). It may be noted that the urea price in India has remained abysmally low compared to global prices, especially after 2002, and in particular during the global price shock of 2007-08. However, DAP (and MOP) prices took a dramatic jump in domestic prices, coming very close to international prices. This happened under the NBS scheme, which more or less freed the domestic prices from controls, while urea prices were still tightly controlled. This created a huge imbalance in the relative price structure, which got transmitted to major distortions in the use of N, P, and K, damaging soil health and getting suboptimal results from usage of fertilizers.

Seen in conjunction with the minimum support prices (MSP) of wheat and paddy, it is even more revealing that Indian policymakers missed a golden opportunity in the post-2006-07 scenario when MSPs were increased by 20%, plus in 2007-08 and then again in 2008-09. When a major alignment was being done to domestic prices of basic staples to catch up to their international levels, domestic urea prices remained practically stagnant (Fig. 5.7). It is this policy paralysis that led to an exploding fertilizer subsidy in 2008-09, touching U.S. $21 billion, when global prices of fertilizers had spiked (Figs. 5.5 and 5.6; Table 5.1). However, by 2013-14, the fertilizer subsidy had come down to U.S. $11 billion but this is somewhat misleading. It is widely known that a part of the payments due on account of fertilizer subsidy has not been shown in the expenditure budget of the central government. This amount stands at anywhere between Rs 35,000 and 40,000 crores (roughly about U.S. $6 billion). If this is added in the budgeted subsidy, the decline in the fertilizer subsidy from its peak in 2008-09 is not. It is this delay/non-payment of owed subsidy bills that acts as a major disincentive to the industry to increase domestic production.



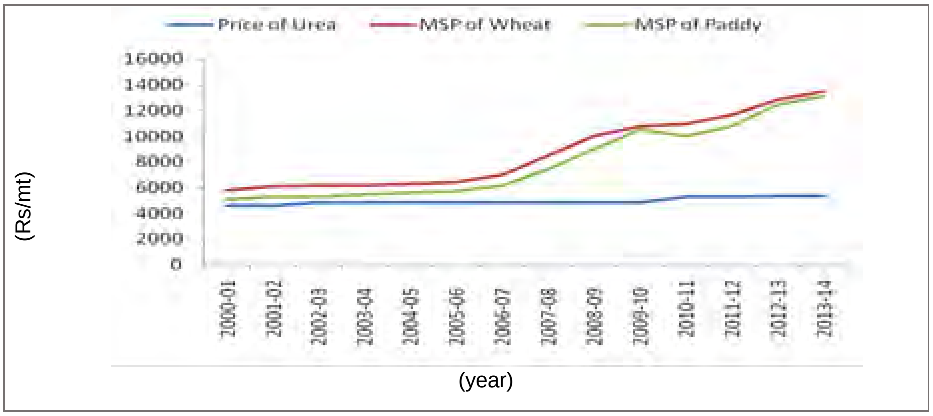
Source: Computed from data from the Government of India and World Bank.

Fig. 5.5 *Urea Prices, Domestic and Global (Rs/mt)*



Source: Computed from data from the Government of India and World Bank.

Fig. 5.6 *DAP Prices, Domestic and Global (Rs/mt)*



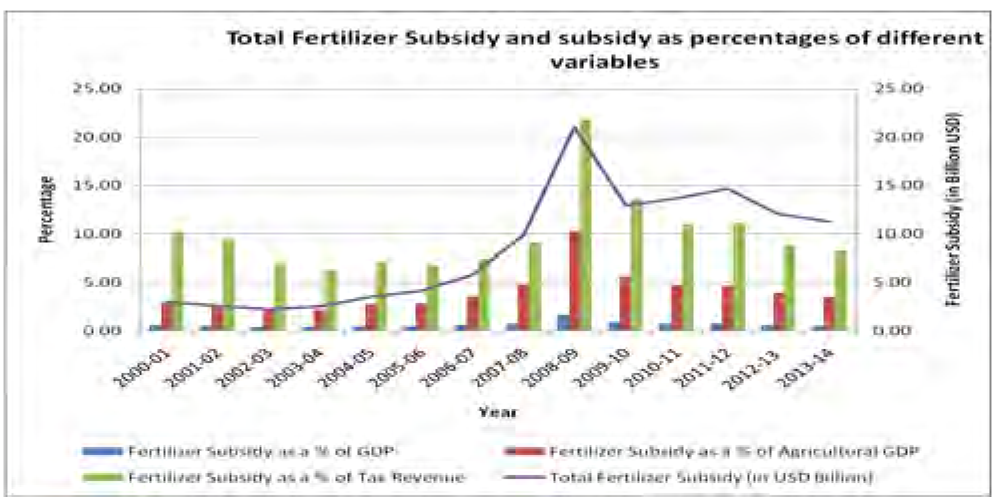
Source: Computed from data from the Government of India and World Bank.

Fig. 5.7 *Price of Urea in Relation to MSP of Wheat and Paddy*

Table 5.1 *Fertilizer Subsidy (Component Wise) in Rs Crores and in U.S. $ Billion*

Year	Subsidy on Urea[a]		Sale of Decontrolled Fertilizer with Concession to Farmers[a]	Subsidy Provided Through Bond[b]	Total	Total (in U.S. $ billions)	Exchange Rate[c] (Rs/U.S. $)
	Indigenous	Imported					
	in Rupees Crore						
2000-01	9,480	1	4,319		13,800	3.02	45.684
2001-02	8,044	47	4,504		12,595	2.64	47.692
2002-03	7,790		3,225		11,015	2.28	48.395
2003-04	8,521		3,326		11,847	2.58	45.952
2004-05	10,243	494	5,142		15,879	3.53	44.932
2005-06	10,653	1,211	6,596		18,460	4.17	44.273
2006-07	12,650	3,274	10,298		26,222	5.79	45.285
2007-08	12,950	6,606	12,934	7,500	39,990	9.93	40.261
2008-09	17,969	10,079	48,555	20,000	96,603	21.00	45.993
2009-10	17,580	4,603	39,081		61,264	12.92	47.417
2010-11	15,081	6,454	40,766		62,301	13.67	45.577
2011-12	20,208	13,716	36,089		70,013	14.61	47.92
2012-13	20,000	15,133	30,480		65,613	12.06	54.41
2013-14 RE	26,500	12,044	29,427		67,971	11.23	60.5
2014-15 BE	36,000	12,300	24,670		72,970		

Sources: a. Expenditure budget, volume 1, various years.
b. Annual Report 2010-11 of Department of Fertilizers.
c. Economic Survey.
RE = Revised estimate.
BE = Budget estimate.



Sources: Computed from data from the Government of India.

Fig. 5.8 *Fertilizer Subsidy in Relation to Other Key Variables*

But it is interesting to see that the fertilizer subsidy as a percentage of the central government's tax revenue amounted to more than 20% in 2008-09, causing huge pressure on the budget and leading to a massive jump in the fiscal deficit, which increased by more than 100% in a single year, although in subsequent years it came down. In 2013-14 it was still hovering at around 8% of tax revenue of the central government (Fig. 5.8). As a percent of agriculture gross domestic product (GDP), the fertilizer subsidy was less than 4% in 2013-14, and as percent of overall GDP, it was less than 1%.

5.4 Effect of Fertilizer Subsidy Policies: Imbalanced Use of Nutrients

The ideal ratio of NPK fertilizer use in India is generally believed to be 4:2:1.[50] But, primarily due to the pricing policy of the fertilizers, in India the ratio was never close to the ideal except for a few years. At the start of the last decade (2000-01), the ratio was 7.0:2.7:1. The ratio was the closest to the ideal ratio when it was 4.3:2:1 in 2009-10. But after the introduction of the NBS regime for P and K fertilizers in 2010, the prices of these nutrients shot up substantially while urea prices remained controlled and significantly lower. As previously noted, prices of phosphate fertilizers (DAP) have gone up by over 153% from Rs 9,950/mt in 2010-11 to Rs 25,183.5/mt (average of four quarters) in 2013-14. Similarly MOP prices shot up by 255% from Rs 5,055 in 2010-11 to Rs 17,972/mt (average of four quarters) in 2013-14. This has led to the imbalanced use of nutrients again. The ratio of NPK usage deteriorated to 9.9:3.3:1 in 2012-13 and 8.4:2.8:1 in 2013-14.

This picture at the national level of the N:P:K ratios in some states like Punjab, Haryana, and Rajasthan are alarming (Table 5.2). Even in some states like Andhra Pradesh, where the usage ratio was close to the ideal ratio, it has started to deteriorate from 2011-12 onward. The main reason behind this is surely the exclusion of urea from the NBS scheme, thereby increasing the gap between the prices of urea, DAP, and MOP in recent years. Farmers are getting perverse price signals to use more urea, thereby creating an imbalance in the N:P:K ratio in the soil and adversely affecting the fertility of the soil.

[50] Some experts have questioned the basis of this widely prevalent belief. There seems to be a need for more scientific basis of this ideal ratio, based on proper soil testing in various agro-climatic regions of the country and major crops being grown in those areas. This is an area for further study.

***Table 5.2** NPK Consumption Ratios for Selected States*

Year	NPK Ratio				
	All-India	Haryana	Punjab	Rajasthan	Andhra Pradesh
1	2	3	4	5	6
2000-01	7.0:2.7:1	73.9:21.3:1	42.5:11.9:1	92.1:30.5:1	6.5:2.9:1
2007-08	5.5:2.1:1	39.8:10.9:1	34.3:9.0:1	33.7:12.5:1	3.8:1.7:1
2008-09	4.6:2.0:1	32.2:10.7:1	23.6:6.7:1	30.2:13.6:1	3.5:1.7:1
2010-11	4.7:2.3:1	20.5:7.1:1	19.1:5.9:1	24.9:11.8:1	3.9:2.1:1
2011-12	6.7:3.1:1	27.2:9.8:1	26.8:8.5:1	34.9:15.9:1	6.1:3.2:1
2012-13	9.9:3.3:1	61.4:18.7:1	61.7:19.2:1	44.9:16.5:1	7.1:2.8:1

Source: Calculated from state-wise and all-India NPK consumption figures given in Agricultural statistics at a Glance, various years.

The imbalanced use of fertilizers has caused many problems, such as a widespread deficiency of secondary and micronutrients, spread in salinity and alkalinity, etc., all of which have adversely affected the growth in productivity. On a country-wide basis, the deficiency of sulfur has been found to be 41%, zinc 48%, boron 33%, iron 12%, and manganese 5%. Also in the last decade, the decreasing response of crops (particularly food grains) to fertilizer use has been noticed. According to the Working Group on Fertilizer Industry for the 12th Five-Year Plan (2012-13 to 2016-17), Department of Fertilizers, "The average response to fertilizer application used to be around 10:1 during the 1960s and 1970s. The response ratio obtained by research scientists, which had been adopted by the Department of Agriculture and Cooperation, Government of India, for calculating demand projections was 1:7.5 for the 8th Plan, 1:7 for the 9th Plan, 1:6.5 for the 10th Plan, and 1:6 for the 11th Plan. However, the Indian Agricultural Statistics Research Institute (IASRI) and the Indian Council of Agricultural Research (ICAR) have recently conducted a study to work out the response ratio of fertilizers for food grains based on the farmers' field data and has concluded the response ratio of NPK as 1:7.8. However, the response ratio varied for different crops—from 1:4.9 for oilseeds to 1:7.1 for pulses and 1:8.6 for cereals." The main reason behind this decline in response rate is conceived to be the imbalanced use of chemical fertilizers for a prolonged period.

Since land is scarce in densely populated India, increasing agricultural productivity is the only way out to ensure food security for its 1.25 billion existing population, which is likely to increase by another 200 million in the next 15 years. And to increase agricultural productivity, along with

the use of HYV seeds and proper irrigation, the importance of the balanced use of fertilizers cannot be overstated. Hence, there is dire need to get the pricing of fertilizers right, preferably toward a more market-oriented system. No amount of education to the farmers, and even having soil health cards, will work efficiently and effectively if the prices of NPK remain highly skewed in favor of N, as is the case today. It is worth remembering that in a free market system, pricing is a great teacher leading to efficient use of that product, which ultimately promotes efficiency and growth of that sector. Both of these objectives, efficiency and growth, have suffered badly in the case of fertilizers in India during the last 15 years, and most notably since 2010 with the introduction of NBS.

Another interesting and unintended consequence of this low pricing of urea has been its increasing use in non-agricultural industries, in addition to being smuggled to neighboring countries, especially Bangladesh and Nepal, where borders are quite porous. There are no reliable statistics about how much urea is being diverted to other uses or smuggled out of the country, but knowledgeable sources in the industry guesstimate that 10-15% is the minimum going through these channels. This obviously poses an extra burden on the already bloated bills for the fertilizer subsidy, without giving any gain to agricultural production in the country.

5.5 The Way Forward: Exploring Alternative Options

The above discussion makes at least three things clear about the impact of existing fertilizer pricing and subsidy policy: (1) the fertilizer subsidy has ballooned quite substantially, especially after 2006-07, and currently stands at around U.S. $12 billion in the central government budget of FY 2014-15, plus unpaid bills of about U.S. $6 billion due from previous years; (2) the current policy of hugely underpricing urea has led to its suboptimal use in agriculture worsening the N:P:K ratios and diversion of urea to non-agricultural uses and even its smuggling to neighboring countries; and (3) expansion of domestic urea capacity has been very limited during the last 14 years, leading to higher imports of urea and greater dependency on imports.

Under the new government in India, where a new slogan “Make in India” has been trumpeted, fertilizer policies require some rethinking in terms of subsidies, production investments, and balanced fertilization. What could be the way forward in this context?

One option is to gradually increase the price of urea and reduce the imbalance that has crept in the pricing of NPK, and consequently their imbalanced use in the country. The Expenditure Reforms Commission (2000), headed by K.P. Geethakrishnan, had recommended a 7% increase in real prices of urea on a per annum basis, starting from 2001 and going to 2006, after which pricing was expected to be import competitive, and much of the controls could be dismantled. But these increases were not implemented, and the subsidy situation continued to worsen. Could this be followed now? How much increase would be needed to bring Indian pricing of urea nearer to global pricing? For example, if Indian urea prices were around U.S. $85-90/mt (depending upon the exchange rate one uses) while the global prices were approximately U.S. $300/mt (FOB), it would require more than a 200% increase. Can this be done in the next 2-3 years? It would be a major challenge to Indian policymakers, and especially as past experience suggest such actions are unlikely.

Another option is to bring urea under NBS, wherein N is accorded similar treatment as P and K. This option would also amount to large increases in urea prices, as happened in the case of DAP and MOP.

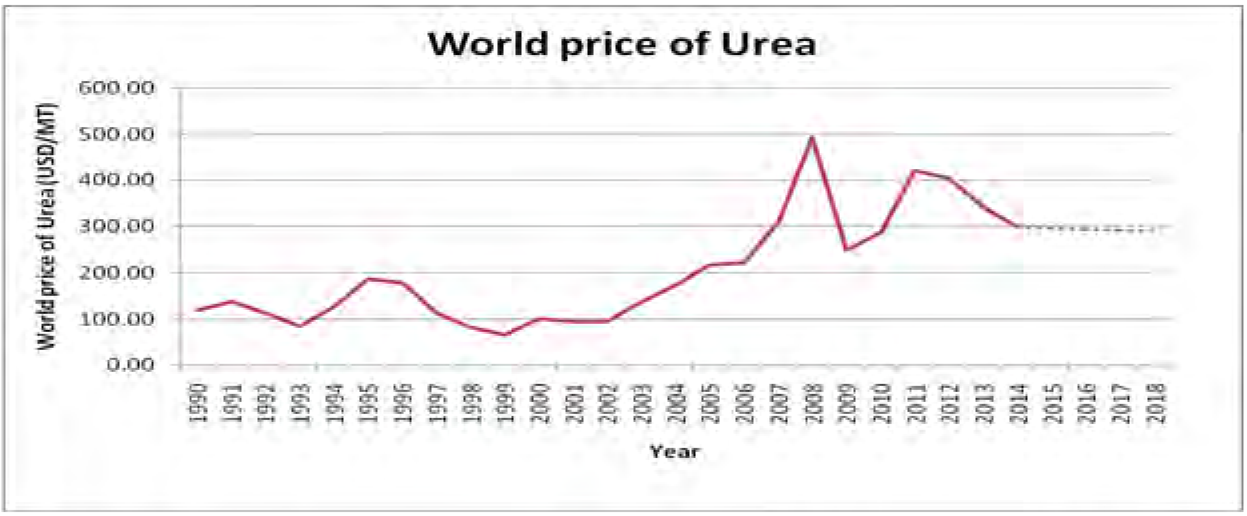
Yet another option is to totally “think outside the box” and go for a total overhaul of the urea sector pricing policies: decontrol prices of urea coupled with a one-time capital subsidy to urea plants, and transfer the fertilizer subsidy directly to farmers as cash transfers on per hectare basis. This would obviously imply that imports are fully open, urea pricing is freed from government controls and would be determined by market forces of supply and demand.

Let us examine its plausible impacts on various stakeholders and how their interests could be accommodated.

5.5.1 Decontrol of Urea: Likely Impact on Urea Industry

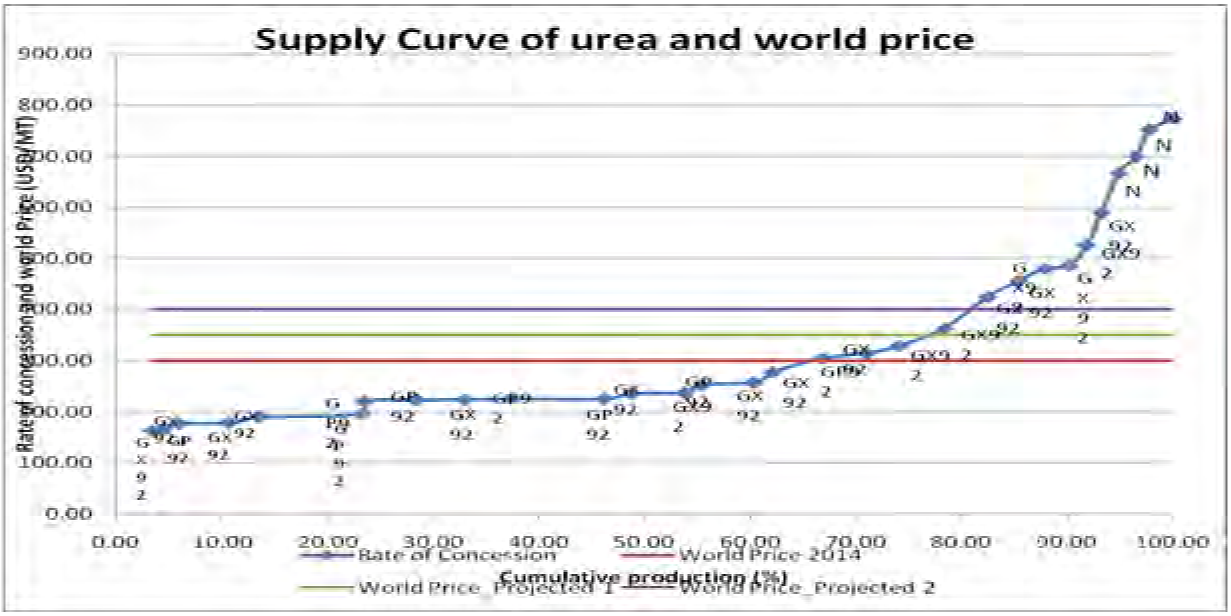
The supply price of urea will be determined by the cost of production of urea at home and what is the cost of importing urea from global markets and selling it in India (free on road [FOR]). The international price of urea has increased substantially from U.S. $100/mt in 2002 to about

U.S. $300/mt in 2013-14 (Fig. 5.9). Not only has the level of urea prices risen three times over this decade or so, its volatility also seems to have increased, touching almost U.S. $500/mt in 2008, then dropping to half at U.S. $250/mt in 2009, then again crossing U.S. $400/mt in 2011, and then falling below U.S. $300/mt in 2014. The future projections of urea prices by the World Bank reveal that urea prices are likely to stay below U.S. $300/mt until 2018 (presumably due to the increasing shale gas revolution) (Fig. 5.9).



Source: World Bank (pink sheets).

***Fig. 5.9** Global Urea Prices (U.S. $/mt)*



Note: GP92 means gas-based pre-1992 urea plants; GX92 means gas-based post-1992 plants; and N means naphtha-based plants.

Source: Computed from data from FAI and World Bank.

Fig. 5.10 Domestic Supply Curve of Urea and Likely Import Parity Price (FOR) (U.S. $/mt)

Now let us turn to the basic question: At what price urea would be made available to Indian farmers under the scenario of full decontrol of the urea sector and its pricing?

The available domestic sources for making urea are the 30 urea plants, which together produce about 23 Mt of urea. Each plant has a different cost structure and gets a retention price (also called "rate of concession") from the government based on certain norms of efficiency, capacity utilization and 12% post-tax return on capital employed, etc. The weighted average retention price of these 30 urea plants in the January-March quarter of 2014 was Rs 18,550/mt (roughly U.S. $309/mt at an exchange rate of Rs 60 = U.S. $1). This sounds reasonable given that the international price of urea is likely to remain a little below U.S. $300/mt, and if one has to convert the international price (FOB) into an equivalent domestic price, it must add in FOB prices not only international freight (about U.S. $15-20/mt depending upon whether imports are coming from China or Gulf countries). It must also add domestic freight costs from Indian ports to Indian roads (average of about U.S. $40-50/mt depending upon where it is being taken from the ports). This means to get the FOR price of imported urea, one needs to add about U.S. $55-

70/mt. So, a comparable price of imported urea would be about U.S. $350/mt (if the FOB price in international markets is around U.S. $280-290/mt). What this indicates then is that it will not have any impact on the Indian urea industry as its weighted average rate of concession (without sales tax) is U.S. $309/mt. In fact, the chances are that it will prosper, quickly displacing imports as the FOR price is likely to be much higher (about U.S. $350/mt) than the domestic weighted retention price (U.S. $309/mt). But this may not be as simple as it appears.

What really matters for domestic supplies is not the weighted average cost of 30 urea plants but the marginal costs of each plant. In a free-market economy, pricing of a product is determined by its marginal costs and not on average costs. It is the marginal cost (MC) curve that forms the supply curve of a particular industry for a particular product. We have constructed that MC curve (supply curve) for the domestic urea industry by taking the rate of concession (retention price) of each plant and its production at that price. They are arranged in ascending order, with cumulative production of these plants forming the X-axis and retention price of each plant on the Y-axis (Fig. 5.10). It may be noted that the price at which the Indian urea industry is supplying urea to the domestic market ranges from U.S. $164/mt by a gas-based pre-1992 plant to U.S. $773/mt by a naphtha-based plant. This is a very wide range because of the manner government calculates their costs, from capital to their feedstock costs, for giving them "rates of concession." All the naphtha-based plants are on the higher end of the supply curve, while most of the gas-based plants (not all) of pre-1992 vintage are at the lower end, and those of post-1992 vintage in the middle. Juxtaposing this domestic supply curve (MC curve) against the freely importable urea under the full de-control scenario, one can find where the likely price is going to settle, how many domestic plants and their production capabilities will become economically unviable, and how much importing may take place. We have assumed three alternative FOR prices for imported urea: U.S. $300/mt as the low-price case scenario; U.S. $350/mt as the most likely scenario till 2018; and U.S. $400/mt as the optimistic scenario for the domestic fertilizer industry. As it turns out, at U.S. $300/mt, U.S. $350/mt, and U.S. $400/mt, respectively, 14, 11, and 10 urea plants would become economically unviable. All the four Naphtha-based plants have very high retention prices, ranging from U.S. $666/mt and U.S. $773/mt, which is way above the world prices. All these plants will be in a serious viability crisis, as would many gas-based ones with high retention prices. If they close down, the required increase in imports of urea (assuming

demand stays at the existing levels) would be 8.58 Mt (37.77% of total production), 5.86 Mt (25.79% of total production), and 4.91 Mt (21.61% of total production) under the three scenarios, respectively. Interestingly, this will save the government U.S. $3.16 billion, U.S. $2.54 billion, and U.S. $2.28 billion, respectively, under the three scenarios as it will not have to pay high retention prices to high cost urea plants. These savings can increase further, and import dependence be reduced, if the low cost plants can expand their production at their prevailing costs as the decontrolled prices would give them sufficient profits. Additionally, the naphtha-based plants will convert to natural gas feedstock once pipeline access is completed and similar cost savings will be generated.

In reality, however, even at urea prices of U.S. $300-400/mt (under the three scenarios), the demand is likely to shrink somewhat. The smuggling of urea to neighboring countries, and its diversion to other non-agricultural uses, is likely to disappear, and high prices are also likely to incentivize farmers to use urea more rationally and efficiently in the fields. Our rough estimate is that demand for urea is likely to shrink by 10-15% if not more, without any adverse impact on grain production. To that extent, imports will be somewhat less than estimated earlier—around 3-4 Mt in the most likely scenario.

But whatever the level of imports, these scenarios beg an answer to one important question: what would happen to world prices of urea if India enters into global markets with additional demand for urea, say 3-5 Mt. As per the World Integrated Trade Solution (WITS) data of the World Bank, the world trade in urea in 2012 was about 30 Mt. So naturally, if India comes up with additional demand for 3-5 Mt, the world price may increase at least in the short run, perhaps for one or two years depending on the total supply response. But if the world market comes to know that India has finally adopted a more market-oriented pricing policy, and if India stays in the import market, there will be a global supply response quite quickly. Already, China has been expanding its capacity fast and emerging as a big exporter. There is also ample gas and capital in the world (especially in the Gulf countries, Russia, and now even the United States with the shale gas revolution) to set up new plants quickly. Our calibrated best understanding is that the

aberration in global prices, because of additional demand from India, will not last beyond two to three years.[51] After that prices will return to their normal levels of less than U.S. $300/mt (FOB).

What may happen within the domestic industry as a result of decontrol is also interesting. Those with their cost structures well below the FOR prices will find it profitable to expand production and bring down urea prices; they may also try to acquire some of the high cost plants and run them together with low cost plants. So, there is a possibility of acquisitions and mergers. It will also induce them to be efficient for the very sake of their survival, and "gold plating" may be a thing of the past. So, overall, there would be a major shakeout in the Indian urea industry, but it will consolidate within two to three years, and thereafter will be on the path of efficiency and expansion, which are the fundamentals to grow in a market economy. If the government wants to soften the blow of decontrol to some segments of urea industry (e.g., gas-based post-1992 plants), it can give them a one-time capital subsidy so that thereafter they operate fully on market principles. This way it may reduce the need for extra imports to less than 3 Mt, and this will not put as much pressure on international prices either. So, with this one time help in the form of a capital subsidy, the transition can be much smoother for the industry to switch from a controlled price environment to market economy principles.

One uncertainty in this is the pricing of feedstock, especially gas. Out of 30 urea plants operating in the country today, 26 are gas-based. And the pricing of gas is controlled by the government. Plants get gas at different prices, as gas is allocated by the government, with a combination of domestic gas and imported gas. The delivered cost of domestic gas to different urea plants ranged between U.S. $5 and $7/million British Thermal Units (mBTU), while the cost of imported gas was between U.S. $16 and $20/mBTU, with a weighted average of U.S. $10-11/mBTU during the period May 2014 to August 2014. The domestically produced gas is obviously underpriced compared to imported gas. India is today importing about 30% of its gas. So, logically, and purely from an economic point of view, domestic gas prices need to be revised/de-controlled. There is intense discussion within the country on this subject, and the Rangarajan Committee has already recommended almost doubling the prices of domestic gas, from U.S. $4.2/mBTU to U.S. $8.4/mBTU. But the new government has not accepted the

[51] Some industry people feel that it may take even five years.

recommendations of the Rangarajan Committee and has just announced the price of gas to be U.S. $5.61/mBTU in October 2014. Interestingly, the government has changed the base of gas pricing from net calorific value to gross calorific value. Comparable pricing on a net calorific basis, as per newspaper reports, will turn out to be U.S. $6.17/mBTU, up from U.S. $4.2/mBTU —an increase of almost 47%. This is to be revisited after every six months. If all urea plants get gas at this price, it may be better for the urea sector as a whole to get a level playing field.

Industry sources calculate that every U.S. $1 increase in gas price under the retention price scheme increases the fertilizer subsidy by about U.S. $350 million. Therefore this U.S. $2 increase in gas pricing (in terms of net calorific value), would mean that the fertilizer subsidy bill may go up by another U.S. $700 million. It may be kept in mind that the issue of gas pricing, and its market-based distribution, will have significant implications on the urea industry, and these will have to be taken into account before taking a full-fledged move in this direction.

5.5.2 Likely Impact on Farmers, Food-Grain Production, and Food Security

The other major factors in this decontrol scenario are the farmers and the country's objective of having ample grains production to ensure food security to its 1.25 billion people. If the price of urea shoots up from the existing price of U.S. $89/mt (Rs 5,360/mt) to U.S. $300-350/mt for the farmers, this can create a major political problem. Although DAP and MOP prices shot up abruptly when they were decontrolled in 2010, and those price spikes were absorbed by the farmers; a urea price rise by more than three times could be a different story. Thus, the transition to a market-oriented system will have to be well thought out. Currently, the fertilizer subsidy is about Rs 720 billion (U.S. $12 billion) with pending bills of more than U.S. $6 billion. Together, it is more than Rs 100,000 crores, and it will go up further with the recent increase in gas pricing. The gross cropped area (GCA) in the country hovers around 190-200 million ha, the net sown area (NSA) around 140 million ha, distributed over around 120 million farming families. Broadly, it works out to Rs 5,000/ha of GCA and Rs 7,100/ha of NSA. An overwhelming number (85%) of farming families have small and marginal holdings (less than 2 ha), but together they operate around 44% of area. If all those small and marginal holders receive Rs 5,000/ha as full compensation for the fertilizer subsidy, politically, one might get full support

of these 85% farming families. To others, one can reduce the level of compensation to Rs 4,000/ha, thereby saving 20% of the subsidy on 56% of cultivated land. These monetary compensations can be frozen for two to three years so that with inflation, they reduce in real terms. Today, technology exists to reach each and every farmer through Aadhaar and Unique Identification Number (UID). The Jan Dhan Yojana (Financial Inclusion Scheme) of the new government will also come in handy to do this transfer and then switch over to market-based pricing of fertilizers.

If farmers receive a cash subsidy for fertilizers, and prices of fertilizers are market determined, there would be incentive to use fertilizers more efficiently, improving the N:P:K ratio, which in turn would improve the overall response of grains to fertilizers and raise grain production. It would also help reduce the fertilizer subsidy bill by about U.S. $2-3 billion a year, stop fertilizer smuggling to neighboring countries and lower use of fertilizers in alternative non-agricultural uses. These savings could be reinvested into agriculture by strengthening extension of best farming practices, identifying more innovative methods and products usage (like fertigation), and getting soil health cards for each farmer by testing the nutrients in farmers' fields through mobile labs. All these measures will promote efficiency in the use of fertilizers and induce higher production of fertilizers at home and at globally competitive rates. In brief, it is feasible, and can be a win-win situation. And this seems to be the best time, when internationally urea prices have moderated and India has huge stocks of grains. It is a unique opportunity, as it will easily absorb any disruption in the supplies of urea or grain production. Overall, food security will remain intact, and within two to three years, India will be marching on the road to efficiency and growth in fertilizer production and food grains. The option of maintaining the status quo is not sustainable. It will lead to ballooning subsidies, lower investments, and greater inefficiency in the use of fertilizers and deceleration in the growth of grain productivity, which India can ill afford. Therefore the best option seems to be of marching ahead with bolder reforms, and with due consideration to the interests of the affected industry (through capital subsidy) and of farmers (through cash transfers). The window of opportunity is knocking at India's doors!

Addendum

The analysis of gas pricing, as described in the second paragraph of page 164, is based on the information available for early 2014. Since then, a few important developments on the gas policy have taken place, which have a direct bearing on fertilizer subsidy. These are listed below.

1. ***Gas pooling***: The Government of India (GOI) approved a policy intervention on March 31, 2015, to supply gas at a uniform delivered price to all fertilizer plants utilizing natural gas for the production of urea through a pooling mechanism. This policy has reduced inter-plant variation in the energy cost component of the total production cost of urea and has created a level playing field for all gas-based urea plants. For example, as of November 2016, the delivered price of gas from domestic sources was U.S. $4-5 per million British Thermal Units (mBTU), and imported liquefied natural gas (LNG) under medium- and long-term contract was U.S. $10-12/mBTU. Spot LNG cost was U.S. $12-14/mBTU. The pooled price was around U.S. $6.90/mBTU.
2. ***Energy consumption***: There remains a variation in gas cost for individual units due to differences in per unit energy consumption, which varies from U.S. $5.5 to U.S. $8.5 Gcal/mt of urea. In 2015 under the New Urea Policy, the GOI mandated existing gas-based urea plants to reduce the energy consumption level to between US $5.5 to U.S. $6.5 Gcal/mt by 2018-19. This will further reduce the inter-plant variation in cost of urea production.
3. ***Conversion to gas by naphtha-based plants***: Currently, there are three naphtha-based plants: Mangalore Chemicals & Fertilizers, Mangalore; Madras Fertilizers, Manali; and SPIC, Tuticorin. These plants were modified to utilize gas as feedstock and can switch to gas as soon as pipeline connectivity is available.
4. ***Competitiveness of the Indian urea industry***: The weighted average cost of production of Indian urea plants has remained competitive with imports in the last decade. With the recently implemented gas policies for urea plants and availability of gas pipeline connectivity to the three existing naphtha-based plants, the inter-plant variation in cost of urea production will be considerably minimized within the next two to three years, allowing all Indian domestic urea plants to remain competitive with imported urea.

References

Fertiliser Association of India (2013) Fertiliser statistics 2012-13. FAI, New Delhi

Government of India (Various Years). Agricultural statistics at a glance. Agricultural Statistics Division, Directorate of Economics and Statistics, Department of Agriculture and Co-operation, Ministry of Agriculture, New Delhi

Government of India (Various Years) Annual report. Department of Fertilizers, Ministry of Chemicals and Fertilizers, New Delhi

Government of India (Various Years) Economic survey. Ministry of Finance, New Delhi

Government of India (Various Years) Expenditure budget, Vol. I. Ministry of Finance, New Delhi

Government of India (2012) All India report on input survey 2006-07. Agriculture Census Division, Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi

Government of India (2012) Report of the Working Group on Fertilizer Industry for the twelfth plan (2012-13 to 2016-17). Department of Fertilizers, Ministry of Chemicals and Fertilizers, New Delhi

Government of India (2014) National accounts statistics 2014. Central Statistical Organisation, Ministry of Statistics and Programme Implementation, New Delhi

Gulati A (1989) Input subsidies in Indian agriculture—A state-wise analysis. Economic and Political Weekly, June 24

Gulati A, Narayanan S (2000) Demystifying fertilizer and power subsidies in India. In: Bhalla S (ed) New economic policies for a New India. Indian Council of Social Science Research, New Delhi

Gulati A, Narayanan S (2003) The subsidy syndrome in Indian agriculture. Oxford University Press, New Delhi

Sharma VP, Thaker H (2010) Fertilizer subsidy in India: Who are the beneficiaries? Economic and Political Weekly, March 20

Singh R (2004) Equity in fertilizer subsidy distribution. Economic and Political Weekly, January 27

Venkateshwaralu S, Sen A (2002) Fertilizer industry in India: moulded by government policies. Economic and Political Weekly, January 26

Online Resources

- For role of macronutrients in plants: http://www.noble.org/ag/soils/back2basics/ accessed on 10.09.2014
- Department of Agriculture and Cooperation: http://agricoop.nic.in/
- International Zinc Association: http://www.zinc.org/info/zinc_crops accessed on 10.09.2014
- Statistics Division of the Food and Agriculture Organization of the United Nations (FAO): http://faostat.fao.org/
- Union Budget and Economic Survey: http://indiabudget.nic.in/
- World Bank Pink Sheet: http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/0,,contentMDK:21574907~menuPK:7859231~pagePK:64165401~piPK:64165026~theSitePK:476883,00.html accessed on 22.09.2014
- Ministry of Statistics and Programme Implementation: http://mospi.nic.in/Mospi_New/site/home.aspx accessed on 27.08.2014.

6 Indonesia

Muhammad Firdaus

6.1 Introduction

6.1.1 National Fertilizer Demand and Supply

6.1.1.1 Overview of National Fertilizer Consumption

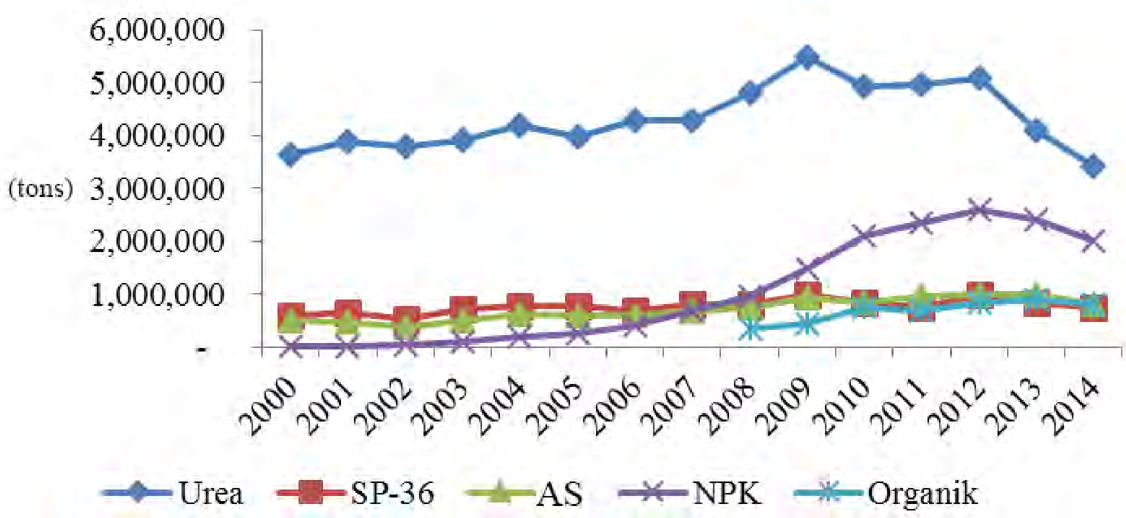
Agriculture plays an important role in Indonesia employing about 35% of the labor force (Central Statistical Agency [BPS] 2014). Since the agricultural intensification program began in the 1970s, fertilizer use has become one of the most essential factors in the production of agricultural commodities. Consumption of inorganic and organic fertilizers has experienced rapid growth each year, especially for food crops. Increased fertilizer use is greatly influenced by the planting of some new varieties of paddy that are more responsive to inorganic fertilizers. Low amounts of fertilizer application on these varieties results in reduced plant growth and lower yield.

Meanwhile, increasing population in Indonesia fosters the conversion of agricultural land to non-farm use, thus more fertilizer is used to support intensive cultivation on smaller plots. Farmers tend to apply fertilizers more intensively on smaller land areas compared to large-scale farms. As a result, both inorganic and organic fertilizer use in Indonesia continues to increase. The total fertilizer consumption in 2000 was 5.49 Mt (urea, SP-36, AS, and KCl[52]). The total fertilizer consumption in 2012 was 8.95 Mt (urea, SP-36, AS, NPKs and organic fertilizers), an increase of 63.1% from the consumption in 2000. This increase was partially due to the new types of fertilizers being subsidized, such as NPK and organic fertilizers. The consumption of inorganic fertilizers in Indonesia is dominated by urea, which accounts for about 63% of total fertilizer use.

Almost all fertilizers used in Indonesia are subsidized. Figure 6.1 presents the development of subsidized fertilizer demand in Indonesia from 2000 to 2014. The data for the last two years represent projected fertilizer consumption.

---

[52] SP-36: superphosphate; ZA: ammonium sulfate; KCl: potassium chloride.



Source: Ministry of Agriculture (2013).

Fig. 6.1 *Subsidized Fertilizer Demand, 2000-14 (ton fertilizers per year)*

Although fertilizer demand varies among different regions in Indonesia, the total consumption for all types of subsidized fertilizers from 2000 to 2012 has increased from about 4 million to 10 million Mt. Urea increased by 40%, from 3.562 Mt in 2000 to 5.100 Mt in 2012; while other inorganic fertilizers, consisting of SP-36, AS, and NPKs increased by 319% from 1.097 million to 4.594 million Mt. The most significant increase in demand for fertilizer comes from NPKs; consumption of NPKs was 2,000 mt in 2000, and increased to 2.594 Mt in 2014. From 2013 to 2014, demand for inorganic fertilizers decreased by about 12%. Data for organic fertilizers are available from 2008, when the Government of Indonesia (GoI) allocated an organic fertilizer subsidy. Consumption of organic subsidized fertilizers is still very small compared to inorganic fertilizers—about 4-9% of total demand, or about 300,000 to 900,000 mt during 2008 to 2014.

Meanwhile, consumption of subsidized fertilizers is larger than consumption of non-subsidized fertilizers. Based on Asosiasi Produsen Pupuk Indonesia (2014), urea consumption in 2007-13 for estate crops and the industrial sector (neither sector is allowed to use subsidized fertilizers) was close to 2 Mt/year, or just half of the consumption of subsidized urea.[53] Consumption of SP-36, AS, and organic fertilizers for these sectors (estate crops and industrial sector) in the same period did not reach 40,000 mt/year. These data can be found in Appendix Table 6.2.

[53] Only in 2008 the average urea consumption for estate crops and industrial sector was close to 1 Mt, when it dropped to 1.3 Mt from 2007 due to economic downturn.

Besides the price of crops (a major factor in determining the amount of fertilizer used), the price of fertilizer is also determined by the quantity of fertilizer used by farmers and government policies (Pramusinto et al. 2009). Moreover, the fertilizer price at the farm level fluctuates significantly. Such fluctuation is mainly caused by an imbalance between the increasing domestic demand for fertilizer and its limited production. The data show that since the 2000s, imports of fertilizer increased in Indonesia, including urea.

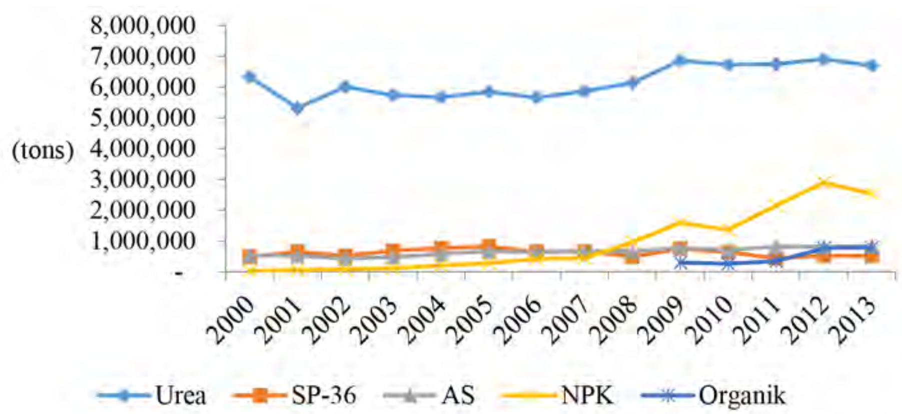
6.1.1.2 Overview of National Fertilizer Production

Food is a strategic commodity for Indonesia as its population is over 240 million. To meet such a large demand for food, the agriculture sector is supported, particularly for fertilizer supply. Therefore, the fertilizer industry has a very strategic role for food security in Indonesia. Since the movement to intensify agricultural production in the late 1950s, the GoI has committed to develop state-owned fertilizer factories. Mineral fertilizer has been used since the colonial period, including AS, which farmers applied to increase the yield of plantation crops such as sugarcane. During that period, all AS components were fully imported. When natural gas became massively available, the government started to establish a urea factory which used natural gas as the main feedstock for fertilizer production. In 1963, the first state-owned fertilizer factory was established in Palembang, South Sumatera, with a production capacity of 100,000 mt/year. The GoI declared the first phase of a development plan in 1969, with the agriculture sector as the main target. Fertilizer demand was estimated at more than 700,000 mt/year. Many new factories were constructed during the 1970s.

Since the 1980s, the fertilizer industry in Indonesia consisted of five state-owned companies (Badan Usaha Milik Negara/BUMN). They are PT Pupuk Sriwijaya (PT PUSRI), PT Petrokimia Gresik (PT PKG), PT Pupuk Kujang (PT PKC), PT Pupuk Kalimantan Timur (PT PKT) and PT Pupuk Iskandar Muda (PT PIM). As of 1997, these companies were managed under a holding company, PT PUSRI. Starting in 2012, PT PUSRI, as the lead holding company, changed its name to PT Pupuk Indonesia. Those companies produce inorganic fertilizer such as urea, AS, SP-36 and NPKs. Some types of organic fertilizers are also produced but in very limited quantity. Recently, the availability of fertilizer in the domestic market is handled directly by the

government, so that the total production of each type of fertilizer is determined by the need for fertilizer, which is estimated by the Ministry of Agriculture. The development of fertilizer production during the last 10 years is shown in Fig. 6.2. The fertilizer which is most widely produced in Indonesia is urea, which constitutes nearly 75% of all produced fertilizers, with an average output of 6 Mt/year.

Although urea dominated the production of fertilizers, its development was relatively stable. Over the past 10 years, on average, the increase in urea production was about 9%. Other types of inorganic fertilizers, namely SP-36, AS, and NPKs, experienced a high growth rate. The increase in production of NPK fertilizers reached thousands of percent over the last 10 years; production increased from only 29,000 mt in 2000 to 2.538 Mt in 2013. Meanwhile, for organic fertilizer, of which production started in 2008, the annual output increased by 167% from 294,000 mt to 787,000 mt during the last four years.



Source: Ministry of Agriculture (2013).

Fig. 6.2 *Development of Fertilizer Production, 2000-13 (mt/year)*

Over the last 10 years, the global economy has remained the dominant driver of the national macroeconomic situation. It also had an impact on the development of the national fertilizer industry. The main problem encountered in fertilizer production is the rising tendency of the price of natural gas and raw materials for non-urea fertilizers. Imports of raw materials for fertilizer production such as phosphate, potash, and sulfur are still conducted because these materials are not available in Indonesia or the quality of available materials is poor. In addition,

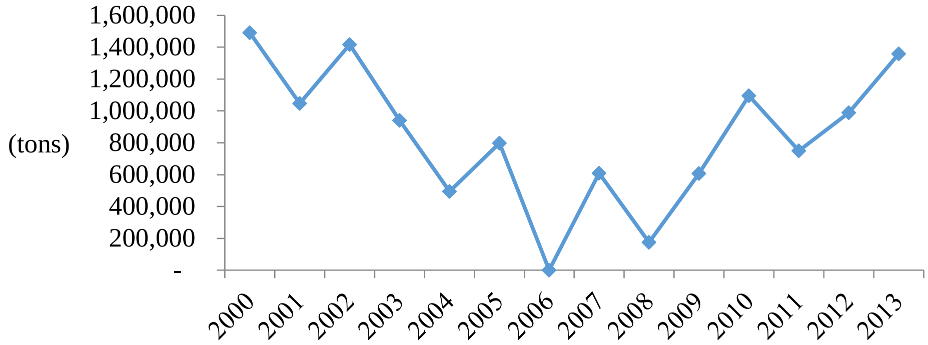
the availability and price of natural gas is a major challenge for development of the national fertilizer industry. Another factor that affects the continuity of the national fertilizer industry is the high maintenance cost of fertilizer factories (PT Pupuk Indonesia 2014). But this does not significantly influence the products whose raw materials are imported.

According to Hadi et al. (2007), there are four factors that may influence the amount of fertilizer production in Indonesia: government policy, domestic demand, natural gas supply and physical condition of the factories. Related to the last factor, Rachbini (2006) revealed that in order to increase production of fertilizers, especially urea, it would be very effective to increase the operating rate of the existing factories. Almost all fertilizer factories in Indonesia still produce below optimal capacity. Over the next three years there are substantial new capacity developments planned and closure of a few smaller, older plants.

6.1.1.3 Overview of National Fertilizer Exports and Imports

As fertilizer prices rose on the global market, the GoI captured this opportunity by permitting exports to the world market, especially for urea. Based on the National Socio-Economic Survey in 2008 (BPS 2009), the export of inorganic fertilizers accounted for about 40% of national income, which was higher than the income derived from the domestic market. But, based on Financial Audit Board of Indonesia (2012), the realization of profit share from export sales in 2012 is around 30%, while in the subsidized sector, profit is around 7%. The government's decision to permit exports is also aimed at overcoming the accumulation of stocks of fertilizer that are not absorbed by the market. This decision did not disrupt the supply of fertilizers in the country, as production of urea tended to exceed consumption.

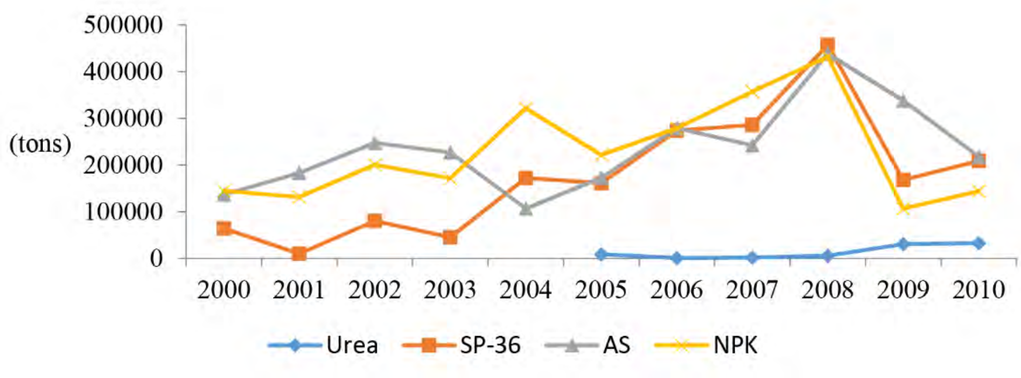
During the period from 2000 to 2013, exports of urea fertilizer had a tendency to fluctuate each year. The trend of urea exports is presented in Fig. 6.3. During this period, the average export of urea fertilizer was 900,000 mt/year. Exports of urea decreased after 2002, then were not permitted in 2006. From 2007 until 2013, exports of urea tended to increase, reaching 1.359 Mt in 2013.



Source: The Ministry of Industry (2011); PT Pupuk Indonesia (2014).

Fig. 6.3 *Urea Fertilizer Exports, 2000-13 (mt)*

On the contrary, for other types of fertilizer such as SP-36, AS, and NPKs, domestic production is not sufficient to meet domestic needs, thus imports of these chemical fertilizers are still significant. The five state-owned producers are permitted to import fertilizers as long as domestic production cannot meet demand. The import of fertilizer is due to the lack of phosphate and potash raw materials available to the national fertilizer industry. Figure 6.4 presents the trend of inorganic fertilizers which were imported during 2000-10. The import of fertilizer tended to increase and reached a peak in 2008. SP-36, AS, and NPK imports were about 400,000 mt. Meanwhile, for urea, although the exports were fairly large, since 2005 Indonesia has imported 1,000 to 30,000 mt/year. In the case of KCl or potassium chloride, this kind of fertilizer is not produced in Indonesia. Thus, the needs of KCl are covered by imports only (Hadi et al. 2007). According to data from Ministry of Industry (2015), the import of KCl in 2012 was U.S. $1.24 billion and decreased to U.S. $890.8 million in 2014.



Source: Ministry of Industry (2011).

Fig. 6.4 *Fertilizer Imports, 2000-10 (mt/year)*

6.1.1.4 Market Outlook for National Fertilizer

National fertilizer demand is increasing along with the increase in domestic food demand. Government policy requires that to meet the needs of the food industry, the national fertilizer industry has to supply the necessary fertilizers to increase agricultural production. The opportunity to develop the fertilizer industry is large, supported by the national urea supply-demand projections.

6.1.2 Efficiency of Fertilizer Use

Since 1978, Indonesian farmers were encouraged by a government program to apply balanced fertilization (nitrogen, phosphorus, and potassium NPKs). Proper use of fertilizers was believed to be the determinant of the quantity and quality of agricultural production. The use of fertilizers by farmers in Indonesia is illustrated in Table 6.1. There are four main food crops cultivated by farmers: paddy (rice), maize, soybean, and sugarcane. Farmers are categorized by the composition of fertilizer use which consists of organic, inorganic or a combination of both fertilizers. Most farmers apply inorganic fertilizers for paddy and sugarcane cultivation. Some farmers combine inorganic and organic fertilizers, especially for maize cultivation. The percentage of farmers who use solely organic fertilizers is still very small, ranging between 0.6% and 7.3%. However, there is quite a large portion of farmers who do not apply fertilizer in Indonesia, especially for maize and soybeans. The reasons for this might be economic and non-economic factors, which will be explained in the next section. This still gives challenges to the government to encourage Indonesian farmers to apply inorganic and organic fertilizers precisely.

Table 6.1 Distribution of Farmers Based on Fertilizer Use (%)

Fertilizer	Paddy	Maize	Soybean	Sugarcane
Organic and inorganic	23.46	46.12	31.83	29.00
Organic	0.63	2.01	7.31	2.21
Inorganic	67.73	36.82	42.34	67.35
No fertilizer	8.18	15.05	18.52	1.44

Source: Ministry of Agriculture (2010).

However, many previous studies found that the use of fertilizers by farmers in Indonesia is generally characterized by very inelastic production. This figure is indicated by the value of production elasticity being much smaller than one. This fact is rather contrary to the data in Table 6.1. The use of fertilizer is very intensive by farmers in some regions, mainly in Java Island. More than 70% of food crops are planted in Java Island. Outside of Java, many farmers still do not apply organic or inorganic fertilizers. Some supporting infrastructures for fertilizer application, such as irrigation canals, are mostly found to be well established in Java Island.

Suwarto (2008) found that the value of the elasticity of production of inorganic fertilizers was much lower than organic fertilizers. Elasticity of production for nitrogen fertilizer was 0.026, while the elasticity of production for organic fertilizer was 0.113. This indicated that the production is insensitive to the use of fertilizers. In other words, each additional unit of inorganic or organic fertilizers in production would produce additional output lower than the additional unit of fertilizers used. This means that there is still room to encourage farmers to increase the use of fertilizers. The use of organic fertilizers needs to increase more than the use of inorganic ones, as elasticity of inorganic fertilizer is closer to zero compared to organic fertilizer. The use of organic fertilizer is expected to increase overall soil fertility.

In Indonesia, based on some studies during the last decade, the impact of inorganic fertilizer application on paddy production was not significant. Triyanto (2006) found that when fertilizer use increased by 1%, rice yield increased by 0.017% only. A similar finding was presented by Bagio (2007): any increase in fertilizer use by 1% increased the yield by only 0.09%. However, for fertilizer application, several factors have to be considered, such as the optimal dose needed by plants, the availability of nutrients in the soil, land management, etc.

Various studies in Indonesia have shown that the use of inorganic fertilizers, especially in paddy farming, tended to be inefficient. The farmers are free to determine their own dose regardless of the condition of the land so that there is a possibility of excessive fertilizer use, especially when fertilizer is heavily subsidized. At the farm level, the use of urea reached 300-400 kg/ha, whereas the technical recommendation is generally only 250 kg/ha (Kariyasa 2007). One of the reasons for excessive use of urea was that farmers consider urea as the primary fertilizer, and SP-36, AS, and NPKs as supplementary fertilizers.

The overuse of urea in Indonesia and its negative impact on soil quality is well documented. Simatupang and Timmer (2008) documented the link between soil degradation and urea overuse and land farming intensity in Indonesia.

Studies on the impact of fertilizer use on various crops produced similar findings. For chili, the use of manure or organic fertilizers still had a significant effect on production. Kalsum (2008) showed that an addition of 1% of manure would increase yield by 0.467%. Meanwhile, urea fertilizer has a negative production elasticity valued at -0.035. This finding revealed that the use of urea fertilizer was already higher than the optimum level. Another study which observed the impact of fertilizer use on cocoa production showed that each 1% addition of inorganic fertilizer was only able to increase cocoa production by 0.048% (Tumangor 2009).

A study carried out by Osorio et al. (2011) using Indonesian agriculture census data found the use of urea was above the recommended levels. The relationship between urea use and paddy yields was described as an inverted-U relationship. By using an econometric model, the study estimated the threshold at which the relationship between urea use and yields would revert at 226 kg/ha, in line with the recommended amounts by the Ministry of Agriculture at 200-250 kg/ha. However, most farmers reported that they used higher than recommended levels. Many farmers in the census reported the use of urea two to three times higher than the recommended levels.

ICASEPS (2005), a research center under the Ministry of Agriculture, investigated some reasons for the high rates of urea fertilizer used by farmers. There are non-economic and economic reasons. The non-economic reasons included such things as inherited habits, following other farmers and the nature of commodities produced. For economic reasons, the study found that farmers were less concerned about fertilizer price, particularly as GoI fertilizer subsidies were favorable. Farmers believe that the yield would not be as much as they expected if they did not use large amounts of fertilizer. A study carried out by Hadi et al. (2007) found that economic factors such as the price of fertilizer, estimated output prices at harvest time and cost of production, as well as the level of farm profit, were less considered by farmers. Technical recomendations delivered by extension workers also received little attention from farmers.

However, excessive fertilizer use does not occur in regions where farmers apply fertilizers based on the Definitive Plan of Group Needs (*Rencana Definitif Kebutuhan Kelompok* [RDKK]). The plan is established based on recommendation of local extension officers (PPL). PT Pupuk Indonesia recommended the use of fertilizer using an N:P:K ratio of 5:3:2 based on trials which gave the best results, while the government also has fertilizer recommendations, but their implementation has not been fully operational.

6.1.3 Fertilizer Subsidy in Indonesia

The GoI continues some efforts to increase domestic food production in order to achieve the food security target. One is the provision of fertilizer subsidies. The subsidized fertilizer price is set through the regulation of the agriculture minister so that the price of subsidized fertilizer at the farm level is stable when compared to non-subsidized fertilizer prices and export prices. Fertilizer prices should be maintained as low as possible to be affordable by the farmers. However, the economic value of fertilizer prices is maintained to stabilize the fertilizer industry and avoid a big loss.

Government policy that aims to ensure the availability and price stability of fertilizers in the long term was seen as desirable in order to increase agricultural productivity. Specifically, the main objectives of the fertilizer subsidy are to increase food production, protect the farmers from world fertilizer price hikes, increase farmers' income, absorb labor, and ensure the availability of

fertilizers. From the industry side, the subsidy program relates to the provision of raw materials. Although Indonesia is one of the major producers of fertilizer, the fertilizer industry in the country finds it quite difficult to obtain the required natural gas supply. Thus, without government subsidies, the price of fertilizers at the farm level would definitely be significantly higher.

6.1.3.1 Evolution of the Subsidy System

The policy for the fertilizer subsidy has been progressing in line with the dynamics of agricultural development in Indonesia. Since the first five-year plan (1969-74), the GoI has considered the availability of fertilizer as one of the main factors to be safe guarded. In the initial periods, the fertilizer subsidy was directed toward the expansion of the rice supply in Indonesia. From 1971 until the mid-1980s, the amount of the fertilizer subsidy had grown substantially and dominated government spending in the agriculture sector. The main purpose of the subsidy program is to provide fertilizers at an affordable price to farmers so that farmers are able to apply fertilizers according to technical recommendations to increase their income.

The mechanism and calculation of the subsidy amount implemented by the GoI are as follows. During the old regime, the fertilizer subsidy was provided by fixing the government purchasing price (GPP). Before 1992, the price was calculated on a “cost plus fee” basis. For every metric ton produced, the industry received a fee of Rp 5,000. From 1992 to 1997, purchases by the government were based on a border price, where the selling price of urea was standardized for all fertilizer factories and calculated based upon the oil price of U.S. $1.00/mBTU. From 1997 to 1998, the GPP was calculated based on foreign currency expenditures for the main raw material, supporting feedstock, factory spare parts, and insurance. The Minister of Finance then agreed to subsidize the exchange rate difference. Starting in 1987, the GoI gradually reduced the budget for the fertilizer subsidy due to the limited fiscal capacity: it declined from about 8.1% of the agriculture budget in 1986 (Rp 671.5 billion) to a mere 0.4% in 1997 (Rp 137 billion). The subsidy was reduced through increasing the ceiling retail price (CRP) and improving the efficiency of distribution. From December 1998 until 2000, the fertilizer subsidy was discontinued to comply with the memorandum of understanding between the GoI and the International Monetary Fund (IMF). The agreement aimed to implement economic and monetary

programs for revitalizing the national economy after the 1997 crisis (Fuglie 2004). In other words, fertilizer became a free commodity at this time. However, some previous studies showed that the subsidy removal did not have any significant impact on farmers' fertilizer use (Hartoyo 1994; Rusastra et al. 1997).

After 2000, due to the new political situation, the government was forced by the parliament to re-implement the fertilizer subsidy. In 2001, the CRP of urea at the farmer level was set again. Urea producers were subsidized by the government with the domestic gas incentive. Principally, the calculation of CRP was based on farm cost structure. Then, the cost was deducted from the gross revenue to get farmers' willingness to pay. Some assumptions were used, such as the share of fertilizer cost of total production cost (13-15%) and a farm profit margin of about 20-30% with a given grain price. Meanwhile, by using the subsidized fertilizer, margins can reach more than 30%.

The CRP of subsidized fertilizer at an official retailer is determined by distributor by cash purchase of one bag (50 kg) for urea; 50 kg for AS and SP-36; and 20 kg for NPK fertilizers. The same price applies all over Indonesia. The calculation of CRP reflects the distributor fee (5%), retailer fee (3%), and transportation costs (Hendrawan 2012).

Before 2003, all producers sold fertilizer exclusively to one state enterprise, PT PUSRI. The price paid by PT PUSRI to the other firms was established by an agreement between the government and producers. It was estimated from the cost of production, plus a percentage for profit. However, that estimate differed among the factories. PT PUSRI then distributed the subsidized fertilizer throughout Indonesia. PT PUSRI sold the fertilizer to the distributors at a price equal to the CRP less the costs of distribution. In 2003, the government changed the subsidy scheme for urea into the gas subsidy, while the non-urea subsidy still followed the price subsidy. This was because of the gas contract after 1992—the producer paid a higher price of between U.S. $1.50 and 2.00/mBTU, compared to the price of the gas contract before 1992, which was U.S. $1.00/mBTU. However, the producers had to sell the subsidized fertilizer with the limited price. Within this scheme, the producers only paid for the gas with the price of $1.00/mBTU. Then the government paid the producers for the amount of gas used. The amount

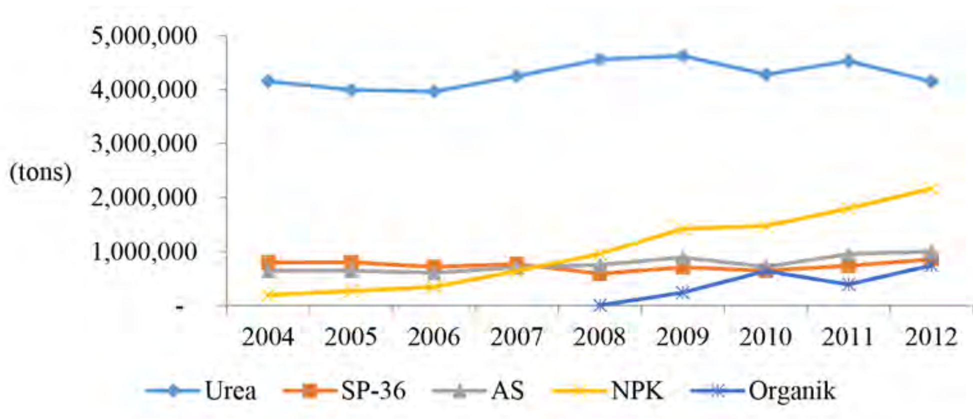
of the incentive was determined by the Ministry of Finance. In line with this new scheme, in August 2003 the government revised the previous ceiling price of urea from Rp 1,150 to Rp 1,050/kg. The highest retail price for the other types of subsidized fertilizers in 2003 was Rp 1,400/kg (SP-36); Rp 950/kg (AS), and Rp 1,600/kg for NPKs.

In September 2006, based on the requirement from the producers, the government implemented the price subsidy scheme again. This was due to increasing domestic fuel and gas prices. With the new scheme, producers would be able to apply the least cost distribution in delivering the fertilizers to the distributor. This scheme was used until recent years. The subsidy is accounted for by government using the difference between the CRP and cost of goods sold (COGS) at the farmer level (break-even price + distribution costs from the factory-gate to farmers + margin 10%). The break-even price is determined by the Ministry of State Owned Enterprises (BUMN). Since 2006, there have not been any changes in the CRP.

Based on the Minister of Agriculture's decree in 2008, the fertilizer subsidy was limited to crop farmers with 2 ha or less per planting season, or to fisheries farmers who operate land below or equal to 1 ha. Subsequently, each eligible farmer was given a "smart card" that contained private information for each farmer on the above indicators, as well as the officially permitted volume of subsidized fertilizer. However, after it had been tested in the field in Java during 2007 and 2008, some potential problems were found when the smart card was implemented. For example, the cards were ruined by farmers or simply misplaced. Then in 2009, the government decided to use manual registration forms. Only farmers who registered from July to December 2008 were permitted to buy the subsidized fertilizer. The lists of farmers and farmer groups were verified by the Head of Village. Retailers were to use this form to propose the amount of subsidized fertilizer to the distributor and so on. In order to minimize the delivery variance, the producer had to provide the red label on the fertilizer bag: "*Pupuk Bersubsidi Pemerintah/ Barang Dalam Pengawasan*" (subsidized fertilizer/commodity under government supervision).

The latest legal base for the fertilizer subsidy in Indonesia is Presidential Decree No. 15/2011. This instruction is implemented by involving four different ministries: Ministry of Agriculture, Ministry of Trade, Ministry of Finance, and Ministry of Industry. Each ministry has different

responsibilities. The Ministry of Agriculture is responsible for determining the allocation, break-even price, and CRP. The distribution of fertilizer is controlled by Ministry of Trade. To review and propose the budget for the fertilizer subsidy, the Ministry of Finance sends the proposal to the Parliament every year. Finally, the standardization and quality control of fertilizer is tackled by the Ministry of Industry. Implementation of the fertilizer subsidy program in Indonesia is operationally implemented by the Directorate of Fertilizer and Pesticide, Directorate General for Infrastructure, Ministry of Agriculture. The type of subsidized fertilizers consists of urea, SP-36, NPKs, AS, and organic fertilizers. The distribution of all subsidized fertilizers experienced an increasing trend every year, except for urea. Fig. 6.5 shows the evolution of subsidized fertilizer distribution during 2004-12.



Source: The Ministry of Industry (2011); PT Pupuk Indonesia (2014).

Fig. 6.5 *Distribution of Subsidized Fertilizers, 2004-12 (mt/year)*

6.1.3.2 Evolution of Distribution System

Fertilizer subsidies in Indonesia faced some problems, mainly in the process of subsidy distribution. Figure 6.6 presents the flow of fertilizer from the factory (Line 1) to processing and bagging units (Line 2). Then fertilizers are delivered into warehouses at the district level (Line 3). At the final stage, fertilizers are distributed by warehouses into a distributor/kiosk at the sub-district and village level (Line 4). Because of the locations of the fertilizer factories which are limited to only a few places as opposed to the widespread agricultural areas, the government has long intervened in many ways to ensure the availability of fertilizer in all areas. Those interventions can be divided into the following periods. The period from 1960 to 1979 was the

beginning of the regulation of fertilizer distribution in order to support the agricultural program of Massal Supervision or Bimbingan Massal (BIMAS), the most seminal program through which Indonesia achieved self-sufficiency in rice in the early 1980s. In this period, production and distribution of fertilizers were controlled by a single player. There was no stock regulation so that there was no supply guarantee from government and fertilizer producers.

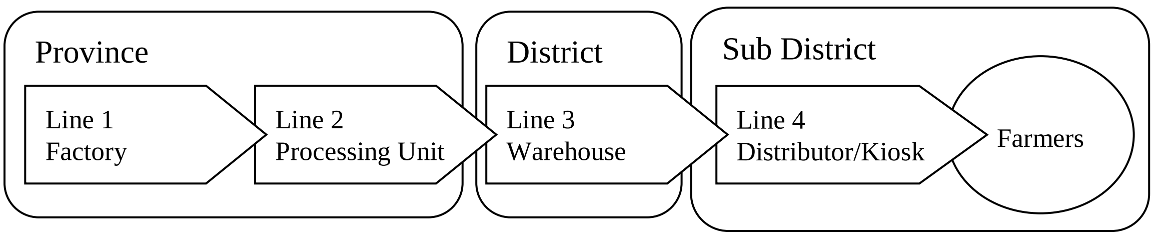


Fig. 6.6 *Flow of Subsidized Fertilizer Distribution*

The period of 1979 to 1998 was known as the subsidized and regulated marketing era. This period can be divided into two phases. First, between 1979 and 1993, PT PUSRI was the sole company in charge of distributing subsidized fertilizers. It was also known as the full-regulation period. In this first phase, production and distribution of fertilizers were relatively easy to manage, particularly for a certain area experiencing a shortage. In 1994, the government decided to remove AS and SP fertilizers from the subsidy program. In 1997, the government established the holding company consisting of five producers, but PT PUSRI was still the sole company in charge of distribution. In 1998, AS and SP were subsidized again and the price of subsidized fertilizers for the food crops was differentiated from the estate crops subsector. But, at this second phase, some problems arose—for example, the leakage of fertilizer for subsidized food crops to other sectors, the illegal export of subsidized fertilizer, a shortage of fertilizer in several areas, and high prices of fertilizers at the farmer level. At this point, the GoI authorized private parties and cooperatives as fertilizer distributors or retailers to the farmers, based on a decree from the Minister of Trade and Industry.[54]

As the fertilizer subsidy was removed during the period of 1998-2000, fertilizer marketing was deregulated. Fertilizer shortages and high prices occurred in many areas. Thus, the Minister of

[54] Since 2004, the Ministry of Trade and Industry is divided into two different ministries – Ministry of Trade and Ministry of Industry.

Industry and Trade again regulated the production and distribution of fertilizer as of March 2001. Until 2003, fertilizer distribution for all domestic destinations was coordinated by PT PUSRI, which functioned as the holding company. In 2003, the government decreed a regionalization, an appointment of distribution areas based on districts for each producer. Based on a Minister of Industry and Trade decree in 2004, the government no longer gave authority to cooperatives to distribute subsidized fertilizers. The distributor was assigned by the producer and the retailer was assigned by the distributor. In 2007, in total, there were five processing and bagging units, 314 warehouses, 1,382 distributors, and about 35,000 retailers under PUSRI holding (PUSRI 2007). However, shortage problems persisted until recent years.

In 2005, subsidized fertilizers were regulated by Presidential decree as an under-supervision commodity. To implement such a regulation, since 2006, the Minister of Trade has regulated the rights and obligations of producers, distributors, and retailers in distributing subsidized fertilizer to farmers. That decree also regulated the distribution areas of each producer, as shown in Fig. 6.7. The producer could export the fertilizer if it had already fulfilled the fertilizer requested by its distribution area. However, high prices still frequently occurred, mainly in Line 4. Some reasons were identified, for example:

1. Total fertilizer demand from the agriculture sector was far greater than availability of subsidized fertilizers. For example, the shortage problems in 2005 occurred because real demand of urea was about 5.2 Mt, but the Ministry of Agriculture (MOA) had set the amount of subsidized fertilizer at 3.99 Mt. This gap stimulated leakages of subsidized fertilizers to large food crop farmers and private plantations.
2. Indonesia paddy production follows a seasonal cycle. Demand for fertilizers reaches a peak from September to December. As distributors rarely had quota-standard holding facilities, their responsibility to provide a buffer stock was often neglected.
3. The distributor broke the rule where they only sold subsidized fertilizers allocated by the company, and retailers sold subsidized fertilizers at prices above the ceiling price. Also, retailers sold subsidized fertilizers to other parties such as “tengkulak” (traders) and hullers. While many small farmers did not have cash to buy subsidized fertilizers, those parties gave them fertilizers. Farmers paid for fertilizers after the harvest season at a higher price.

4. Price differentiation between the domestic and international markets might lead to illegal exports.

To deal with some of these problems, the GoI has adopted a new system to distribute subsidized fertilizers. According to the Minister of Trade decree of 2008, a new “closed” distribution system was created. This revision covered the following aspects:

1. Change in the regionalization of subsidized fertilizers. Distribution for Central Java is only controlled by the holding company PT PUSRI.
2. The heads of district (Bupati) and province (Governor) are fully responsible for supervising distribution of subsidized fertilizers to the farmers.
3. The retailer must register the name, address, land size, and fertilizer needs of farmers. This data will be confirmed by the Head of Village and will be verified by the Agency of Trade. (The data from July 1 to December 31, 2008, were used as the basis for distributing subsidized fertilizers in 2009.)
4. The distributor must deliver fertilizers to retailers by using their own facilities.
5. Penalties would be enforced against distributors and retailers breaking the rule.

Currently, the mechanism for the fertilizer subsidy at the farmer level is regulated based on the Minister of Agriculture Decree No. 43/2008. The allocation of the subsidy is based on the farmer’s needs. Those are calculated based on the total area and a specific recommendation from a farmer group which are submitted to the District Agriculture Office. The proposal is called RDKK. Once the proposal is approved by the technical officer, it will be forwarded to the Provincial Agriculture Office and then verified by the Ministry of Agriculture. The results of verification then are legitimized by Governors’ decree, which gives the order to the producers within the province to produce subsidized fertilizers. The distribution process is run top-down by distributors and retailers. The entire process in the distribution chain involves active participation of relevant regulatory body in each stratum. Implementation of the subsidy mechanism imposed at this time is presented in Fig. 6.7.

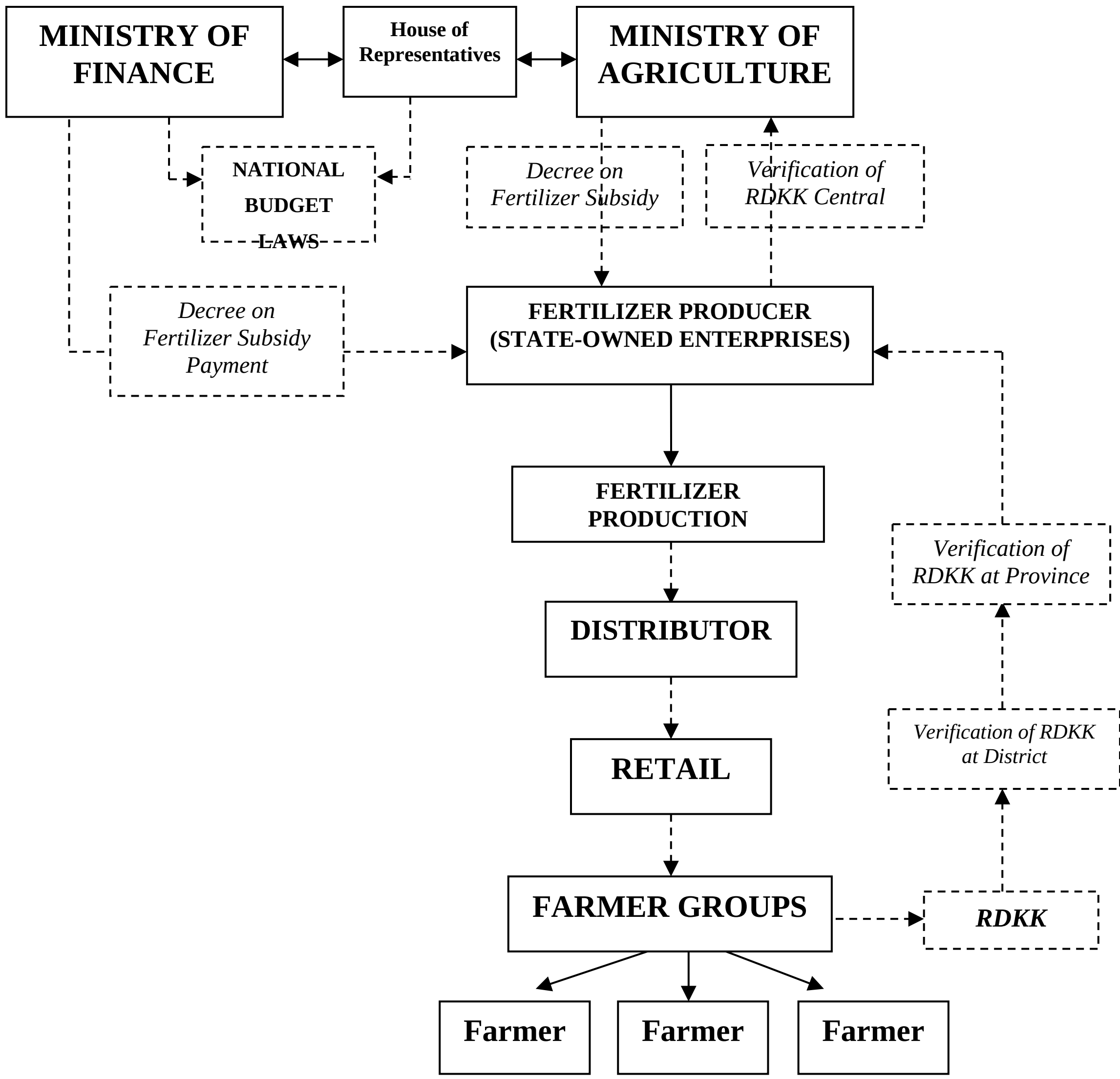


Fig. 6.7 Implementation Mechanism of Fertilizer Subsidy

6.2 Evaluation of the Subsidy Impact

6.2.1 Fiscal Implication

The allocation of subsidy for the agriculture sector delivered by GoI is relatively small compared to the subsidy spending for the energy sector: fuel, gas, and electricity. However, the budget for the agriculture sector continued to increase in recent years. The budget for the fertilizer subsidy also experienced a sharp increase in both amount and percentage of the agricultural budget. Table 6.2 presents the development of allocation of fertilizer subsidy during 2006-14. In 2014, nearly 30% of the government expenditure on the agriculture sector was used for the fertilizer subsidy, which is equal to about 1.14% of total government spending. The fertilizer subsidy is

one of the largest expenditures in the agriculture sector. The development of the fertilizer subsidy allocation issued by the government showed an increasing trend from 2006 to 2014.

Law No. 23/2013 on State Budget article 14 was the basis for implementing the fertilizer subsidy in 2014. In addition to determining the budget allocation, this law also outlined several policies including: (1) in order to reduce the burden of agricultural subsidies, especially the fertilizer subsidy, in the future, the government would ensure the domestic price of gas to be stable in order to meet the needs of state fertilizer companies, (2) government would prioritize the provision of gas required by domestic fertilizer producers in order to ensure food security, while optimizing revenues from gas sales, and (3) local governments were given the authority to monitor the distribution of subsidized fertilizers through the mechanism of RDKK.

Table 6.2 *Development of Allocation of Fertilizer Subsidy, 2006-14*

Year	Fertilizer Subsidy (Rp Billion)	Percentage of Agriculture Budget	Percentage of Total Government Budget
2006	3,166	17.50	0.47
2007	6,261	27.91	0.83
2008	15,182	37.04	1.54
2009	18,329	39.75	1.96
2010	18,411	36.60	1.77
2011	16,345	28.33	1.26
2012	13,959	21.78	0.90
2013	17,900	24.90	1.06
2014	21,049	29.01	1.14

Source: Ministry of Finance (2014).

In recent years, some variables used to calculate the allocation of subsidy for fertilizer include: (a) the amount of fertilizer need is calculated based on acreage and recommended rate of fertilizer, (b) the type of fertilizer, and (c) the difference between the CRP and COGS. All these variables are determined through Minister of Agriculture decree. COGS covers the cost of fertilizer production and distribution from the factories to retailers. The fertilizer subsidy is allocated by the government to cover the difference between the CRP-subsidized price and the COGS-non-subsidized price (National Development Planning Agency/Bappenas 2011). Development of CRP and COGS for inorganic fertilizers (urea, AS, SP-36, and NPKs) during

2006-14 is presented in Table 6.3. Generally from 2006 to 2014, for all types of fertilizer, the CRP has increased by about 50%. However, the increase in COGS ranged from 150% to 300%. This meant that the government must allocate a larger amount of money to subsidize fertilizers used by farmers. The faster growth of COGS is closely correlated with the increase in gas prices, as the main raw material for producing inorganic fertilizer, and also the fuel price, which influences distribution costs. However, to maintain the use of fertilizers by farmers and to support their income, the GoI decided to increase the subsidy budget for fertilizers.

Table 6.3 *Ceiling Retail Price (CRP) and Cost of Goods Sold (COGS), 2006-14 (Rp/kg)*

Year	Ceiling Retail Price				Cost of Goods Sold			
	Urea	SP-36	AS	NPK	Urea	SP-36	AS	NPK
2006	1,200	1,400	950	1,600	1,352	1,654	1,182	2,227
2007	1,200	1,550	1,050	1,750	1,803	2,432	1,815	3,104
2008	1,200	1,550	1,050	1,750	2,153	2,655	3,573	5,134
2009	1,200	1,550	1,050	1,750	2,183	2,879	3,657	5,179
2010	1,600	2,000	1,400	2,300	3,207	2,982	2,307	4,847
2011	1,800	2,200	1,650	2,450	3,132	3,139	2,422	5,100
2012	1,800	2,000	1,400	2,300	3,419	4,300	2,610	4,505
2013	1,800	2,000	1,400	2,300	3,132	3,139	2,422	5,100
2014	1,800	2,000	1,400	2,300	4,514	5,322	3,238	5,796

Source: Ministry of Agriculture (2014).

6.2.2 *Implications of Subsidy Procedures on Businesses*

There are a number of advantages in a fertilizer subsidy mechanism that is in the form of direct payment to the producers (Syafa'at et al. 2007). First, management of the subsidy is relatively easy because the government only needs to deal with a few producers (five state-owned enterprise [SOE] fertilizer producers). Second, the identification of subsidy-recipient farmers is not necessary, as the authorized retailers may sell the subsidized fertilizers to farmers who are eligible to receive them. Third, the effectiveness of the effort to increase the purchasing power of farmers is relatively high when fertilizers can be guaranteed at the same price as the CRP.

However, some potential disadvantages also arise. A study by ICASEPS (2010) showed that construction of such a mechanism may raise market dualism and lead to diversion to the non-subsidized domestic market and to unauthorized exports. This pattern causes price disparity between subsidized fertilizers and non-subsidized fertilizers, which results in the leakage of

subsidized fertilizer to estates or farms of more than 2 ha. This eventually will lead to shortages of fertilizers in the farm sector that should get the subsidy. This condition may lead to rent-seeking which will reflect the ineffectiveness of the fertilizer subsidy system in Indonesia. This mechanism also requires a very strong monitoring effort to protect the farmers against higher prices than the CRP.

Implementation of the fertilizer subsidy requires the producers to maintain fertilizer distribution in adequate amounts and payment by farmers at the CRP set by the government. However, the ability of producers is limited and it is challenging to reach all the eligible farmers spread among hundreds of islands with poor infrastructure. Thus, the price of fertilizers paid by farmers is often higher than the CRP. Osorio et al. (2011) showed that very few farmers were paying for fertilizers at the CRP. Based on 2003 and 2008 agriculture survey data, only 10% of 11,000 farmers paid at the CRP or below, while a large majority of the farmers paid more than the CRP. Moreover, the result of this study showed that 60% of fertilizer subsidies were utilized by approximately 40% of large farmers. On the other hand, 20% of subsidy recipients with the smallest land area received only 7% of the total subsidy allocation.

The shortage of fertilizer when needed by farmers, especially early in the planting season, is still often an issue in relation to the effectiveness of a fertilizer subsidy program. The total volume of distributed subsidized fertilizer is lower than the volume demanded by farmers. This phenomenon occurs repeatedly almost every year. Budget allocation to fertilizer subsidies continues to rise, but the scarcity of supply indicates at least two things: inefficient use of fertilizers by farmers and a failure to provide subsidized fertilizer to the target of the subsidy program.

According to Bappenas' study (2011), large land owners enjoyed a larger portion of the subsidies. These farmers financially had more access to subsidized fertilizer sources due to their strong capital ownership. In contrast, smallholders who did not have enough capital had to pay more for fertilizers. They generally used the "yarnen/bayar panen" system (pay after harvest), which would restrict them from buying fertilizers. In addition, many small-sized land owners cultivated their rice fields only in their spare time, as they also worked in the non-agriculture

sector in urban areas. After they finished planting in early season, they would leave for the cities. They usually did not apply fertilizers as recommended by extension workers.

Prasetyo et al. (2012) identified some factors which may cause higher prices at the retailers than the CRP. Many retailers are still burdened by the cost of transporting fertilizer from distributors. Usually retailers had to deliver the fertilizer from the distributor’s warehouse at their own expense. In addition, the retailers also spent money to cover the cost of fertilizer loading and unloading at the warehouse. Some criteria had been determined by the government including the following: farmers must buy fertilizers from an authorized retailer, purchases must be made in cash, and the subsidized fertilizers would be available in specified packaging: 50 kg for urea, SP-36 and AS, as well as 50 kg or 20 kg for NPKs. When farmers purchased the fertilizers from unofficial retailers or postponed payment for the fertilizer, retailers would offer a price above the CRP. The price of fertilizer paid by farmers was up to 50% above the CRP, particularly if it occurred during the planting season.

Fertilizer prices above the CRP at the farmer level might occur if distributors felt that CRP was too low. In order to maintain a reasonable profit, the distributor adjusted the marketing cost unofficially, which resulted in prices above the regulated level. An increase in the marketing margin was also triggered by illegal fees along distribution channels (Syafa’at et al. 2006). The loss from the difference between the actual and regulated price would be very significant. An increase in the actual price of fertilizer of Rp 200/kg above the CRP, implied that farmers would subsidize the fertilizer producer by more than Rp 1 trillion. Thus, producers not only obtained subsidies from the government, but also received a “subsidy” from farmers.

Evaluation on the distribution process of subsidized fertilizers from the factories, distributor warehouses, and retailers/kiosks showed that the principle of right amount—fertilizer must be available with the quantity needed by the farmers—was often not met. This was indicated by the actual distribution of subsidized fertilizers, which was generally lower than the proposal. This might lead to desynchronization with the cropping patterns followed by farmers. The increasing need for subsidized fertilizers accelerated with the new development of plantations following high commodity prices on the global market. Increased demand was also derived from the new

planting area of paddy in Java Island in order to reach the target of self-sufficiency in rice. In 2007, the area grew at the rate of 2.87% (338,400 ha/year).

The difference between the planned and actual subsidized urea is presented in Table 6.4. During recent years, for all types of subsidized fertilizers, actual production could not fulfill total requirements. Production fluctuated every year from 2005 to 2010. In 2010, only 84.1% of the total amount of subsidized urea could be satisfied by the government. For SP-36 and NPKs, production reached about 70% in 2010 and 2011, respectively. Production of subsidized AS was closer to the planned amount, as compared to others. Organic fertilizers, which have been subsidized since 2008, fluctuated more than the mineral fertilizers during their short history.

Table 6.4 *Realization of Distribution of Subsidized Fertilizers from the Plan, 2005-12 (%)*

Year	Urea	SP-36	AS	NPK	Organic
2005	98.7	101.1	101	99.7	-
2006	100.1	100.0	108.6	100.0	-
2007	92.1	101.6	100.2	85.0	-
2008	98.8	95.6	100.2	91.1	-
2009	95.0	72.5	100.1	99.3	0.2
2010	84.1	70.7	96.3	94.5	52.5
2011	86.8	75.9	84.0	70.2	84.8
2012	91.4	97.5	97.8	76.4	55.1

Source: Ministry of Agriculture (2014).

The effectiveness of the fertilizer subsidy program is mainly determined by the performance of the fertilizer market. A price disparity between subsidized and non-subsidized fertilizers due to a market dualism leads to leakage of subsidized fertilizers from small farmers to large estates.[55] This certainly will create a shortage of supply of subsidized fertilizers and eventually trigger a surge in fertilizer prices. Moreover, a scarcity of supply and price bounce may occur if fertilizers are delivered in incorrect amounts within the same subsidized markets. This will result in farmers being unable to apply the fertilizers at a correct dose and consequently leading to lower productivity. Finally, farm income targets will not be achieved.

[55] In a market dualism, subsidized fertilizers are allowed to be bought only by small-sized farmers while the large-scale growers must purchase fertilizers at market prices.

Direct subsidies to fertilizer producers also may cause disparity between domestic and international prices. Domestic fertilizer prices are relatively cheap because of the subsidy allocation. Comparatively, international fertilizer prices are relatively high because of the prevailing market price in line with the weakening of rupiah against the U.S. dollar. As a result, there is often smuggling or illegal export of subsidized fertilizer. This generates a shortage of subsidized fertilizers, which leads to a surge back of subsidized fertilizer prices above the CRP. In conclusion, Syafa'at et al. (2007) stated that there were several factors which cause shortages of fertilizers and fertilizer price hikes at the farm level: (1) the infiltration of subsidized fertilizers into the non-subsidized market due to the large price disparity between the two markets, (2) rampant illegal exports of fertilizers as a result of rising fertilizer prices in the world market, and (3) increased rent charges for warehouse and transportation costs of subsidized fertilizers.

6.2.3 Impact on Agricultural Productivity and Farmers' Income

The fertilizer subsidy policy is associated with efforts to increase food crop productivity. As discussed before, fertilizer use is strongly influenced by prices. Based on a study by Syafa'at et al. (2007), by simulation of secondary data, the decline in the price of fertilizer would increase productivity and vice versa. An increase of CRP of urea by 1% would reduce production of dry grain by 0.12%. Furthermore, profit of farmers would decrease by 4.93%. If the CRP of urea fertilizer decreases by 1%, productivity of paddy would increase by 0.068%. The study then tried to determine farmers' willingness to pay. Farmers would be able to buy fertilizers if the price of urea increased by 15%, those of SP-36 by 8%, of AS by 20%, and of NPKs by 5%. This means that if the government is forced to raise the CRP of fertilizers, an average percentage of increment in CRP would be of about 12%. The simulation in this study showed that if the subsidy was removed completely, average fertilizer prices would increase by 70%, then earnings from rice production would be expected to decline by 12.93% and the price of rice would increase by 14%. Overall, agricultural productivity would be reduced by 9.5%.

A study conducted by Kariyasa (2007) showed that if the fertilizer subsidy was reduced by increasing the CRP of urea by 25%, performance of rice production in Indonesia would improve. This study concluded that there would be some benefits from an increase in the CRP of urea.

First, the excessive use of urea could be avoided, which can create collateral environmental benefits as well. If the CRP of urea would increase, farmers would change the combination of their fertilizer usage. If the price of urea fertilizer would become relatively more expensive, more SP-36 would be used, so the dosage of fertilizer use would be approaching the technical recommendation. A more precise fertilizer use would lead to an increase in the production and yield of food crops. Second, an increase in the CRP of urea would lead to a more rational use of fertilizers, so that the scarcity of fertilizer at the farmer level might be reduced. Third, if inorganic fertilizers would be more expensive, farmers would use more organic fertilizers. Greater use of organic fertilizers would improve the structure and soil nutrient availability and would increase the fertility and productivity of land.

A study conducted by Andari (2001), which employed the primary data by comparing the farming survey data before (1998) and after (2000) removal of fertilizer subsidy, showed that fertilizer prices increased on average by about 20% after the subsidy was removed, the use of urea did not change significantly. However, the study by Rusastra et al. (1997) found that liberalization of fertilizer prices led to a positive impact on the balanced use of fertilizer types; the use of urea and SP-36 decreased, but the use of other fertilizers increased. The change increased rice production by 5.1%. Fertilizer price changes had an effect on farmer's buying interest so it influenced the dosage of fertilizer used by the farmers.

6.2.4 Private Sector Participation

As previously noted, fertilizer production in Indonesia is dominated by five SOEs, under a single holding company, PT Pupuk Indonesia. Meanwhile, the private sector holds only a very small market share in the fertilizer industry. Fertilizer production from the private sector mainly aims to fulfill the needs of mixed compound fertilizers. The existence of government subsidies and price controls results in a very limited number of private companies entering the market to supply fertilizers. However, the private sector is more involved in the provision of imported fertilizers. To be registered as an importer, a company must have a recommendation letter from the Ministry of Industry. It must have experience as an importer for at least two years. The letter can be used for a maximum of three years. The current fertilizer subsidy system cannot support

sustainable private sector involvement. This condition restricts competition between producers and distributors of fertilizers.

6.3 Challenges and Key Successes

Generally, the challenges in the implementation of the fertilizer subsidy policy of Indonesia, include: (1) lack of natural gas supply as the main raw material for fertilizer production, (2) the number of damaged and old fertilizer plants, (3) the emergence of seasonal fertilizer traders or speculators during the planting season, (4) fertilizer use by farmers which is not in line with technical recommendations, (5) the purchase of subsidized fertilizers above the CRP by many farmers, and (6) leakage and smuggling of subsidized fertilizers which have increased in recent years.

More specifically, the challenge that always arises in the accomplishment of a fertilizer subsidy program is the distribution process. The provision of subsidized fertilizers at the farmer level is often not in line with real needs. Calculation of fertilizer needs is often made only on the basis of the aggregate acreage and dosage of fertilizer use in general. In fact, the exact use of fertilizer varies among regions of Indonesia (Prasetyo et al. 2012). The cropping pattern applied by farmers in Indonesia is often uncertain. Thus, the time plan and the actual distribution of subsidized fertilizers do not match. As presented in Table 6.4, distribution of subsidized fertilizers was generally less than 100% compared to the plan during the last decade.

To improve effectiveness of subsidized fertilizer distribution, improved accuracy in determining the allocation of the subsidy is required. Synchronization of fertilizer needs which are proposed by the farmer groups with the allocation of fertilizer subsidy becomes the key factor. Distribution of fertilizers by producers needs to be more closely monitored to match farmers' cropping patterns (Rachman 2009). In this way, fertilizer shortages may be prevented. An alternative is to transfer fertilizers from a surplus region to another. The reallocation policy may be decided by the governor or head of districts. Then the transferred fertilizers can be returned again when fertilizers become available.

Moreover, in order to improve the distribution process, the government plans to simplify the distribution flow of fertilizer. The high number of distributor units may cause inefficiency in the distribution flow. In this context, a merger between distributor units would be an alternative, which could reduce supervision costs. Monitoring distributors is also important. The government may provide some strict sanctions if producers or distributors fail to provide the subsidized fertilizers at the farm level. Currently, this plan has been done by the Group of PT Pupuk Indonesia through the Single Responsibility (SR) program.

The next challenge for implementing the fertilizer subsidy program is the gap between CRP and COGS. In 2012, the gap reached over 50% of COGS (Table 6.5). This wide gap is a burden for the fertilizer subsidy budget. Currently the Minister of Agriculture has a target to reduce the gap to less than 30%. This target will be achieved by increasing the CRP, meaning that farmers must pay for fertilizer at higher prices. The higher CRP is also expected to avoid the reduction in the quantity of subsidized fertilizers (Bappenas 2011). The higher CRP is also required to cover the costs of transport and distribution, which are increasingly expensive. However, the determination of CRP price needs to consider the farmers' purchasing power to buy fertilizers, sufficient incentives for distributor (manufacturers to kiosk) and the ability of the government to provide the subsidy.

Table 6.5 *Comparison Between the CRP and COGS in 2012*

Fertilizer	CRP (Rp/mt)	COGS (Rp/mt)	Subsidy (%)
Urea	1,800,000	3,512,135	48.75
SP-36	2,000,000	5,391,054	62.90
AS	1,400,000	3,153,594	55.61
NPK	2,300,000	5,754,848	60.03
Organic	500,000	1,876,746	73.36

Source: Ministry of Agriculture (2014).

A more realistic CRP is expected to reduce the willingness of the distributors to break the rules, so that the possibility of scarcity of supply and fertilizer price hikes can be minimized. The price of fertilizer should not be too high from the side of the farmers, but not too low from the side of fertilizer distributors. The CRP must include adequate incentives for distributors in the form of marketing margin and marketing costs. Without adequate incentives, the distributors will raise

the distribution fee so that the regulation of CRP will be ineffective at the farm level (Kariyasa et al. 2004; Rachman 2009). However, the decision on the CRP level must continually consider the ability of farmers to pay without reducing the demand for fertilizer, thus still allowing farmers to make an adequate profit.

The long debate on fertilizer subsidy among scholars in Indonesia often ends with the question of whether the government should apply an indirect subsidy pattern (to producers) or subsidies that are allocated directly to the farmers. By using the direct subsidy pattern, the farmers would be provided cash or a coupon to buy fertilizers. The allocation of subsidies would be distributed by a bank through the farmer's account. The farmers would be charged the market price (ICASEPS 2010). If this pattern would be implemented, there would be one price for fertilizers which would be the market price. Thus, in the domestic fertilizer market, the market dualism problem would be solved. This could minimize disparity between domestic and international fertilizer prices. This might reduce illegal exports of subsidized fertilizers and could prevent the tendency of excessive fertilizer use by farmers. However, the effectiveness of the direct subsidy pattern is still constrained by the low level of education of farmers in Indonesia and the validity of data at farm level. Some studies suggest that farmers who are registered in the RDKK could be provided a fertilizer subsidy card. Thus, farmers who would have the card would be entitled to redeem the subsidized fertilizer at the registered kiosks. The card might contain some information such as data on cultivated area, fertilizer allocation, fertilizer use, and the remaining quota for fertilizers. Farmers also need access to transparent information on fertilizer subsidies—for example, the retailers or kiosks could be required to provide the list of CRP in a place that could be viewed directly by farmers. Farmers also need to know the volume of subsidized fertilizer that has been channeled from the quota for the local area. In conclusion, this scheme would ensure that the subsidies would reach the right targets.

Some new ideas are also proposed to improve the fertilizer subsidy program in Indonesia. For example, if the aim of the subsidy program is to strengthen national food security, beneficiaries of subsidized fertilizer should not be limited to farmers who cultivate 2 ha or less. Basically, farmers who own more than 2 ha of land have the capacity to stimulate growth in rice production in order to create some marketable surplus (Bappenas 2011). In contrast, farmers with small land

(less than 1-2 ha) are less able to have a production surplus, which can be sold into the market, because they often produce to meet their own consumption needs. At the farmer level, some actions need to be prepared. For example, farmers usually use fertilizers with the same ratio between N, P, and K. The typical ratio is 15:15:15. Based on some studies from the Ministry of Agriculture and Bogor Agricultural University, the formula should be 15:10:10. The application of this guideline may reduce the use of raw materials for P and K, which are mostly imported. This would have a significant impact considering the weakening of rupiah vs. any foreign currencies during recent years.

Finally, based on the data from the Director General of Agricultural Infrastructure, Ministry of Agriculture, the allocation of subsidy for fertilizer is proposed to be reduced by increasing the CRP. The savings from this reduction in subsidy may be allocated into other subsidy programs. There are at least three alternatives for new public spending allocation in the agriculture sector: supporting agricultural insurance, paddy price subsidy, and improvement of agricultural infrastructures. If the value of the fertilizer subsidies is assumed at about Rp 28 trillion per year, Table 6.6 presents the allocation of savings from reducing the fertilizer subsidy. The subsidy that might be allocated to other programs under the scope of agriculture work could be increased gradually.

Table 6.6 *Plan of Subsidy Program for the Agriculture Sector in Indonesia, 2015-18*

No.	Allocation	Amount (billion Rp)			
		2015	2016	2017	2018
1.	Agricultural Insurance	2,320.01	2,320.01	2,320.01	2,320.01
2.	Paddy Price Subsidy	-	2,295.57	4,137.27	8,211.23
3.	Improvement of Agricultural Infrastructure	-	2,295.57	4,137.27	8,211.23
Total		2,320.01	6,911.15	10,594.55	18,742.47

Source: Ministry of Agriculture (2014).

References

Abdullah M, Hakim L (2011) Peta Masalah Pupuk Bersubsidi di Indonesia. Pusat Telaah dan Informasi Regional, Jakarta

Andari TT (2001) Impacts of removing subsidy on fertilizer demand and rice production in West Java. Thesis. Sekolah Pascasarjana, Institut Pertanian Bogor

Badan Pusat Statistik (2014) Laporan Bulanan Data Sosial Ekonomi Edisi 49 Juni 2014

Badan Perencanaan dan Pembangunan Nasional (Bappenas) (2011) Laporan Kajian Strategis Kebijakan Subsi di Pertanian yang Efektif, Efisien, dan Berkeadilan

Bagio M (2007) Analisis Usahatani Padi Sawah di Jawa Tengah. Fokus Ekonomi 6(1):18-35

BPS (2009) Badan Pusat Statisk

Darwanto (2010) Analisis Efisiensi Usahatani Padi di Jawa Tengah (Penerapan Analisis Frontier). Jurnal Organisasi dan Manajemen 6(1):46-57

Direktorat Jenderal Prasarana dan Sarana Pertanian (2013) Statistik Prasarana dan Sarana Pertanian Tahun 2008-2012

Fuglie K (2004**)** Productivity growth in Indonesian agriculture, 1961-2000. Bulletin of Indonesian Economic Studies, Taylor & Francis Journals, vol. 40(2)

Hadi PU, Swastika DKS, Dabukke FBM, Hidayat D, Agustin NK, Maulana M (2007) Analisis Penawaran dan Permintaan Pupuk Indonesia 2007-2012. PSEKP-Badan Penelitian dan Pengembangan (Balitbang) Pertanian Kementerian Pertanian

Hartoyo S (1994) Impacts of infrastructure on food crops supply in Java Island. Disertasi. Sekolah Pascasarjana, Institut Pertanian Bogor

Hendrawan DS (2012) Kebijakan Subsidi Pupukdan Pengaruhnya terhadap Pertumbuhan dan Distribusi Pendapatan dalam Perekonomian Indonesia. Disertasi. Sekolah Pascasarjana, Institut Pertanian Bogor.

ICASEPS (2005) Pandangan PSEKP terhadap Kinerja Kebijakan Subsidi Pupuk Selama Ini dan Perbaikannya ke Depan. PSEKP-Balitbang Pertanian, Kementerian Pertanian.

ICASEPS (2010) Rancangan Kebijakan Subsidi Pupuk Langsung kepada Petani. PSEKP-Balitbang Pertanian, Kementerian Pertanian

Kalsum U (2008) Analisis Efisensi Faktor Produksi Usahatani Cabe Merah (Capsicum Annum) di Kecamatan Penengahan Kabupaten Lampung Selatan. Jurnal Bisnis dan Manajemen 5(1):73-86

Kariyasa K, Maulana M, Mardianto S (2004) Usulan Tingkat Subsidi dan Harga Eceran Tertinggi (HET) yang Relevan Serta Perbaikan Pola Pendistribusian Pupuk Indonesia. Analisis Kebijakan Pertanian 2(3):277-287

Kariyasa K (2007) Usulan HET Pupuk Berdasarkan Tingkat Efektivitas Kebijakan Harga Pembelian Gabah. Analisis Kebijakan Pertanian 5(1):42-85

Ministry of Agriculture (2006) Model Subsidi Pertanian Terpadu: Landasan Konseptual dan Faktual serta Sistem Operasinya

Ministry of Industry (2011) Revitalisasi Industri Pupuk. Kementerian Perindustrian, Jakarta

Ministry of Industry (2015) Perkembangan Impor Komoditi Hasil Industri dari Negara Tertentu. Retrieved from http://kemenperin.go.id/statistik/query_komoditi.php

Manaf DRS (2000) Pengaruh Harga Pupuk Terhadap Pendapatan Petani: Analisis Sistem Neraca Sosial Ekonomi. Tesis. Sekolah Pascasarjana, Institut Pertanian Bogor

Osorio CG, Abriningrum DE, Armas EB, Firdaus M (2011) Who is benefiting from fertilizer subsidies in Indonesia? (Policy Research Working Paper 5758). The World Bank East Asia and Pacific Region, Poverty Reduction and Economic Management Unit

Pramusinto W, Hariyati Y, Hapsari TD (2009) Dampak Subsidi Harga Pupuk TSP dan Urea terhadap Kontribusi Produksi Jagung Jawa Timur Pada Produksi Jagung Nasional. J-SEP 3(3)

Prasetyo B, Hadi PU, Agustin, NK, Adawiyah CR (2012) Kajian Alternatif Model Bantuan Benih dan Pupuk untuk Peningkatan Produksi Pangan. PSEKP-Balitbang Pertanian

PT Pupuk Indonesia (2014) Laporan Tahunan 2013: Integrasi dan Sinergi Pengembangan untuk Pertumbuhan Berkelanjutan

PT Pupuk Sriwijaya (2007) Annual report 2007: sustainable growth through synergy

Rachbini W (2006) Dampak Liberalisasi Perdagangan Pupuk terhadap Kinerja Perdagangan Pupuk dan Sektor Pertanian di Indonesia. Disertasi. Sekolah Pascasarjana, Institut Pertanian Bogor

Rachman B (2009) Kebijakan Subsidi Pupuk: Tinjauan terhadap Aspek Teknis, Manajemen, dan Regulasi. Analisis Kebijakan Pertanian 7(2):131-146

Rusastra IW, Kustiari R, Pasandaran E (1997) Effects of removing fertilizer subsidy on fertilizer demand and rice production. Jurnal Agro Ekonomi 16(1-2)

Simatupang P, Timmer CP (2008) Indonesian rice production: Policies and realities. Bulletin of Indonesian Economic Studies 44(1)

Suwarto (2008) Produktivitas Lahan dan Biaya Usahatani Tanaman Pangan di Kabupaten Gunung Kidul. Jurnal Ekonomi Pembangunan 9(2):168-183

Syafa'at N, Purwoto A, Maulana M, Muslim C (2006) Analisis Besaran Subsidi Pupuk dan Pola Distribusinya. PSEKP-Balitbang Pertanian, Kementerian Pertanian

Syafa'at N, Purwoto A, Anugrah IS, Suryani E, Noekman KM, Marisa Y, Suryadi M, Askin A (2007) Kaji Ulang Kebijakan Subsidi dan Distribusi Pupuk. PSEKP-Balitbang Pertanian, Kementerian Pertanian

Triyanto J (2006) Analisis Produksi Padi di Jawa Tengah. Tesis. Program Pascasarjana, Universitas Diponegoro, Semarang

Tumangor DS (2009) Analisis Faktor-Faktor yang Mempengaruhi Produksi Coklat di Kabupaten Dairi. Tesis. Program Pascasarjana, Universitas Sumatera Utara, Medan

Appendix Table 6.1 *Development of Subsidized Fertilizer Demand, 2000-14 (mt/year)*

Year	Urea	SP-36	AS	NPK	Organic
2000	3,652,082	587,629	506,663	2,888	
2001	3,904,815	654,379	470,286	13,541	
2002	3,783,983	522,855	392,460	39,934	
2003	3,911,255	727,192	510,427	100,288	
2004	4,210,586	787,595	633,580	192,464	
2005	3,989,487	797,506	592,700	262,187	
2006	4,300,000	700,000	600,000	400,000	
2007	4,300,000	800,000	700,000	700,000	
2008	4,800,000	811,400	750,350	962,680	345,000
2009	5,500,000	1,000,000	923,000	1,500,000	450,000
2010	4,931,000	850,000	849,749	2,100,000	750,000
2011	4,954,238	750,000	975,000	2,350,000	703,986
2012	5,100,000	1,000,000	1,000,000	2,593,920	835,000
2013	4,100,000	850,000	1,000,000	2,400,000	900,000
2014	3,418,000	760,000	800,000	2,000,000	800,000

Appendix Table 6.2 *Fertilizer Consumption for Estate Crop and Industrial Sector (non-subsidized), 2007-13 (mt/year)*

Year	Urea	SP-36	AS	Organic
2007	1,952,176	38,198	30,542	
2008	1,338,369	4,197	29,175	117
2009	1,709,675	-	19,993	422
2010	2,317,782	933	32,387	2,496
2011	1,889,819	1,998	20,278	10,722
2012	2,380,938	2,911	22,374	25
2013	2,682,902	7,009	36,244	75

Data for NPK are not available.

Appendix Table 6.3 *Development of Fertilizer Production, 2000-13 (mt/year)*

Year	Urea	SP-36	SA	NPK	Organic
2000	6,334,878	482,769	528,692	29,727	
2001	5,319,761	650,820	514,843	56,191	
2002	6,006,221	520,855	426,965	83,011	
2003	5,733,121	687,657	479,281	113,842	
2004	5,667,000	763,225	572,599	201,978	
2005	5,848,655	819,704	664,432	276,876	
2006	5,654,692	647,868	631,645	412,663	
2007	5,865,856	660,652	652,486	446,347	
2008	6,133,000	493,000	670,000	962,000	
2009	6,858,000	743,000	765,000	1,592,000	294,555
2010	6,726,000	632,000	701,000	1,362,000	260,705
2011	6,743,945	441,223	817,760	2,146,879	341,476
2012	6,907,236	521,486	812,123	2,893,868	761,657
2013	6,698,349	515,757	827,225	2,528,347	787,516

Appendix Table 6.4 *Development of Urea Fertilizer Export, 2000-13 (mt/year)*

Year	Urea
2000	1,491,151
2001	1,047,221
2002	1,417,340
2003	939,716
2004	495,373
2005	797,538
2006	-[a]
2007	609,270
2008	176,000
2009	607,000
2010	1,096,000
2011	750,430
2012	989,611
2013	1,359,109

a. Exports not permitted in 2006.

Appendix Table 6.5 *Development of Fertilizer Import, 2000-10 (mt/year)*

Year	Urea	SP-36	SA	NPK
2000		64,394	136,628	144,747
2001		10,347	183,344	131,440
2002		80,651	247,623	200,724
2003		45,446	227,067	171,763
2004		172,275	106,824	321,399
2005	9,000	161,122	172,762	221,539
2006	1,000	274,000	279,000	279,000
2007	2,000	286,000	242,000	357,000
2008	6,000	457,000	438,000	432,000
2009	31,000	168,000	338,000	107,000
2010	33,000	209,000	218,000	144,000

Appendix Table 6.6 *Distribution of Subsidized Fertilizer, 2005-12 (mt/year)*

Year	Urea	SP-36	SA	NPK	Organic
2005	3,992,689	797,506	643,458	262,166	
2006	3,962,404	711,081	600,972	339,997	
2007	4,249,409	764,821	701,647	637,456	
2008	4,557,823	588,123	751,325	955,708	684
2009	4,623,889	706,937	888,607	1,417,703	236,451
2010	4,279,901	644,858	713,765	1,473,346	636,244
2011	4,528,949	731,502	953,760	1,794,767	388,158
2012	4,152,170	855,533	996,777	2,167,656	741,155

7 Pakistan

Mubarik Ali, Faryal Ahmed, Hira Channa, and Stephen Davies

7.1 Introduction

Despite many gains attributed to increased fertilizer use in agriculture, public policies designed to promote its production and uses remain controversial (Ali et al. 2015). Successive governments have alternated between subsidizing its production, importation, and distribution, withdrawing these subsidies in a piecemeal manner and reverting back when fertilizer prices escalated. This indicates the popularity of fertilizer among policymakers to ensure food security in their own perception (CCP 2010). However, these subsidies were highly biased toward promoting nitrogen (N) use at the cost of ignoring other important nutrient inputs like phosphate (P) and potassium (K).

As a result of fertilizer subsidies—alongside a host of other market and institutional factors such as, for example, scale efficiencies in fertilizer processing, lack of institutional capacity to introduce new and more efficient fertilizer products and application methods, and strict regulation for market entry and exit—Pakistan now faces widespread misuse and declining productivity of fertilizer at the farm-level, and untenable fiscal burdens for the government. This country report on Pakistan explores these issues in greater depth by reviewing the state of the fertilizer industry, identifying main policy issues with an emphasis on subsidies and taxes, and analyzing the costs and benefits associated with alternative policy interventions. The remainder of this report proceeds as follows: Sect. 7.2 provides a brief history of the industry, followed by an analysis of trends in fertilizer use in Sect. 7.3; Sect. 7.4 examines the trends in relative fertilizer prices and discusses various types of subsidies and taxes on fertilizer; Sect. 7.5 explains the trends in fertilizer use efficiency, and estimates the level of its optimal use, with and without subsidies under farmers' conditions and environments. Sect. 7.6 develops an equilibrium displacement model (EDM) and simulates the impacts of major government policy interventions. Sect. 7.7 concludes with recommendations aimed at improving the performance of Pakistan's fertilizer sector and its contribution to future agricultural productivity growth.

7.2 Historical Perspective of Pakistan's Fertilizer Industry

7.2.1 Processing

Nitrogenous chemical fertilizers in Pakistan were introduced through imports in 1952, followed by phosphorus in 1959 and potassium in 1967 (NFDC 2014). Beginning in the late 1950s and early 1960s, the government pursued an import-substituting industrialization policy and used strategic manufacturing investments to build a domestic fertilizer industry via both joint ventures with foreign companies as well as the establishment of domestic fertilizer plants. Upon nationalization of the fertilizer industry in 1973, production by all fertilizer companies was undertaken through the parastatal, the National Fertilizer Corporation of Pakistan (NFC).

By the late 1960s, Pakistan's emerging domestic fertilizer industry built on an abundant domestic gas supply that allowed the country to simultaneously increase the national supply of fertilizer and reduce the share of imports, which drew on valuable foreign exchange reserves. Of course, large quantities of certain fertilizer products that are produced without natural gas (for example, diammonium phosphate [DAP] and potassium [K] compounds) still had to be imported, but domestic production of both nitrogen and phosphate fertilizers nonetheless continued to increase (Appendix Table 7.1). Fertilizer use gained momentum since 1970, when farmers began adopting high-yielding modern wheat and rice varieties in Pakistan's irrigated areas, substantiated with its promotion by the government through subsidies as well as research and extension support.

These policies and factors led to a sizable fertilizer industry in Pakistan. Total domestic installed capacity of all types of fertilizer production is estimated at 9 Mt in 2013-14, 70% of which is for urea, 8% for DAP, and 22% for other products, such as SSP, calcium ammonium nitrate (CAN), NP, NPK, and phosphate fertilizer. During 2013-14, the industry was operating below its capacity, at approximately 75%. Urea production suffered the most with operating capacity estimated at 78%, while DAP was running at almost full capacity (Table 7.1). Had there been no underutilization of urea capacity, due to inadequate gas supply as claimed by the industry, its installed capacity would have been sufficient to meet its domestic demand.

The value of fertilizer sales (estimated at domestic retail prices) was estimated at U.S. $3.6 billion in 2014, up from just U.S. $554 million in 1971 (both in nominal values). Approximately 76% of fertilizer consumed in Pakistan is produced domestically, with domestic production supplying 83% of nitrogen, 51% of phosphorus, and 47% of potassium consumed nationally. The growth in N fertilizer production (6.15%) was greater than the offtake growth (5.54%), thereby keeping the growth in import at 3.4% from 1971 to 2014, although trends in phosphorus and potassium production, based on content of processed NPK fertilizer, and offtake were less dramatic.

Table 7.1 *Operating Capacity of Selected Firms by Type of Fertilizer (%), 2013-14*

Firm	Urea	DAP	NPK	NP	CAN	Phosphate Fertilizer[56]	Total
Fauji Fertilizers*	116.6	-	-	-	-	-	116.6
Engro	80.3	-	40.0	87.5	-	-	77.8
Fatima	71.4	-	-	101.7	124.4	-	95.5
Pak Arab	5.8	-	-	23.1	28.2	-	22.7
Agri Tech	31.7	-	-	-	-	-	31.7
Dawood Hercules	9.7	-	-	-	-	-	9.7
Fauji Fertilizers	38.1	102.8	-	-	-	-	73.7
Others	-	-	-	-	-	21.0	21.0
Total	78.0	102.8	40.0	63.8	76.3	21.0	75.3

Source: Authors' calculation based on MNFSR (2013).
*The overutilization of the installed capacity is mainly because of continued operation during sanctioned holidays and the time allocated for plant maintenance, etc.

The production capacity and marketing power in the fertilizer industry in Pakistan is concentrated in relatively few firms. The three big players—Fauji Fertilizer Company Limited (FFC), Fauji Fertilizer Bin Qasim Ltd. (FFBL) and Engro Fertilizer Ltd. (EFL)—hold about 75% of total installed urea capacity (MNFSR 2013), and out of this, about 41% is held by FFC and FFBL.[57] Urea imports, which accounted for about 20% of total urea supply in 2011 to 2013, have supplemented domestic production, which has been constrained by the lack of natural gas supply. With respect to DAP, the situation is slightly different. FFBL is also the only producer of DAP in the country, with about 54% of its demand met by that domestic producer, and with the rest being imported by a large number of smaller firms. As such, there is likely greater

[56] Phosphate fertilizer includes SSP.
[57] FFBL is a subsidiary of FFC, which is controlled by the Fauji Foundation.

competition in the market for DAP, and domestic DAP prices tend to be closely linked to the international price of DAP. But this comes with greater exposure to international price volatility and currency risk.

7.2.2 Marketing

Initially, fertilizer was distributed through the agricultural extension wing of the provincial agriculture departments. There was no independent marketing system for agricultural inputs until the formation of the West Pakistan Agricultural Development Corporation (WPADC) in 1961 (Hussain 2011; Hassan and Pradhan 1998). However, WPADC was abolished in 1972, when this responsibility was transferred to the provincial governments. Later, fertilizer marketing was the responsibility of National Fertilizer Marketing Limited (NFML), a parastatal established in 1976, which carried the responsibility for distributing the entirety of domestic production from NFC companies as well as all imports of fertilizer. After privatization of all manufacturing units of NFC over the period 1996 to 2005, NFML's role has become restricted to the distribution of imported urea. Currently, domestically produced supply is marketed by private sector processing companies through their registered dealers' networks (Ali et al. 2015).

7.2.3 Regulatory and Policy Framework

The growth of fertilizer production and use in Pakistan gave rise to a series of policies designed to regulate the industry. First and foremost, from 1954 until the present, the government maintained control of the supply and allocation of natural gas to industry. The Provincial Essential Commodity Act (PECA), initially promulgated in 1971 and amended in 1973, placed fertilizer production and marketing under the direct regulatory purview of the federal government. At the provincial level, the Punjab Fertilizer (Control) Order of 1973 further strengthened the power of federal regulators by rendering provincial management of fertilizer subservient to PECA. Specifically, laws formulated and executed under PECA provide almost complete powers to the controller in the management of prices, imports, and even the size of daily fertilizer transactions.[58] Other policies that have been deployed over the past 40 years

[58] For the current management of prices, the controller is at the provincial agriculture department. For imports of urea, the Commerce Ministry, through NFML, has the responsibility.

include subsidies on fertilizer importation and distribution and sales tax imposition on farmers' fertilizer purchases.

The introduction of these policies, alongside the growth of fertilizer production and use, also led to the establishment of several key organizations aimed at promoting fertilizer use. Fertilizer research and development (R&D) was initially undertaken by the Directorate of Soil Fertility in the Research Wing of the Agriculture Department of the Government of West Pakistan, which was converted into provincially separate Soil Fertility Research Institutes (SFRI) in 1971. Issues pertaining to economic policy (for example, concerning production, imports, pricing, subsidies and regulations) were addressed by the National Fertilizer Development Centre (NFDC), which was established in 1977 by the Federal Planning and Development Division.

At the farm level, the Extension Wing of the Agriculture Department of the Government of West Pakistan was responsible for conveying recommendations for fertilizer use to farmers. Credit for fertilizer purchases was made available to farmers through a variety of formal and informal sources. Initially, the primary formal source of credit was the Agricultural Development Bank of Pakistan, now known as the Zarai Taraqiati Bank (ZTB), established in 1961 to provide affordable financial services to rural Pakistan. Commercial banks such as Habib Bank, Askari Bank, and Punjab Bank began providing agricultural credit at market rates beginning in 1972 (MNFAL 2007c).

In recent decades, Pakistan's fertilizer industry has undergone several changes aimed at addressing some of these issues. After the gradual privatization of NFC's manufacturing units, NFML's role has become restricted to the distribution of imported urea. In the 2013/14 *Rabi* season (from November to April), even this role was reduced further when the government transferred the responsibility for the distribution of urea imports to domestic manufacturers. But subsidies are still central to the production and distribution of fertilizer, with the Ministry of Industry and Production deciding on the production subsidy by controlling the supply of gas to manufacturers and the NFML deciding on the amount of fertilizer to be imported and the distribution subsidy to be applied.

In summary, the development of Pakistan's fertilizer industry has been both a success story and a source of difficulty for farmers, industrialists, and policymakers alike. The success story was driven by a number of key factors: a major technological shift initially in rice and wheat cultivation during the Green Revolution and later in cotton, sugarcane, and maize; Pakistan's perceived abundant endowment of natural gas at the time; and the willingness of policymakers and investors to build a domestic fertilizer industry from the ground up. But difficulties in sustaining this success have emerged in the form of unbalanced fertilizer use, poor management practices, and poor allocation of public resources for R&D. We examine these elements in the sections that follow.

7.3 Fertilizer Use

To provide a better sense of how fertilizer intensification occurred in Pakistan, this section examines regional fertilizer application rates, and imbalance caused in its use.

Data in this section are drawn from NFDC. The data provide fertilizer use across agro-ecological zones and provinces at an aggregated level.[59] The total fertilizer offtake increased over 14-fold between 1971 and 2014 in Pakistan. The three-year average N usage per hectare increased from 21 kg over 1971-74 to 139 kg during 2009-14, while phosphate fertilizer increased from 3 kg/ha to 32 kg/ha in the corresponding period. The highest increase in per hectare fertilizer use was recorded in 2009-10 when the output-fertilizer price ratio jumped to a record level. During this time, fertilizer application rates increased from 157 kg/ha to 183 kg/ha in just one year but dropped back to 165 kg/ha in 2012 (Appendix Table 7.2). These figures are comparable to those of India (141.3 kg/ha) but less than those in neighboring Indian Punjab (229 kg/ha).

Fertilizer consumption in Pakistan's province of Punjab exhibited both the lowest level of nutrient use per hectare and the slowest growth rate between 1990-91 and 2011-12 (Table 7.2). The highest levels of nutrient use were found in Sindh and the highest rate of growth was found in Baluchistan.

---

[59] All fertilizer traders in the country registered with the extension department are obliged to provide daily sale, price, and stock information to the Extension Wing of the provincial agriculture departments. The NFDC collects this information from importers and companies directly to verify this data. We used annual values for our analysis.

Table 7.2 Fertilizer Use by Cropping Region (kg/ha), 1990-91 to 2011-12

Cropping Region	1990-91	1995-96	2000-01	2005-06	2010-11	2011-12	Annual Growth Rate (%)
Pakistan	**89**	**111**	**135**	**168.90**	**166**	**165**	**2.98**
Punjab	**90.7**	**114.9**	**107.43**	**150.68**	**158.71**	**157.40**	**2.66**
Barani	19.6	22.4	23.23	30.25	58.51	36.05	2.93
Mixed crop	70.0	103.1	94.08	134.2	136.52	137.22	3.26
Wheat-cotton	137.7	175.2	148.89	209.4	213.49	210.01	2.03
Wheat-rice	70.4	90.9	83.67	134.7	160.65	157.10	3.90
Wheat/gram-mungbean	67.9	66.7	80.43	107.2	112.15	115.40	2.56
Sindh	**88.0**	**134.7**	**154.88**	**208.8**	**246.48**	**296.51**	**5.96**
Mixed crops	136.3	123.0	151.29	179.1	154.57	325.78	4.24
Wheat-cotton	60.4	161.6	182.62	233.6	365.13	363.87	8.93
Wheat-rice	100.4	107.1	121.84	201.5	167.63	184.98	2.95
Khyber Pakhtunkhwa	**59.4**	**70.0**	**90.11**	**161.1**	**156.15**	**172.70**	**5.21**
Barani	16.8	20.1	24.85	129.4	110.85	69.22	6.99
Mixed crops	72.0	88.3	108.60	169.7	166.64	199.30	4.97
Baluchistan	**28.7**	**31.9**	**64.98**	**299.5**	**148.21**	**215.20**	**10.06**
Wheat-cotton	31.6	22.4	40.84	1496.8	65.39	109.21	6.09
Horticulture	26.8	43.1	100.54	325.44	255.96	352.58	13.06

Source: Authors' calculations based on NFDC (2008), NFDC (2002), and NFDC (1998).
Notes: All districts having a common major *Kharif* season (during May-October) crop in a province, like cotton, rice, or gram-mungbean, are merged into separate cropping regions. For example, the wheat-cotton region implies that the region is dominated by the cotton crop in the *Kharif* season (May-October). The district where no crop dominates in *Kharif* is called a mixed cropping region. Moreover, all districts where 85% of the area depends on rain for irrigation in a province are categorized as *barani* regions. In Baluchistan, horticulture regions consist of districts where horticulture cultivation dominates. The data for 2010-11 and 2011-12 were collected from NFDC headquarters in Islamabad.

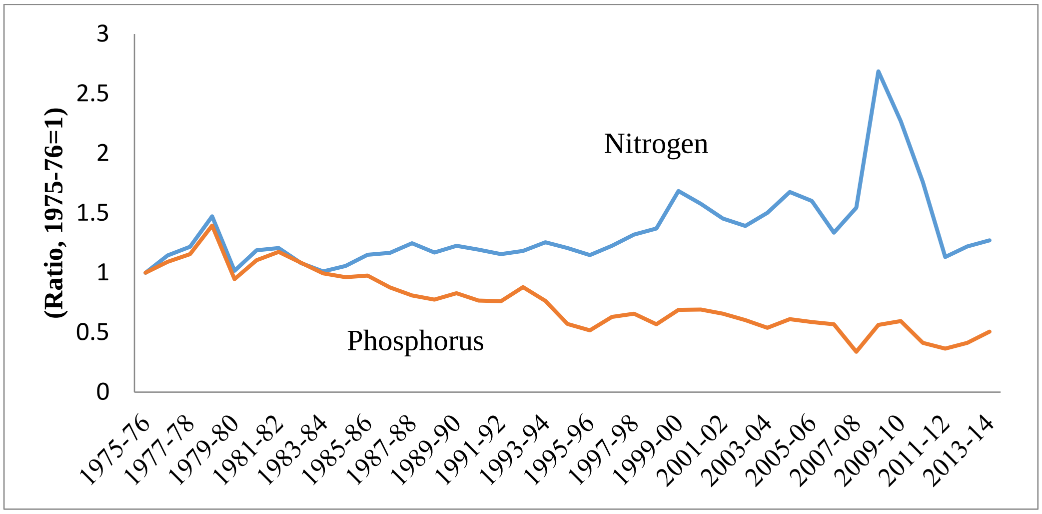
The balanced use of fertilizer is very important in improving its efficiency. Haerdter and Fairhurst (2003) show that the recovery of N increases from 60% within a traditional NP fertilization program to 76% in a balanced NPK application. Also, the recovery of P in the year of application improves with balanced fertilization, namely from 1% using NP to 13% with NPK, and the recovery of K increases from 22% with a nitrogen-potassium application to 61% with NPK fertilization. In Pakistan, the recommended ratio of N:P is 1:0.5, while the optimal level for K is to be determined, as its use in the country is very small. However, the average use of P and the N:P proportion is far from optimal (Appendix Table 7.2). In fact the ratio of N:P has dropped from its peak of 1:0.37 in 2006-07 to 1:0.28 in 2013-14. The ratio of N:K reached its

peak at 1:0.036 in 1985-86 but then gradually decreased to 1:0.007 in 2013-14. The unbalanced use of fertilizer, which reduces the use efficiency and effectiveness of all nutrients, especially those used in abundance, has also serious implications for the environmental sustainability (Ali et al. 2015) and quality of produce.

7.4 Pricing Behavior, Fertilizer Policy, and Subsidies

7.4.1 Relative Prices

This section examines the relative prices of fertilizer compared to major outputs, the extent of government subsidies on fertilizer and the international and regional competitiveness. Fertilizer prices—in real terms and relative to output prices—have evolved in Pakistan as follows. The grain output prices (a weighted average of wheat and rice) increased more than the N price, implying that one unit of N purchases more grain in 2014 than in 1975. However, the opposite was true for P (Fig. 7.1). Thus, farmers' profitability did not shrink due to increased N prices, while it did due to increased P prices. Additionally, this helps explain the declining N:P ratio away from its optimal level.



Source: Authors' estimates from NFDC (2014), MNFSR (2013), MNFAL (2007a), MNFAL (2007b), and MNFAL (2007c).

Fig. 7.1 *Output Price to Subsidized N Price Ratio (1975-2014)*

7.4.2 Fertilizer Policy

The Fertilizer Policy of 2001 is built around the provision of a gas subsidy on the manufacturing of urea. It states:

> *"It is the intent of this policy to provide investors in new fertilizer plants in Pakistan a gas price that enables them to compete in the domestic market with fertilizer exporters of the Middle East so that indigenous production is able to support the agricultural sector's requirement by fulfilling fertilizer demand."*

Clearly, the policy has been developed to encourage import substitution to meet all demand from indigenous sources. Initially, differential and low rates for gas were offered to new plants to encourage their investment. Lately, such differences have been removed. More importantly, the fertilizer policy ignores the distribution, demand, and utilization sides of the sector, and particularly, farmers' and traders' interests are overlooked. Thus, the policy fails to offer incentives to enhance efficiency in fertilizer distribution and application or to encourage new and more efficient products.

7.4.3 Fertilizer Subsidies

7.4.3.1 Gas Subsidy

Against the fertilizer policy, public subsidies for the production and distribution of fertilizer have also evolved. The most significant subsidy comes through the provision of natural gas to urea producers,[60] as approximately 16% of total gas consumed in the country is used by the fertilizer industry (HDIP 2013). The government subsidizes fertilizer manufacturing through a dual gas price policy: one price, similar to the market price in the country, is applicable to the fuelstock for general use, while another, which is far lower than the market price (although closer to the Middle East price), is for gas used in feedstock or fertilizer manufacturing. The subsidy is made available to all urea producers, although issues with access to gas for smaller producers do exist.[61]

---

[60] The gas subsidy does not directly accrue to the exchequer in terms of cash outlays, but to the public sector gas supply companies in terms of cash inflow foregone.

[61] The approval of plant installment from the Production Ministry was linked to the gas that could be supplied. Some smaller firms (with the exception of FFC, Fatima, EFL, and AgriTech) complained about facing 35-50 days of gas shortage in a year. No schedule of gas supply was provided, which deterred companies from making operational plans. This had increased their fixed and operational costs (Mr. Nadeem Tariq on August 15, 2013).

In Pakistan, during the 2005-14 period, the feedstock prices in Pakistan were lower than the Middle Eastern prices for three years, and the reverse was true for the remaining five years, although these phenomena did not occur consecutively. On average, the Pakistani and Middle Eastern prices are not significantly different. On the contrary, these prices have been substantially lower than the U.S. gas prices, which can be seen as proxy for international prices (Appendix Table 7.3). The fuelstock prices are comparable with other sectors of the Pakistani economy, except for the energy sector where the prices are lower.

We estimated the total value of the production (or gas) subsidy on fertilizer manufacturing in 2013-14 as U.S. $475 million (PKR 48 billion). It has gradually increased from U.S. $79 million (PKR 2.64 billion) in 1995-96 (Table 7.3). While the prices of fuelstock increased by over seven times, the growth in feedstock price was less than four times during the period. The difference in fuel and feedstock prices grew by 14 times between 1995 and 2012; this, multiplied by a 1.5 times increase in feed gas consumption, has resulted in a 21 times increase in gas subsidy over the period (Table 7.3).

There were clearly two upward shifts in the production subsidy trend shown in Table 7.3: one in 2002, when it jumped by four times, and the other in 2008, when it increased by 1.5 times. The latter jump overlapped with the start of the ongoing crisis of gas shortage in the country. Although the shortage is not apparent from the gas supply data to the industry in Table 7.3, which continuously increased even though there was a 39% drop in gas availability to the cement sector and a 4% decrease to the power sector since 2006. However, the effect of the gas shortage in the country on the fertilizer industry is obvious from the underutilization of the extending capacity.[62] The increase in urea capacity by 45% in 2008 was not matched by gas supply availability, which has remained flat to declining since then.

[62] Capacity expanded due to new plants of Engro in 2010 and capacity enhancement of FFC in 2009.

Table 7.3 Trends in Production Subsidy During 1995-2014

Year	Gas Prices (Rs/mcf) Feedstock	Fuelstock	Difference in Price	Gas Supply (billion mcf)	Total Production Subsidy* (Billion PKR)
1995-96	44.2	67.6	23.4	90.2	2.1
1996-97	47.7	77.7	29.9	90.0	2.7
1997-98	52.7	77.7	25	88.2	2.2
1998-99	49.5	80	30.5	100.6	3.07
1999-00	56.9	88.1	31.2	105.7	3.3
2000-01	63.9	117.2	53.2	106.0	5.6
2001-02	70.8	95.6	24.7	110.0	2.7
2002-03	76.1	170.4	94.4	112.8	10.6
2003-04	79.6	175.7	96.1	116.1	11.2
2004-05	61.2	185.7	124.5	119.9	15.0
2005-06	110.8	229.2	118.4	124.2	14.71
2006-07	124.7	256.7	132.0	122.8	16.2
2007-08	124.7	256.6	132.0	128.1	16.9
2008-09	120.3	341.2	220.9	129.6	28.6
2009-10	132.3	360.4	228.1	140.5	32.1
2010-11	138.7	375.2	236.5	140.7	33.3
2011-12	161.8	492.4	330.6	135.0	44.6
2012-13	116.3	460.0	343.7	116.7	41.4
2013-14	123.4	488.2	364.8	128.3	48.0

Source: Authors' estimates based on HDIP (2013).
*The production subsidy on fertilizer is calculated as the difference between fertilizer feedstock and fuelstock prices per million British thermal units (mBTU), multiplied by the amount of feedstock gas used by each firm and then aggregated for the sector. Gas consumption figures for the sector were obtained from HDIP (2013).

The production subsidy to each firm depends upon the gas field used as a source until 2010 (after which prices were constant irrespective of the gas field) and on the installation date of the plant.

7.4.3.2 Distribution Subsidy

In addition to domestic production subsidies, the government subsidizes the importation and distribution of fertilizers in an attempt to maintain the domestic prices at a reasonable level. Underutilized capacity arose because of gas shortages in 2008, which forced Pakistan to import urea alongside regular imports of DAP. NFML intervenes in the market when the difference in domestic and international prices becomes significant and domestic supply falls short of demand, and it does so by importing higher-priced fertilizer and selling it at the lower domestic price (NFML 2014). Normally, this intervention is limited to imported urea, but for the first time ever during 2006/07 to 2009/10, the government intervened in the DAP market through a subsidy on

imported DAP.[63] Beginning in 2014, the government allowed the private sector to import urea and sell it at the domestic price, while the NFML covers the price difference, including transportation and handling charges.[64] Either way, NFML's intervention in the market is costly for the government (Table 7.4).

***Table 7.4** Subsidy on Fertilizer Distribution (Billion PKR)*

Year	Subsidy on Imported Urea (Billion PKR)	Imports of Urea ('000 mt)	Subsidy on Other P & K[65] Fertilizer (Billion PKR)	Total Subsidy
2004-05	1.52	307	-	1.52
2005-06	3.60	825	-	3.60
2006-07	1.69	281	13.7	15.39
2007-08	2.49	181	17.4	19.89
2008-09	15.91	905	26.50	42.41
2009-10	10.57	1,525	0.50	11.07
2010-11	6.39	635	0	6.39
2011-12	8.41	1,449	-	8.41
2012-13	1.63	761	-	1.63
2013-14	11.35	1,155	-	11.35

Source: Authors' calculation based on NFDC (2014).
Note: Subsidy figures for urea were calculated as import quantity multiplied by the difference between the international and domestic prices. The figures for 2011-12 were collected from NFDC in Islamabad. The subsidy for P and K was taken from NFDC (2008, 2014).

The total production and distribution subsidy in the fertilizer sector during 2013-14 amounts to U.S. $506 million (PKR 51 billion), which is about 0.21% of the national GDP, 0.87% of agriculture GDP, and 6% of the annual development program (ADP) expenditure of the country during the year (Appendix Table 7.4). The fertilizer subsidy is 10 times the R&D expenditure in the agriculture sector during 2009, the latest year such expenditure data are available.

7.4.4 Taxes

7.4.4.1 General Sales Tax

The government also intervenes in the fertilizer market through its tax policies. In 2001, the federal government exempted urea from the general sales tax (GST), but withdrew the exemption in 2011, along with the taxes on other agricultural inputs that had been exempted. This tax is

[63] The government also announced subsidy on DAP sales for 2014-15 (Khan 2014).
[64] However, the standard operating procedures for the mechanism have not been developed yet.
[65] Subsidy for DAP applied only during periods of peak international procurement prices.

charged from the farmers at the retail level and submitted in the government treasury by the retailers. If all such proceeds are honestly submitted, we estimate the GST revenue (offtake multiplied by price and the tax rate) from urea at approximately PKR 32 billion in 2011-12.

7.4.4.2 Gas Input Development Charges

The government tried to impose 20% gas input development charges (GIDC) in 2013. However, the Peshawar High Court (PHC) struck down the charges in 2014, and the decision of PHC was maintained by the Supreme Court of Pakistan in its August 22, 2014, decision (Supreme Court of Pakistan 2014). Even if the GIDC is imposed, just like the GST, it will be passed on to the farmers and will not help recover the production subsidy from the processors. Moreover, GIDC is imposed on all consumers to bring the gas price closer to its international price without markedly closing the gap between fuelstock and feedstock prices.

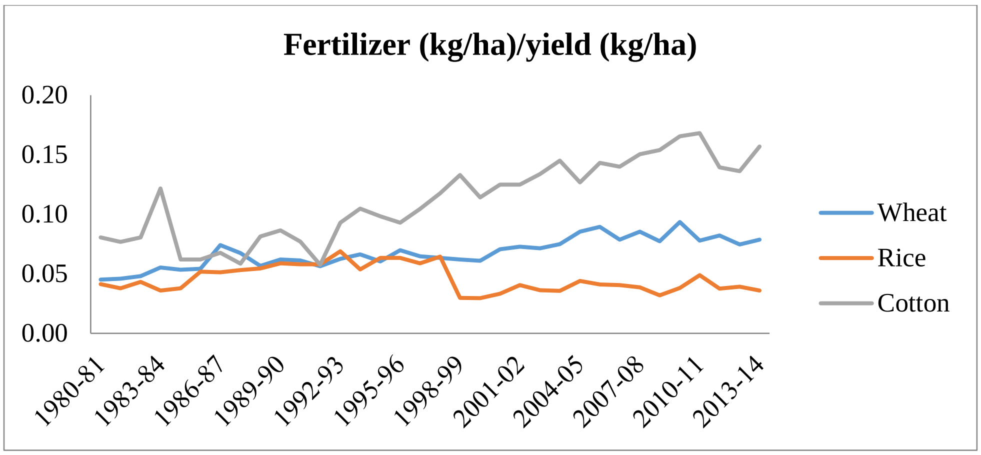
7.5 Fertilizer Use Efficiency

Fertilizer policies and investments in Pakistan have tended to overlook the promotion of fertilizer efficiency-enhancing practices. For example, fertilizer subsidies have been primarily allocated to the promotion of urea despite the fact that use has reached close to its optimal level, while other nutrients—namely phosphorus and potassium, as well as secondary and micronutrients—are underutilized by farmers and overlooked by the subsidy policies until very recently. Meanwhile, extension agents tend to place limited emphasis on educating farmers on practices that can improve fertilizer use efficiency, such as timeliness of application, application methods, and appropriate combinations of different fertilizers.

As a consequence, fertilizer use inefficiency (defined as fertilizer nutrient use divided by yield per hectare) has increased in Pakistan for major crops like wheat and cotton, as more fertilizer per unit of yield has been used over time (Fig. 7.2). Possible explanations include increasing resource degradation, such as soil salinity, waterlogging or decreases in soil organic matter and nutrient content. In very few cases since the Green Revolution have technological changes such as the introduction of a new, more fertilizer-responsive variety or a change in soil and water management practices helped to address this problem. An exception is in basmati rice, when a more efficient fertilizer variety was introduced in 1996. This new variety led to a one-time jump

in nutrient use efficiency in rice, indicating the importance of introduction of new varieties to maintain fertilizer use efficiency (Fig. 7.2).

Production of 100 kg of wheat in 1980-81 used 5 kg of fertilizer nutrient, but by 2014 to produce the same amount of wheat, 7.9 kg of fertilizer nutrient was applied. Similar trends have been observed in cotton, and fertilizer use efficiency in rice has remained largely unchanged in the past 15 years.



Source: Authors' calculation based on NFDC (2014), MNFSR (2013), MNFAL (2007a), and MNFAL (2007b).

***Fig. 7.2** Ratio of Fertilizer Use/Yield (1980-2014)*

To determine the factors that affect fertilizer use efficiency and to determine its optimal level under actual field conditions, we estimate a yield response function for wheat from the Farm Household Panel Data (FHPD) of the International Food Policy Research Institute (IFPRI).[66] To do this, a semi-log function was estimated in which the log of per hectare yield was regressed on the quantities of various inputs and their square terms, resource quality variables, climate-related variables and district dummies.[67] (See Ali et al. [2015] for details about the data, variable definitions and estimated results.)

[66] FHPD are drawn from the first round of the Pakistan Rural Household Panel Survey (RHPS) conducted in 2012 (IFPRI/IDS 2012). The FHPD on fertilizer use, yields, and related variables are specifically drawn from a sub-sample of 942 agricultural households across three provinces surveyed in November 2012 under RHPS Round 1.5.
[67] Previous literature mostly uses log-log specification (Zuberi 1989). However, in our case the semi-log form fits better.

The results relevant here for this chapter are the following: The first and most obvious finding is that yield is significantly responsive to nitrogen use but is also subject to decreasing marginal returns as captured in a squared term of nitrogen use; the estimates of elasticity at average levels of input use suggest that a 1% increase in the use of nitrogen results in a 0.2% increase in wheat yield.

Surprisingly, the use of phosphorus, included as a dummy variable in the model, did not have a significant impact on yield. This may be due to the large number of observations that did not report any use of phosphorus, little variation in its use across the sample, and its highly correlated use, whenever reported, with the use of nitrogen. It could also be due to the lag effect of P applications (over at least a decade).

Using the elasticity estimated from our yield response function, the marginal value-cost ratio at different levels of fertilizer use was estimated (Table 7.5). The optimal (profit-maximizing) value of an input is where marginal value of the output is equal to the unit cost of the input or marginal value-cost ratio (MVCR) is equal to 1. For nitrogen applied to wheat, the MVCR ratio becomes 1 at around 126 kg/ha, when subsidy is included, which is almost equal to the actual level of 118 kg/ha under farmers' own set of resource-quality and socioeconomic constraints. However, the optimum level of fertilizer use dropped significantly to 100 kg/ha, or 16% of the subsidy level when fertilizer price without subsidy was employed in the calculation. Using the production elasticity of 0.2, this drop will bring a 3.2% reduction in wheat production, which will cost farmers about PKR 18.5 billion through lower sales.

Table 7.5 *Marginal Value-Cost Ratio at Different Levels of Fertilizer Use With and Without Subsidy in Wheat Production in Pakistan During 2011-12*

Nitrogen Level (kg/h)	MP (kg of Wheat/kg of Fertilizer)	MP*PR (PKR/kg of Fertilizer)	Cost of Nitrogen With Subsidy (PKR/kg)	Subsidy on Nitrogen (PKR/kg)	Cost of Nitrogen Without Subsidy (PKR/kg)	MVCR (With Subsidy)	MVCR (Without Subsidy)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
70	6.0	137.3	74.7	18.1	92.8	1.8	1.5
100	4.5	103.8	74.7	18.1	92.8	1.4	1.1
120	3.5	81.4	74.7	18.1	92.8	1.1	0.9
126	3.2	74.7	74.7	18.1	92.8	1.0	0.8

MP = Marginal productivity of fertilizer in column (2) derived from the estimated production function by taking its first derivative and evaluating it at the mean value of all other inputs, where PR is the price of output in (3).
VCR = Value-cost ratio in columns (7) and (8) are estimated as value of marginal productivity in column (3) divided by per unit cost of fertilizer with subsidy in column (4) and without subsidy in column (6), respectively.

7.6 Impact of Policy Interventions

In this section, we use an Equilibrium Displacement Model (EDM) to estimate the impact of exogenous policy shocks on the input and output market. The analysis not only allows us to understand how fertilizer market functions in response to various interventions, but also identifies winners and losers from each intervention, thereby enabling policymakers to make more informed policy choices on fertilizer.

The model uses parameters derived from demand and supply equations specified for the input (urea and DAP) and output (i.e., cotton, rice, wheat, and other crops) markets.[68] The supply and demand for both inputs and outputs are linked with domestic production and international markets. The producers' prices of both input and outputs at the processor/producer levels are assumed to be endogenously determined, while their retail prices at farmer (for fertilizer) and consumer (for agricultural outputs) levels are differentiated by adding separate, fixed exogenously determined margins in producer/processor prices. Thus, the impact of tax or subsidy on any commodity can be evaluated by changing these margins. In addition, the world input and output prices, equal to the respective domestic producer/processor prices plus the constant wedge, are included in all the respective equations. Thus, positive or negative changes in world prices and gap in supply-demand in Pakistan provide incentives or disincentives to the international traders to export or import the respective commodity to or from the Pakistani market. Both input and output markets were cleared by allowing international trade to balance any deficit or surplus produced in the domestic market.

The input and output market equations were reduced by substituting these in the market clearing equations (where supply and imports are equated to demand), and then all the parameters were transformed into proportions and elasticities. These reduced-form equations were then entered in

[68] We do not differentiate between the basmati and non-basmati rice varieties in our model but took the weighted average price of the two.

the General Algebraic Modeling System (GAMS) with their respective elasticities to estimate the impact of exogenous shocks on the endogenous variables (see Ali et. al. [2015] for details).

Many simulations can be made using the EDM model, but we consider four of the most important policy interventions related to this paper: (1) removing the gas subsidy; (2) exempting GST on fertilizer; (3) removing gas subsidy and GST simultaneously; and (4) removing gas shortage in fertilizer manufacturing.

7.6.1 Policy Scenario 1: Removing the Subsidy on Natural Gas

To completely remove the subsidy on natural gas, the government must exogenously increase the price of the fuelstock by 297%. The first important impact from this policy is the rise in the factory cost, which shifts the supply curve upward. This increases the factory price of fertilizer and reduces the domestic supply. However, a higher domestic price creates incentives for the importers; thus, imports increase depending upon the import elasticity or easiness of imports. In the low elastic import supply scenario (e.g., with import elasticity of 1), the equilibrium factory price of urea increases by over 10%, while the increase is only 4% in case of high import elasticity scenario (with import elasticity of 5). The price of DAP fertilizer also increases in both scenarios, but to a far lesser extent because the one unit of DAP requires less than one-half of the ammonia produced from natural gas than for the same unit of urea. Farm-gate prices of urea and DAP (including GST) also increase parallel to their factory prices, as the difference between the two is only a constant wedge. The increased cost of urea and DAP processing reduces domestic supplies, increases their imports, and puts pressure on farm-gate prices (except in high import elasticity, which results from lower taxes where pressure on prices will not be great).

The changes in the fertilizer market trigger dynamisms in the crop markets, which produce impacts on government, farmers, and manufacturers. A lower demand of fertilizer reduces the crop output, depending upon the output supply elasticity with respect to fertilizer price.[69] This

[69] See Ali et al. (2015) for the full set of elasticities with reference used in the EDM. We want to highlight here that the crop supply elasticity with respect to fertilizer prices used in our EDM are from Haile et al. (2014). This is an international study and has reported low crop supply elasticities for Pakistan compared to the one in relatively old Pakistani studies. One reason for high elasticities in earlier Pakistani studies may be the low use of fertilizer at the time when these elasticities were estimated. In addition, using high elasticities from Pakistani literature blows up the effects of any policy intervention on crop production to an unbelievable level.

creates pressure on output prices. The farmers lose from lower crop production, but they benefit from higher output prices and lower production cost as fertilizer demand reduces. In the scenario of low import elasticity, farmers' overall loss was about PKR 11 billion, or 0.5% of the original value of farm production. However, this loss can be mitigated and turned into a profit of PKR 15 billion if imports are made flexible enough, reflected in high import elasticity in our model. Although crop outputs still decrease and output prices increase, both are moderated because of the higher imports of the fertilizers and farmers' loss from lower output sales reduced from PKR 7 billion to PKR 3 billion. On the other hand, fertilizer expenses reduce by PKR 19 billion because of the lower increase in fertilizer prices and higher decrease in demand. Thus, the moderation effect of higher import elasticity or facilitation in imports on input and output prices can be used as a toll to lower the impact of reduced gas subsidies.

The government is the biggest net beneficiary, as gas subsidies reduce by PKR 47 billion. There will be a small change in GST and distribution subsidies, and the net gain to the government would be around PKR 42 billion in the high import scenario and 46 billion in the low import scenario.

The decrease in crop production also affects international crop trade. Compared to 2013-14, the generally higher commodity prices provide incentives to international traders to export more commodities or reduce import from Pakistan. This causes an increase in imports of cotton and decline in the exports of rice, wheat, and other crops producing the trade deficit in these crops by PKR 1 billion. The trade loss can be further reduced when import elasticity of fertilizer is increased.

The manufacturers would be the biggest losers in this scenario, as their profit declines by PKR 46 billion in the case of low and PKR 58 billion in the case of high import elasticity. The cost of gas used in fertilizer processing increases by PKR 38 and 35 billion, while revenue from fertilizer sales decreases by over PKR 8 and 23 billion, respectively. The greater loss of manufacturers in the case of a liberal import scenario is because of the higher loss in fertilizer sales revenue as more imports are brought into the country.

With the increase in output prices, consumer expenditure on agricultural commodities would increase by PKR 10 billion, although the reduction would be only PKR 3 billion if fertilizer imports are more liberally imported. The society as a whole would lose by about PKR 5 billion in this scenario.[70]

In this simulation, we assumed elasticity of fertilizer supply with respect to price of natural gas as 0.1 and 0.025 for urea and DAP, respectively. As this elasticity may be argued as low, we also simulated the impact with an increased elasticity of 0.4% and 0.1%, respectively. This further increases the manufacturers' loss, from PKR 46 and 58 billion in the scenarios of low and high import elasticity, respectively, to PKR 70 and 116 billion, mainly because of the greater decline in revenue from fertilizer sales.

7.6.2 Policy Scenario 2: Removal of General Sales Tax

Removal of the 17% GST on urea and DAP prices would immediately reduce the cost to farmers, which will shift their demand functions outward. With this intervention, different reactions occur in all markets and final outcome again depends upon import elasticity.[71] In our model, eventual decline in urea and DAP prices at the farm-gate level was around 14% and 12%, respectively. This also increases fertilizer demand, which pushes the factory prices of urea and DAP upward by 3% and 5%, respectively, as imports start competing with domestic manufacturers. This increases the domestic supply of urea and DAP by about 2%.[72] The reduction of prices at farm-gate can be further induced nearer toward the full-scale reduction in GST if import elasticity is enhanced. This, however, will reduce the impact on factory-gate prices; thus, domestic supply will be further abandoned as imports are encouraged.

The production of major crops (cotton, rice, wheat, and other crops) in our model increases by only PKR 11 billion. The trade surplus in these crops increases by PKR 1 billion. Overall, the

---

[70] The net social gain to society was estimated as change in the value of crop demand + government revenue + farmer benefit + manufacturer benefit.

[71] Here we first explain the results with low import elasticity of 1, and then generalize the impact of high import elasticity of 5.

[72] Although, the model assumes that any additional input including gas will be freely available to produce equilibrium quantities of fertilizer (as well as crop), one may, however, consider achieving a small increase in fertilizer supply, such as in this scenario, through enhanced efficiency even if additional gas is not available or by encouraging imports.

greatest beneficiaries of the removal of the GST would be farmers as they save nearly PKR 37 billion in fertilizer cost, and their revenue from crop production also increases by about PKR 11 billion. Urea and DAP manufacturers would also gain by PKR 8 billion because of the higher factory prices and greater demand. However, their gains are reduced to PKR 3 billion if high import elasticity is assumed, as some of the high fertilizer demand is captured by importers. The government revenue would be affected as it loses the tax revenue equal to PKR 50 billion. Another beneficiary of GST removal from fertilizer is the consumer, as their demand increases by 0.4%, worth PKR 10 billion.

7.6.3 Policy Scenario 3: Removal of Gas Subsidy and GST Simultaneously

Some policymakers are thinking of the fertilizer sector without any tax, but also seeing no subsidies. We analyze the impact of this policy scenario in this simulation. This means shifting the supply curve of fertilizer downward and its demand curve upward. The net results depend upon supply and demand elasticities. Under the assumed elasticities in our model, the demand of urea has decreased despite the decrease in fertilizer prices. However, in DAP the demand and prices move in opposite directions. The factory prices and fertilizer supply both have increased, although the response is relatively low.

The factory price of urea and DAP increases by 13% and 9%, but their farm-gate prices decrease by 4% and 7%, respectively, as farmers do not have to pay the GST. This decreases the supply of urea and DAP by 12% and 5%, mainly because of the increased manufacturing cost as the gas subsidy is removed. This will also increase the import cost of fertilizer by 24%, worth PKR 21 billion, in both high and low import elasticities, which can be reduced to some extent by increasing the import elasticity of fertilizer.

This change in policy leaves the government with little change in revenue despite its loss of PKR 50 billion from the GST, because it saves PKR 47 billion from gas subsidy.

The 7% and 3% decrease in urea and DAP demand lowers crop production and creates upward pressure on prices, which costs the economy PKR 4 billion without much change in trade deficit. Farmers gain PKR 33 billion in this scenario from increased output prices and lower fertilizer

prices. The farmers' return with the policy, however, can be improved to PKR 70 billion with higher import elasticity of fertilizer. Manufacturers are the greatest losers in this scenario also, as their gas expenses increase, which will be further intensified with higher import elasticity because of the reduced sale of fertilizer as higher induced demand will be captured by the importers. The social cost of this reshuffling from the removal of all taxes and subsidies would be PKR 5 billion, which can be turned into social profit of PKR 20 billion when high import elasticity is assumed.

7.6.4 Policy Scenario 4: Removal of Gas Shortage

The fertilizer industry as of 2013-14 was operating at around 78% of its installed urea capacity. The use of limited gas resources in a sustainable manner mainly determines the long-term viability of the fertilizer sector. To determine this, we increased the amount of natural gas supplied to the fertilizer industry by 28%, presumably by more oil and gas exploration, while keeping all other exogenous effects constant. We also assume that despite the availability of 28% additional gas, the industry will utilize to meet the equilibrium demand.

The policy scenario would shift the supply curve to the right and decrease urea and DAP prices by 4% and 2%, respectively, both at the farm and factory levels, while it increases the equilibrium quantity of domestic supply by about 6% and 4%. As domestic prices decrease, imports become less competitive and would be reduced by 4% and 2%, respectively (the decrease in fertilizer prices and its import are higher under the high import elasticity scenario, implying more increase in domestic supply as well as demand).[73] The domestic demand increases by 4% and 0.2%, respectively. The quantities of domestically produced wheat, cotton, rice, and other crops increase and put downward pressure on crop prices. Given the base values in 2013-14, the domestic production of all crops increases by about PKR 3 billion, while trade surplus of these crops increases insignificantly.[74]

---

[73] Note that no account of changed nutrient use efficiency was incorporated into this scenario.
[74] It should be noted that this analysis through our EDM model does not take into account the quickly depleting supply of natural gas in Pakistan and the cost to the other sectors if gas was allocated from those to the fertilizer sector.

Farmers would gain by nearly PKR 6 billion, half of which would come from an increase in the value of crop production (despite a decrease in their prices) and the remaining half from low fertilizer cost due to its lower prices (despite its higher use). Urea manufacturers will see an increase in their revenue by PKR 2 billion, half of which will be consumed by an increase in processing cost. Consumers will also gain by PKR 3 billion. The government subsidy on gas will increase by PKR 2 billion.

Although the policy of removing gas shortage benefits all stakeholders, except the government, the extent of the benefits is relatively small. Moreover, the policy relies on the utilization of scarce economic resources in the country. It is estimated that, with the existing rate of utilization, the most extensive recoverable gas reserves available to the fertilizer sector from Mari field shall be exhausted within 16 years.[75]

7.7 Conclusions and Policy Recommendations

7.7.1 Conclusions

The rapid expansion of Pakistan's fertilizer production capacity—alongside increases in fertilizer consumption and imports and the growth of the policy, market, and institutional infrastructure required to promote fertilizer use—led to significant yield gains in wheat and rice during the 1960s, 1970s, and 1980s and introduced new challenges to Pakistan's agriculture sector. First, relatively smaller subsidies, if any, for nutrients other than nitrogen led to a long-term pattern of unbalanced fertilizer use. Second, the regulators' tight rein over the fertilizer industry, as set forth in PECA, and control of the gas supply placed significant discretionary powers in their hands. Third, the public sector's extensive investment in the formation and management of Pakistan's fertilizer industry—from the pricing and allocation of natural gas to the distribution of fertilizers to farmers—created interest groups that made more market-oriented reforms difficult.

Another dimension to this problem has been the absence of new product testing and promotion until the first decade of the 2000s. During the initial years of fertilizer introduction, provincial

[75] According to the data from the Ministry of Petroleum and Natural Resources, the balance recoverable reserve of gas from Mari field as of December 31, 2014, was 3,382 billion cubic feet and the utilization rate during 2014 was 211 billion cubic feet, giving the remaining life to the field not more than 16 years. This is also recognized by IRG (2011) in its report on page 17.

extension services played a major role in promoting fertilizer based on recommendations made by SFRI for every crop. However, the emphasis of these demonstrations remained focused on the expansion of fertilizer use, meaning that few more efficient products or application methods were either tested or promoted. Meanwhile, SFRI had little success in formulating and disseminating new fertilizer recommendations—either general or site-specific—based on their R&D activities. These limitations in the research and extension system have exacerbated trends toward unbalanced and inefficient fertilizer use, which promoted resource (soil and water) degradation.

The simulated results through our EDM suggest that removing the gas shortage for fertilizer processing will not benefit any stakeholder substantially, but rather will incur cost to the government in terms of more subsidies. Instead, removing the gas subsidy and GST on fertilizer simultaneously would decrease fertilizer prices at the farm-gate, have a positive impact on crop production, and could substantially benefit the farmers, if trade is freely allowed. On the other hand, the policy would not cost the government substantially.

References

Agritech (2014) Our company. Retrieved from http://www.pafl.com.pk/our-company

Ali M (1990) The price response of major crops in Pakistan: An application of the simultaneous equation model. The Pakistan Development Review 305-325

Ali M, Ahmed F, Channa H, Davies S (2015) Pakistan's fertilizer sector: Structure, policies, performance and impacts, Discussion Paper 01516, International Food Policy Research Institute, Washington, D.C. (forthcoming)

Ali M, Flinn JC (1989) Profit efficiency among basmati rice producers in Pakistan Punjab. American Journal of Agricultural Economics 71(2):303-310

Competition Commission of Pakistan (CCP) (2010) Competition assessment study of the fertilizer sector in Pakistan. CCP, World Bank, Islamabad

Department of Fertilizer (DoF) (2012) Indian fertilizer scenario 2012. DoF, Ministry of Chemicals and Fertilizers, Government of India, New Delhi

Energy Information Administration (EIA) (2014) Natural gas. Retrieved from http://www.eia.gov/dnav/ng/hist/rngwhhdd.htm

Fauji Fertilizer Bin Qasim Limited (FFBL) (2005). Annual report 2004. FFBL, Rawalpindi

FFBL (2006) *Annual report 2005*. FFBL, Rawalpindi

FFBL (2008) *Annual report 2007*. FFBL, Rawalpindi

FFBL (2010) *Annual report 2009*. FFBL, Rawalpindi

FFBL (2012) *Annual report 2011*. FFBL, Rawalpindi

FFBL (2014) *Annual report 2013*. FFBL, Rawalpindi

Fauji Fertilizer Company Limited (FFC) (2004) *Annual report 2003*. FFC, Rawalpindi

FFC (2006) *Annual report 2005*. FFC, Rawalpindi

FFC (2008) *Annual report 2007*. FFC, Rawalpindi

FFC (2010) *Annual report 2009*. FFC, Rawalpindi

FFC (2012) *Annual report 2011*. FFC, Rawalpindi

FFC (2014) *Annual report 2013*. FFC, Rawalpindi

Haerdter R, Fairhurst T (2003, October) Nutrient use efficiency in upland cropping systems of Asia. IFA Regional Conference, Cheju Island, Korea

Haile MG, Kalkuh M, von Braun J (2014, August) Agricultural supply response to international food prices and price volatility: A cross-country panel analysis. Paper prepared for

presentation at the EAAE 2014 Congress Agri-Food and Rural Innovations for Healthier Societies, Ljubljana, Slovenia

Hassan UM, Pradhan P (1998, October) Coordinated services for irrigated agriculture in Pakistan. Proceedings of the IWMI National Workshop, Lahore, Pakistan

HC Securities & Investment (2014) Industries Qatar-setting itself to attain higher peaks. Retrieved from http://content.argaam.com.s3-eu-west-1.amazonaws.com/db1d08f5-5287-4531-b421-eaa1c5496ad5.pdf

Hydrocarbon Development Institute of Pakistan (HDIP) (2013) Pakistan energy yearbook 2012. Hydrocarbon Development Institute of Pakistan, Ministry of Petroleum and Natural Resources, Government of Pakistan, Islamabad

Hussain A (2011, March) Seed industry in Pakistan. Paper presented at World Bank Roundtable Discussion on Agriculture and Water, Islamabad, Pakistan

International Food Policy Research Institute/Innovative Development Strategies. Pvt. Ltd. (IFPRI/IDS) (2012) Pakistan rural household survey 2012. Pakistan Strategy Support Program (PSSP). IFPRI, Washington, D.C.; IDS, Islamabad

International Resource Group (IRG) (2011) *P*akistan integrated energy model (Pak-IEM) (Final Report Volume II, Policy Analyses Report). Prepared for Asian Development Bank and Ministry of Planning and Development, Government of Pakistan, ADB TA-4982 PAK.

Khan AS (2014, July 12) DAP sales plunge on subsidy issue. Dawn

Ministry of Food, Agriculture and Livestock (MNFAL) (2007a) Agricultural statistics of Pakistan volume IV (1981-1990). Economic Wing, MNFAL, Government of Pakistan, Islamabad

MNFAL (2007b) Agricultural statistics of Pakistan volume V (1991-2000). Economic Wing, MNFAL, Government of Pakistan, Islamabad

MNFAL (2007c) Agricultural statistics of Pakistan volume III (1971-1980). Economic Wing, Ministry of Food, Agriculture and Livestock, Government of Pakistan, Islamabad

Ministry of National Food Security and Research (MNFSR) (2013) Agricultural statistics of Pakistan 2011-2012. Economic Wing, MNFSR, Government of Pakistan, Islamabad

National Fertilizer Development Centre (NFDC) (1998) Pakistan fertilizer related statistics. NFDC, Planning Commission, Government of Pakistan, Islamabad

NFDC (2002) Pakistan fertilizer related statistics. NFDC, Planning Commission, Government of Pakistan, Islamabad

NFDC (2008) Pakistan fertilizer related statistics. NFDC, Planning Commission, Government of Pakistan, Islamabad

NFDC (2014) Statistics. Retrieved from www.nfdc.gov.pk/stat.html

National Research Council (NRC) (1989) Alternative agriculture. National Academy Press, Washington, D.C.

NFML (2014) National Fertilizer Marketing Limited

Pakistan Press International (PPI) (2012, November 21) Gas shortage: fertilizer manufacturers claim losses of nearly Rs5b. The Express Tribune

Supreme Court of Pakistan (2014) Judgment on civil appeal nos. 1540-1599 of 2013 and civil appeal nos. 21 of 2014. Retrieved from http://www.supremecourt.gov.pk/web/user_files/File/c.a.1540-1599_2013.pdf

Zuberi HA (1989) Production function, institutional credit and agricultural development in Pakistan. The Pakistan Development Review 43-55

Appendix Table 7.1 *Fertilizer Production, Offtake, Import, and Stock ('000 mt) by Nutrient During 1970-2014*

Fiscal Year	Offtake				Production				Import				Stock[a]			
	N	P	K	Total	N	P	K[b]	Total	N	P	K	Total	N	P	K	Total
1970-71	251.5	30.5	1.2	283.2	140.1	4.5	0.0	144.7	107.8	38.6	5.0	151.4	131.5	42.7	6.1	180.3
1971-72	344.0	37.2	0.7	381.9	215.1	4.9	0.0	220.0	73.0	0.0	0.0	73.0	75.7	10.3	5.4	91.4
1972-73	386.4	48.7	1.4	436.5	274.5	8.2	0.0	282.8	115.6	72.1	0.0	187.7	79.4	41.9	4.0	125.3
1973-74	341.9	58.1	2.7	402.7	300.1	4.2	0.0	304.3	225.0	104.3	6.3	335.6	262.5	92.3	7.6	362.5
1974-75	362.8	60.6	2.1	425.5	296.3	10.6	0.0	307.0	106.5	26.1	0.8	133.3	302.5	68.4	6.3	377.2
1975-76	441.6	103.6	2.9	548.1	316.5	10.6	0.0	327.1	73.5	109.2	0.0	182.7	250.9	84.6	3.4	338.9
1976-77	511.0	117.9	2.4	631.3	309.3	11.9	0.0	321.2	137.1	140.1	2.5	279.6	186.2	118.7	3.5	308.4
1977-78	549.9	156.3	6.0	712.2	312.5	15.0	0.0	327.5	341.8	204.8	2.1	548.7	290.6	182.1	-0.4	472.3
1978-79	684.3	188.0	7.6	879.8	334.0	27.0	0.0	361.0	443.9	205.6	9.9	659.4	384.2	226.7	1.9	612.8
1979-80	806.0	228.5	9.6	1044.1	388.9	49.8	0.0	438.6	440.8	142.4	13.8	596.9	407.9	190.4	6.1	604.3
1980-81	842.9	226.9	9.6	1079.5	579.7	57.7	0.0	637.4	386.7	302.3	22.0	711.0	531.3	323.5	18.5	873.3
1981-82	830.6	225.2	21.7	1077.5	699.2	66.9	0.0	766.1	88.8	28.5	15.6	132.8	488.8	193.7	12.3	694.8
1982-83	952.7	265.3	25.7	1243.6	987.3	71.3	0.0	1058.6	133.3	249.3	21.5	404.1	656.7	249.0	8.1	913.8
1983-84	914.3	259.8	28.5	1202.6	1015.3	91.8	0.0	1107.1	79.4	189.1	27.2	295.7	837.1	270.1	6.9	1114.1
1984-85	934.9	293.9	24.7	1253.4	1028.7	90.0	0.0	1118.7	86.5	233.1	21.3	340.9	1017.5	299.3	3.5	1320.2
1985-86	1128.1	349.8	33.2	1511.1	1041.7	93.3	0.0	1135.0	66.3	159.3	40.3	266.0	997.3	202.1	10.6	1210.0
1986-87	1332.5	408.9	42.5	1783.9	1120.1	93.3	0.0	1213.3	210.2	354.0	46.2	610.4	995.1	240.5	14.3	1249.9
1987-88	1281.7	393.5	45.1	1720.2	1097.1	95.2	0.0	1192.3	204.6	295.8	57.1	557.6	1015.2	238.1	26.3	1279.5
1988-89	1324.8	390.6	24.5	1740.0	1113.8	100.5	0.0	1214.3	134.2	317.5	9.4	461.1	938.3	265.5	11.1	1214.9
1989-90	1467.9	382.5	40.1	1890.4	1156.4	105.1	0.0	1261.5	285.5	262.9	41.5	590.0	912.3	251.1	12.6	1175.9
1990-91	1471.6	388.5	32.8	1892.9	1110.6	104.6	0.0	1215.2	360.6	252.9	54.6	668.1	911.8	220.1	34.4	1166.2
1991-92	1462.6	398.0	23.3	1883.9	1043.8	105.5	0.0	1149.3	369.9	269.8	10.1	649.7	862.8	197.4	21.2	1081.4
1992-93	1635.4	488.2	24.1	2147.6	1227.3	104.8	0.0	1332.1	409.6	388.9	14.9	813.5	864.4	202.9	12.0	1079.3
1993-94	1659.4	464.3	23.2	2146.8	1565.9	92.9	0.0	1658.9	310.5	540.9	33.5	884.9	1081.4	372.5	22.4	1476.3
1994-95	1738.1	428.4	16.6	2183.1	1544.1	92.1	0.0	1636.2	87.7	258.4	12.8	358.8	975.1	294.6	18.6	1288.3
1995-96	1990.9	494.5	29.7	2515.0	1693.4	96.1	0.0	1789.5	297.9	397.2	39.0	734.1	975.5	293.4	27.9	1296.8
1996-97	1985.1	419.5	8.4	2413.0	1681.5	80.7	0.0	1762.2	472.9	381.0	24.3	878.1	1144.8	335.7	43.7	1524.2
1997-98	2075.1	550.9	20.0	2646.1	1660.5	67.5	0.0	1728.0	297.7	433.5	17.6	748.8	1028.0	285.7	41.3	1354.9
1998-99	2097.0	465.0	21.3	2583.3	1795.2	90.7	0.0	1885.9	421.8	425.0	37.2	884.8	1147.9	336.4	57.2	1542.3
1999-00	2217.8	597.2	18.5	2833.4	2039.6	223.5	0.0	2263.2	233.0	416.0	13.8	662.8	1202.8	378.8	52.5	1634.9
2000-01	2264.2	675.8	23.1	2963.1	2053.8	243.8	0.4	2298.1	194.0	369.1	16.5	579.6	1186.4	315.9	46.4	1549.5

Fiscal Year	Offtake				Production				Import				Stock[a]			
	N	P	K	Total	N	P	K[b]	Total	N	P	K	Total	N	P	K	Total
2001-02	2285.3	624.5	18.8	2928.6	2134.0	142.7	8.9	2285.6	178.5	429.5	17.7	625.7	1213.5	263.6	54.2	1532.1
2002-03	2349.1	650.2	20.5	3019.8	2192.4	111.1	11.5	2315.0	215.7	542.4	7.9	766.0	1272.6	266.9	53.1	1593.4
2003-04	2526.7	673.5	21.8	3222.0	2272.5	253.9	12.9	2539.3	204.2	553.5	6.4	764.1	1222.6	400.8	50.6	1674.8
2004-05	2796.4	865.1	32.5	3694.0	2373.1	324.8	20.1	2718.0	309.7	458.2	16.9	784.8	1109.0	318.7	55.1	1483.6
2005-06	2926.6	850.5	27.0	3804.2	2476.0	341.4	14.7	2832.2	603.4	639.8	25.1	1268.3	1261.8	449.4	67.9	1779.9
2006-07	2649.7	978.8	43.1	3671.6	2426.8	307.9	11.9	2746.5	307.6	476.2	12.1	795.9	1346.4	254.8	48.8	1650.7
2007-08	2924.6	629.7	26.9	3581.2	2513.0	294.0	16.0	2822.0	286.7	565.7	23.9	876.3	1221.5	484.8	61.8	1767.8
2008-09	3034.9	651.2	25.3	3711.4	2532.0	364.0	10.0	2907.0	456.6	111.5	0.0	568.1	1175.2	309.1	46.5	1531.5
2009-10	3476.3	860.4	23.8	4360.5	2669.0	403.0	10.0	3082.0	900.8	522.4	20.9	1444.1	1268.7	374.1	53.6	1697.1
2010-11	3133.5	767.0	32.3	3932.8	2642.0	423.0	12.0	3076.0	383.2	243.5	18.0	644.7	1160.4	273.6	51.3	1485.0
2011-12	3206.5	633.2	21.2	3860.9	2541.0	431.0	10.0	2983.0	871.0	291.0	15.0	1177.0	1365.9	362.4	55.1	1784.1
2012-13	2853.5	746.9	20.8	3621.2	2257.5	438.6	7.5	2703.6	456.4	271.2	6.8	734.5	1226.3	325.3	48.6	1601.0
2013-14	3184.0	881.0	23.6	4089	2644.0	455.0	11.0	3110.0	703.0	432.0	14.0	1149.0	1389.3	331.3	50.0	1771.0

a. Stock = Production+Import+previous year's stock-consumption.
b. Potash production data are derived from macro statistics of NFDC, which include imported potash content of NPK blends as production.
Source: NFDC (2014).
Note: Error in totals can occur due to rounding.

Appendix Table 7.2 *Fertilizer Use Rate (kg/hectare) (1970-2014)*

Fiscal Year	Nitrogen	Phosphate	Potash	Total	P/N	K/N
1970-71	15	1.83	0.07	17	0.12	0.005
1971-72	21	2.24	0.04	23	0.11	0.002
1972-73	23	2.88	0.08	26	0.13	0.003
1973-74	19	3.18	0.15	22	0.17	0.008
1974-75	21	3.49	0.12	25	0.17	0.006
1975-76	25	5.75	0.16	30	0.23	0.006
1976-77	28	6.47	0.12	35	0.23	0.004
1977-78	30	8.45	0.32	39	0.28	0.011
1978-79	35	9.73	0.39	46	0.28	0.011
1979-80	42	11.85	0.5	54	0.28	0.012
1980-81	44	11.81	0.5	56	0.27	0.011
1981-82	43	11.67	1.13	56	0.27	0.026
1982-83	47	13	1	62	0.28	0.021
1983-84	46	13	1	60	0.28	0.022
1984-85	47	15	1	63	0.32	0.021
1985-86	56	17	2	75	0.30	0.036
1986-87	64	20	2	85	0.31	0.031
1987-88	66	20	2	88	0.30	0.030
1988-89	61	18	1	80	0.30	0.016
1989-90	69	18	2	89	0.26	0.029
1990-91	69	18	2	89	0.26	0.029
1991-92	69	19	1	88	0.28	0.014
1992-93	77	23	1	101	0.30	0.013
1993-94	76	21	1	98	0.28	0.013
1994-95	79	19	1	99	0.24	0.013
1995-96	88	22	1	111	0.25	0.011
1996-97	87	18	0.4	105	0.21	0.005
1997-98	91	24	1	116	0.26	0.011
1998-99	91	20	1	112	0.22	0.011
1999-00	97	26	1	124	0.27	0.010
2000-01	103	31	1	135	0.30	0.010
2001-02	104	28	1	133	0.27	0.010
2002-03	106	29	1	136	0.27	0.009
2003-04	116	31	1	147	0.27	0.009
2004-05	122	38	1	161	0.31	0.008
2005-06	130	38	1	169	0.29	0.008
2006-07	115	42	2	159	0.37	0.017
2007-08	125	27	1.2	153	0.22	0.010
2008-09	128.2	28	1.1	157	0.22	0.009
2009-10	146.1	36	1	183	0.25	0.007
2010-11	132.4	32	1.4	166	0.24	0.011
2011-12	137	27	0.9	165	0.20	0.007
2012-13	122	32	0.9	155	0.26	0.007
2013-14	140	39	1.0	180	0.28	0.007

Source: NFDC (2014).

Appendix Table 7.3 *Feedstock Gas Prices ($/mBTU) for Fertilizer Manufacturers in Pakistan, the Middle East, and the USA*

Year	Pakistan	Middle East	Henry Hub, USA
2004-05	1.0	1.1	6.3
2005-06	1.9	1.4	8.9
2006-07	2.1	1.3	6.9
2007-08	2.0	1.7	8.3
2008-09	1.5	2.7	5.9
2009-10	1.6	1.1	4.3
2010-11	1.6	1.4	4.2
2011-12	1.8	1.9	3.2
2012-13	1.2	2.0	3.8
2013-14	1.2	2.1	4.3
Average	1.6	1.7	5.6

Source: Data retrieved from HDIP (2013), EIA (2014), and HC Securities & Investment (2014).

Appendix Table 7.4 *Total Subsidy to the Fertilizer Industry (Million U.S. $)*

Year	Production Subsidy	Distribution Subsidy			Total Subsidy	% of GDP	% of ag. GDP	% of ADP
		Urea	Other (P&K)	Total				
2004-05	222.9	25.39	0	25.39	248.29	NA	NA	NA
2005-06	219.3	60.14	0	60.14	279.44	0.204	0.942	4.582
2006-07	239.7	27.87	225.95	253.82	493.52	0.324	1.486	6.900
2007-08	243.5	39.81	278.19	318	561.5	0.330	1.467	7.772
2008-09	326.1	202.68	337.59	540.27	866.37	0.515	2.268	14.160
2009-10	339.7	126.13	5.97	132.1	471.8	0.266	1.142	6.445
2010-11	343.7	74.74	0	74.74	418.44	0.196	0.779	7.069
2011-12	410.9	95.23	0	95.23	506.13	0.223	0.940	6.107
2012-13	366.8	16.8	0	16.8	383.6	0.165	0.686	4.789
2013-14	397.2	109.1	0	109.1	506.3	0.207	0.870	6.197

Source: Authors’ calculation based on HDIP (2014) and NFDC (2014).

Appendix Table 7.5 Proportion of Subsidy in Price for Urea (2004-05 to 2013-14)

Year	Subsidy on Domestic Production (million $)	Subsidy on Imported Urea (million $)	Total Subsidy (million $)	Urea Production ('000 mt)	Imported Urea ('000 mt)	Total Urea Supply ('000 mt)	Domestic Prices ($/mt)	Average Production Subsidy ($/mt)*	Average Import Subsidy ($/mt)**	Total Subsidy ($/mt)***	Proportion (Production Subsidy/ Domestic Price)	Import Subsidy/ Domestic Price (%)	Total Subsidy/ Domestic Prices (%)
2004-05	222.9	25.4	248.3	4610.7	307.0	4917.7	156.4	48.3	82.7	53.8	31%	53%	34%
2005-06	219.3	60.1	279.4	4803.9	825.0	5628.9	169.7	45.7	72.8	58.2	27%	43%	34%
2006-07	239.7	27.9	267.6	4731.7	281.0	5012.7	173.8	50.7	99.3	56.5	29%	57%	33%
2007-08	243.5	39.8	283.3	4925.1	181.0	5106.1	187.4	49.4	219.9	57.5	26%	117%	31%
2008-09	326.1	202.7	528.8	4921.7	905.0	5826.7	191.6	66.3	224.0	107.4	35%	117%	56%
2009-10	339.7	126.1	465.8	5154.9	1525.0	6679.9	192.4	65.9	82.7	90.4	34%	43%	47%
2010-11	343.7	74.7	418.4	4994.0	635.0	5629.0	244.4	68.8	117.6	83.8	28%	48%	34%
2011-12	410.9	95.2	506.1	4686.0	1449.0	6135.0	389.2	87.7	65.7	108.0	23%	17%	28%
2012-13	366.8	16.8	383.6	4364.0	761.0	5125.0	350.4	84.0	22.1	87.9	24%	6%	25%
2013-14	397.2	109.1	506.3	4932.0	1155.0	6087.0	361.7	80.5	94.5	102.7	22%	26%	28%

* Estimated on domestic production only.
** Estimated on imported urea only.
*** Estimated on production plus import.
Source: Authors' calculation based on NFDC (2014).

8 Sub-Saharan Africa

Maria Wanzala-Mlobela[76]
IFDC

8.1 Introduction

Fertilizer subsidies gained prominence in Africa between the 1960s and early 1980s in an attempt to promote increased agricultural production by encouraging the adoption of new technologies through fertilizer cost reduction and risk mitigation. In the 1980s and 1990s, the consensus among African governments, development organizations, and donors was that conventional subsidies had been ineffective and costly in Africa; as a result, many African countries eliminated their subsidy programs.

Following the 2006 *Abuja Declaration on Fertilizer for an African Green Revolution*, there emerged a political commitment by African leaders to arrest land degradation and improve crop productivity by increasing fertilizer use from the then average of 8 kg/ha to at least 50 kg/ha of arable land. This commitment was reinforced by the 2007/08 soaring food, fuel, and fertilizer prices which prompted several countries in SSA to re-introduce fertilizer subsidies as a way to boost food production. Approximately 20 countries now have subsidy programs and the annual cost is over U.S. $1 billion.[77] Table 8.1 provides data on the cost of fertilizer subsidy programs for ten of these countries, which on average accounted for 28.6% of their public expenditure on agriculture between 2008 and 2011 (Jayne and Rashid 2013).

---

[76] The author acknowledges technical support and review from Dr. Joshua Ariga and Dr. Porfirio Fuentes, IFDC, Office of Programs.

[77] These countries are the following: Burkina Faso, Burundi, Chad, Djibouti, Ethiopia, Ghana, Kenya, Lesotho, Malawi, Mali, Mozambique, Namibia, Nigeria, Rwanda, Senegal, Seychelles, South Sudan, Sudan, Tanzania, and Zambia.

Table 8.1 *Fertilizer Subsidy and Public Agricultural Expenditures in Selected African Countries*

Country	Year	Program Cost (million U.S. $)	Program Cost per Metric Ton of Program Fertilizer Distributed (U.S. $/mt)	Public Expenditure on Agriculture (million U.S. $)	Program Cost as a Percentage of Public Agricultural Spending
Mali	2011	38.6	890	213	18.1
Burkina Faso	2010	21.7	867	259	8.4
Ghana	2011	111.7	634	374	29.9
Senegal	2010	42.4	785	163	26.1
Nigeria	2010	190.0	719	729	26.0
Kenya	2011	61.1	1,072	318	25.7
Malawi	2011	179.2	1,200	308	58.3
Tanzania	2011	134.1	1,056	291	46.0
Zambia	2011	134.8	1,310	438	39.9
Other subsidy programs					
Ethiopia[a]	2011	55.0	130	530	10.4

a. The Ethiopian Government does not refer to its subsidization of retail fertilizer prices as a subsidy program.
Source: Jayne and Rashid (2013).

The fertilizer subsidy programs currently being implemented in SSA range from conventional subsidies to “market-friendly” subsidies. Conventional fertilizer subsidies include the following key features: government importation and distribution of fertilizer, the sale of fertilizer at subsidized pan-territorial prices via state-owned enterprises and universal program availability to all categories of farmers. The key features of market-friendly subsidies are the use of a targeting mechanism such as input vouchers to target poor farmers and delivery of the subsidized fertilizer via the private input distribution system.

This chapter focuses on four countries to examine fertilizer subsidy programs in SSA: Malawi (Southern Africa); Rwanda and Tanzania (East Africa); and Nigeria (West Africa). It analyzes the subsidy programs, their performance, some key lessons and best practices and discusses some perspectives/options for the way forward. Sect. 2 provides an overview of trends in fertilizer consumption, production and trade for SSA. Sect. 3 describes the fertilizer subsidy programs for each of these countries, providing some background information, a summary of the fertilizer supply, consumption and trade trends, a description of the main types of fertilizer being used and their suitability for the crop and soil needs of the country, and a description of the

fertilizer market. Sect. 4 provides an evaluation of the subsidy programs in terms of impact and results. Sect. 5 provides some lessons and challenges vis-à-vis fertilizer subsidy programs in SSA. The Appendix provides a table comparing some aspects of these programs across the selected countries.

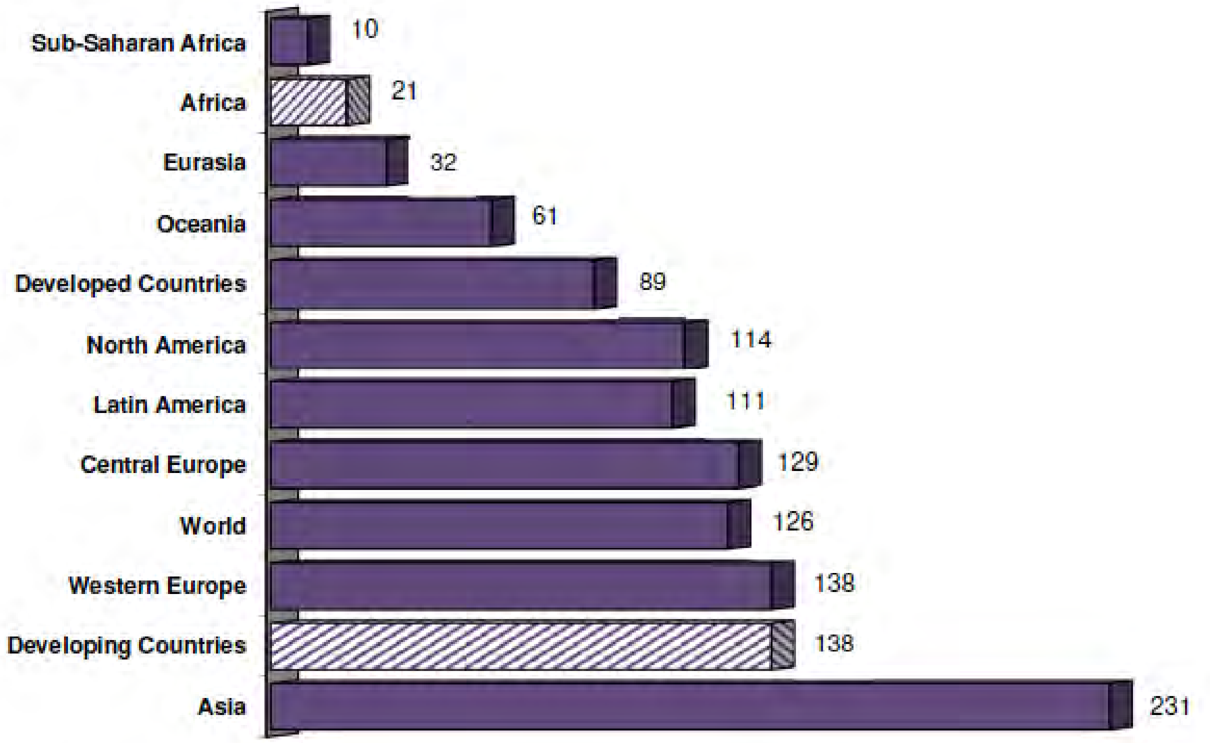
8.2 Sub-Saharan Africa: Overall Trends in Fertilizer Production, Consumption, and Trade

8.2.1 Trends in Fertilizer Consumption

North Africa (Algeria, Egypt, Libya, Morocco, and Tunisia) and South Africa accounted for 2.95 Mt of nutrients, or 57% of Africa's total fertilizer consumption in 2012. Globally in 2012, fertilizer nutrient consumption was 194 Mt, of which Africa accounted for 2.7% (IFDC 2015 estimations based on FAOSTAT data).

In SSA, although fertilizer consumption fluctuated during the 1980-95 period, it remained almost stagnant at an average of 1.1 Mt of nutrients per year. Consumption started increasing since 1995 and markedly after 2003, reaching 2.2 Mt by 2012. This increase is in large part explained by the introduction of fertilizer subsidies in many SSA countries beginning in the late 1990s. Despite these increases, overall consumption remains low. SSA, with over 10% of the global population, accounted for only 2.7% of global fertilizer nutrient consumption as of 2012.

Africa's small share of global fertilizer consumption is a reflection of the small fertilizer markets, particularly in SSA, which in turn, is also a reflection of the low fertilizer use per hectare. Average fertilizer use in SSA is 10 kg/ha, equivalent to 10% of the world average, 23 times less than the average for Asia (231 kg/ha) and 11 times less than the average for Latin America (111 kg/ha) (Fig. 8.1).



Source: Authors from FAOSTAT (2015).

Fig. 8.1 *Per Hectare Fertilizer Use by World Regions, 2012 (kg/ha)*

Low fertilizer use per hectare does not auger well for achieving food security or reversing the severe soil nutrient depletion in Africa. Henao and Baanante (1999) estimated that in several SSA countries, nutrient depletion exceeded more than 60 kg/ha during the mid-1990s due to continuous cropping with little or no replenishment of nutrients.

Of the 45 countries in SSA (excluding South Africa), fertilizer consumption statistics are available for 34 countries as of 2012. Of these, only 14 countries used more than 50,000 nutrient metric tons, and 10 countries used less than 10,000 nutrient metric tons. Eight countries (Ethiopia, Ghana, Kenya, Mali, Nigeria, Malawi, Sudan, and Zimbabwe) accounted for 72% of SSA's fertilizer consumption, with each of them consuming more than 100,000 nutrient metric tons of fertilizer. In each of these countries, there is considerable fluctuation in consumption across the years, which is partly a reflection of frequent changes in fertilizer policy and the effects of fertilizer subsidies. Nearly 40% of the fertilizer consumed in SSA is used on maize, followed by other cereals (wheat, barley, teff, sorghum, and millet) while fruits, vegetables, and

sugarcane account for 15% , and rice, tobacco, cotton, and traditional tubers (cassava, yams) account for 2-3% each (Morris et al. 2007).

Declining nutrient consumption and low fertilizer application rates have translated into cereal crop yields per hectare for Africa (1.6 mt/ha) and SSA (1.4 mt/ha) that are much lower than the world average (3.8 mt/ha as of 2013) and lower than what farmers are capable of achieving under conducive conditions. Hence, over the last 50 years, production growth has come mainly from area expansion in SSA, in contrast to South Asia where agricultural intensification or yield increases are the main source of increases in agricultural output (Wanzala-Mlobela et al. 2009). Clearly there is a need to increase fertilizer use substantially in SSA to increase agricultural productivity and to restore the soil nutrient balance.

8.2.2 Fertilizer Production in Africa

8.2.2.1 Raw Materials (N-P-K) for Fertilizer Production

Africa is well endowed with natural resources for fertilizer production (Van Kauwenbergh 2006; 2010). These resources include deposits of phosphate rock, potash deposits, accumulations of natural gas, and deposits of coal that can be used to produce nitrogen fertilizers. North Africa (Algeria, Egypt, Morocco, and Tunisia) has substantial resources of phosphate rock and natural gas. Egypt, Morocco, and Tunisia account for 92% of Africa's fertilizer production, most of which is exported. South Africa, the fourth-largest producer, has significant phosphate rock deposits and produces 90% of its phosphate fertilizer requirements. Currently there is no commercial production of potassium in Africa.

In many countries in SSA the deposits of raw materials are often too small to be commercially viable, or the quality of resources presents production challenges. In addition, resources are often poorly located in relation to domestic and export markets, and/or markets are too small to realize economies-of-scale in production. Although there are numerous small deposits of phosphate rock throughout SSA, substantial commercial deposits are found only in Tanzania, Togo, and Senegal; preliminary explorations have also indicated substantial deposits in Mozambique and off the coast of Namibia. DRC and Ethiopia are the only countries in SSA with commercially viable deposits of potash. Nigeria, Angola, Equatorial Guinea, Ethiopia, Côte d'Ivoire, Ghana,

Mozambique, Namibia, DRC, Madagascar, and Tanzania have considerable deposits of natural gas.

The main fertilizer producers in SSA are Mauritius, Senegal, and Zimbabwe, while Nigeria has recently resumed urea production. Zambia has produced nitrogen and phosphate fertilizers in the past, but production has declined substantially in recent years and current production levels are unknown. Tanzania currently produces small quantities of phosphate fertilizers (Minjingu guano deposits). Small-scale production of phosphate rock for direct application takes place in Burkina Faso, Madagascar, Mali, Senegal, and Zimbabwe. Bulk blending plants have been established in all the larger fertilizer-using countries: Côte d'Ivoire, Ethiopia, Ghana, Malawi, Mozambique, Nigeria, Tanzania, Kenya, Zambia, and Zimbabwe.

8.2.2.2 Current Production

Fertilizer production has increased substantially in the past 10 years. In 2012 the fertilizer industry in Africa produced 6.7 Mt of nutrients, compared to 5.7 Mt produced in 2002, representing an 18% increase in 10 years. Reliable production statistics are unavailable, but we estimate that in 2012 the total production in SSA was 224,576 mt of nutrients, up from 161,450 mt in 2002. Africa as a whole only accounted for about 3.2% of world production in 2012 (FAOSTAT). Egypt, Morocco, and Tunisia accounted for most of the fertilizer produced in Africa, producing 6.2 Mt of nutrients or 92% of Africa's total of 6.7 Mt of nutrients produced in 2012 (IFDC 2015 calculations based on FAOSTAT).

8.2.2.3 Investments in Fertilizer Production Capacity

This section provides a brief summary of some planned or ongoing investments to expand fertilizer production in SSA. However, fertilizer is a globally traded commodity and most of the investments described below do not specifically target the African market but are driven by commercial considerations, for example, attractiveness of the feedstock (quality and price) and the geographic position in relation to markets. At the present time, the majority of Africa's fertilizers are produced in North Africa and are traded in the global market; SSA is not the main destination for these fertilizers. However this situation may change over the next decade or so, as more and more African governments are taking a greater interest in investing in their natural

resources that can have a positive impact on their economies. This will provide a competitive advantage (through reduced transport costs) for companies producing on the African continent. It will also create significant savings in foreign exchange, and industrial development opportunities through value addition to the raw material (Wanzala and Groot 2013).

Urea. Nigeria – currently the only urea producer in SSA – has the potential to become a manufacturing and export hub within the next five years. Currently there is one plant with a production capacity of 500,000 mt/year, but several companies (Nigerian and Indian investors) have advanced plans for construction of ammonia-urea plants, which could raise capacity to well over 5 Mt/year. In 2013, the Ethiopia government initiated a program to install four blending plants in each of the four main geopolitical zones. This program is aligned closely with a program to identify and implement balanced nutrition programs for all crops. Moreover, the government proposes to build five urea plants with a production capacity of 300,000 mt/year based on coal gasification (Makepeace 2014). In Gabon, a urea plant with a capacity of 1.3 Mt/year is at an advanced stage of feasibility assessment. This is a joint investment of the Government of Gabon with Indian and Singaporean investors. In Angola, a Japanese consortium is preparing plans to construct a 1.75 Mt urea plant. Three companies are currently discussing opportunities for urea production in Mozambique, based on proven offshore gas reserves. In Ghana, preliminary plans have been developed to invest in urea production using offshore gas reserves (Wanzala and Groot 2013).

Ammonium Sulfate. An American company, International Raw Materials, has been contracted to market 250,000 mt/year of locally produced ammonium sulfate in Madagascar, which is a byproduct of the nickel and cobalt mining activities of the mining company Ambatovy. The majority of the product is exported. But the company plans to stimulate local demand for ammonium sulfate in Madagascar.

Phosphate. In Mozambique, a Brazilian mining company has conducted a study to estimate phosphate reserves. The original estimates are 155 Mt of apatite ore, making it the largest known reserve in Central and East Africa. In Namibia the Namibia Marine Phosphate Pty project has announced an estimated initial reserve of 133 Mt at 20.41% phosphate. The project originally

planned to produce 3 Mt/year of phosphate rock pending the outcome of an environmental impact assessment and financing package. In Uganda, the Sukulu Hills phosphate and fertilizer project is also an active feasibility study for development, and in Togo, Elenitto is developing plans for mining 5 Mt/year of phosphate rock and, with Chinese partner Wenfgu, produce 1.5 Mt/year of fertilizer.

Potash. In Ethiopia, Allana Potash, owned by ICL of Israel, has 450 Mt reserves of KCl in the Danakil depression in the north of the country. The company has received mining approval from the government and is preparing to embark on construction. The plan is to eventually produce 1 Mt/year of MOP.

8.2.3 Fertilizer Trade

At present, fertilizer trade between African countries is very small compared to trade between Africa and the rest of the world. Trade of total nutrients (imports and exports) increased between 1995 and 2012 for Africa as a whole and for SSA. Within this period, total imports for Africa more than doubled from 1.4 Mt to 3.4 Mt of nutrients. The increase in imports for SSA was more than double as well, from 0.83 Mt to 2.3 Mt. Total exports from Africa increased from 2.7 Mt to 4.7 Mt (an increase of 74%). The increase in exports from SSA in 2012 was more than three times that from 1995, increasing from 78,000 to 267,000 nutrients tons. Therefore, as of 2012, Africa as a whole was a net exporter of fertilizer nutrients; however, SSA was a net importer. FAO data show that in 2012 Africa was a net exporter at 1.3 Mt of nutrients while SSA was a net importer at 2 Mt of nutrients.

Therefore, almost all of the phosphate rock and fertilizers produced in Africa are exported outside the continent. In contrast, most of the fertilizer consumed in SSA is imported from outside the continent. Nevertheless, there is some degree of both inter-regional and intra-regional trade of fertilizers in Africa. Although data on import and export volumes and values were not provided, the 2010 NEPAD report indicated that 95% of the respondents reported trade with other African countries during the current reporting period (NEPAD 2013). Much of this trade involves landlocked countries importing from coastal neighbors, but it is also importation from manufacturers in other African countries. For example, with regard to inter-regional trade,

countries like Sudan import fertilizers from Egypt, Libya, and Tunisia; Mali imports fertilizers from Morocco; Kenya and Uganda import from Egypt and South Africa; and Tanzania imports fertilizers from Egypt, Morocco, South Africa, and Tunisia. However, countries like Uganda import fertilizers from manufacturers overseas via Kenya (coastal neighbor). Regarding intra-regional trade, countries in southern Africa, such as Malawi, Lesotho, and Namibia, import fertilizers from manufacturers in South Africa; Mali imports fertilizers from manufacturers in Côte d'Ivoire and Senegal; Seychelles imports from manufacturers in Mauritius and South Africa; and Egypt imports fertilizers from Libya and Morocco. In many cases, intra-regional imports are from countries outside the continent en route to a landlocked country, e.g., Burundi and Uganda import their fertilizers from overseas via the ports of Mombasa in Kenya and Dar es Salaam in Tanzania.

8.3 Fertilizer Subsidies in Sub-Saharan Africa: Four Case Studies

8.3.1 Malawi

Malawi has an estimated population of approximately 16.3 million with 88% of the population living in rural areas and relying on agriculture for their livelihood. With an annual per capita income of U.S. $860, Malawi is one of the poorest countries in SSA, with an estimated 52% of the population living below the national poverty line. Agriculture is a vital economic sector, accounting for one-third of GDP, half of total export earnings and employing two-thirds of the population (Arndt et al. 2013).[78]

Approximately 37% of the arable land is under cultivation and over 50% of this is dedicated to cereal crops. Maize is the main staple food crop and occupies 46% of cultivated land and accounts for almost 90% of the land allocated to cereal crops. Other food crops are pulses, groundnuts, and sweet potato. The main cash crops are tobacco, sugar, and tea, which together account for 86% of agricultural exports; other cash crops are coffee, sunflowers, and soybeans. These cash crops are mostly grown on plantations.

[78] The service and industry sectors account for 53.5% and 16.9% of GDP, respectively (IFDC 2013).

Most agricultural output comes from smallholder farmers who cultivate 96% of total cropland and produce 99% of total agricultural output on average landholdings of between 0.5 and 0.8 ha (Arndt et al. 2013).

Smallholder farmers in Malawi practice rainfed agriculture, mono-cropping, the use of highly labor-intensive rudimentary production technologies such as the hand-hoe, the use of open-pollinated seed varieties which give lower yields than hybrid seeds, and applying low levels of fertilizer. The level of fertilizer used per cultivated hectare declined from 40 kg/ha in 2006 to an estimated 30 kg/ha in 2011/12 (IFDC 2011).

Consequently, maize yields among smallholder farmers in Malawi are at 3.0 mt/ha (compared to average yields among estate farms of 3.2 mt/ha).

8.3.1.1 Fertilizer Market in Malawi

Trends in Consumption

Fertilizer consumption has more than doubled from approximately 114,000 mt in the mid-1990s to more than 260,000 mt by late 2011. This is mostly attributed to the fertilizer subsidy program, which accounts for 50% or more of total imports (IFDC 2013). Nevertheless, fertilizer use still only represents about 47% of potential needs based on recommended application rates for all crops.

Before market liberalization in the 1990s, the main fertilizers used in Malawi were NPK products (specifically NPK 23:21:0+4S mainly for maize) and diammonium phosphate (DAP) mainly for topdressing. After market liberalization, and with the advent of the subsidy program, the product mix changed considerably. The DAP formulation is now mainly used in blending, and the main fertilizer types currently used in Malawi are: urea and NPK, calcium ammonium nitrate (CAN), Compound D, and Super D for tobacco production.

Hence, NPKS (23:21:0+4S) still dominates the fertilizer market, even though its use may no longer be applicable to current crop and soil nutrients. The NPK 23-21-0+4S formulation was developed in the 1980s as a compound maize fertilizer when the potassium levels were high in

Malawian soils. But, the Malawian soils have experienced potassium depletion since the 1980s, as well as depletion of other primary (e.g., nitrogen), secondary (e.g., magnesium), and trace (e.g., zinc) elements, due to low rates of application or absence of use. Nevertheless, this formulation is still popular for maize production and for tobacco cultivation.

Trends in Production/Supply

As is the case for the majority of countries in SSA, Malawi has limited natural resources for fertilizer production. Although the country has phosphate rock deposits, they are too small to be of economic value. Moreover, while the phosphate rock has high concentrations of P_2O_5 (up to 38.9%), the rock is of low solubility and therefore requires high levels of concentrated sulfuric acid to process it into phosphoric acid and its derivative processes. Therefore, the current phosphate rock deposits are small and not of economic value (IFDC 2013).

Consequently, Malawi is a net importer of fertilizer, most of which is used for blending or applied directly for basal and topdressing. Malawi imports almost its entire fertilizer requirement from the international market, via the ports of Beira and Nacala in Mozambique and the port of Dar es Salaam in Tanzania. There are also two blending companies in the country and they produce fertilizer for local consumption. The fertilizer market is comprised of a relatively well-developed network of three main supply chains based on the first level of demand after the import level (Fig. 8.1). In the first supply chain, fertilizer is imported by approximately 20 importers and importer-distributors. These are national companies, international companies with country offices, as well as independent traders, all of which have close links to international suppliers, and hence can receive fertilizer on credit at reasonable terms. These market players distribute fertilizer via their own company-owned or -controlled wholesaler/distributors to over 800 formal private and public retail outlets (farmer cooperative shops, shops owned by farmer associations, etc.). They sell their fertilizer in the peri-urban market, to large-scale farmers, estates, and approximately 250 independent agro-dealers who are mostly based in rural areas. These agro-dealers are supported by donor programs through the Agricultural Input Suppliers Association of Malawi (AISAM) and the Rural Market Development Trust (RUMARK)/Citizens Network for Foreign Affairs (CNFA), as well as donor-funded programs and non-governmental organizations (NGOs) involved in input procurement and distribution to smallholder farmers.

Some of these importers also blend compound fertilizers and sell these blends to tea and coffee estates and to farmers via the private distribution network (Wanzala et al. 2013; IFDC 2013).

In the second supply chain, the National Small Farmer Association of Malawi (NASFAM), a large farmers' association, procures fertilizer from importers and distributes it via its association's retail shops. The third supply chain is for the government fertilizer subsidy program. The government procures from the private sector through tendering process and distributes via two parastatals, the Smallholder Farmers Fertilizer Revolving Fund of Malawi (SFFRFM) and the Agricultural Development and Marketing Corporation (ADMARC). Both state agencies have the ability to obtain government credit guarantees, which means they can access finance in the domestic and international market and distribute the subsidized fertilizer using government storage and transportation facilities. The SFFRFM has a wide-range distribution network comprised of 321 small- to medium-sized warehouses and three central depots in the three regions of the country, which extends into rural areas that are not served by agro-dealers. The private sector imports the fertilizer and delivers the product to the SFFRFM regional warehouses. From this point, the SFFRFM delivers the product to ADMARC rural warehouses and its own retail shops located in the rural interior close to the farm-gate (Wanzala et al. 2013; IFDC 2013).

Data on fertilizer imports for commercial sale for 2008/09 (the latest year for which data are available) were 100,000 mt, while imports for the Farm Input Subsidy Program (FISP) for the same period were 170,000 mt. Therefore, approximately 60% of imported fertilizer in 2007/08 was for the FISP, and the remainder was supplied to the open market (Wanzala et al. 2013).

The current fertilizer market is at 330,000 mt, of which 150,000 mt or 45% is for FISP, with the remainder (180,000 mt) for the commercial market.

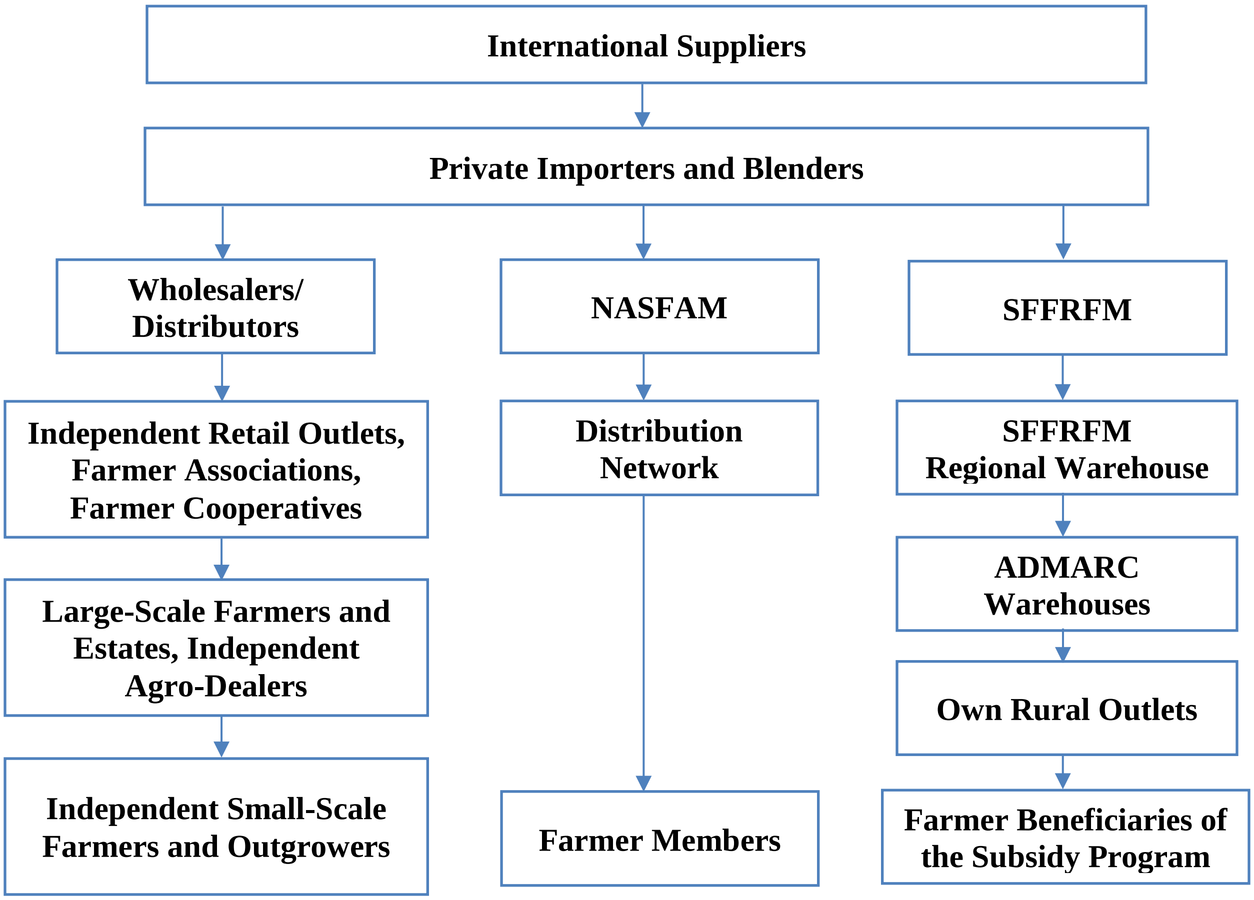


Fig. 8.2 Malawi Fertilizer Supply Chain

8.3.1.2 Malawi—Fertilizer Subsidy Program

The current fertilizer subsidy program in Malawi, the FISP, was introduced in 2005 in response to the severe droughts and famine in the early 2000s. The frequency of droughts is high in Malawi, and therefore increasing maize yields and improving their robustness to adverse climatic conditions is of paramount importance for food security and reduction in poverty levels (Arndt et al. 2013). The goal of FISP is to improve national and household food security through improved smallholder access to fertilizer and improved seeds, thereby increasing productivity and production as well as incomes among resource-poor farmers. The program is managed by the Ministry of Agriculture and Food Security (MoAFS) and implemented by two parastatals, the

SFFRFM and ADMARC, with the participation of the private sector. Under the program, selected farmers throughout the country receive vouchers that can be exchanged for fertilizer with a cash payment equal to the unsubsidized portion of the market price. Although the basic design characteristics and implementation modalities of the program have remained the same since inception, there have been some changes over the years, and the subsidy delivery design and scale of operations have also evolved (Table 8.2).

Table 8.2 *FISP Principal Program Features, 2005/06 to 2009/10 Seasons*

Variable	2005/06	2006/07	2007/08	2008/09	2009/10
Total subsidy (mt)	131,388	174,688	216,553	202,278	161,495
Total farm household beneficiaries (million)	2.5	2	-	1.6	1.6
Households receiving one or more fertilizer vouchers (%)	n/a	54	59	65	n/a
Voucher value (MK/50-kg bag)	1,750	2,480	3,299	7,951	3,841
Redemption fee (MK/50-kg bag)[a]	950	950	900	800	500
Subsidy rate (%)	64	72	79	91	88
Retail market price of fertilizers (MK/50-kg)	2,700	3,430	4,199	8,751	4,341

a. This is the payment for a 50-kg bag of fertilizer in addition to transferring ownership of the input voucher to the agro-dealer. On average it is less than one-third of the retail market price for fertilizer.
Source: Dorward and Chirwa (2011). Adapted from Minde et al. (2008), based on data from the World Bank (2008).

The quantity and type of inputs provided under the program have also changed since its inception. The exception is fertilizers; farmers have always received two vouchers each, one for a 50-kg bag of NPK (basal) and the other for a 50-kg bag of urea (topdressing). Under FISP (2005/06), 2.5 million smallholders growing maize (or 50% of the smallholders in the country) received a 65% subsidy on 100 kg of fertilizers, plus 2.0-4.0 kg of open-pollinated variety (OPV) maize seed. Under the FISP (2008/09), over 1.6 million smallholders received a 91% subsidy on 100 kg of fertilizers and a 100% subsidy on 2.0 kg of hybrid maize seed or 4.0 kg of OPV maize seed. In addition, another one million households received flexible vouchers that could be redeemed for maize, legume, or cotton seed. Moreover, tobacco, tea, and coffee producers also received fertilizer subsidies, cotton farmers received subsidized pesticides and most smallholders received free grain storage chemicals. Under the FISP (2009/10), 1.6 million smallholders received their 50 kg of NPK at an 88% discount and their 50 kg of urea at a 90% discount. These

farmers also received a subsidy with a redemption value of MK 1,500 (U.S. $4.55) to exchange for 5 kg of hybrid maize seed or 10 kg of open-pollinated maize seed, and were given the option of making an additional cash contribution of no more than MK 100 (U.S. $0.30). The same selected farmers also received a legume seed voucher with a redemption value of MK 350 (U.S. $1.06) that could be exchanged for a seed pack containing one of the following: beans, cowpeas, pigeon peas, groundnuts, or soya. The package size for the legumes varied. Certified bean and groundnut packs were to be 1.0 kg. Soya, cowpea, and pigeon pea packs were 1.2 kg, and tested bean and groundnut packs were 1.5 kg (Wanzala et al. 2013).[79]

After 2007, the cash payment from farmers for the subsidized fertilizer was gradually reduced over the subsequent seasons, from MK 950 (U.S. $2.88) to MK 900 (U.S. $2.73), MK 800 (U.S. $2.42) and MK 500 (U.S. $1.52) for fertilizer used on both tobacco and maize. By 2009 this was equivalent to a subsidy of 91% of the market price. In addition the subsidy program was extended to cotton producers. By 2010/11, the Government of Malawi (GoM) discontinued the subsidies on cotton and tobacco and retained it only for maize and legume, and this level of subsidy is still in effect (IFDC 2013).

Regarding modalities for the procurement and importation of the fertilizer for the FISP, for the FISP (2006/07) and FISP (2007/08), the private sector was allowed to import and distribute fertilizers in competition with two state agencies or parastatals, ADMARC and SFFRFM. After FISP (2007/08), the government lost trust in the ability of private companies to import and distribute subsidized fertilizer. Distribution of subsidized fertilizer by the private sector was discontinued and the responsibility fell under the sole purview of the two parastatals. However, the private sector is still allowed to participate in procurement and importation of fertilizer for the subsidy program.

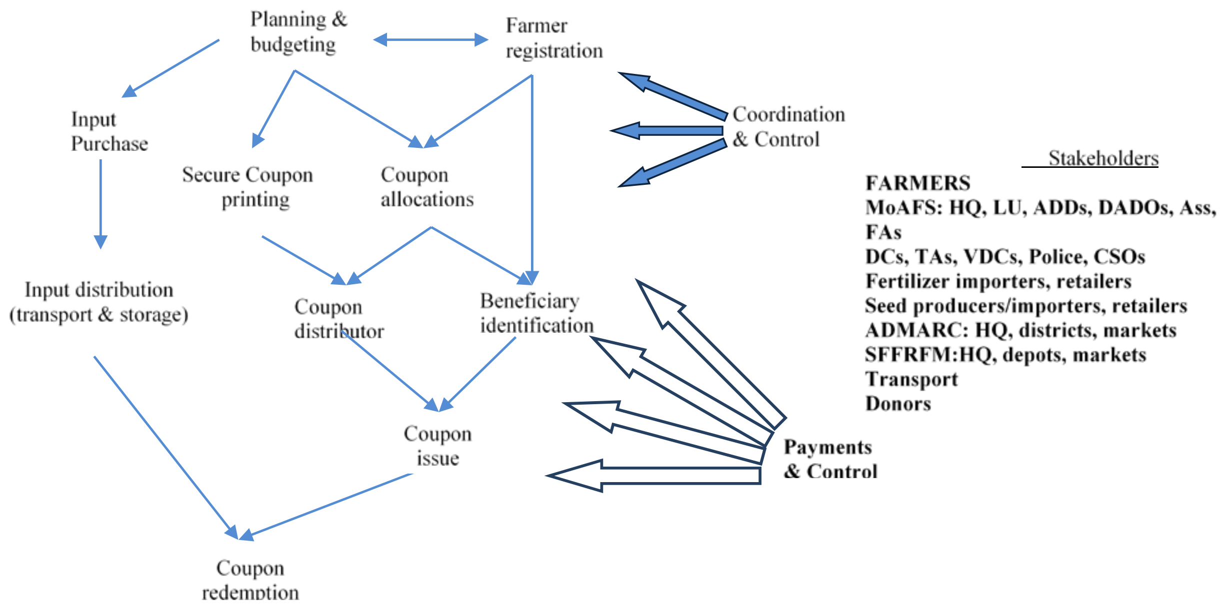
Currently the arrangement is as follows: the SFFRFM announces a competitive tender for private companies to bid for the importation of fertilizers for the subsidy program and delivery at the

[79] Therefore, farmers can choose between open-pollinated and hybrid seed varieties. OPVs are lower yielding and require a higher seeding rate but can be recycled at the end of the season, whereas higher yielding hybrids cannot be recycled. Initially, about 60% of the seeds under FISP were hybrids, but this increased to almost 90% in 2009/10 (Arndt et al. 2013).

three SFFRFM main regional warehouses located in the north (Mzuzu), south (Blantyre), and central (Lilongwe) regions of Malawi. SFFRFM supplies the fertilizer to the selected ADMARC and SFFRFM rural warehouses for distribution. Both parastatals have extensive rural retail network facilities located close to the farmers. ADMARC supervises the distribution of the fertilizer through private sector transporters (also awarded a bid under government tenders) to the selected ADMARC and SFFRFM depots where the fertilizers are sold to farmers in exchange for the vouchers along with the cash payment of top-up amount (the unsubsidized portion of the fertilizer market price).

The MoAFS is responsible for organizing the printing and packaging of all vouchers. The District Agricultural Development Officers (DADOs) of MoAFS, working with local community leaders, are responsible for the selection of the beneficiaries and the subsequent distribution of the vouchers. Vouchers are initially allocated to each district according to a distribution matrix constructed by the MoAFS. The voucher books are then distributed to each district. The Area Development Committee then decides how many vouchers each village will be awarded. The Village Level Committee is responsible for developing the criteria for targeting and identifying the beneficiaries and provides the broad guidelines for beneficiary selection, namely: (a) the beneficiary should not be a recipient of a similar program, (b) the beneficiary should be able to afford the discretionary cash (top-up) required to redeem the fertilizer voucher, and (c) the beneficiary should be a bona fide farmer from the area. The actual beneficiary selection takes place at the sub-village level (extension planning areas). The role of the Logistics Unit of the MoAFS in the beneficiary selection and voucher distribution process consists of updating the Farm Family registers used by the DADOs when manually recording the beneficiary names during the selection process. On completion of selection, the unit then produces the electronically generated Beneficiary Registers, which are used by the DADOs in the distribution of the vouchers. The distribution is done in the open at the village level, where all farmers would gather and names are called upon (Fig. 8.3).

In an effort to improve on the operation of the voucher system the government piloted an electronic voucher (e-voucher) system in three districts with a view of rolling it out in subsequent years.



Key: *ADDs: Agricultural Development Divisions; HQ: Headquarters ADMARC: Agricultural Development and Marketing Corporation; LU: Logistics Unit; CSOs: Civil Society Organizations; MoAFS: Ministry of Agriculture and Food Security: DADOs: District Agricultural Development Officers: SFFRFM: Smallholder Farmers Fertilizer Revolving Fund of Malawi: DCs: District Commissioners; TAs: Traditional Authorities: FAs: Field Assistants; VDCs: Village Development Committees*

Fig. 8.3 *Schematic Structure for the Implementation of the Agricultural Input Subsidy Program in Malawi*

8.3.1.3 Evaluation of Impacts of the Fertilizer Subsidy Program in Malawi

Fertilizer Accessibility

The subsidy program in Malawi has been effective in reducing the fertilizer market price; therefore, the program has made fertilizer more accessible to small farmers. Fertilizer prices have been reduced by as much as 91% of the market price due to the subsidy (Table 8.2). In fact, since its inception, the FISP has effectively cushioned participating Malawian smallholder farmers from high fertilizer prices by continuously raising the voucher value (subsidy) each year while either maintaining the redemption (top-up) price or even reducing it. For example, between 2007/08 and 2009/10 the international fertilizer market prices increased by 242.7% for DAP and 141.3% for urea. On the local market, the price of a 50-kg bag of fertilizer increased on average

by 108.41%. However, during this same period the Government of Malawi reduced the redemption price from MK 900 in 2007/08 to MK 500 in 2009/10.

Due to budgetary constraints, the FISP is only targeted at poor small farmers. Beneficiaries are supposed to be the “productive poor,” meaning smallholders who cannot afford fertilizer at market prices but have sufficient land and human resources to make effective use of subsidized inputs (Arndt et al. 2013). Each selected registered beneficiary receives three vouchers that entitle him or her to purchase the subsidized fertilizers and improved maize seeds from designated selling points. Vouchers are distributed via the extension system of the Ministry of Agriculture, and the fertilizers are distributed via a dense network of 920 ADMARC market outlets across the entire country. Since its inception, the program has increased in size. For example, the percentage of smallholder farmers who received at least one voucher increased from 54% in 2007 to 65% in 2009, and about 60% of smallholder farmers in Malawi received at least one fertilizer voucher in the last five seasons (Table 8.2).

Chibwana and Fisher (2011) report the results of research by Chibwana et al. (2010) on the effectiveness of FISP voucher distribution to smallholder farmers and on impacts of the FISP on fertilizer use, maize yields, and land allocation. The studies used data from a 2009 survey of 380 farm households in two districts in central and southern Malawi. During the 2008-09 season, a total of 150,000 mt of maize fertilizer and 20,000 mt of tobacco fertilizer were acquired by the Malawi Government for distribution to smallholder farmers through the FISP. The cost was estimated at U.S. $221 million, 95% of which was financed through the government budget and 5% by Malawi’s development partners.

The results of the research indicated that, contrary to stated FISP criteria, households headed by young females were less likely to receive a complete input subsidy packet than households headed by older males. Furthermore, poor households were less likely than rich households to receive any voucher. The reason may be that female-headed households and poor households often have relatively small landholdings, and these households may have been considered ineligible for the program. On average, householders with more education received more coupons than the recommended amount, possibly because educated individuals were more

successful at bargaining with village chiefs and village development community members. Household heads that had lived in their villages for longer periods had a higher probability of receiving coupons, suggesting that duration of residency had a positive influence on relationships with village leaders. Overall, the studies found that poor and vulnerable households were not the primary beneficiaries of the subsidized inputs in the two districts studied. Chibwana and Fisher (2011) report that other researchers came to similar conclusions using nationally representative datasets. A review of evaluation studies by Arndt et al. (2013) also found that resource-poor farmers are less likely to receive subsidies. The studies also concluded that the criteria of "productive poor" is flawed since identifying this category is a challenge. In practice, farmers' eligibility has been determined by local leaders who do not always apply the same criteria (Arndt et al. 2013) at the end of the day—the contentious question of how to define a poor farmer and a non-poor farmer is left to each community to decide, agree, and select the beneficiaries. The result is inconsistent targeting across districts or over time. Moreover, the findings indicated that on average, beneficiaries receive less than the intended 100 kg of fertilizer, probably because local leaders allocate fertilizer more broadly across communities in the interests of equity.

Fertilizer Availability

Since the introduction of the FISP, the total amount of fertilizer used in Malawi has increased steadily each year, driven by the increase in the total amount of subsidy (Table 8.2). Therefore, the subsidy program has been effective in making subsidized fertilizer increasingly available to smallholder farmers in Malawi. However, the average fertilizer amount received per farmer has declined as the number of farm household beneficiaries has also increased rapidly. For example, the average amount of fertilizer received per farmer decreased from around 85 kg in 2006/07 to only 60 kg by 2012/13 (Pauw and Thurlow 2014).

The availability of subsidized fertilizer products is also determined by the timing of delivery of agro-inputs in the market and the issuing of vouchers to beneficiaries where applicable. This timing is critical for the effective use of fertilizer and seed at the start of the agricultural season. For fertilizer products, the timing of input availability depends upon the following: timing of the tendering of input purchases, supplier deliveries to depots, staffing and stocking of input markets, subsidy redemption contracts with retailers, and retailer stocking and staffing of input

sales points for private sector sales. Overall, timeliness in the issue of vouchers and the delivery of fertilizer to beneficiaries has improved with the implementation of each new FISP.

Impact of Subsidies on Agricultural Productivity, Farmers' Income, and Nutrient Management Performance

Researchers agree that the subsidy program increased fertilizer use and crop production, but opinions are mixed on the impact on yields of FISP participants. Chibwana and Fisher (2011) report that the results of the studies by Chibwana et al. (2010) found that the maize subsidy program increased fertilizer use among recipient households. With regard to impacts on production and productivity, Pauw and Thurlow (2014) conclude that maize yields in Malawi have definitely increased since the introduction of FISP from 1.3 mt (pre-FISP) to an average of 2.7 mt/ha (after FISP was introduced). They further conclude that since there was only a marginal increase in the land cultivated under maize pre-FISP period (before 2005) and after the introduction of FISP in 2005, these increases in production can be attributed mainly to improvements in yield. Chibwana and Fisher (2011) also found a positive relationship between the amount of fertilizer used in the subsidy program and maize yields.

However, Pauw and Thurlow (2014) are not confident that these yield gains were achieved by FISP beneficiaries, and provide the following explanation. On average, FISP fertilizer is comprised of 33% nitrogen (N); it includes equal amounts of NPK (23% nitrogen) and urea (43% nitrogen). The FISP (2006/07) distributed 150,000 mt of fertilizer, which is equivalent to approximately 50,000 mt of additional N to the soil (assuming no displacement). Based on an average of grain yields per kilograms of N (kg/kgN) applied to local maize, OPV and hybrid varieties that are typically used by conventional agronomists, they assume that one kilogram of N translates into approximately 12-18 kilograms of grain. Hence, 50,000 mt of additional nitrogen should produce additional production of 600,000-900,000 mt of grain. In comparison, the Ministry of Agriculture and Food Security provides an official estimated production increase of 1.5 Mt for the FISP (2006-07) over pre-FISP levels, whereas the estimates for 2006/07 by the National Census of Agriculture and Livestock are incremental production of 751,000 mt.

Furthermore, whereas evidence from maize field trials suggests an average return of 16.8 kg/kgN for Malawi, the review by Pauw and Thurlow (2014) of survey evidence suggests that yields

obtained by FISP beneficiaries were substantively lower at 9-12 kg/kgN and poorer households fared even worse with marginal returns of 2.8 kg/kgN.[80] At returns of 9-12 kg/kgN, program costs exceed the value of additional maize produced, thus yielding a "production-based" benefit-cost ratio (BCR) of less than 1. However, at the higher rates of 16.8 kg/kgN, the BCR is close to 1 or exceeds 1, suggesting benefits exceed costs (Pauw and Thurlow 2014).

Although the FISP has been successful in moving farm households toward food self-sufficiency, the average increase in maize yield attributable to the receipt of a complete packet of coupons (i.e., both seed and fertilizer subsidies) was 447 kg/ha, which is only about twice the gain from receiving only fertilizer. This suggests that FISP may be placing too much emphasis on fertilizer relative to hybrid seed. The fertilizer-to-seed ratio in FISP vouchers is 25:1, but the optimal ratio is 5:1 for most areas in Malawi. Based on the differences between yields of traditional and hybrid maize, and the high cost of fertilizer compared to seed, greater promotion of hybrid seed use would probably make the FISP even more effective (Chibwana and Fisher 2011).

Impact on the Private Sector

It is inevitable that large subsidy programs will have some displacement effect on the private fertilizer retail market. During the early to mid-2000s, the private fertilizer industry in Malawi showed strong growth, with an estimated 1,000 private fertilizer retailers operating in the country by 2005. With the introduction of the FISP in the 2005/06 season, some displacement was reported on private retail fertilizer sales. Dorward et al. (2010) reports that commercial fertilizer sales by private retailers fell from an estimated 186,354 mt in 2003/04 to 117,719 mt in 2006/07. It is estimated that commercial fertilizer sales in Malawi fell by 20-30% in 2005/06 and by 30-40% for 2006/07 (Pauw and Thurlow 2014; Wanzala et al. 2013).

This indicates that some of the fertilizer provided under FISP displaced the fertilizer used in Malawi before the program was implemented. This is indicative of a program that targets farmers that would have purchased fertilizer even in the absence of a subsidy. Ricker-Gilbert et al. (2011) estimate a 22% fertilizer displacement rate, implying that each kilogram of

[80] The marginal return to fertilizer use measures the additional quantity of maize grain produced per kilogram of nitrogen (kg/kgN) added to the soil, nitrogen being the key chemical component of fertilizer (Pauw and Thurlow 2014).

subsidized fertilizer provided under FISP increased final fertilizer use by 0.78 kg (Arndt et al. 2013).

The displacement effect in Malawi is both direct and indirect. The direct displacement relates to leakages where farmers who could otherwise afford to purchase the fertilizers at market prices from commercial sellers also benefited from the subsidy program. Indirect displacement occurrs when subsidized fertilizer is sold on or diverted to the secondary market through theft or corruption, hence displacing some commercial fertilizer sales (Pauw and Thurlow 2014).

On the other hand, private fertilizer importers clearly benefited from both the growing import volumes as a result of the subsidy program and their growing dominant share in the imports portfolios of the AISP (Table 8.3). Importers are selected on open tender process; some of the selected importers are supported by the government with access to loans and foreign currency to finance their import allotments.

Table 8.3 *Private Sector Involvement in Fertilizer Imports and Sales for FISP, Malawi, 2005/06 to 2008/09*

	2005/06	2006/07	2007/08	2008/09
Private sector fertilizer subsidy tender deliveries (mt)	70,000	99,386	97,845	162,784
Private sector fertilizer subsidy tender deliveries (%)	48	72	71	88
Private sector fertilizer retail (%)	0	28	24	0

Source: Malawi country report (2011).

Fiscal Implications for Government Budgets

The GoM has covered the costs of fertilizers (the largest expenditure item) and related operational expenses of the FISP, whereas donors have typically made direct contributions to cover the costs of seeds and logistics, amounting to 10-15% of FISP total annual costs (Dorward and Chirwa 2011). Since the government has not adjusted farmers' redemption prices to reflect world market prices, the government expenditures on fertilizers increased dramatically in 2008 and 2009 when world market prices tripled. The range of planned expenditure of the FISP was U.S. $51-139 million per year during 2005/06-2009/10; in comparison, the range of actual expenditure was U.S. $81-228 million. On average, during this period, FISP has accounted for about 9% of the national budget and 60-75% of the agriculture budget. Today FISP accounts for

42% of the agriculture budget and 18.8% of the national budget. Therefore, the subsidy places a substantial burden on the agricultural budget and a significant burden on the national budget. This has necessitated large cuts to other agricultural programs, such as irrigation, research, and extension, and to other economic sectors, including roads, industry, and the environment (Arndt et al. 2013).

8.3.2 Nigeria

Nigeria has an estimated population of approximately 154.7 million, and 51% of the population lives in rural areas. Despite a relatively high per capita GDP of U.S. $1,222, 34% of the population lives below the national poverty line. Forty-one percent of the arable land is under cultivation. Most of this land is used for staple food, commercial and industrial crop production. The main staple food crops are cassava, maize, millet, sorghum, and yams. The main cash crops produced include cocoa, cotton, palm oil, and rubber. The agriculture sector accounts for about 40% of the GDP, 5% of foreign exchange (the oil sector accounts for 95%), and about 70% of employment. Most agriculture output comes from smallholder farms (with average land holdings of between 0.8 and 1.2 ha), which are characterized as resource-poor and practice rainfed agriculture using no or very low levels of fertilizer or hybrid seeds. The level of fertilizer used per cultivated hectare has varied considerably as follows: in 1993 average fertilizer use was 14 kg/ha; 6 kg/ha in 1995; 7.1 kg/ha in 2008; and then dropping to 2 kg/ha in 2009 which is below the regional average of 4 kg/ha and is low relative to other developing regions of the world (Wanzala et al. 2012; Fuentes et al. 2012).

8.3.2.1 Fertilizer Market—Nigeria

Trends in Consumption

The main types of fertilizer imported and consumed in Nigeria include straight products, particularly urea and phosphate compounded fertilizer, and various NPK compounds and blended formulations (for example, triple 15, 20:10:10, etc.). It is not clear whether these fertilizer types are appropriate for the current crop mix and soil nutrient needs. The amount of fertilizer imported has varied considerably since 1990; between 1990 and 1993, fertilizer imports increased from approximately 400,000 t to 500,000 t of nutrient NPK. In 1993 the Federal Government of Nigeria (FGN) discontinued fertilizer subsidies as part of its overall market

liberalization policy. Consequently, fertilizer imports decreased sharply from around 500,000 t in 1993 to just over 100,000 t in 1999. A key reason for the dramatic fall in imports was that initially the private sector was unprepared to fill the void in the fertilizer market created by the withdrawal of the FGN. In the late 1990s the FGN resumed its involvement in the importation and production of fertilizers and also reintroduced fertilizer subsidies at a 25% subsidy rate. Fertilizer imports began to increase rapidly thereafter, reaching 853,000 t by 2008 (Fuentes et al. 2012).

Trends in Production/Supply

In the mid-1970s the FGN embarked on domestic fertilizer production and established two major fertilizer plants: the Federal Superphosphate Fertilizer Company (FSFC) and the National Fertilizer Company of Nigeria (NAFCON) for urea production. The FSFC was established in 1973 with an installed production capacity of 100,000 t of single superphosphate (SSP) fertilizer, mainly to supply the national market with the phosphate rock from a mine in Kaduna State in northwestern Nigeria. Since its establishment, FSFC has operated below capacity and consequently the plant was closed in 2000. In 2008, the plant was privatized and purchased by TAK Continental and resumed operations, producing TSP (Fuentes et al. 2012).

NAFCON was established in 1981 near Port Harcourt in southern Nigeria, for the production of ammonia and urea. This plant was fully operational by the mid-1980s and at the time was the only production facility in West Africa for granulated nitrogen products. The plant had an installed production capacity of 1,000 t of ammonia, 1,500 t of urea, plus blending capacity of 1,650 t NPK per day. In 1997, NAFCON halted operations due to mismanagement and damaged equipment (Fuentes et al. 2012). Thereafter, NAFCON was privatized and purchased by Notore Chemical Industries Ltd. (NCIL). NCIL’s plans were to reactivate the plant with a gradual increase in production starting with urea and NPK blends for domestic use and export by 2008, then scale up production until it reaches maximum capacity. Today NCIL is the only urea fertilizer plant in Sub-Saharan Africa. The NCIL plant has a capacity of 350,000 mt of ammonia per annum; 500,000 mt of urea per annum; and 650,000 mt of blended NPK. NCIL commenced production of ammonia and urea in January and July 2009, respectively. It plans to increase capacity to over 2 Mt of fertilizer and there are plans for the company to go public to fund a

second ammonia/urea plant at Onne, River State, Nigeria. In addition, in 2012 NCIL signed a joint venture with Mitsubishi Corporation to build an ammonia (1,700 mt per day) and urea (3,000 mt per day) plant in addition to a petrochemical plant. The estimated date of operation is 2016 (Makepeace, P., unpublished write-up for AFAP "Overview—Nigeria Fertilizer Manufacturing Investments").

At least four other companies are currently in various stages of investing in ammonia and urea production in Nigeria. Greenpark Petrochemical Company is a fertilizer company that is being established in Edo State to use the natural gas resources in Nigeria to meet the growing global demand for fertilizer. The initial planned plant capacity is 1,900 mt per day of urea with plans to increase capacity to 3,380 mt per day, with an expected date of operation of 2015. Indorama Eleme Petrochemicals Limited (IEPL) is a group company of the Indorama Corporation which is registered in Indonesia. IEPL which is based in Port Harcourt purchased and refurbished the redundant Nigeria National Petroleum Corporation Olefins plant in 2006. The planned capacity of the plant is 4,240 mt of urea per day, to come online in 2016. Dangote Group, the largest manufacturing conglomerate in West Africa, plans to build Dangote Fertilizer and make it the largest urea plant in Africa. The plant, which will be located in Edo State, has a planned capacity of 2,200 mt per day of ammonia and 7,700 mt per day of urea. Nagarjuna Fertilizer and Chemicals Limited (NFCL), which is based in India and a dominant manufacturer and supplier of fertilizers, plans an understanding with the Xenel Corporation of Saudi Arabia to build a petrochemical plant and fertilizer factory in the Delta State, Nigeria. The plant has a planned capacity of 2,200 mt per day of ammonia and 7,700 mt per day of urea (Makepeace, P., unpublished write-up for AFAP "Overview—Nigeria Fertilizer Manufacturing Investments").

In addition, a few blending plants with varying production/processing capacities have been established in different states countrywide by state governments, private companies, as well as public-private investments. Total installed capacity is almost 3 Mt/year. The rationale was to establish plants to produce blended fertilizer formulations for specific areas and crops using the nitrogen products from NAFCON and phosphate products from FSFC. However, only a few of the over 30 blending plants that were established have ever reached active production after installation; the combined output of all the blending plants in the country is less than 1 Mt of

product or just one-third of the country’s installed capacity. After NAFCON halted operations in 1997, the urea supply dried out, forcing these plants to operate mostly with imported products (N, P, K). Most of these plants have been out of operation for many years and the equipment has become deteriorated and obsolete. There are some efforts underway to reopen some of the plants with the intention to seek efficiency in the supply of blended fertilizer by blending locally and, in the process, reduce cost and the price for farmers (Fuentes et al. 2012).

In spite of Nigeria’s local fertilizer manufacturing facilities for urea and NPK, quantities produced are still relatively small, and consequently the vast majority of fertilizer consumed in the country is imported. The Nigerian fertilizer market is essentially comprised of one supply chain (Fig. 8.3). At the first level, approximately 19 private companies either procure fertilizer from overseas suppliers and/or manufacture/blend it locally or sell it via two distribution channels. The first distribution channel is the private sector distribution network of wholesalers and retailers, local markets, and semi-urban areas, who then sell the fertilizers to commercial farmers, plantations, and smallholder farmers at unsubsidized prices. The second distribution channel is the subsidy distribution network comprised of 1,450 redemption centers and 880 agro-dealers who sell the fertilizer to farmer beneficiaries of the subsidy program in exchange for an e-voucher plus the cash to cover the unsubsidized portion of the market price. After 2004, the importation of fertilizer under the government programs started increasing rapidly from 121,000 in 2005 up to about 435,000 mt in 2010 (including FGN and state government procurements). These amounts of fertilizer were enough to meet on an average, 65% of the estimated need per year within the same time period, up to 96% in 2009; depending on the government budget (Fuentes et al. 2012).

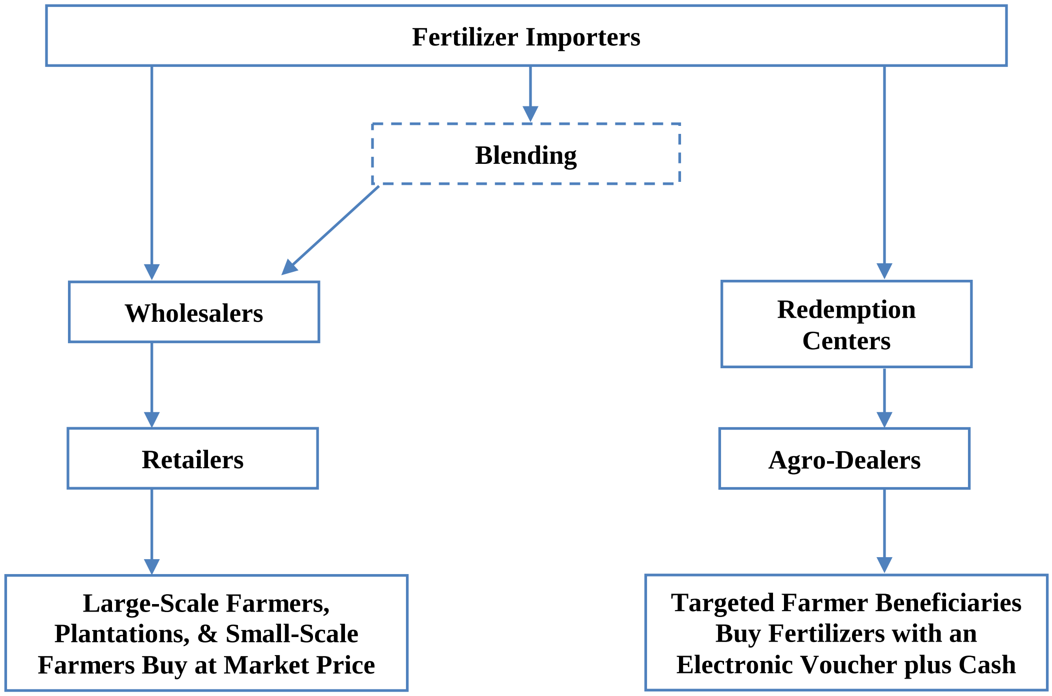


Fig. 8.4 *Nigeria Fertilizer Supply Chain*

8.3.2.2 Nigeria—Fertilizer Subsidy Program

The recent fertilizer program in Nigeria, the Growth Enhancement Support (GES) Scheme, was introduced by the FGN in 2011. Before the GES Scheme, the fertilizer subsidy program in Nigeria involved the federal and state governments, as well as private and public organizations, for the procurement, transportation, and distribution of imported and domestically produced fertilizer. The FGN did not import fertilizer directly; instead it issued tenders to local blenders and importers each year and procured the fertilizer from the winning bidders. Each year, the FGN consolidated orders from, and allocated funds to each of the states to pay 25% of the delivery cost to state warehouses as a means to subsidize fertilizer. This cost was paid at the source (importers or producers), depending on the federal budget allocation. In addition to the FGN subsidy, states and local government authorities (LGAs) could add to the amount of subsidized fertilizer supplied by the FGN through direct purchases from importers to complement their needs and/or add an additional subsidy. LGA commitments typically amounted to as much as 40-60%, for a maximum of 85% combined FGN, state, and LGA subsidies (Fuentes et al. 2012).

In 2010, the FGN announced that it would completely withdraw from fertilizer procurement in support of the expansion of the private agro-dealer network. To facilitate a smooth transition and to ensure that fertilizer reached the target beneficiaries, the FGN and some state governments began experimenting with a paper voucher program in 2009. Essentially, the government policy switched the focus of the program from subsidizing procurement to supporting farmers to be able to purchase fertilizer. As this was a new policy, the government initially introduced the program as a pilot voucher program in two states, Kano and Taraba, in 2009/10. The voucher program was expanded to two more states (Bauchi and Kwara) in 2010/11. The paper voucher system targeted specific crops (maize, millet, rice, sorghum, and soya beans) and had two goals: (a) to guarantee that fertilizer reached the farmers who need it most and (b) to support the expansion of the private sector fertilizer supply and distribution channel to the rural interior, closer to farmers. Hence, in addition to helping improve farmers' access to inputs, the voucher program was expected to provide training and technical assistance to both farmers and agro-dealers. Three fertilizer suppliers and over 150 private agro-dealers participated in the paper voucher pilot program. Agro-dealers received training to serve as private extension agents, to introduce new technologies, and to teach their farmer-customers how to use such technology and inputs correctly. Nearly 10,000 chairmen of farmers' groups, extension officers, agro-dealers, and "master" trainers were trained through the subsidy program.

Participating farmers were provided with paper vouchers, redeemable at certified agricultural input dealers in the local market within their ward of residence. Beneficiary selection and inspection systems were in place to deter fraud and abuse and to ensure that fertilizer reached smallholder farmers. The value of the voucher was N 2,000 (about U.S. $13 in 2009) per 50-kg bag for two bags of NPK formulation and one bag of urea in Kano and on two bags each of NPK and urea in Taraba. Farmers were to pay the differential between the vouchers' value and the market price. Vouchers were allocated according to the volume of fertilizer product requested by the states from the federal government and distributed through suppliers to specific agro-dealers in the various local government areas (Wanzala et al. 2013).

In 2011, the FGN expanded the subsidy program nationwide through the use of an e-voucher under the GES Scheme. Private sector was selected to participate in the supply of fertilizers under the GES. Nominations were sought from interested parties to supply geographic areas of interest in the 36 states of Nigeria. Nineteen importer/manufacturers/suppliers were chosen to supply to the subsidy program using selection criteria that ensured capacity to import/procure and distribute the fertilizer. Nominations were also called for “Agro-dealers” in all states. Selection criteria were developed and states had the final selection. Eight hundred and eighty agro-dealers were chosen, each owning one or several distribution points. There were a total of 1,450 distribution centers established and one distributor was chosen to centrally serve 5,000 registered beneficiaries. This took the onus off the importers to develop their own distribution channel. The other advantage was that the distribution channel was built from the ground up. Importers were connected with agro-dealers and margins negotiated within a defined range, depending on services offered (for example, does the agro-dealer own their building, are they buying the stock with cash or by consignment, etc.).

The FGN mandated that states collect information about their farmers to create a database of targeted beneficiaries. Data were to be collected about each farmer via a paper survey that was filled out by extension agents. Then the paper forms were shipped back to Abuja, collected at a data center, and the data and information were manually entered into a computer. Targeted beneficiaries received e-vouchers via an SMS to their cell phone for a pack (one bag of urea, one bag of NPK, and 5 kg of improved seed). The amount of subsidy varied depending on the value chain but was typically equal to about half of the value of the fertilizer. Recipients were required to bring the cash balance and redeem the e-voucher with an agro-dealer. Agro-dealers would in turn submit the vouchers to importers/suppliers for payment, and they would ultimately redeem the vouchers from the FGN Escrow account. By the end of 2013, 10 million farmers had been registered, essentially doubling the number of participants in the subsidy program.

Farmers were required to have mobile phones and network coverage in order to redeem their subsidies. However, this created a number of problems. First, less than half of the registered farmers had mobile phones, access to a mobile network (mobile networks still fail to cover large portions of the country) and the frequent interruption of the electricity means farmers’ phones are

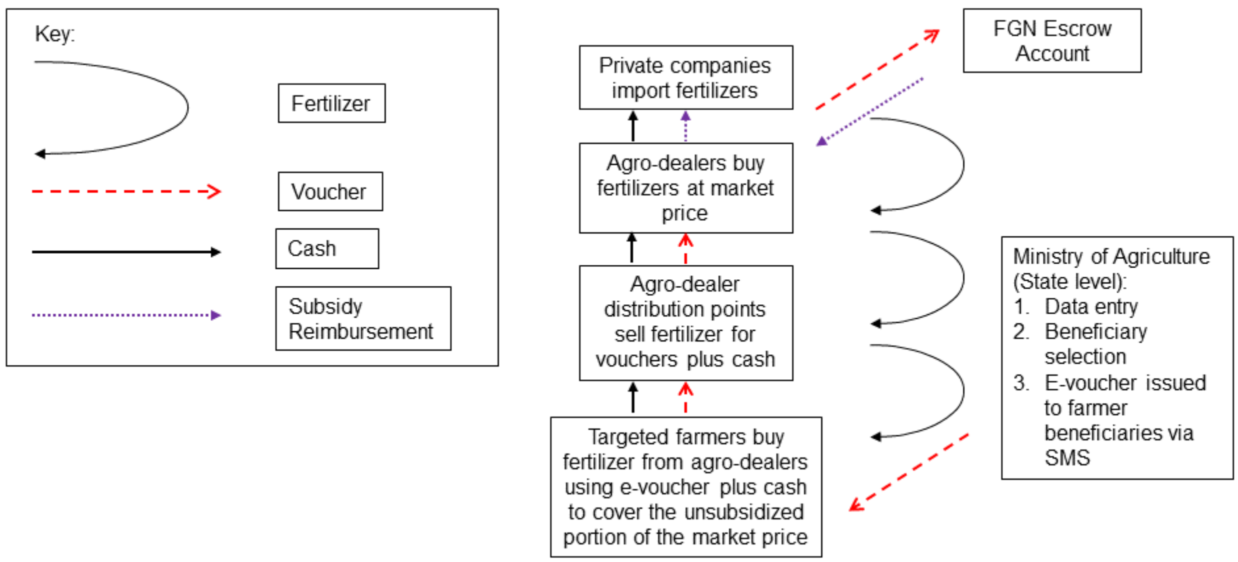
often not charged. As a result less than 50% of the intended farmer beneficiaries were able to receive a text message that they could go and collect their fertilizer from a particular agro-dealer. Second, as described earlier, the enumerative process involved a paper survey rolled out by hand in the field. The information was written down by one person and brought to the data center, read out by another person, and a third person entered the data into a computer. Thus, there was a lot of opportunity for errors, loss in data capture, incomplete filling out of forms, etc. Moreover, getting data back to the GES database using network coverage was slow, inefficient, and in some cases impossible. So essentially, the GES was plagued by inconsistent mobile coverage and the inefficiencies of paper-based systems.

Therefore, in 2014 the FGN embarked upon a pilot project to be implemented by IFDC and Consult Hyperion (a UK-based company which has vast experience and expertise in identity management and electronic payments) with funding from the United Kingdom's Department for International Development (DFID). The objective of the project was to use an e-voucher system called the Token Administration Platform (TAP), or more popularly known as "Touch and Pay," to change the system of data entry and voucher delivery to farmers. The TAP is being piloted in two states (Federal Capital Territories and Sokoto State) between December 2013 and September 2014, targeting 500,000 farmers. The key innovative feature of the TAP is that it demonstrates that vouchers can still be delivered to targeted farmers and redeemed at agro-dealer shops where no network coverage exists, using a Near-Field Communication system.

The process was as follows: first, Consult Hyperion designed a user-friendly interface to administer the farmer survey. Second, IFDC reviewed approximately 4,000 CVs to identify a set of 450 enumerators who had the requisite language skills and experience to engage in what promised to be a challenging initiative. Third, each enumerator was issued a tablet computer to administer the farmer surveys. Using the list of farmer beneficiaries that had already been prepared, the enumerators surveyed each farmer, took their photograph, and if available, a photograph of his/her ID card was taken as well. Fourth, each farmer was then given a TAP card which uniquely linked that farmer to his/her data that had already been entered onto the tablet by the enumerator. Since this data was captured digitally—it only had to be entered once by the enumerator—directly on the tablet with no need for network coverage. Eventually the tablets

were brought back into network coverage (this could be either Wi-Fi or an existing mobile network) and the data on them was uploaded to the server. Fifth, each agro-dealer (or their assistants) was trained to use the tablet computers and provided with a tablet computer for redemption. Sixth, farmers came to the redemption centers with their TAP card, where they physically "tap" the card on the agro-dealer tablet computer and the farmer's photo, data, and subsidy entitlements appear on the screen of the tablet computer. The farmer makes her selection of the inputs she wants (e.g., one 50-kg bag of NPK, one 50-kg bag of urea, one 10-kg bag of maize). The farmers then pay for the unsubsidized portion and the agro-dealer confirms the transaction. For the sake of increased accountability and reduction of fraud, IFDC placed an individual at each agro-dealer shop to verify that photo which appeared on the screen, was indeed the photo of the farmer. The tablet allows the agro-dealer to see all of the transactions completed over a period of time. Once the data are uploaded to the server—it also allows the government to track how many farmers have redeemed, track stock levels of the shop and discover outliers, and red flag potentially dubious transactions; for example, the tablet's built-in global positioning system (GPS) and time stamp help see if transactions are taking place off location or late at night (Source: email communication with L. Tweed) (Fig. 8.4).

A



B

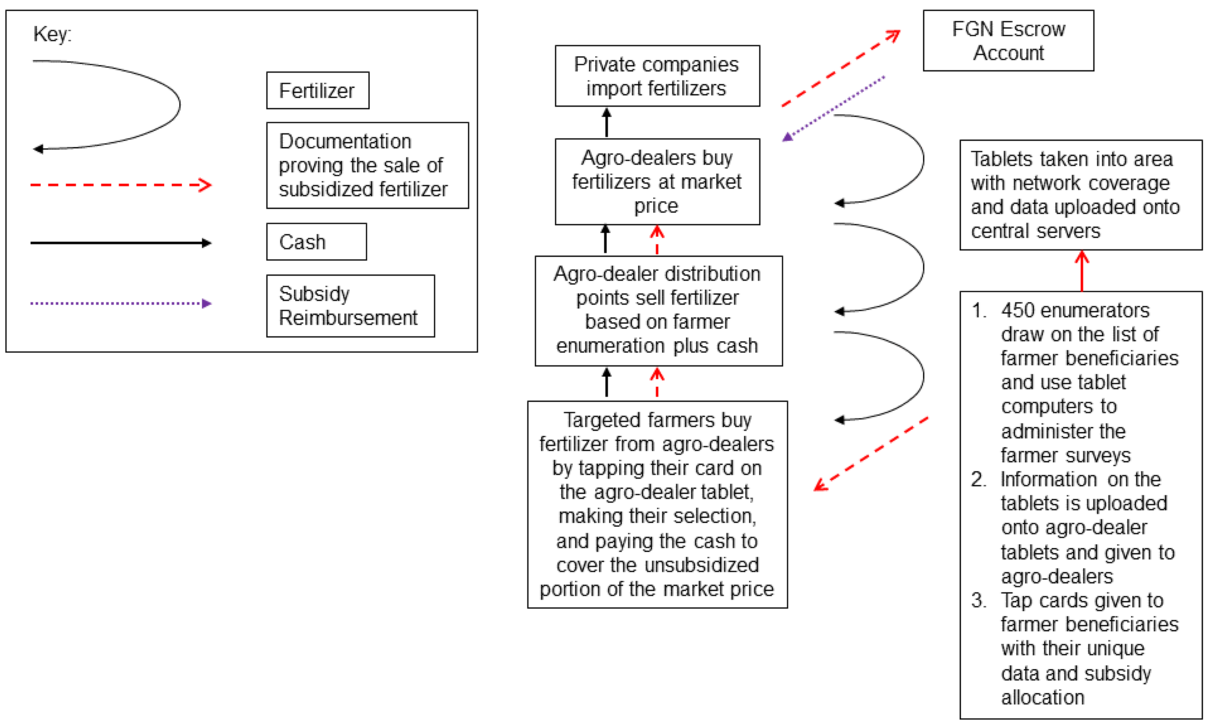


Fig. 8.5 *Fertilizer Subsidy Program in Nigeria (GES)*

8.3.2.3 Evaluation of the Fertilizer Subsidy Program in Nigeria

An impact assessment of the GES has yet to be carried out. However, there are some initial indications that it is yielding positive results with regard to some important parameters such as number of farmers reached and cost of program. Nevertheless, there is also some evidence that some of the issues with the paper voucher system still remain (for example, delayed payment of the private sector by government).

Fertilizer Accessibility

The fertilizer subsidy program in Nigeria has been effective in increasing farmers' accessibility to fertilizer by reducing the price by 25-75% of the market price. The actual market price is determined through the FGN negotiation with private importers under the subsidy program (Wanzala et al. 2013).

Although the GES-TAP is still ongoing there are early indications that a high proportion of farmers are being reached under this new system. That is, although the TAP is currently only active in Nigeria's Federal Capital Territory and Sokoto State, the initiative has already delivered some impressive results. The pilot enumerated about 504,000 farmers, exceeding its target of 500,000 farmers. Moreover, out of these 500,000 farmers, over 381,000 (76%) redeemed their inputs.

Therefore, TAP is a more secure, efficient, and reliable system for enumeration of farmers and redemption of vouchers. Its key innovative contribution is that it takes the subsidy to the farmers by effectively extending mobile network coverage into an offline environment, beyond the current reach of mobile networks. Thus, it enables farmers in remote areas where there is no network coverage to have access to the subsidy program. Moreover, TAP vastly reduces the risk of fraud because its use of biometric data helps ensure that fertilizer subsidies reach the farmers for whom they are intended.

Fertilizer Availability

With regard to availability, the total demand for fertilizer in Nigeria is more than 2 Mt. Table 8.4 shows the amount of subsidized fertilizer available in Nigeria since 2005, intended amounts and

the actual amounts delivered (IFDC 2012). The data show that although the amount of subsidized fertilizer delivered has almost tripled since 2005, these amounts have consistently fallen short of the committed amounts. Moreover, only a small percentage of the delivered subsidized fertilizer reached smallholder farmers; the Ministry of Agriculture estimates that less than 11% of the amount of subsidized fertilizer delivered before 2011 was reaching smallholder farmers. There is evidence that the situation has improved under GES-TAP: it has delivered 470,000 t of fertilizer to over 5 million farmers which is a significant improvement.

Table 8.4 *Amount of Subsidized Fertilizer (NPK and Urea) Targeted and Delivered by the FGN, 2005 to 2010*

Fertilizers in the Nigerian Market			
Year	Subsidized Quantity Targeted by FGN (mt)	Subsidized Quantity Delivered (mt)	Percent
2010	870,000	435,000	50
2009	380,000	365,542	96
2008	600,000	464,036	77
2007	498,000	316,120	63
2006	454,680	226,609	50
2005	172,000	120,664	70
Overall (2005-2010)	2,974,680	1,927,971	65

Source: IFDC (2012).

Impact of Subsidies on Agricultural Productivity

Under the subsidy program before GES, more than 80% of farmers received less than a 50-kg bag of government-subsidized fertilizer over the years identified. Under the present subsidy scheme, this quantity of fertilizer cannot have a significant impact on yield and production (Wanzala et al. 2013).

Given the substantive increase in number of farmer beneficiaries under GES-TAP, it is anticipated that there will be an increase in agricultural production at the household and national level. However, whether this will also translate into an increase in agricultural productivity is hard to say. As was the case with the pre-GES subsidy scheme, since the demand for subsidized fertilizer outstripped availability, some households may apply less than 50 kg/ha, which may

negatively affect productivity. On the other hand, the subsidy package under GES includes hybrid seed, which should improve the crop response to fertilizer use.

Impact on the Private Sector

Prior to the introduction of the GES in 2011, the FGN allowed the involvement of the private sector in the subsidy program by procuring subsidized fertilizer through private importers, based on FGN-importer negotiations. Before 2007 the FGN awarded contracts to importers, many of whom had limited capacity to undertake the importation process. Most of them represented private entrepreneurs who had registered specifically to participate in the subsidy scheme. However, many of them did not import fertilizer but were engaged in arbitrage, using contracts issued by the government as negotiable instruments with the few established, more legitimate importers with the capability and the logistics to actually import fertilizer. After 2008, the FGN reduced the number of eligible contractors to three. However, this practice prevented other genuine participants from competing in the Nigerian fertilizer market because of the difficulty in competing against heavily subsidized products. Many stopped importing and those that remained did not have access to FGN contracts and instead developed strong affiliations with the state governments to supply product. These practices contributed to higher prices of imported fertilizers under the government contracts because of excessive markups introduced in the process (IFDC 2012).

Since the private sector was not allowed to participate in the distribution of subsidized fertilizer, it was being crowded out by the sale of subsidized fertilizer on the black market, at prices that were typically below the market price and above the subsidized price. This reduced fertilizer sales by the private sector. It also meant that the intended beneficiaries of the subsidized fertilizers, small-scale subsistence farmers who can only afford fertilizer at the subsidized price, were not gaining access to the subsidized fertilizer. Instead, this fertilizer was being purchased by commercial farmers—a group who would otherwise be willing and able to pay the market price. A key reason for this distortion was that the subsidy program was not targeted. Hence, the private sector was being crowded out by the illicit sale of the subsidized fertilizer. This also resulted in a reduction in the total amount of fertilizer that would otherwise be consumed in the country. The establishment of an elaborate federal- and state-sponsored distribution network to

distribute the subsidized fertilizer meant the private sector had no incentive to invest in the retail distribution network. The fact that the subsidy program accounted for 70% of the fertilizer market further discouraged the expansion of the private distribution network (Wanzala et al. 2013).

With the introduction of the GES in 2011 and then the GES-TAP in 2014, all this changed. The private sector now has sole responsibility for the importation and distribution of fertilizer; the role of the FGN is just to put purchasing power into the hands of farmers through the distribution of vouchers. Nineteen importers/suppliers, 1,450 redemption centers, and 880 agro-dealers have been established to service the subsidy system. Redemption centers tend to be either: (a) large agro-dealers with multiple warehouses, which also serve as redemption centers. They typically have sufficient capital to buy fertilizers from importers in cash or they have the credibility to buy fertilizer from importers on credit. Small agro-dealers typically do not have sufficient capital to purchase fertilizer and are unable to get credit from suppliers (importers or large agro-dealers) or the banks. Therefore, the GES is dominated by large importers and agro-dealers; few smaller agro-dealers have the financial resources to participate or (b) temporary structures erected by large agro-dealers for the purpose of participating in the subsidy program. They are essentially hired warehouses located in different parts of the state/in different states. These redemption centers are only in operation when the subsidy program is running so they do not provide farmers with access to inputs year-round. Therefore, the subsidy program is not establishing a foundation of a sustainable private sector-led distribution system. It is for this reason that the FGN should provide financial and technical support to the small permanent agro-dealers, so they can participate in the subsidy scheme, and provide farmers with access to inputs year-round. At present, these small agro-dealers are typically too small to participate in the subsidy program even if they were able to secure the requisite capital: for example a farmer may want to buy 100-200 bags, but the shops may only have the capacity to store 50-100 bags at a time. Therefore, both financial and technical support will be required to enable them to participate in the subsidy program and begin to establish a permanent source of fertilizers and other inputs for farmers.

Another disadvantage of GES-TAP, which is common to many subsidy programs in SSA, is the bureaucracy of the system. Late payments by the FGN are crippling the private sector

redemption centers. This is despite the fact that GES-TAP was supposed to help provide a solution to this problem. In the past the FGN blamed lack of and/or inaccurate data, or requisite time taken to verify the data and information provided, for the delays in payment to the private sector for the subsidy component. With GES-TAP, reports can be generated in real time and accurate data is returned to the GES database within a week, which should allow for faster settlement and loan repayments. Nevertheless, the GES-TAP is still plagued by delays in government disbursements to the private sector. The time lag between the submission of the documents and payment by the Ministry is between two and six months. At present there is no strategy to address these delays. Delayed payment places a financial constraint on importers, may restrict their ability to procure fertilizer for the following cropping season, and also discourages the private sector from continuing to participate in the program.

The Nigerian subsidy program does not have an exit strategy nor does it have a graduation program for farmers who benefit from the subsidies. As such, the program risks creating a group of subsidy-dependent farmers and weakening the entrepreneurial growth among the small farmers.

Fiscal Implications for Government Budgets

Since GES-TAP entails an enumeration process that validates the farmer to an extent that has never been achieved before by any other voucher program in SSA, it is difficult to make a comparative cost between the more traditional voucher systems and the cost of the GES-TAP. In addition, the first phase of the scheme covers the software development after which the cost then decreases. That said, the cost is approximately $7 per farmer during Year 1 (which is the same as the cost of the GES which used the traditional paper voucher system). However, the cost goes down to approximately $2.50 per farmer in Year 2 and $1.50 per farmer in Year 3 (Source: informal communication with S. Wallace, former IFDC Country Representative in Nigeria).

The cost of the subsidy program is $408.5 million and the program accounts for 40-50% of the agriculture budget. Data on program cost as a percentage of the national budget were not available at the time this paper was being written. However, the cost of the subsidy program

clearly accounts for a substantive proportion of the agriculture budget implying that availability of funds for other investments in the agriculture sector may be compromised.

8.3.3 Rwanda

Rwanda has an estimated population of 12 million, with 81% living in rural areas and 45% living below the national poverty line. Rwanda has an annual GDP per capita of U.S. $644, with agriculture as a critical economic sector, contributing 33% to GDP, 63% of foreign exchange and employing 90% of the economically active population. Fifty-two percent of the total land area is considered suitable for agriculture production and 90% of that total is on hillsides. The main agricultural enterprises are bananas, beans, Irish potato, sorghum, maize, sweet potato, and livestock, while the major commercial crops are coffee, tea, and pyrethrum. Most agriculture farmland is in the hands of smallholder farmers, with an extremely small average farm size of 0.3 ha, due to a high population density of 355 inhabitants per square kilometer, the highest in SSA (Morris et al. 2009). Therefore, there are severe limitations to expanding food production through crop extensification. Given these constraints, any increase in food production must come from agriculture intensification, which implies increasing yields on the same land area. Moreover, the country's topography and heavy seasonal rains make it prone to soil erosion; hence, there is a great need for farmers to implement soil conservation measures and continually replenish lost soil nutrients. The level of fertilizer used per cultivated hectare in Rwanda is 29 kg/ha (2012) a significant increase from 4.2 kg/ha before the fertilizer subsidy program was launched in 2007 (Wanzala et al. 2013).

8.3.3.1 Fertilizer Market in Rwanda

Trends in Consumption

Fertilizer consumption increased fourfold from an average of 8,000 t during the years before the introduction of the fertilizer subsidy in 2007 and the post-subsidy years. Since the introduction of the subsidy, fertilizer imports have increased substantively reaching 35,000 t in 2013. This increase has been mainly driven by the fertilizer subsidy program; for example, 30,000 t or 88% of the 34,000 t imported during 2012/13 was imported for the subsidy program and the remaining 4,000 t was imported for the tea and coffee sector. Hence, the subsidy program accounts for over three-quarters of total imports.

The main fertilizers used in Rwanda are urea, DAP, and NPK formulations (mainly 17-17-17). These fertilizers are mainly used on roots and tubers, legumes, fruits and vegetables, and tea and coffee. The NPK formulations 25-5-5 and 20-10-10 are used on tea and coffee, respectively.

Trends in Production/Supply

In Rwanda, there are no domestic fertilizer manufacturing facilities, only a small fertilizer blending plant. Hence, Rwanda's fertilizer requirements are imported directly from international markets and the private sector actively participates in the distribution of fertilizers. In the decades preceding the introduction of the subsidy program in 2007, fertilizer imports remained below 10,000 t (with the exception of 1993 when imports were approximately 13,000 t). Fertilizers were mainly imported by development partners and NGOs as part of their fertilizer support programs and the fertilizer was used mainly on tea, coffee, and other cash crops. In 2007 the Government of Rwanda (GoR) introduced the Crop Intensification Program (CIP) and fertilizer imports increased steadily to 35,000 t, with 88% of the imports resulting from CIP.

In recent years, the fertilizer market in Rwanda is characterized by three supply chains. In the first supply chain, five companies have been approved by the Government to import approximately 30,000 t of DAP, urea, and NPK to sell at ceiling prices set by the Government. Importers sell this subsidized fertilizer with some competition through a network of approximately 800 trained and registered agro-dealers who have been approved to sell subsidized fertilizers. In the second supply chain, government imports approximately 2,000 t of fertilizer for coffee, which it sells to coffee washing stations for onward sale to coffee farmers; although the government is involved, fertilizers are sold without subsidies. The third supply chain is comprised of private importers who are free to import other fertilizers, and who import about 3,000 t which they sell without subsidies direct to large buyers (tea estates) as well as to agro-dealers. This third supply chain is currently aimed mostly at tea estates. It is free to import and sell other fertilizers such as MOP, micronutrients, and ammonium sulfate at unsubsidized prices; this trade is currently very limited.

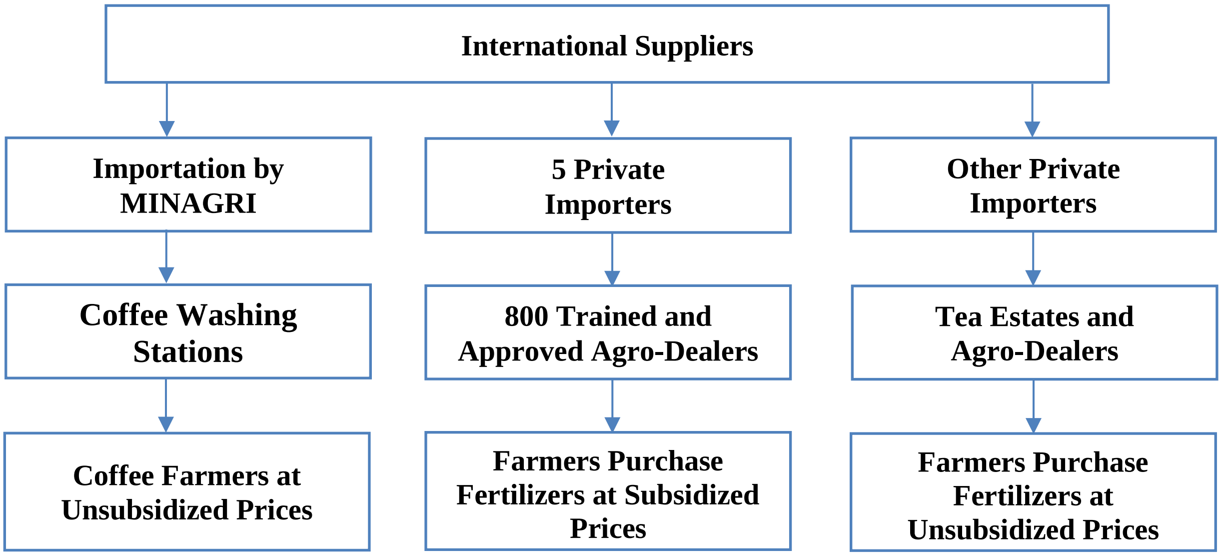


Fig. 8.6 *Rwanda Fertilizer Supply Chain*

8.3.3.2 Rwanda—Fertilizer Subsidy Program

In 2007, the GoR launched its fertilizer subsidy program under the auspices of the national agricultural program, the Crop Intensification Program (CIP). The objectives of CIP are to *raise productivity of the main food crops, boost food production and safeguard national food self-sufficiency by creating incentives for producers to adopt new production technologies*, particularly fertilizer, seed, and irrigation. The key strategies are as follows: create awareness of the benefits of fertilizer use among smallholder farmers in Rwanda using the following strategies: land consolidation; provision of credit facilities to farmers for the purchase of seed and fertilizers; promotion and stimulation of fertilizer markets through the provision of input vouchers to farmers; and updating of technical recommendations. Accordingly, CIP was comprised of five key interventions, which together form a strategic package aimed at enabling smallholder farmers to increase productivity of major staple food crops. These were: (1) crop regionalization, (2) land use consolidation, (3) seed subsidy, (4) intensification of agricultural extension services, and (5) fertilizer subsidy. The Ministry of Agriculture and Animal Resources (MINAGRI) also implemented measures to support CIP, namely, improvements in agricultural extension and information dissemination, promotion of investments in storage facilities,

encouragement of registration of new businesses in the agriculture sector to avoid monopolistic practices, and reform of the systems providing credit to farmers to improve recovery rates.

The first CIP (2007) was implemented as a pilot program, under which 9,000 mt of fertilizer were imported and distributed by MINAGRI for CIP's priority crops (maize, wheat, rice, Irish potatoes, beans, and cassava) as well as the key cash crops (tea and coffee). This fertilizer was sold to farmers at actual landing cost; domestic transportation costs (from the capital of Kigali to the production zones) were absorbed by the government. For the government, a key lesson from CIP 2007 was the need to phase out public sector involvement in the fertilizer market and promote the development of a private sector-led fertilizer market. Accordingly, under CIP 2008, the objectives were to encourage private firms to replace the government agencies in retail fertilizer distribution while continuing with the government policy of bulk imports to reduce the effect of the record-level global fertilizer prices that prevailed at that time. Therefore, one of the major medium-term goals of the CIP auction system was to stimulate competition among private distributors and facilitate the maturity of these distributors in terms of business acumen and financial means to the point that they can procure and distribute fertilizers independently, hence providing an exit strategy for the government.[81]

The main objective of CIP for the subsequent three seasons (2009/10, 2010/11 and 2011/12 was to make fertilizer easily available and accessible to smallholders. The program design, which was similar to CIP 2008, consisted of a fertilizer auction and the implementation of a fertilizer voucher program.

[81] Crop Intensification Program Evaluation Report, IFDC CATALIST Project, March 2010.

As a first step, CIP determined the amount of fertilizer to be imported. The Rwanda Agricultural Development Authority (RADA)[82] contracted service providers to collaborate with the local governments to estimate seed and fertilizer requirements and generate a corresponding list of eligible target beneficiaries at district and provincial levels. Eligible target beneficiaries were farmers who consented to land use consolidation in accordance with the requirements of crop regionalization.[83] A list of the eligible target beneficiaries was prepared and the individual land areas contributed by each farmer aggregated upward to the district level and across provinces in order to calculate the total national requirement.

Based on requirement estimates, MINAGRI issued a public tender and procured fertilizer from neighboring countries. Private traders and distributors were then invited to participate in an auction and present their bids to purchase and sell the MINAGRI-procured fertilizer. For a trader or distributor to qualify, they had to meet the following criteria: (a) have experience in the marketing and distribution of agricultural inputs; (b) show proof of their experience by providing a trading license; and (c) provide evidence that they are operating as agricultural input traders. They were also required to have distribution linkages with at least four agricultural input stockists in at least one area that had been targeted for distribution of subsidized fertilizers. To facilitate the distribution process and increase the likelihood of program success, MINAGRI also organized training workshops with RADA and IFDC for selected distributors and their appointed agro-dealers to raise awareness and understanding how the subsidy program was to be administered and the roles of the various actors. The workshops also built distributors' and agro-dealers' capacity to participate in program implementation, which included giving technical advice to farmers about correct fertilizer use. This selection and training process created a pool

[82] MINAGRI is the chief executive agency of the fertilizer subsidy program. It is responsible for planning and coordination, including procurement of the program's fertilizers. RADA is the major operations agency. RADA is a government organization operating under the supervision of MINAGRI, but with entity and financial autonomy. With respect to the current subsidy program, RADA is responsible for field operations including farmer targeting, estimation of fertilizer subsidy national requirements, providing extension services on appropriate fertilizer application rates, seeding rates and spacing, and appropriate planting methods. To enhance its performance of these operational functions, RADA uses contracted service providers, who collaborate with MINAGRI's extension service officers at sector and district levels to provide technical assistance to farmers.

[83] Crop regionalization refers to the practice of encouraging farmers to abandon the traditional practice of crop diversification for food security purposes and instead grow crops according to the agro-climatic and soil conditions of the area. Land use consolidation refers to an operational (not physical) practice whereby groups of neighboring smallholders agree to cultivate the same crop on their land using the same seed variety provided by the government agronomist.

of potential distributors to draw from for the auction. Qualifying distributors who met all of the above criteria were informed by telephone. The approved list of qualifying distributors was also published in print media.

The selected traders and distributors participated in an open auction using an electronic bidding system in which each bidder was given about three minutes to make open bids for purchase on an electronic screen; the tender was awarded to the bidder offering the highest purchase price per metric ton of fertilizer. Bidding for distribution was done on lots for each zone. To allow distributors' margins to vary by zones (based on differentials in transportation costs), the total amount of imported fertilizer is divided into lots according to the distribution zones. In spite of the tender-bid process, fertilizer prices were fixed pan-territorially by the government. These price levels were determined on a cost-plus basis, in which MINAGRI offered a maximum margin over the government reserve (floor) price. Therefore, the government set the maximum sale price for the winning distributors, so the higher the purchase price bid by a prospective distributor, the lower his or her profit margin will be.

The third step in the process entailed distribution of the procured subsidized fertilizer to outlets closer to farmers. When the fertilizer arrived into the country, RADA served as a central distribution point from which distributors that won bids collected their allocations for transportation to their respective distribution zones. There were two types of distributors: independent distributors and farmers' cooperatives/associations. The distributors transported fertilizers from the RADA central warehouses in Kigali to their rural warehouses; from there, they coordinated distribution to agro-dealers.

The fourth step was the distribution of the subsidized fertilizer using the electronic fertilizer voucher system. RADA contracted the voucher processing activity to service providers who issued vouchers according to the previously compiled list of eligible target beneficiaries. The vouchers were distributed to eligible farmers when they collected their CIP-subsidized seed. Farmers were required to produce their national ID card, which was scanned to produce an electronic record of the beneficiary farmer and then used to process and print the voucher. Under CIP 2009, each voucher qualified the farmer for 50 kg of DAP and 25 kg of urea, enough for

0.5 ha. If the land was consolidated among several farmers to compose 0.5 ha, a voucher was issued to only one of the farmers. In order to acquire subsidized fertilizer, the farmer had to present the voucher plus the cash to cover the unsubsidized portion of the market price to the agro-dealer in exchange for fertilizer. Transportation from the agro-dealer to the farms was the responsibility of the farmers, and was usually done by bicycle. Agro-dealers then presented collected vouchers to the bank for payment of the outstanding value of each.

MINAGRI imported fertilizers from regional fertilizer suppliers and stored them in a warehouse in Kigali, set national maximum retail prices, divided the country into lots with specified amounts of fertilizers to be distributed to each lot and then auctioned off the rights to buy fertilizers from the government to local distributors who then delivered it to farmers. The winning companies had regional distribution monopolies in specified districts to agro-dealers at a subsidized pan-territorial price. The subsidy rate (which was the difference between MINAGRI's import costs and the auction price) ranged from 30% for NPK 17-17-17 to 50% for urea and DAP.

The advantage of CIP up until 2012 was that it provided the opportunity for multiple businesses to bid to distribute the fertilizers and allowed multiple distributors to participate. However, there was a serious drawback to this arrangement; companies bid by setting the margin at which they could distribute fertilizers, with the lowest margin winning the contract and during the auction, distributors who won the bids were expected to make a 30% down payment on their bid price, with the balance of the bidding price to be paid to the government after the distributor had received payment from the farmers. Essentially, MINAGRI allowed distributors to take fertilizers from its warehouses on credit, and encouraged distributors to extend this supplier's credit to agro-dealers. In turn, agro-dealers were expected to extend credit to farmers who would pay the agro-dealers once they had harvested and sold their crop, allowing payments to flow back up the supply chain from farmers to MINAGRI.

However, this resulted in unpaid credits year after year, which accumulated to more than $20 million. Obtaining repayment was now a big problem for the government since there was often no clarity on who had paid and who had not paid along the supply chain, and to make

matters worse, at the local level, distribution to farmers was often not managed as a commercial activity. Therefore, although MINAGRI has tried to collect these debts, a substantial percentage remained uncollected (Source: informal communication with David Gisselquist, COP of IFDC project in Rwanda).

Therefore, in 2013 the GoR introduced fundamental changes in the way it administers its fertilizer subsidy program in order to address the above shortcomings, including the prohibitive costs of administering the program consisting of millions of dollars for annual product procurement and cumulative credit arrears not paid by farmers. The GoR ceased the importation and auctioning of fertilizer and nominated three private distributors (ENAS, Top Services, and Tubura/One Acre Fund) to procure, import, and distribute fertilizers at fixed, subsidized retail prices to farmers and then get reimbursed by government based on evidence of sale to farmers.[84] One company had a monopoly covering 20 districts, and the second company had a monopoly covering 10 districts. MINAGRI's subsidy, as a percentage of the fixed retail price, was 16% for NPK and 50% for DAP and urea (Fig. 8.7).

The GoR also eliminated its interest-free credit that flowed from the distributors to the farmers, letting private importers fend for themselves and make new arrangements with other players in the value chains. The GoR thus transferred credit decisions and risks to the private sector. The selected importers have been assigned quantities to import and regions to distribute. Two of the three importers, ENAS and Top Services, worked together. These two companies imported 25,000 mt while Tubura/One Acre Fund imported 5,000 mt in the first season, but more in the second.

The initial launch of this new subsidy scheme in mid-2013 was rocky as the financial system was unwilling to extend credit to these new entrants in a sector that had a bad credit history, forcing MINAGRI to provide guarantees through the private banking system for importers to have access to credit. MINAGRI provided a credit guarantee to the largest private importer to cover a

[84] In 2013, the unilateral price determination system by MINAGRI was reformed to include the participation of the private sector in negotiations to establish retail prices and markup margins that better reflect underlying market conditions.

portion of the loan equivalent to MINAGRI's expected subsidy payment to that importer. Importers were responsible for any supplier credit they might provide to agro-dealers and farmers. Still, the amount of credit was not enough to cover the total importation of fertilizer needed for the 2014 seasons. Despite the withdrawal of MINAGRI trade credit, forcing agro-dealers and farmers to finance fertilizer trade and use from their own resources, fertilizer sales increased 10% in 2013/14 compared with the previous year.

Companies compete for tenders from MINAGRI for the importation and distribution of subsidized fertilizers (urea, DAP, NPK) with the lowest bid winning or getting approved. At least three companies are allowed in each district to encourage competition but with a fixed maximum retail price for each fertilizer. The approach by MINAGRI is to gradually reduce the levels of subsidies over time. MINAGRI contracted to pay subsidies equivalent to 15% of the ceiling price for NPK (so importers could sell NPK at retail price minus 15% and government would pay that difference), 30% for urea, and 35% for DAP. With lower prices in world markets, these lower subsidies promised to keep MINAGRI's subsidy bill below the previous year, even if quantities sold increased by 67% as desired. The largest subsidy—for DAP—is equivalent to around $340/mt, a significant reduction from subsidies in the previous year.

MINAGRI has stopped using input vouchers for targeting and replaced targeted subsidies with a universal system to cut the bureaucracy and the costs of administering the subsidy program.

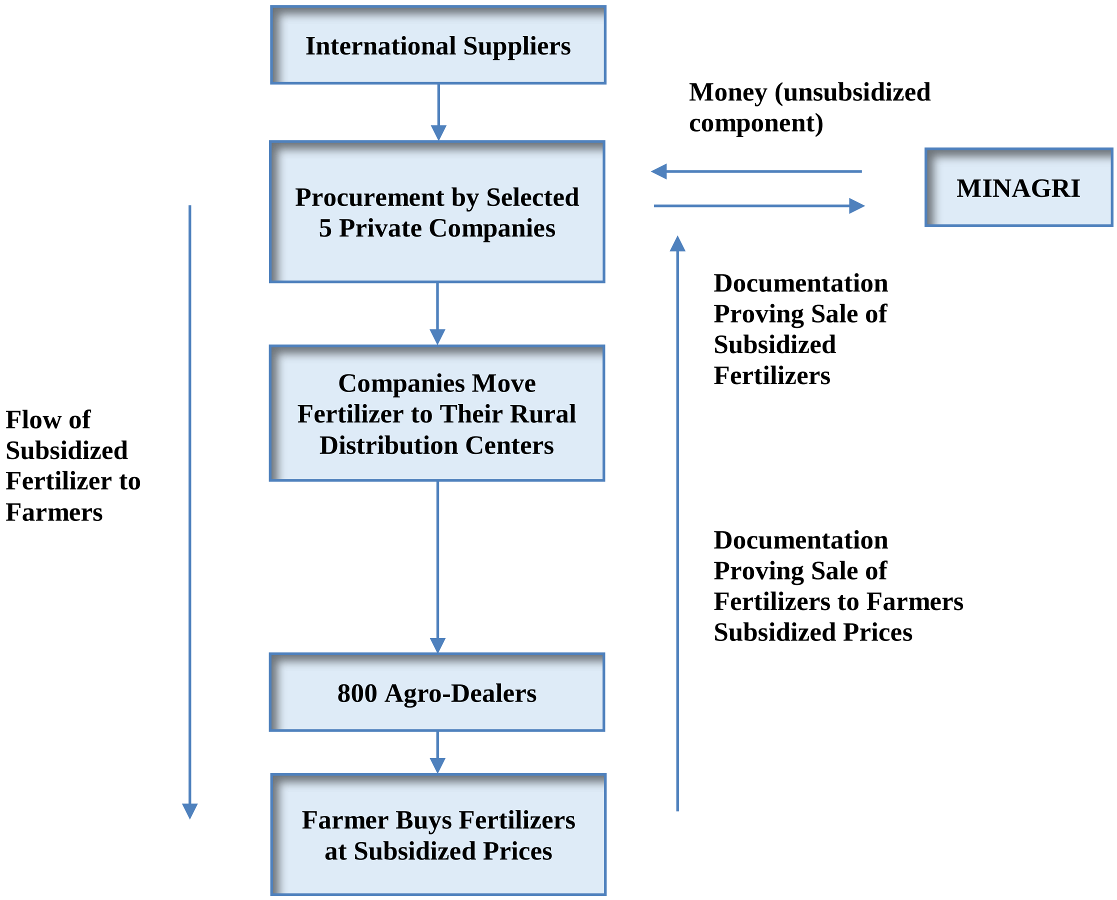


Fig. 8.7 *Schematic Structure for the Implementation of the Fertilizer Subsidy Program in Rwanda*

8.3.3.3 Evaluation of the Impacts of the Fertilizer Subsidy Program in Rwanda

Fertilizer Accessibility

Until 2013, the MINAGRI subsidy component of the CIP program included transport subsidies as well as an additional price subsidy. The transport subsidy, covering 50% of the transport costs from port to Kigali, was terminated in 2013. At that point, all subsidies were consolidated into a single price subsidy on specific fertilizers (NPK, DAP, and urea). This subsidy was set in Rwandan francs per kilogram and was paid to importers on evidence that farmers had bought their fertilizers at the established subsidized price. Until 2013, the subsidy was approximately 50% on DAP and urea sold to maize and wheat farmers with at least 0.5 ha of land. As of 2014, the subsidies have been reduced to 15% of the retail price for NPK, 30% for urea, and 35% for DAP. Therefore, in Rwanda, the CIP program has been effective in improving the financial

accessibility of fertilizers to farmers by reducing the price of fertilizers although the subsidy rate has been reduced substantially in 2014.

However, there is evidence that CIP has not been effective in reducing the distance traveled by farmers to access subsidized fertilizers (physical accessibility). Despite the selection criteria used during the bidding process, none of the participating distributors have an extensive agro-dealer network. As a result, when they distribute the subsidized fertilizer, they fall short of reaching the farm-gate due to their weak or non-existent agro-dealer networks. Instead, they deliver the fertilizer to their rural warehouses in the production zones, which are still considerable distances from the farm-gate. The responsibility of transporting the fertilizer to the farm-gate is left to the farmers.

Prior to 2014, the Government of Rwanda used an electronic-based voucher system for targeting fertilizer to the intended farmer population. The process of voucher redemption was simple and relatively transparent. Once the farmer redeemed the voucher with an agro-dealer, the latter submitted it for payment at the designated bank. There were no regional or district committees or signatures required, as is the case in Malawi. The process was centralized under the control of RADA (an autonomous body within MINAGRI), which contracted out many of the services to independent service providers. Unfortunately, the system was not implemented successfully, affecting the effectiveness in terms of timely delivery of vouchers to farmers. This was due to a number of issues with the voucher system—printing the vouchers was time-consuming (printing 500 vouchers could take 42 hours, which created long waiting lines for farmers), and some rural areas lacked sufficient electricity and information and communication technology (ICT) equipment.[85] This compromised the performance of the voucher system; for example, in 2009[86] only 26% of all the fertilizer sold through the auction system was distributed by CIP via vouchers to maize and wheat farmers. The balance of the subsidized fertilizer was sold at government-specified ceiling prices by private distributors, primarily to rice and potato farmers.

[85] Crop Intensification Program Evaluation Report, IFDC CATALIST Project, March 2010.
[86] CIP has been implemented for four agricultural seasons: 2007/08, 2008/09, 2009/10, and 2010/11. The data and analysis will apply to the periods 2008/09 (referred to as 2009A) and 2009/10, unless stated otherwise.

In mid-2014, the voucher system was discontinued and the subsidy is universally available to farmers in Rwanda.

A key characteristic of the design of the CIP program is that the fertilizer subsidy program is implemented as part of a comprehensive technical package that combines the use of improved seeds, fertilizers, and the provision of extension services to promote awareness of the subsidy program and ensure the use of correct farming techniques including the proper use of inputs, and incorporates economic incentives (linkages with private sector providers) to induce farmers to adopt the input packages.

Fertilizer Availability

The implementation of the subsidy has resulted in a substantive increase in total fertilizer consumption in Rwanda from 8,000 mt in 2007 to about 35,000 mt in 2012, of which 30,000 mt was supplied by MINAGRI under the CIP subsidy program.

The data in Table 8.5 indicate that, every year since the subsidy program was launched in 2007, the actual amount of fertilizer imported for distribution under the voucher system has increased, and is slightly below the planned amount for an average of 99.5% of the intended amount. For instance, in 2009 the actual amount of fertilizer provided by the voucher program was 13,442 mt; the intended amount was 13,500 mt and the program reached an estimated 128,019 farm households[87] (Table 8.5). This increase in the total amount of subsidized fertilizer provided by the voucher program (2007 and 2009) reveals an improvement in the overall ability of the subsidy program to increase the availability of subsidized fertilizers to farmers in Rwanda.

[87] These estimates are taken from the Rwanda country report; the computation is based on a subsidy rate of 75 kg/0.5 ha and average land holding of 0.7 ha per farm household.

Table 8.5 Availability of Subsidized Fertilizer in Rwanda, 2007-09

	2007	2008	2009
Intended amount of subsidized (vouchered) fertilizer (mt)	7,132	6,200	13,500
Actual amount of subsidized (vouchered) fertilizer (mt)	7,077	6,189	13,442
Actual amount as % of intended amount of subsidized fertilizer (%)	99.2	99.8	99.6
Number of Farm Households reached by subsidy	67,400	58,943	128,019

Source: Rwanda country report, Table 5, p. 23.

In 2008/09, approximately 29,261 vouchers were distributed under CIP, representing nearly 4,500 mt of fertilizers. According to a CIP 2008-09 evaluation, the number of farmer beneficiaries was 87,000 maize and wheat growers, less than the target of 100,000 (IFDC, March 2010); this indicates that in spite of the program being highly effective at providing the targeted amount of subsidized fertilizer, and therefore increasing availability in the domestic market, it has not been as effective at reaching the targeted population. A key reason for this in the past was local officials lack the capacity and facilities to produce vouchers for distribution to eligible farmers, leading to an ad hoc approach to distribution and poor targeting of the subsidy to maize and wheat farmers who meet the criteria.

With the elimination of input vouchers, this is no longer an issue and there are early indications that more farmers are being reached under this new "voucherless" subsidy program. Fertilizer sales increased by 10% between 2013 and 2014, although it is likely that the beneficiaries are the relatively well-off farmers since those who still find the subsidized price too high will be unable to participate in the subsidy program.

Impact of Subsidies on Agricultural Productivity and Farmers' Income, and Nutrient Management Performance

Before CIP was launched in 2007, the average fertilizer application rate was 4.2 kg/ha, but by 2012 the average fertilizer application rates in Rwanda had increased to 29 kg/ha. This may be attributed to the fact that the subsidy program increased awareness of the benefits of fertilizer use and the willingness of farmers to pay for it, irrespective of the subsidy.

There has been an increase in yields for some priority crops since the implementation of CIP. Between 2008 and 2012, maize yields increased from an average of under 1 mt/ha to approximately 2.2 mt/ha, potato yields increased from approximately 9 mt/ha to 14 mt/ha, and yields of cassava increased from just over 6 mt/ha to 15 mt/ha.

Under CIP, the use of improved seeds by farmers also increased from 3% to 40% which contributed to higher yields, especially for maize, since farmers were using hybrid seeds and improved planting materials from other countries in the region.

Though the new system has eliminated vouchers and fertilizer sales increased by 10% over the previous year, it is too early to assess the impact on agricultural productivity.

Impact on the Private Sector

The results of the main objective of the CIP system to support the development of a private sector-led fertilizer marketing and distribution network are mixed.

On the one hand, in order to promote trade by the private sector at the retail level, the GoR and its development partners have trained more than 1,000 agro-dealers. Today, fertilizer supply in Rwanda is mainly a private sector activity with government oversight and in the case of subsidized fertilizer, some tight controls (on prices and margins in particular) by the government.

On the other hand, although the government requires that distributors who participate in the program must have a network of agro-dealers, in reality, the successful bidders included a combination of business people with different types of expertise (producer cooperatives, fertilizer dealers, entrepreneurs). These business people are all experienced in fertilizer importation, but have little to no experience in fertilizer distribution. As a result, they have underestimated their distribution costs, overbid in the auction, and incurred losses. Moreover, because bids are offered by region in Rwanda, it is possible for a bidder to win fertilizer lots intended for a region that is different from their last area of operation. This creates uncertainty, discourages the establishment of organized retail networks, and disrupts the relationship with agro-dealers in the districts for a given distributor.

Under the new system the private sector has been given a lot of leeway to operate more freely in the market. MINAGRI has been forced to provide some support in the form of guarantees so importers can secure finance and it still influences markets through the determination of retail prices, therefore denying markets this role. However, MINAGRI has withdrawn trade credit, forcing agro-dealers and farmers to finance fertilizer trade and use their own resources. Despite the continued (albeit vastly reduced) involvement of the government in the fertilizer market, early indications are that sales increased by 10% under the new system. Therefore, though it is too early to gauge the impact on individual players in the market, overall sales have increased.

Although the GoR participation in the subsidy program has led to increased national consumption of fertilizer, the intervention has skewed private fertilizer market participation to the mostly commercial export-oriented production sector, catering to tea, coffee, potato, and rice growers while neglecting the smallholder farmer producers of food grains (maize and wheat) who are the supposed intended beneficiaries of the subsidy program. This has raised questions about the role of the GoR in the fertilizer market, particularly its impact on private investment and development in the fertilizer supply chain.

Fiscal Implications for Government Budgets

In 2010/11, subsidy program cost as a percentage of the national budget was 22%; it currently is 8% of the agriculture budget and a mere 0.4% of the national budget. This implies that a key factor in the decision of the GoR to scale back and privatize its subsidy program was to deal with unsustainable costs.

8.3.4 Tanzania

Tanzania has an estimated population of 43.7 million, with 74% living in rural areas. The GDP per capita is U.S. $527, and 33% of the population lives below the national poverty line. Agriculture is a critical economic sector, contributing 23% to GDP and 14% to foreign exchange while employing 77% of the labor force. Only 11% of the arable land is under cultivation. Food crops are grown on 87% of Tanzania's agricultural land, and the remainder (13%) is devoted to cash crops. The main food crops grown are cassava, bananas, maize, sweet potatoes, pulses, and

rice, and the main commercial crops are cashew nuts, coffee, cotton, sisal, sugarcane, tea, and tobacco. Smallholder farmers cultivate approximately 85% of agricultural farmland with an average farm size of between 0.2 ha and 2.0 ha (Wanzala et al. 2012; IFDC 2012). According to the 2007/08 national agriculture census, only 7.2% of smallholder area that was under cultivation during the long rains of 2008 received inorganic fertilizer and 9.2% of smallholders who planted annual crops in the same season applied any inorganic fertilizer. The level of fertilizer used per hectare of agricultural land[88] in Tanzania is about 7.0 kg/ha (Benson et al. 2012).

8.3.4.1 Fertilizer Market in Tanzania

Trends in Consumption

There has been considerable variation in the amount of fertilizer imported into Tanzania over the past 20 years, much of which has been driven by the introduction and withdrawal of subsidy programs. Total imports of nutrients between 1992 and 2000 ranged between 20,000 and 42,000 mt of nutrients. With the removal of the subsidy in 2001 and 2002 imports decreased to 10,000 t. In 2004 a new subsidy was introduced and imports increased to 160,000 t. Since its introduction, the subsidy has accounted for over 50% or more of total imports (IFDC 2012).

Nitrogen fertilizers comprise 61% of the fertilizer used in Tanzania. The main fertilizers used are urea, NPK blends and calcium ammonium nitrate (CAN) with DAP being the main phosphate fertilizer used. Potassium fertilizers are hardly used in Tanzania (Benson et al. 2012). Therefore, nitrogen and phosphate fertilizer dominate the fertilizer market, although it is not clear whether they are still appropriate for the current nutrient needs of the crops and soils.

Trends in Production/Supply

There is one fertilizer manufacturer in Tanzania, Minjingu Fertilizer Company (MFC), which produces Minjingu phosphate rock from its mine in northern Tanzania. The phosphate deposit at Minjingu has P_2O_5 concentration of between 22 and 25%, and reserves are estimated at over 9 Mt. The rock, which is considered to be among the highest quality rock exploited in Africa, is of high solubility and MFC beneficiates the phosphate ore mechanically to a P_2O_5 content of between 28% and 30% and granulates the product. The agronomic response to straight MRP is

[88] Agricultural land is defined as land that is arable, under permanent crops, or under permanent pasture.

comparable to that for TSP in acidic soils, but the crop response can be delayed. Consequently, the demand for MRP from farmers in Tanzania is low even though the cost per unit of P_2O_5 is 35% less for MRP than for DAP (the main phosphate fertilizer used in Tanzania). As a result, in 2011/12 the processing factory at MFC was only using 20% of its production capacity of 100,000 mt. In order to address the problem of low demand for straight MRP due to the delayed agronomic response, MFC installed blending machinery to produce an MRP blend with urea, *Minjingu mazao,* which has a nutrient content of 10:25:0 or about half the nutrient content of DAP (18:46:0) per unit of product; that is, two bags of Minjingu mazao are equivalent to one bag of DAP. With the additional N the agronomic response is comparable to that seen with DAP (Benson et al. 2012; IFDC 2012). MFC sells its fertilizer to the government subsidy program but it also distributes its fertilizer via the existing network of private agro-dealers.

Tanzania sources the remainder of its fertilizer requirements from overseas suppliers. There are six main importers, each of whom has strategically established depots at the regional or district level, or alternatively appoint and contract distribution agents. All of the importers are private companies with the exception of the Tanzania Fertilizer Company, a government parastatal fertilizer corporation. Their regional- or district-level depots or agents sell the fertilizer directly to farmers or to the over 2,000 agro-dealers spread countrywide who then sell the fertilizer to farmers. Commercial farmers procure fertilizers via the main importers for their own use and/or distribute them to their outgrowers via their own distribution network. The government also participates in the fertilizer industry; it imports and distributes fertilizer for the fertilizer subsidy program via the private import companies and also purchases some of its requirement from the MFC (Fig. 8.8).

The importers have formed an association, the Fertilizer Society of Tanzania, as a platform for joint discussion of issues related to fertilizer in Tanzania and to have a common stance for further discussion with government regarding policy issues. This includes advising the Ministry of Agriculture on the design and implementation of the subsidy program (Benson et al. 2012).

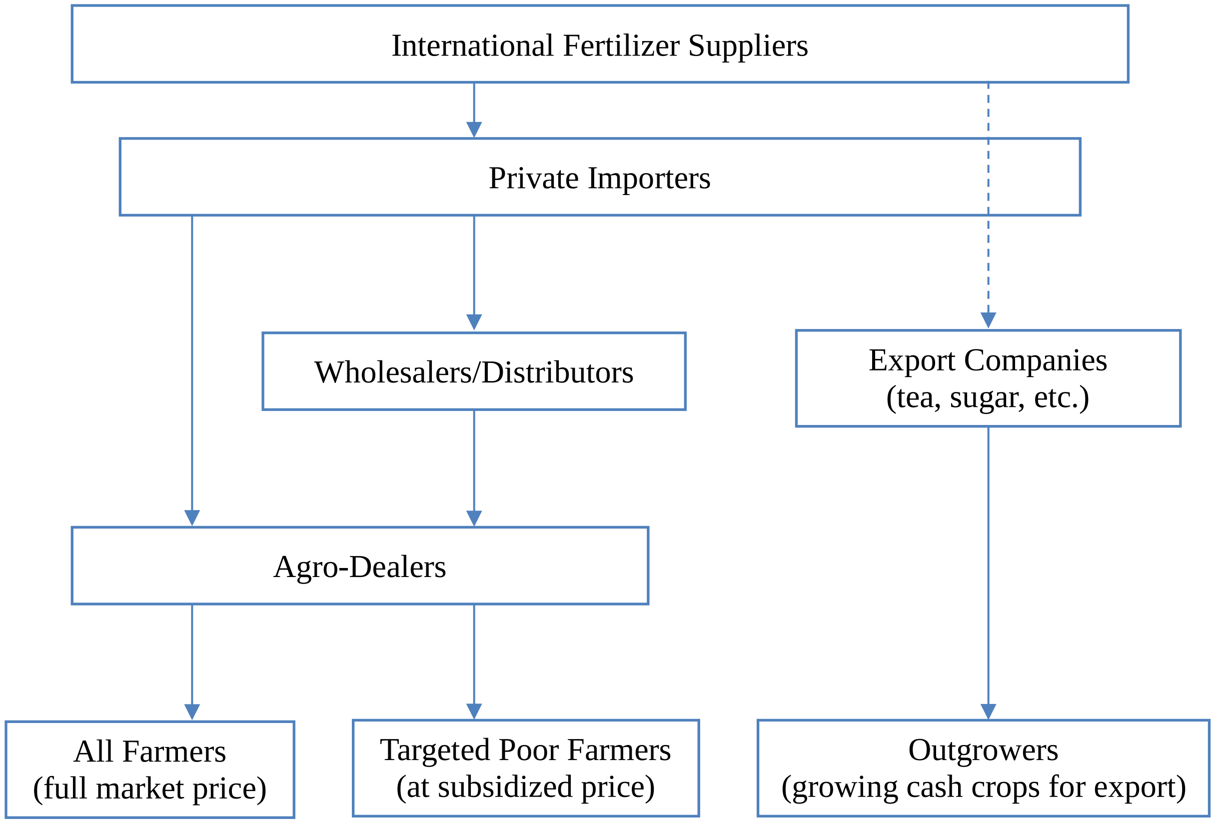


Fig. 8.8 *Tanzania Fertilizer Supply Chain*

Therefore, the Tanzanian fertilizer market is comprised of two main supply chains. In the first supply chain, fertilizer is manufactured by MFC and also imported by approximately six importers for the private market as well as for the government subsidy program. The fertilizer is distributed via the companies' own or contracted distribution outlets who then sell to independent agro-dealers who are mostly based in rural areas. These independent agro-dealers sell fertilizer to farmers at the market price for cash or at the subsidized price (vouchers plus cash). The second supply chain is comprised of commercial farmers growing cash crops such as tea, sugarcane, sisal, and tobacco, who import via the importers and use their own distribution networks to deliver the fertilizer to their farmers.

The total market was estimated at 385,000 t, out of which 302,000 mt were supplied and 263,390 mt, consumed with 57% (151,000 mt) subsidized (NEPAD-IFDC consultant report 2010).

8.3.4.2 Tanzania—Fertilizer Subsidy Program

The Government of Tanzania (GoT) introduced the current fertilizer subsidy program, the National Agricultural Inputs Voucher Scheme (NAIVS) for maize and rice production, in 2008. The objectives of NAIVS are to: (a) ensure that the targeted farmers have access to inputs; (b) increase efficiency in the subsidy management process through increased clarity and transparency in the selection of farmers, allocation of input subsidies and redeeming processes; (c) strengthen the capacity of agro-dealers to access input credits and agribusiness skills; and (d) ensure proper use of inputs for increasing crop production and productivity. Other objectives are to: (a) facilitate fertilizer use in high-potential areas; (b) offset the rising cost of fertilizers; (c) stimulate production to reduce food prices; and (d) stimulate the development of the private distribution network. The program was designed to cover 65 districts and 2.5 million farmers in high potential areas over a six-year period. In 2007, the program was piloted in two districts; in 2008, it was scaled up to cover 53 districts (about half the districts in the country), targeting 700,000 beneficiaries. In 2009/10, the program was expanded to cover 74 districts and over 2 million farmers and in 2010/11 it covered 87 districts with 1.8 million beneficiaries. Farmers in the project areas receive vouchers for up to three years, after which they are expected to have benefited sufficiently from participation in the program, i.e., generated sufficient additional productivity from their use of fertilizer and improved seed to purchase fertilizers at full market price, and use them correctly, and can graduate from the program (Wanzala et al. 2012; Benson et al. 2012).

The subsidized fertilizer package is either one 50-kg bag of DAP or two 50-kg bags of Minjingu mazao blend for basal dressing, one 50-kg bag of urea for topdressing and either 100 kg of improved seed (open-pollinated variety or hybrid) or 16 kg of rice seed. These inputs are sufficient for application to 0.4 ha (1 acre) of maize or rice. The subsidy is implemented making use of input vouchers which cover 50% of the cost of the subsidy package.

The National Voucher Steering Committee (NVSC) provides guidelines and oversees the implementation of the fertilizer subsidy program. The committee is chaired by the Permanent Secretary of Agriculture and includes representatives from the Ministry of Finance, Ministry of Agriculture, national farmers' organizations, fertilizer producers and importers, and civil society

organizations (CSOs). The Agricultural Input Section in the Ministry of Agriculture serves as the NVSC Secretariat. The Secretariat coordinates project activities and facilitates implementation.

The voucher program is implemented as follows. First, the national demand for agricultural inputs (fertilizers and seeds) based on historical input use is estimated by the Regional Voucher Secretariat (RVS) and transmitted to the NVSC. The RVS also informs districts about their allocation and initiates the process of further allocation of vouchers to wards and villages by the local government authorities. At the district level, the District Voucher Committee (DVC), which is comprised of representatives of farmer groups, agro-dealers, and CSOs, collaborates with the NAIVS district forum to allocate vouchers to wards and villages. At the village level, the Village Voucher Committee (VVC) is responsible for selecting beneficiary farmers and, upon endorsement by the village council, issues the vouchers to the beneficiaries. The VVC also monitors the use of the inputs by beneficiaries and provides regular reports to the village council and government, which then report up the channel through to the NVSC.

The distribution of vouchers to beneficiaries is based on regions (Southern, Northern, and Western Region) and focuses on maize and rice farmers. Farmers are selected to participate in the program by a VVC using the following criteria: the farmer should be living in the village and be a full-time farmer growing maize and rice; the farmer should not own more than 1 ha of land; the farmer should be willing to use the provided inputs on these crops and undertake the recommended agricultural practices; and the farmer should be willing and able to pay for 50% of the market price of the fertilizers. Priority is given to female-headed households and households that have not used any or have used very little fertilizer and improved seeds to grow these crops over the last five years.

Once the voucher is issued to the farmer, it is the responsibility of each farmer to link with an agro-dealer who can supply the desired input at an agreed time and place. The inputs are sold at market price; the voucher is worth 50% of the market price of fertilizer. Therefore, the farmer presents the voucher to the agro-dealer and pays the difference between the face value of the voucher and the market price before taking ownership of the fertilizer. The agro-dealer, in turn, redeems the voucher by depositing it in the National Microfinance Bank (NMB) which was

contracted by the Government to manage voucher redemptions. The NMB makes payments to agro-dealers in an amount equal to the face value of the vouchers. NMB transfers the money into the agro-dealer’s account using the funds that have been transferred from the Ministry of Agriculture to an account that is designated for redeeming vouchers. NMB verifies the authenticity of the voucher, records the transaction, and informs the MOA of the completion of the transaction (Wanzala et al. 2012).

Through the NAIVS the GoT also intends to strengthen the growing private fertilizer market in Tanzania. In order to participate in the subsidy program (that is, be authorized to accept vouchers, submit them for reimbursement, obtain loans from commercial lenders to build sufficient inventory to meet the demand from farmer beneficiaries), agro-dealers had to undergo business and technical training (marketing book-keeping, correct use of inputs, output marketing) from the Tanzania Agricultural Market Development Trust (TAGMARK) and the Citizens Network for Foreign Affairs (CNFA). Over 3,000 agro-dealers were to receive training during the course of the subsidy program. The importation and distribution of the subsidized fertilizer are done by the private sector in response to GoT communication on the quantity and value of the input vouchers to be distributed. The GoT informs importers of the expected demand at the district level for fertilizer under the NAIVS program for the following season so that importers can procure the stocks required and position them at appropriate distribution points along the supply chain in a timely manner. Figure 8.9 provides a description of the fertilizer subsidy program in Tanzania (Wanzala et al. 2012; Benson et al. 2012).

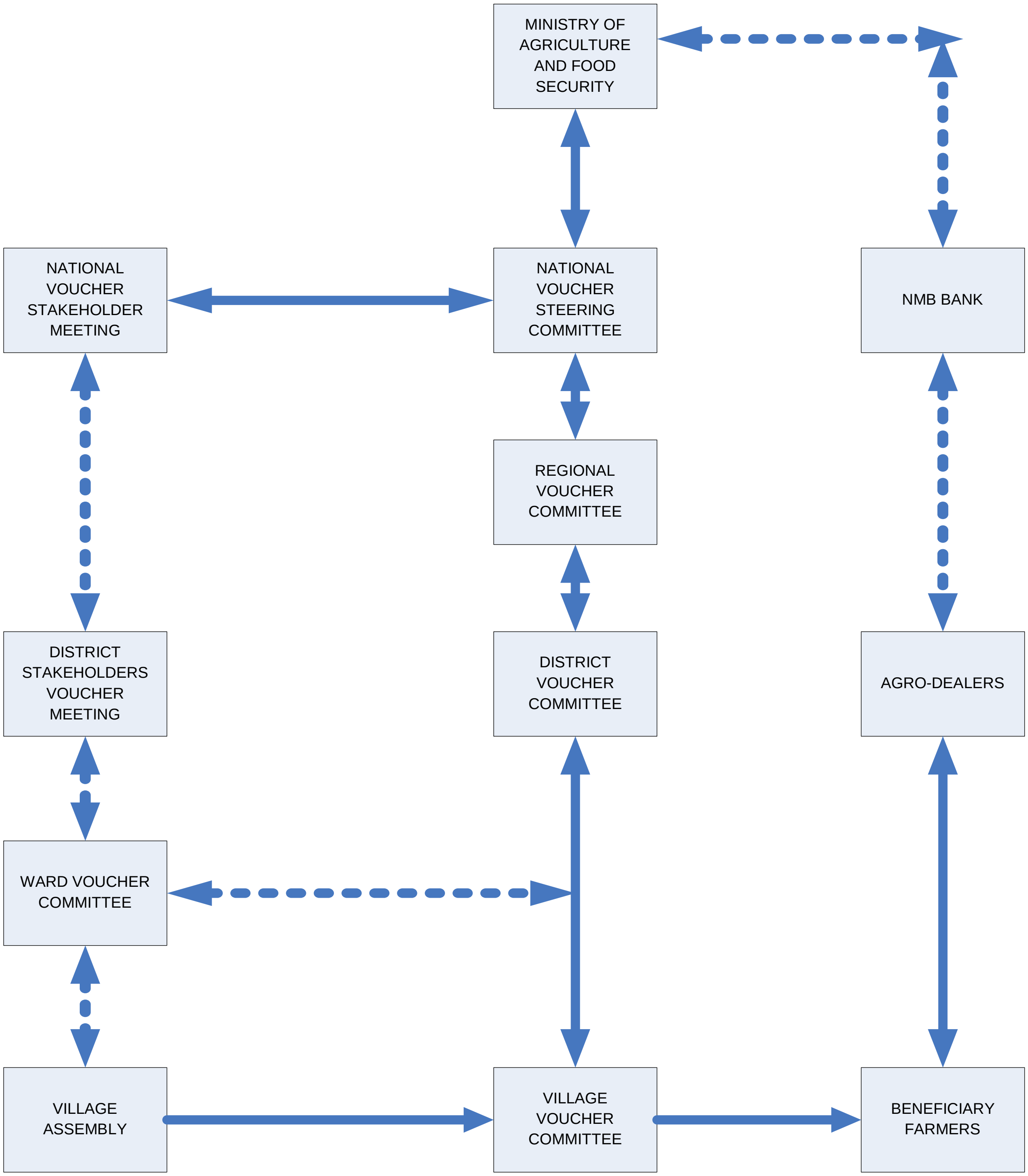


Fig. 8.9 *Schematic Structure for the Implementation of the National Agricultural Input Voucher Scheme (NAIVS) in Tanzania*

8.3.4.3 Evaluation of the Impact of the Fertilizer Subsidy Program in Tanzania

Fertilizer Accessibility

The goals of the fertilizer subsidy program in Tanzania can be summarized as: developing the private sector input supply system, reducing poverty, and attaining household and national food security. The Ministry of Agriculture complemented the subsidy program with fertilizer demonstration plots for farmers to learn about the use of fertilizer and other inputs. Nearly 1,200 demonstration plots were planted throughout Tanzania as part of the program in 2009/10.

The fertilizer subsidy program increased farmers' accessibility to fertilizers by reducing the price by 50% between the years of 2008/09 and 2009/10. In fact, this has been the case since the subsidy program was introduced in 2007/08; that is, while the design of the fertilizer subsidy program in Tanzania has changed, the amount of the subsidy has always been 50% of the market price of fertilizers. However, farmer beneficiaries are expected to pay the remaining 50% of the market price to gain access to the subsidized fertilizers, and the subsidy program does not include credit facilities to farmers. Therefore, the increase in accessibility, in terms of price reduction introduced by the program, is only beneficial to farmers who already have their own funds or access to finance to invest in farming. Consequently, although the subsidy program has increased the price accessibility of fertilizers to farmers, these benefits may not accrue to all of the intended beneficiaries since not all of the targeted beneficiaries may be able to raise the cash equivalent of the remaining 50% of the value of the inputs. Since this is a substantive amount of cash, the program essentially targets middle-income smallholders.

Consequently, a parallel market has developed for vouchers. As a result, farmers unable to pay cash to cover the unsubsidized portion of the fertilizer may decide to sell their vouchers to other farmers or to traders who will use the vouchers to purchase the subsidized fertilizer and resell it at market price or across the border. Although this may benefit the poor farmers economically, it will not contribute to a sustainable increase in agricultural productivity.

Fertilizer Availability

In 2008/09, the national demand for fertilizers in Tanzania was estimated to be 385,000 mt. The estimated demand of the targeted farmer beneficiaries was 130,000 mt (that is, the intended

amount of fertilizer to be provided by the fertilizer subsidy program), but the actual amount of 141,050 mt exceeded this target. In 2009/10, the actual amount of fertilizer provided by the subsidy program (151,000 mt) was 76% of the intended amount (200,000 mt), and the program reached 80% (1,199,596) of farmer households against a target of 1.5 million. The increase in the total amount of subsidized fertilizer provided under the program between 2008/09 and 2009/10 indicates an improvement in the overall ability of the subsidy program to meet the target population's demand for subsidized fertilizers. However, whereas the actual amount of subsidized fertilizers in 2008/09 exceeded the set target, the actual amount of subsidized fertilizers provided in 2009/10 was less than the intended amount. This decline may be due to the rapid expansion of the program between 2008/09 and 2009/10 from 11 to 20 regions (Table 8.6), to budget constraints, and to fertilizer price volatility in the international market.

Table 8.6 *Availability of Subsidized Fertilizer in Tanzania, 2008/09 and 2009/10*

	2008/09	2009/10
Estimated total demand (mt)	385,000	385,000
Intended amount of subsidized fertilizer (mt)	130,000	200,000
Actual amount of subsidized fertilizer (mt)	141,050	151,000
Actual amount as a percentage of the intended amount of subsidized fertilizer (%)	108	76
Actual subsidized fertilizer as a percentage of total demand (%)	37	39

Although the subsidy program increased accessibility and availability of subsidized fertilizers to farmers, it was not successful in terms of reaching farmers on time for planting due to late voucher delivery. Specifically, late delivery of vouchers to farmers and inadequate knowledge or lack of knowledge and understanding about the voucher program by stakeholders were problems. These factors contributed to the discrepancy between the intended and actual amount of subsidized fertilizers. Furthermore, there is anecdotal evidence of inadequate monitoring, coordination, and management of the program at regional, district, ward, and village levels. Members of the Village Management Committees did not meet their responsibilities of selecting beneficiaries who met the criteria and to monitor them. The results are unreliable records of the number of beneficiaries and scant data on the area fertilized (number of hectares) and yields.

Members of the district-level committees did not fulfill their role of coordination, monitoring, and evaluation of voucher committees, which allowed for the selection of dishonest agro-dealers.

Impact on the Private Sector

The market-friendly characteristics of the NAIVS subsidy program have had a positive impact on the private distribution network. In 2005/06, there were just over 500 agro-dealers in Tanzania. In 2008/09, 1,684 agro-dealers were trained and involved in the distribution of subsidized fertilizers. By 2009/10, 2,702 agro-dealers received training in the handling and marketing of agricultural inputs, and 2,345 agro-dealers were involved in distribution of the inputs. As a result, the fertilizer subsidy program in Tanzania has contributed to the expansion of the private distribution network closer to the farmer. The distance farmers traveled to access fertilizers declined from an average of 40 km before 2008/09 to an average of 5 km in 2009/10. This was due to the fertilizer subsidy program's deliberate strategy to inform registered agro-dealers about the voucher program and encourage them to strategically place the inputs to make them more accessible to farmers.

This impressive result can be attributed to the exclusive use of the private sector to import and distribute the fertilizer for the subsidy program and the complementary investments in agro-dealers (training and access to finance). The Ministry of Agriculture is responsible for implementation, but the most involved and time-consuming activity is the selection of farmer beneficiaries. Once the vouchers have been issued to selected farmers, the process of farmer redemption of the voucher and payment to the agro-dealers is a simple one-step process. No additional signatures or trips to various officials are required.

The two main private sector bodies supporting this process are agro-dealers and the National Microfinance Bank (NMB). Agro-dealers are informed of the government's intention to issue vouchers to farmers and are encouraged to place the inputs in strategic locations where the farmers will be able to access them without much difficulty. In 2009/10, 3,000 registered agro-dealers were selected to participate in the provision of inputs to farmers with vouchers. The government then partnered with an ongoing project which is being implemented by CNFA, with funding from the Alliance for a Green Revolution in Africa (AGRA), to provide training and

financial support to the registered agro-dealers. The agro-dealers receive training on their role in the implementation of the voucher system vis-à-vis their linkages with farmers on one hand and the participating commercial bank on the other (in this case, the NMB). The registered agro-dealers also receive support to address their short-term working capital needs through a Credit Guarantee program being implemented by AGRA through NMB. Thus, training agro-dealers, facilitating the adequate supply of inputs to reach the farmers, and addressing the short-term working capital needs of the agro-dealers are areas that the project is addressing directly or in collaboration with other partners such as AGRA.

Nevertheless, the agro-dealers who present their vouchers for reimbursement to the NMB complain that they have frequently faced delays in payment of several weeks and initially, payment was received by agro-dealers in about 45 days. As the program rapidly expanded, payment lags jumped to as much as 180 days, placing a significant working capital burden on agro-dealers participating in the program. This creates blockage in the supply chain as wholesalers are unwilling to provide agro-dealers with additional stock until payment is made for fertilizer previously provided on credit.

Fiscal Implications for Government Budgets

The NAIVS represents a major investment on the part of the GoT and its development partners, most notably the World Bank. Total annual costs of the project are estimated at U.S. $100 million and for the three years 2009/10 to 2011/12, 53% of the cost of the project was to be covered by a credit from the World Bank and the balance coming from the GoT (Benson et al. 2012).[89]

[89] The NAIVS has been replaced by a new delivery system starting in the 2014-15 production season. The new system is agriculture loan-based, targeting registered farmer groups whereby the government undertakes to subsidize farmers through loan guarantees which will allow them to pay a fixed interest rate of 4% p.a. This new system will entail a four-way agreement between: (1) farmers groups, (2) designated financial institutions, (3) appointed input suppliers, and (4) reputable crop buyers. (Source: “First Annual Agricultural Outlook: 2014-2023: Anticipating and Responding to the Region’s Policy Challenges in the Decade Ahead,” Regional Network of Agricultural Policy Research Institutes Policy Paper, November 2014 Issue).

8.4 Lesson Learned and Expected Changes to the Subsidy Regime

The first lesson learned is that fertilizer subsidies will continue to be an inescapable feature of agricultural policy in SSA for the foreseeable future. Fertilizer subsidies are responsible for substantive increases in national fertilizer consumption and on average subsidy programs account for 30-40% of total imports. In most cases, these input programs also account for a large share of the agriculture and national budget. It is apparent that for African governments the cost of the food import bill outweighs the cost of importing and subsidizing fertilizers and using it to produce food for the nation. Given the associated social capital and political mileage to be gained by governments through the implementation of subsidy programs, the situation is likely to remain the same for the foreseeable future. Therefore, any analysis of subsidy programs in SSA should have as their priority how to improve the design, implementation, and performance of these programs, not whether they are fiscally sustainable or indeed whether these same resources could give a higher return in terms of increased agricultural productivity if they were invested in alternative areas such as research and extension or infrastructure.

Having said this, some key areas in need of attention going forward follow.

First, in keeping with the expected longevity of subsidy programs in Africa, none of them have an exit strategy. Therefore, there is a risk creating a group of subsidy-dependent farmers on the continent, which will considerably weaken the prospect of commercializing the smallholder farmer sector. This potential risk could be diminished by suitable design features that help to build a commercial outlook among the farmers. For example, subsidy programs could link farmer beneficiaries to financial institutions and output markets and provide training in receiving and handling credit, as well as in producing quality produce for the market. This would begin to provide farmers with tangible alternatives to subsidies such that after a few years they may have the financial and technical wherewithal to choose to self-select out of the subsidy programs.

Second, the fertilizer formulations being used in the subsidy programs, whether imported or blended/manufactured, are not based on current soil analyses and fertilizer trials. Rather these fertilizers are simply being used because farmers have been using them for the past 50 to 60 years and they are used to them. While these fertilizers may have been suitable to address

nutrient deficiencies and crop nutrient needs in the past, it is reasonable to assume that over the years the soils have been depleted of nutrients and the crop mix has also changed. Hence, there is a strong likelihood that at the most, the fertilizers being provided by subsidy programs cannot meet all of the current crop and soil nutrient needs of their recipients' farms. To remedy the situation, countries in SSA need to conduct soil analysis and update their fertilizer recommendations, and on this basis, modify the fertilizer offering in their subsidy package. Governments can then work with the private sector to import and blend more suitable formulations. This will require a revision of their national Fertilizer Acts, which regulate the supply and distribution of fertilizers in countries in SSA. In most cases, these acts restrict the types of fertilizers that can be imported and sold in the country and allow little leeway for innovation and development of new fertilizer products. Governments need to recognize the limitations of these current acts and revise them accordingly.

With regard to targeting, e-vouchers are likely to become a more and more popular form of subsidy delivery in SSA, having initially been popularized by the Rwandese subsidy program and the more recent Nigerian experience with the GES-TAP. In June 2014, a delegation from the Malawian Ministry of Agriculture and Food Security visited Nigeria to learn more about the GES-TAP system and assess its suitability for Malawi. The GoM has since indicated its intention to use the experiences gained from Nigeria's electronic-based agricultural inputs distribution program as a model to deliver inputs to farmers in Malawi. FISP has poor targeting and it is anticipated that the adoption of the GES-TAP system may improve targeting and the efficiency of distribution because the TAP technology represents a more innovative tool for distributing farm inputs to farmers than the voucher system being used on Malawi. A key advantage of GES-TAP over the FISP is that it simplifies identification of farmer beneficiaries using their unique identification numbers. The TAP card issued upon completion of the registration process vastly improves the probability of fraud-free redemption of inputs by farmers.

Related to the targeting issue, subsidy programs that aim to increase national food security seem to be more successful in terms of number of beneficiaries and amount of fertilizer disbursed, and less costly than their counterparts. There are strong indications that subsidy programs that aim to

target the poorest of the poor, as is the case in Malawi, run into serious challenges for a number of reasons, which follow.

1. Identifying eligible farmers is often an exercise in futility: it tends to be left to local or village leaders who tend to favor certain households over others. The likelihood of this happening is high and is difficult, if not impossible, to monitor without putting into place expensive oversight measures. As a result, some of the poorest households who would not use fertilizers without a subsidy (usually the defined target of these programs) do not receive the subsidized inputs. Instead richer farmers who can afford to buy at least some (if not enough) fertilizer at market prices tend to be the main beneficiaries.
2. Even where the poorest of the poor do receive the vouchers, they may find it more profitable to sell them on the black market, as was the case in Malawi and also Nigeria under the paper voucher system. Moreover, while there is evidence that subsidies have increased fertilizer use and agricultural productivity overall, there is no evidence that the yield gains have been achieved by beneficiary farmers.
3. Even where beneficiaries have experienced yield increases, the increases have not been sufficient to make fertilizer use by beneficiaries profitable. A key reason has been insufficient emphasis by subsidy programs on extension services, use of hybrid seeds (most programs provide a choice between hybrid and OPVs) and provision of irrigation. As a result, some countries like Rwanda have stopped targeting their subsidy and instead have made it a universal subsidy, where anyone can participate as long as they have the cash to pay the "top-up" amount.
4. With regard to complementary services, many subsidy programs include complementary inputs such as seed and extension services. However, they do not include credit to assist the farmers who cannot afford the "top-up" amount. The rationale is that if farmers cannot afford the top-up amount, then they should not participate in the program. Clearly, this is not congruent with an objective of targeting the "poorest of the poor." Rather it implies that the government priority vis-à-vis the subsidy program is to increase national food security, and the source of the increased production is not of primary importance. In this case, it is more likely that the farmer beneficiaries of the subsidy program will be farmers who are relatively well-off in terms of productive assets and ability to buy some fertilizer at the market price, but just need some assistance to purchase more and improve their use of inputs, linkages to

output markets, etc. This may well be the choice of most governments going forward, particularly if their main objective is to increase national food security. But if subsidy programs are primarily to gain political mileage, then governments will continue to target the "poorest of the poor."

Subsidy programs in SSA, even where they comprise a small proportion of the total fertilizer market, have a huge impact on the development of the private sector. In many cases (e.g., Malawi), the government open-tender system, coupled with state agencies competing in the fertilizer market, has placed importers at a disadvantage or driven many agro-dealers out of business. Even where the government has pulled back from importation and distribution (as is the case with Nigeria, Tanzania, and Rwanda), the uncertainty and risks introduced in the market by government policies through the subsidy program still affect performance of the private sector. However, there are also instances where the subsidy program has clearly supported the expansion of the private sector by increasing sales through the distribution of vouchers that give purchasing power to farmers who previously did not buy fertilizers. There is also the serious and recurring problem of government delays in payment of the subsidized component of the market price to importers and agro-dealers. This ties up working capital and discourages participation in the program in subsequent years. Nevertheless, in spite of these debilitating impacts on the private sector, governments in SSA and private businesses, especially importers, believe in and understand the need for a subsidy on fertilizer and perhaps on other inputs, given that without subsidies, demand and consumption will be reduced as the majority of smallholder farmers cannot afford to buy fertilizer at the market price. Their main problem with the subsidy program is the way it is being designed and implemented.

A related point is that, even where governments genuinely want to build up the private sector, the experiences of Rwanda and Tanzania have demonstrated that this is not a simple policy to implement. It requires a clear, well-thought-out strategy that may have to be implemented steadily over a period of time before it begins to yield results (10 or even 20 years). That is, government support needs to go beyond the provision of a conducive legal and policy environment. Government support will have to be more holistic and deliberate. Governments in SSA should use subsidy programs primarily to develop vibrant, competitive, private sector-led

markets by doing the following: boosting private sector sales through the provision of purchasing power to smallholder farmers; business and technical training; credit guarantees to facilitate purchases by importers and agro-dealers; investing in research and extension; and linking farmers to output markets so farmers can experience higher returns to their investments in fertilizers.

Going forward there are some clear trends that point to some expected changes in the design and implementation of the subsidy programs.

- There will be a trend toward using e-vouchers to deliver inputs and a movement away from paper vouchers. However, while some governments will prioritize national food security and hence eliminate targeting, instead making the subsidy available to whoever can afford to pay the cash top-up amount, many governments will continue to use vouchers to target poor farmers, particularly if subsidies provide an important source of political mileage.
- Subsidy programs will expand their portfolio beyond fertilizers and include extension services, credit, irrigation, and linkages to output markets.
- As noted earlier, there are a number of fertilizer production and blending initiatives ongoing in SSA. Given the dominant role of subsidy programs in many countries in SSA, a future trend could be increased linkages between subsidy programs and fertilizer blending companies, as is the case in Tanzania.
- Subsidy programs will see a greater role for the private sector in importation and distribution, as governments shift their focus toward improving purchasing power of smallholder farmers.

References

Arndt C, Pauw K, Thurlow J (2013, September) The economywide impacts and risks of Malawi's farm input subsidy program. Invited paper presented at the 4th International Conference of the African Association of Agricultural Economists, Hammamet, Tunisia

Banful AB (2009) Operational details of the 2008 fertilizer subsidy in Ghana—Preliminary report (Ghana Strategy Support Program Background Paper 18). IFPRI

Benson T, Kirama S, Seleijio O (2012) The supply of inorganic fertilizers to smallholder farmers in Tanzania: Evidence for fertilizer policy development (IFPRI Discussion Paper 01230)

Bumb B, Johnson M, Fuentes P (2011) Policy options for improving regional fertilizer markets in West Africa (IFRPI Discussion Paper 01084)

Chibwana C, Fisher M, Masters W, Shively G (2010, September) Measuring the impacts of Malawi's farm input subsidy program. Presented at the Association of African Agricultural Economists, South Africa

Chibwana C, Fisher M (2011) The impacts of agricultural input subsidies in Malawi (IFPRI Policy Note 5)

Chibwana C, Fisher M, and Shivley G (2012) Cropland allocation effects of agricultural input subsidies in Malawi. World Development 40(1):124-133

Crawford E, Jayne T, Kelly V (2006) Alternative approaches for promoting fertilizer use in Africa (Agriculture and Rural Development Discussion Paper 22). The World Bank, Washington, D.C.

Crawford E, Kelly V, Jayne TS, Howard J (ed.) (2003) Input use and market development in sub-Saharan Africa. Special Issue Food Policy 28(4):277-419.

Dorward A, Chirwa E (2010) The Malawi Agricultural Input Subsidy Programme: 2005-6 to 2008-9. International Journal of Agricultural Sustainability (IJAS) 9(1):232-247

Dorward A, Chirwa E, Matita M, Mhango W, Taylor E, Thorne K (2011) Evaluation of the 2012/2013 Farm Input Subsidy Program, Malawi. Report for Ministry of Agriculture and Food Security, Malawi

Fuentes P, Bumb B, Johnson M (2012) Improving fertilizer markets in West Africa: The fertilizer supply chain in Nigeria. International Fertilizer Development Center, Muscle Shoals; International Food Policy Research Institute, Washington, D.C.

Gregory, I (2006) The role of input vouchers in pro-poor growth. Selected sections from a background paper prepared for the Africa Fertilizer Summit

IFDC (2011) Africa fertilizer situation (Fertilizer Situation Report IFDC-FSR-1). International Fertilizer Development Center, Muscle Shoals

IFDC (2012) Tanzania fertilizer assessment (in support of the African Fertilizer and Agribusiness Partnership). International Fertilizer Development Center, Muscle Shoals

IFDC (2013) Malawi fertilizer assessment (in support of the African Fertilizer and Agribusiness Partnership). International Fertilizer Development Center, Muscle Shoals

Henao J, Baanante C (1999) Estimating Rates of Nutrient Depletion in Soils of Agricultural Lands of Africa, IFDC T-48

Jayne T, Rashid S (2013) Input subsidy programs in sub-Saharan Africa: a synthesis of recent evidence. Agricultural Economics 44:547-562

Kelly V, Crawford E (2007) Policies and actions to stimulate private sector fertilizer marketing in sub-Saharan Africa (Agricultural Management, Marketing and Finance Occasional Paper No. 15). FAO, Rome

Kelly V, Crawford E (2010) Panacea or Pandora's box: fertilizer subsidy impacts and recommendations for improving subsidy performance. Presentation at USAID, Washington, D.C.

Lunduka R, Ricker-Gilbert J, Fisher M (2013) What are the farm-level impacts of Malawi's farm input subsidy program? a critical review. Agricultural Economics 44:563-579

Makepeace P (2014) Situation statement: fertilizer markets and associated industry development in sub-Saharan Africa, IFDC report to AFAP

Minde I, Jayne T, Crawford E, Ariga J, Govereh J (2008) Promoting fertilizer use in Africa: Current issues and empirical evidence from Malawi, Zambia and Kenya (ReSAKSS Working Paper No. 13)

Morris M, Ronchi L, Rohrbach D (2009) Building sustainable fertilizer markets in Africa. Prepared for presentation at the conference Towards Priority Actions for Market Development for African Farmers. Nairobi, Kenya, May 13-15

Morris M, Kelly V, Kopicki R, Byerlee D (2007) Fertilizer Use in African Agriculture: Lessons Learned and Good Practice Guidelines. World Bank, Washington, D.C.

NEPAD (2013) Annual report on progress in the implementation of the *Abuja Declaration on Fertilizers*

Pauw K, Thurlow J (2014) Malawi's farm input subsidy program: where do we go from here? (IFPRI Policy Note 18)

Ricker-Gilbert J, Jayne T (2012, August) Do fertilizer subsidies boost staple crop production and reduce poverty across the distribution of smallholders in Africa? quantile regression results from Malawi. Presented at the International Conference of Agricultural Economists, Brazil.

Ricker-Gilbert J, Jayne T, Chirwa E (2011) Subsidies and crowding out: a double-hurdle model of fertilizer demand in Malawi. American Journal of Agricultural Economics 93(1):26-42

Van Kauwenbergh SJ (2006) Fertilizer raw material resources of Africa, (IFDC R-16). International Fertilizer Development Center

Van Kauwenbergh SJ (2010) World phosphate rock reserves and resources, (IFDC T-75). International Fertilizer Development Center

Wanzala M, Fuentes P, Mkumbwa S (2013) Practices and policy options for the improved design and implementation of fertilizer subsidy programs in Sub-Saharan Africa (NEPAD Planning and Coordination Agency Policy Study). NEPAD-IFDC-FAO-AGRA

Wanzala M, Groot R (2013, May) Fertilizer market development in sub-Saharan Africa Proceedings 731. Paper presented to the International Fertilizer Society at a Conference in Windsor, United Kingdom

Wanzala M, Bumb B, Groot R (2009, May) Fertilizer markets in Africa: Challenges and policy responses. Paper presented at ILRI/AGRA conference Towards Priority Actions for Market Development for African Farmers, Nairobi, Kenya

Wanzala-Mlobela M, Fuentes P, Mkumbwa S (2012) Practices and Policy Options for the Improved Design and Implementation of Fertilizer Subsidy Programs in Sub-Saharan Africa. NEPAD Agency Policy Study

Wiggins S, Brooks J (2010) The use of input subsidies in developing countries. Global Forum on Agriculture, Policies for Agricultural Development, Poverty Reduction and Food Security, OECD Headquarters, Paris

Appendix Table 8.1 *Fertilizer Subsidy Programs in Four African Countries: Some Comparative Data (2014)*

Variable	Malawi	Nigeria	Rwanda	Tanzania (2010)
Types of fertilizers subsidized	NPK (23:21:0 +48); DAP; urea; CAN; Compound D; Super D	Urea; NPK compounds and blends; phosphate compounds	Urea, DAP, NPK formulations	DAP, Urea
Subsidy rate (% of market price)	97%	45-50%	NPK = 16% Urea = 28% DAP = 33%	50%
Total fertilizer subsidy budget (U.S. $)	U.S. $147.8 million	$408.5 million	$10 million	U.S. $63.6 million
Subsidy as % of agriculture budget	42%	40-50%	8%	10%
Subsidy as a % of total government budget	8%	Not available	0.4%	0.79%