



## Improving the effectiveness, efficiency and sustainability of fertilizer use in South Asia

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Fertilizer has played a key role in increasing crop yield in South Asian countries following the widespread adoption of green revolution technology, but now yield growth rates are declining. With the degradation of natural resources and changing climatic conditions in the region, there are increasing concerns about food security.

Cabbage farmers in Peacock Hill colony in Doragala, Gampola district, Sri Lanka. Farmers in this fertile area have formed collective groups to get a better price for their vegetables.

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### Key messages

Fertilizer use in South Asia needs to become more efficient, effective and sustainable, and to be supported by an appropriate policy framework, if food security is to be achieved. Policy initiatives are needed to:

- Expand fertilizer production capacity, improve the availability of quality fertilizer and make the fertilizer distribution system more efficient.
- Promote location, soil and crop-specific fertilizer use; protect adverse environmental consequences and encourage farmers to adopt more efficient fertilizer application techniques.
- Enhance the effectiveness of extension services to improve the efficiency of fertilizer use.
- Emphasize synergy between fertilizer policy and complementary inputs (eg irrigation).
- Expand credit facilities and redesign fertilizer subsidy policies.
- Promote regional cooperation in the fertilizer sector and harmonize subsidy policies across the region.

This briefing paper is one of the 10-part Global Development Network (GDN) Agriculture Policy Series for its project, 'Supporting Policy Research to Inform Agricultural Policy in Sub-Saharan Africa and South Asia'. It is based on a longer synthesis paper, *Improving the effectiveness, efficiency and sustainability of fertilizer use in South Asia*, which draws on extensive published and unpublished research. The full paper can be downloaded at: [www.agripolicyoutreach.org](http://www.agripolicyoutreach.org)

It will be of value to policymakers, experts and civil society working to improve agriculture in South Asia.

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Fertilizer has played a key role in increasing crop yields in South Asian countries following the widespread adoption of green revolution technology, but now yield growth rates are declining. This slowdown in the growth of crop production, together with the degradation of natural resources and changing climatic conditions, has increased the concerns regarding food security in South Asia.

The current pattern of use, with heavy reliance on nitrogenous fertilizer, coupled with poor nutrition management, lack of complementary inputs, declining soil fertility, and weak marketing and distribution systems, have all emerged as major impediments to improving fertilizer effectiveness in the region. Experts are now questioning whether its constant use is sustainable.

Policymakers must seize the initiative to transform the situation and counter the negative effect of inefficiencies arising from policymaking, which has led to price distortion and a reduction in the range of inputs being used. Fertilizer can have a role in reducing poverty and food insecurity if the right policies and practices are developed.



A farm laborer in Narayangonj, Bangladesh sprays a potato field with fertilizer. World fertilizer price spikes result in poorer farmers cutting back on fertilizer use and reducing productivity.

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### Background to the research

The aim of the research project on which this briefing paper is based, was to identify the constraints to efficient, effective and sustainable use of fertilizer in South Asia by looking at existing studies of agricultural practice. The results highlight the main barriers for the region and for countries with similar agro-climatic characteristics, although it is important to point out that national and region-level conclusions cannot necessarily be extrapolated from evidence from one particular area, because of possible significant variations.

There are different policy environments for countries in South Asia. In Bangladesh, the system of pricing, marketing, procurement and distribution of fertilizer along with provision of subsidies, was the responsibility of the government from 1991 to 1995. In 1991, privatization of the fertilizer trade was introduced along with a partial removal of subsidies. In India, the production, distribution, movement and prices of fertilizer were also regulated by the government. A nutrient-based subsidy policy was followed in Nepal until the deregulation of the fertilizer trade in 1997.

## Factors affecting the effective, efficient and sustainable use of fertilizer

**Price** of fertilizer, output prices and other input prices are all important economic factors. Internationally, for instance, the prices of triple super phosphate (TSP), diammonium phosphate (DAP) and muriate of potash (MOP) increased suddenly at the end of 2003. This had the effect of cutting demand from poor farmers without financial flexibility. Partly or fully subsidising fertilizer prices can even out a spike in cost.

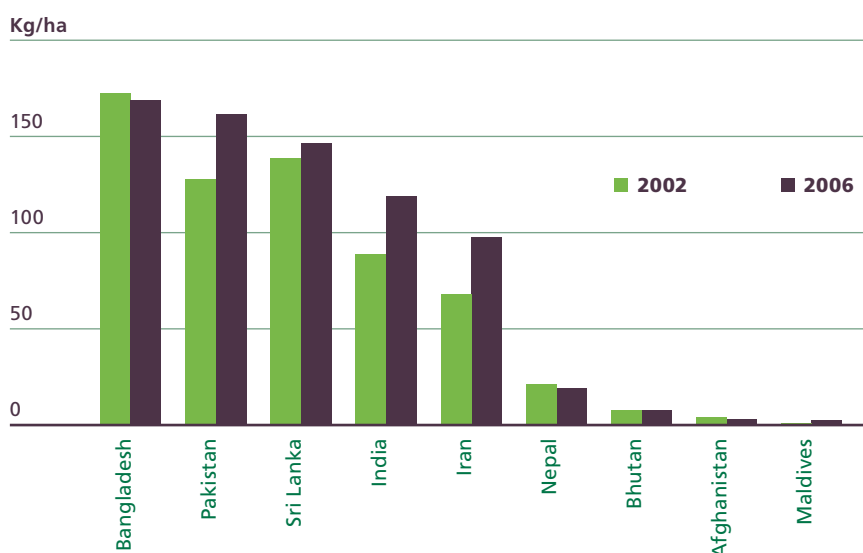
**Transport** costs for fertilizer in South Asia are relatively high. In India, for example, research has shown that the cost ranges from 37 per cent to 86 per cent of total marketing costs (in Bangladesh it is 76 per cent). For Nepal, the cost of imported fertilizer is high because the country is landlocked.

**Soil quality, climate, fertilizer use, nutrient management, irrigation and seeds** are all important determinants of crop yield and the uneven application of fertilizer types is particularly significant as the practice is widespread across South Asia (see chart below). In India, for example, nitrogen-based fertilizers account for 65 per cent of use, phosphate-based fertilizers for 25 per cent and potassium-based, 10 per cent. An imbalance like this seriously affects crop production.

**Irrigation and better seeds** are the other complementary inputs needed for the efficient use of fertilizer. Individual groundwater irrigation systems have affected South Asia's large-scale irrigation schemes and made them under-perform. And despite the potential benefits of drip and sprinkler irrigation methods, studies show that the rate of adoption in South Asia is low and slow.

**Institutional factors** such as inadequate extension services, under-use of domestic capacity, limited access to credit and inefficient distribution systems all constrain the optimal use of fertilizer. Timely availability of good quality fertilizer is a principal concern. In India, around 70 per cent of quality problems are due to adulteration or misbranding, 20 per cent to deliberate manufacture of poor quality goods and the remaining 10 per cent to the difference in quality of fertilizer sold on the official and black markets. In Bangladesh, 52 per cent of fertilizers sampled were found to be sub-standard.

**Fertilizer use intensity in South Asian countries**



Note: Fertilizer use intensity is the amount of fertilizer (nutrients) consumed by agriculture per hectare of temporary and permanent cropland.

Source: World Resources Institute (WRI), Earth trends searchable database results.



There are at least four significant factors that have influenced food security and rural livelihoods in South Asia. They relate to fertilizer subsidies, investment in the agriculture sector, other input subsidies and the impact of sub-optimal use of fertilizer.

### Policy measures adopted by Indian government

- January 2007: Establishment of a Fertilizer Monitoring System (FMS). Formulation of guidelines for production and use of 'customized fertilizers'.
- June 2008: Introduction of nutrient-based pricing of subsidised fertilizers.
- April 2010: Nutrient-Based Subsidy (NBS) policy.

### Fertilizer subsidy

During the period of fertilizer deregulation, subsidies were removed, with a knock-on effect of putting fertilizer out of the reach of many poor farmers. Since the beginning of the millennium, all South Asian countries have reintroduced fertilizer subsidies in a bid to tackle food insecurity.

Fertilizer subsidies were first introduced in the 1960s in Bangladesh to encourage the use of chemical fertilizers. The subsidy to the agricultural sector rose rapidly over the years and is now more than 0.7 per cent of GDP. The amount represents around 0.7 per cent of total public expenditure on agriculture by the government every year.

In India, the government budget support for fertilizer rose by more than 30 times from Rs 2.6 billion in 1976 to Rs 80 billion in 2000 (see Fan, Thorat and Rao, 2004). As a share of GDP, the increase has been from 0.07 per cent to 0.61 per cent over the period. The fertilizer support budget as a share of agricultural GDP has become more than five times larger than the public spending on agricultural research and development.

Subsidized fertilizers played a significant role in raising agricultural production during the initial years after their introduction but their contribution seems to have declined as their use has grown.



Bakerganj, Barisal, Bangladesh. A couple water their field in Srimangal. They receive seasonal microfinance loans used for the purchase of seeds, fertilizers and pesticides.

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One study by Singh in 2004 shows that paddy and wheat farmers are the main beneficiaries of fertilizer subsidy, followed by cotton and sugarcane farmers. Looking at the total amount of fertilizers used:

- Paddy farmers consume 35 per cent.
- Wheat farmers consume 19.3 per cent.
- Cotton growers consume 5.8 per cent.
- Sugarcane growers consume 5.5 per cent.

Fertilizer use per hectare is also higher for paddy (79.7kg) and wheat (85.32kg) farms followed by 28.8kg for coarse cereals and 42kg for other crops.

Not all government budget support for fertilizer goes to farmers in India, with a large share ending up with the domestic fertilizer industry. According to one estimate by Gulati and Narayanan in 2003, farmers' overall share of fertilizer subsidy is about 50 per cent.

Before 1997–98, fertilizer subsidy in Nepal was used extensively to encourage the use of fertilizers. Financing the subsidies required higher taxes and increased external borrowing. Although those subsidies led to increased use of fertilizers, the costs were very high.

The government of Nepal initiated the deregulation of the fertilizer trade in November 1997, along with the complete elimination of fertilizer subsidy on diammonium phosphate and muriate of potash and a phased removal of subsidy on urea, completed by November 1999. In March 2009, the government started to distribute fertilizers at a concessionary rate for small and marginal farmers on a limited scale. The current provision of subsidy is limited to a fixed quantity of 100,000 metric tons of fertilizers per year with an estimated outlay of NRs 1.5 billion (US\$25 million). The farmers with a landholding size of up to 0.75 hectares in the hills and mountains and up to 4 hectares in the terai (Himalayan foothills) are eligible for the subsidy. There is also a provision for meeting the transport cost for 26 remote districts through a special program.

'Plenty of both organic and inorganic fertilizers are being used for farming around Panchkhal, especially diammonium phosphate mixed with farmyard manure as it appears not to have many negative effects. Otherwise, crops sometimes develop deformities.

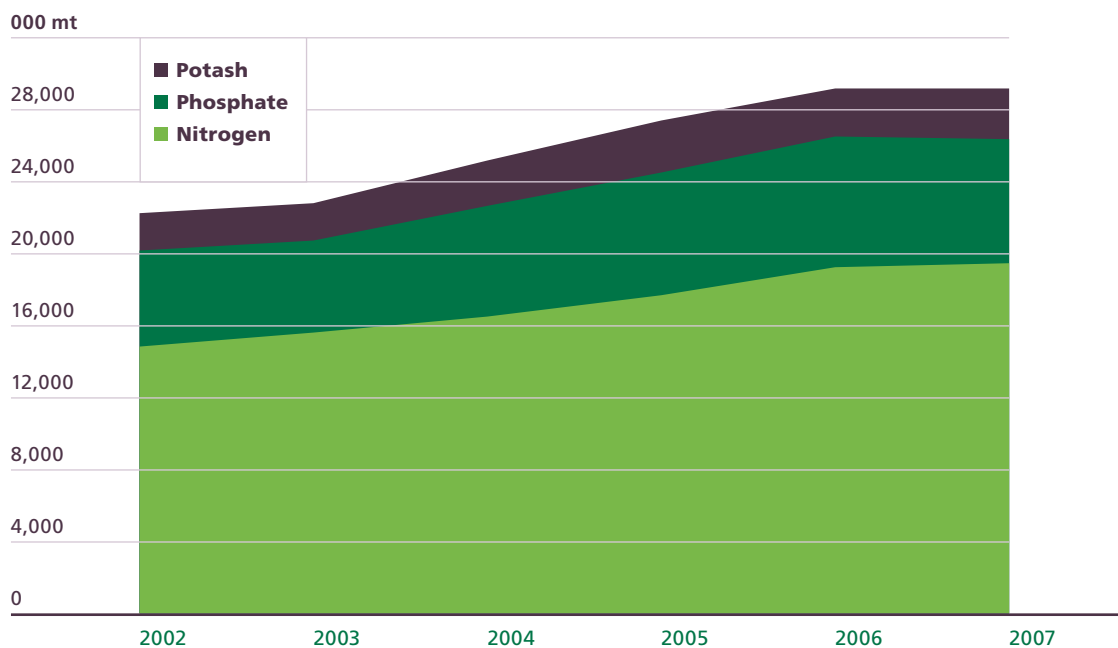
Pesticides, however, are not used properly; they are not used in a balanced way and no safe application techniques or equipment, such as a mask, are used either. Pesticides are mainly used for cucumbers, tomatoes, and bitter gourds to improve their looks. Potatoes grow very well because of the use of both organic and inorganic fertilizers. In fact, these fertilizers are used in greater doses than recommended by extension personnel, in anticipation of much higher yields.'

**Ramesh Sapkota**

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### Consumption of fertilizer by nutrient in South Asia



Source: Food and Agriculture Organization online database.

#### Investment

Public spending on agricultural research, education and rural infrastructure is the most effective way of promoting agricultural growth and poverty reduction in India.

#### Input subsidies

Subsidies for fertilizer, electricity, credit and irrigation make little difference to progress in promoting agricultural growth and poverty reduction, unlike the impact they made in earlier decades.

#### Unbalanced use of fertilizer

Overuse of subsidized urea has had devastating social and ecological impacts in South Asia. Along with unbalanced use of other fertilizers, it has led to serious depletion of organic matter and a consequent deterioration of soil fertility, nutrient deficiencies, an increase in soil acidity and degradation of the soil's physical and chemical properties.

In Bangladesh, high cropping intensity has caused the soil to be degraded so much that currently the organic matter content in the soil is only at 1–2 per cent, whereas it should be maintained a minimum of 3 per cent.

In Nepal, soil acidification has been on the rise and it is reported that 80 per cent of the soil samples analyzed by the Department of Agriculture show acidic features. Acidification stems from excessive use of nitrogenous fertilizers by poorly informed farmers using low quality fertilizer. Increasing the use of organic fertilizer would be one way of reducing the adverse effects on the environment.



The sustainable use of fertilizer should be at the heart of any strategy for achieving food security in South Asia. Agricultural productivity needs to increase in a sustained way, leading to job creation and growth not only in agriculture but also in related sectors. If fertilizer is used sustainably, in combination with effective irrigation, better quality seeds and other yield-augmenting inputs, it can once again play a role in reducing poverty – especially in regions with irrigated agriculture.

For this to be achieved, a number of policy interventions are recommended:

### ■ **Joint ventures to manufacture fertilizer**

Countries with low fertilizer production capacity could invest in factories in countries with high production potential. The use of fertilizer will then need to be much more nuanced, depending on location, crop-specific requirements based on soil types, agro-ecological zones and nutrient supplying soil capacity.

### ■ **Investment in extension services**

Many more trained and well-equipped people are needed to work with the large number of small-scale farmers in South Asia. They should receive continuous training in order to give advice on crop-specific use of fertilizers.

### ■ **'Fertigation'**

The application of fertilizers using the existing irrigation system or 'fertigation' should be promoted by using 100 per cent water soluble fertilizers to enhance the effectiveness of both water and nutrients. By recognizing the synergy between different agricultural inputs, their use will be improved.

### ■ **Efficient distribution**

Distribution systems must be made more effective and infrastructure improved to reduce overall marketing costs for fertilizer, especially in mountain and difficult-to-access regions.

### ■ **Access to credit**

In the right quantities and amount, credit from local, specialist banks and microfinance institutions will support the balanced use of fertilizer, which is crucial to supporting its sustainable use.

### ■ **Quality assurance and testing systems**

Adulterated fertilizers have penetrated South Asian markets with serious consequences for production, health and the environment. Mechanisms to ensure systematic quality testing are needed, along with sanctions for people involved in fertilizer adulteration.

### ■ **Harmonization of fertilizer policies**

Most importantly, with such varying resource endowment across the region, countries should aim to harmonize their subsidy policies to reduce variation in fertilizer prices and discourage trade through unofficial channels.



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