Redesigning India's urea policy

Sid Ravinutala

MPA/ID Candidate 2016

in fulfillment of the requirements for the degree of Master in Public Administration in International Development, John F. Kennedy School of Government, Harvard University.

Advisor: Martin Rotemberg

Section Leader: Michael Walton

ACKNOWLEDGMENTS

I would like to thank Arvind Subramanian, Chief Economic Adviser, Government of India for the opportunity to work on this issue as part of his team. Credit for the demand-side solution presented at the end goes to Nandan Nilekani, who casually dropped it while in a car ride, and of course to Arvind for encouraging me to pursue it. Credit for the supply-side solution goes to Arvind, who from the start believed that decanalization throttles efficiency in the market. He has motivated a lot of the analysis presented here.

I would also like to thank the rest of the members of 'team CEA'. We worked on fertilizer policy together and they helped me better understand the issues, the people, and the data. The analyses of domestic firms and the size and regressivity of the black market were done by other members of the team (Sutirtha, Shoumitro, and Kapil) and all credit goes to them. Finally, I want to thank my wife, Mara Horwitz, and friend and colleague Siddharth George for reviewing various parts and providing edits and critical feedback.

Finally, I would like to thank Michael Walton and Martin Rotemberg for providing insightful feedback and guidance as I narrowed my policy questions and weighed possible solutions.

I also had the opportunity to contribute to the chapter on fertilizer policy in India's 2016 Economic Survey. A large part of this analysis has been presented there.

Executive summary

India has often been criticized as being a 'Subsidy Raj'. It spends almost 2% of GDP (IMF 2016) on food, fertilizer, and fuel subsidizes. Since 2014, fertilizer has been the largest subsidy after food. It remains untargeted, resulting in substantial fiscal costs for a government committed to fiscal consolidation. This policy paper looks at the issues plaguing the market for urea, the most commonly used and most heavily subsidized fertilizer, and suggests some policy reforms.

The urea market is almost fully controlled by the government. First, the price of urea is fixed at Rs. 5350 per metric tonne. Second, manufacturers are paid on a cost-plus basis leaving little incentive to improve efficiency. Third, under the Fertilizer Movement Control Order, the manufacturers, importers, and distributors are directed where to sell. Finally, only four firms are allowed to import urea. They are told when and how much to import, and the subsidy given to them is consignment-specific.

By using data available from the Fertilizer Management System, we show that availability constrains sales. Further, since fertilizer subsidy is not targeted, we show that around 22% of the subsidy accrues to these richer farmers. More seriously, almost 36% of the subsidy is lost through leakage to industry or smuggled across borders.

Considering the political and administrative factor, we suggest two reforms.

First, restrict the amount of subsidized fertilizer that can be purchased. This would require a farmer to scan his Aadhaar card before purchasing the fertilizer. The system would not discriminate between farmers and non-farmers, or rich and poor farmers, making it administratively simple.

Second, following the demand-side reform, we suggest that imports be switched to an Open General License (OGL) allowing anyone to import urea at any time. This will untie the importers and allow them to respond to shortages in the market.

States should be encouraged to experiment with different limits on subsidized fertilizer. Since it is currently unrestricted, states may wish to set a very high limit and reduce it slowly, ensuring small and marginalized farmers are not impacted. States with means to identify a farmer, either through digitized land records or Kisan Credit Cards, may wish to further refine targeting. Note that the order of implementation is essential. Since the market is plagued with leakages, implementing decanalization before constraining demand would result in large fiscal costs.

1 Introduction

In a country where 47% of the people are engaged in agriculture[1], timely access to fertilizer is critical. To ensure this, the Government of India (GOI) has classified fertilizer as an "essential" commodity. The Department of Agriculture and Cooperation controls where and how much fertilizer can be sold.

In this paper, we explore the various issues plaguing the market for urea, the most abundantly used fertilizer, in India. We analyze three of these issues – availability, fiscal sustainability, and imbalance in usage of fertilizer – in more detail. We weigh various policy options to tackle these issues and finally propose a strategy for implementation and scale-up.

2 Background

India has often been called the "Subsidy Raj". About 61% of India's expenditure goes toward direct and indirect subsidies, one of the highest in its income bracket (Figure 1). Of these, fertilizer has the second largest subsidy bill at USD $11.2 billion a year (IMF 2015).

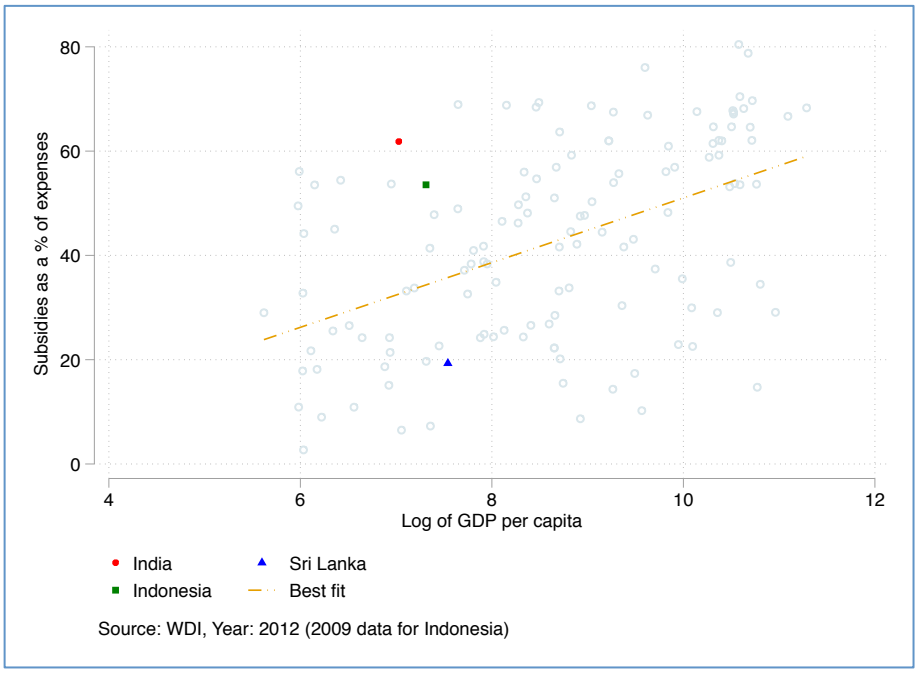


Figure 1: Subsidy as a percentage of expenses

Shortages, especially for urea, are common. Yields have stagnated (WSJ 2010) and are now lower than some of its poorer neighbors. Overuse, or rather imbalanced use of fertilizer, has depleted essential nutrients in the soil and significantly reduced fertility. Understanding

[1] World Bank, 2014. http://data.worldbank.org/

how the current policy evolved and why it persists is necessary before attempting any reform.

Fertilizer and the Green Revolution

In the 1960s India was struggling to feed its people. The previous decade had seen an increase in production at the extensive margin as new land areas were brought under cultivation. With this source of increasing production practically depleted, India was forced to depend on other countries, especially the US, for grain imports to feed its growing population. This was a great strain on India's foreign reserves and flew in the face of India's desire to be self-sufficient, which was deemed necessary for it to continue its position of non-alignment.

A book by William and Paul Paddock released around this time, with a name more suited for reality television, "Famine 1975 – America's Decision: Who Will Survive?" classified countries into three categories: 'walking wounded', 'should receive food', and 'can't be saved'. The brothers believed that the US was the "sole hope of the hungry nations" and India fell squarely in 'can't be saved' category; giving it food was equivalent to "throw(ing) sand in the ocean".

Yet, when 1975 came around, the story was quite different.

India's cereal production increased 45% between 1967/1968 -1977/1978 (Pinstrup-Andersen, Hazell 1985). Not only was India self-sufficient in food, it even sent food shipments to several countries like Afghanistan, Bangladesh, and Vietnam. This reversal of fortune came about due to the Green Revolution. India adopted a number of land reforms, improved infrastructure, and adopted high yielding varieties (HYVs) of seeds. These HYVs were more responsive to chemical fertilizer and therefore large amounts of it were required to maximize yield.

Regulation and subsidy

Since fertilizer was critical to India's Green Revolution, the government passed the Fertilizer Control Order in 1957 to regulate the sale, pricing, and quality of fertilizer. Movement Control Order was added in 1973 to regulate the distribution of fertilizer as well.

Interestingly, no subsidy was paid on fertilizer before 1977. The oil crisis in 1973 increased the price of fertilizer leading to a decline in consumption and an increase in food prices. In 1977, the government intervened by subsidizing manufacturers.

The burden

In 1991, the country was faced with a ballooning fiscal deficit and an impending foreign exchange crisis. Fertilizer subsidies had increased substantially from Rs. 47 million to Rs. 388 million in 1991 (Kaur, Sharma 2012). This fiscal burden weighed heavy on the country's finances. Along with opening up the economy, the government sought to decrease the size of the subsidy on all fertilizer and liberalize the market. Lobbyists fought hard against this and were triumphant. As a compromise, DAP and MOP were decontrolled, but urea, the most abundantly used fertilizer, continued to be controlled by the government.

Box 1: Three major nutrients

There are three major nutrients required for maximizing agriculture yield:

1. Nitrogen (N): Urea is the main source of Nitrogen. This is the most abundantly used fertilizer.
2. Phosphorus (P): Diammonium Phosphate (DAP) is the most widely used phosphate fertilizer.
3. Potassium (K): the third largest crop nutrient group, after nitrogen and phosphorous. Muriate of potash (MOP) is the main source of this nutrient.

The optimal ratio of application of these three nutrients is around 4:2:1 (N:P:K) but varies based on soil type.

With P and K prices being decontrolled, the price of these fertilizers in market became comparatively high. As a result, farmers reduced consumption of P and K while consumption of N in the form of subsidized urea increased significantly (Figure 2). This led to a severe imbalance in the consumption of these fertilizers that adversely impacted soil health and long-term yield.

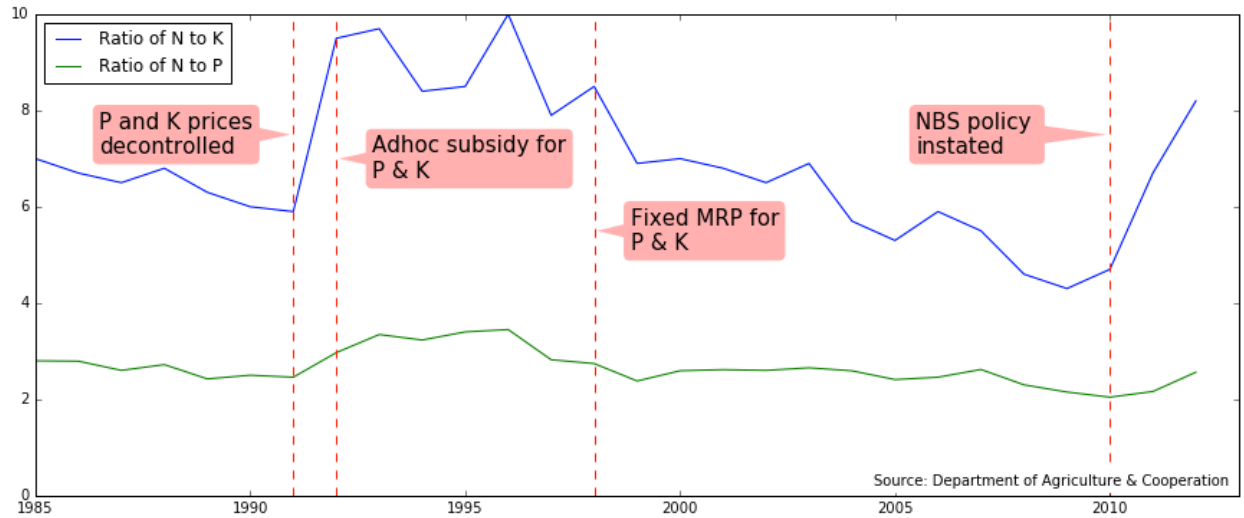


Figure 2: Ratio of nutrient usage

The government reinstated subsidies for P and K the year after and went through a number of policy tweaks without ever changing the maximum retail price (MRP[2]) for urea. The subsidy burden increased by 500% between 2005 and 2010 as world prices again increased substantially. The government was again forced to reassess its subsidy policy and instated the Nutrient Based Subsidy (NBS) for fertilizers other than urea. NBS provides a fixed amount of subsidy based on the amount of nutrient in the fertilizer and allows manufacturers to set MRP. Again, MRP increased substantially (Figure 3) and utilization ratios deteriorated.

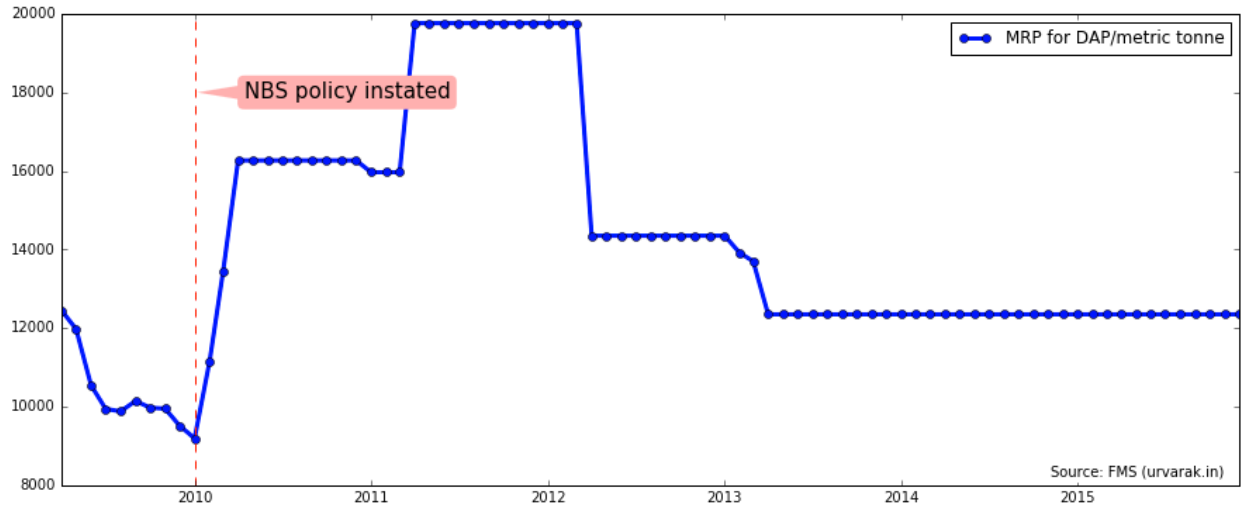


Figure 3: Price of DAP since 2009

Why does it persist?

The classical argument for input subsidies, such as fertilizer, is to increase uptake of new technology. Information asymmetries or learning costs lead to underuse of fertilizer, and temporary subsidies might be necessary to increase uptake to optimal levels. Over time, farmers would gain knowledge of the product through usage, leading to reduction in information asymmetries. Ideally, input subsidies could be rapidly phased out as farmers learn about benefits and correct usage. Yet, after 60 years of use of chemical fertilizers in India, the subsidy persists.

This is in part because the fertilizer subsidy is seen as a way of social protection for the poor and marginalized farmer.

The main reason the subsidy persists is one of political economy. Even in 1992, right after P and K fertilizers were decontrolled, the government was well aware of the growing imbalance between the use of urea versus P and K fertilizers[3]. Since it was not politically

[2] The government sets the maximum price at which urea can be sold.
[3] See 6.1.8, Department of Fertilizer, Annual Report 2014-15

possible to decontrol urea as well, they instead implemented a series of second-order policy reforms. Most of these have seen marginal improvements but failed to tackle the problem at its root. Even in its latest incarnation, the price differential remains large. Urea is subsidized by almost 75% while DAP and MOP by just 35%. Further, as Box 2 shows, the way this subsidy is given also varies. For DAP and MOP, percentage of subsidy is fixed, allowing some pass-through of changes in world prices. In contrast, the MRP is fixed for urea and the percentage of subsidy adjusts to accommodate this. Effectively, this allows for zero pass-through of changes in world prices.

It is quite possible that a catalyst, like the fiscal crisis in 1991 and 2010, may be necessary to shift the politics on urea reform. But with world prices for fertilizers at an all-time low, this opportunity might not arise for a while.

Box 2: Prices and subsidies for various fertilizers

Pricing mechanism for urea is different from P&K fertilizers:

- Urea:
  - Retail price: Rs. 270/50 kg bag
  - Retail price calculation: **Fixed by government**
  - Cost of supply: Variable. Approx Rs. 970/50 kg bag
  - Subsidy rate: Variable. Approx Rs. 700/50kg bag
  - Subsidy calculation: Cost of supply – Retail price
- DAP:
  - Retail price: Variable. Approx Rs. 1190/50 kg bag
  - Retail price calculation: Cost of supply – Subsidy rate
  - Cost of supply: Variable. Approx Rs. 1810/50 kg bag
  - Subsidy rate: Rs. 620/50 kg bag
  - Subsidy calculation: **Fixed by government.**
- MOP:
  - Retail price: Variable. Approx Rs. 850/50 kg bag
  - Retail price calculation: Cost of supply – Subsidy rate
  - Cost of supply: Variable. Approx Rs. 1300/50 kg bag
  - Subsidy rate: Rs. 450/50 kg bag

Apart from political resistance, there is also a much larger reason why the urea subsidy persists. Food prices in India remain extremely low. As part of the National Food Security Act (NFSA), India aims to provide subsidized food grains to around two-thirds of the population. Since urea is a major component of the input cost, any increase in its cost would require food prices to go up as well. The low minimum support prices (MSP), NFSA, and fertilizer policy all together sustain the current equilibrium.

3 Problem Statement

The fertilizer market in India suffers from numerous distortions. Some of these are discussed in Section 6. In this paper, we focus specifically on the urea market and address three key problems:

(i) **Availability:** Since sale of urea is controlled, the government needs to estimate demand in each of the regions. Inaccurate estimation of demand of urea had led to large shortages in the market. Delays in imports also have led to unavailability of fertilizer around planting seasons when the need is most critical.

Significant quantities are siphoned to industries and smuggled over borders where urea costs significantly more. This again reduces the quantity available to the farmer.

Together, these factors have reduced the supply of urea and led to a black market where it is sold at prices well above the government mandated maximum.

(ii) **Usage:** The optimal ratio of consumption of the three major fertilizers, urea, DAP, and MOP, is around 4:2:1, with some variation based on local soil conditions. In 2010, the prices of fertilizers other than urea were decontrolled, leading to a significant increase in their market prices. This growing price differential between urea and other fertilizers led farmers to substitute away from DAP and MOP to urea. Data from the Department of Agriculture shows that since 2010, the ratio of consumption has worsened to 8:3:1 (Figure 2), leading to diminishing crop yields and increased soil toxicity.

(iii) **Fiscal burden:** The government budgeted almost Rs. 730 billion for fertilizer subsidies in 2015, making it the largest subsidy in absolute terms after food. Urea, the most commonly used fertilizer, makes up almost 70% of the fertilizer subsidy allocation. Subsidy for urea has increased from Rs. 780 million in 2002 to Rs. 4,300 million in 2014[4].
The finance ministry set a fiscal deficit target of 3.0% of GDP by 2017/18 from 3.9% in 2015/16. Cutting almost an entire percent of GDP in two years will not be easy. Any policy solution to be politically viable needs ensure that the fiscal burden is reduced, or at the very least, not worsened.

[4] http://data.gov.in/

4 Literature Review

The combination of movement control, price control, and import control creates a unique policy environment. Though very few parallels exist in other countries, there is a substantial amount of literature from India analyzing the impact of the current policies.

Doward (2009) and Morris et al. (2007) consider the role of input subsidies in agriculture in poor rural economies in Africa. They discuss the conditions under which input subsidies are beneficial and common pitfalls when designing such a subsidy policy. Morris et al. (2007, 103-4) describe ten features of smart subsidies: 'promoting fertiliser as part of a wider strategy', 'favouring market-based solutions' and 'promoting competition' in input supply, 'paying attention to demand', 'insisting on economic efficiency', 'empowering farmers', 'involving an exit strategy', 'pursuing regional integration', 'ensuring sustainability', and 'promoting pro-poor economic growth'. The current policy fails on most of these; we keep these ten features in mind when designing a solution.

A majority of the literature focuses on demonstrating the negative impact of the current fertilizer policy. Fan et al (2007) lay the main arguments against input subsidies. They highlight the critical role it played during the Green Revolution but conclude that "Agricultural input and output subsidies have proved to be *unproductive, financially unsustainable, environmentally unfriendly* in recent years, and contributed to *increased inequality* among rural Indian states" (emphasis added). They call for subsidies to be cut back while increasing spending on agricultural research and development, rural infrastructure, and education. While they make a technically sound argument, they do not consider how such a policy might be implemented given India's political economy.

Kapur (2012) makes similar arguments with an increased focus on domestic manufacturing. He lists three major issues with the current fertilizer policy: (a) domestic manufacturers are not sufficiently compensated; (b) the fiscal burden of urea subsidies has increased steadily over the years though yields have plateaued; and (c) the large gap between the price of urea and other fertilizers has encouraged overuse leading to severe soil degradation. He argues that there is little rationale for subsidizing urea to the current extent and pushes for deregulation of urea pricing. In contrast to Fan et al, he admits that removing all subsidies is not economically desirable or politically feasible, and policy should be reformed to encourage investment in domestic manufacturing and better targeting of poor farmers.

Sharma (2012) argues against deregulation of the fertilizer industry and dismantling of subsidies. His main argument stems from his analysis showing "small and marginal farmers receive about 53 per cent of the subsidy, higher than their share in total cropped area

(44.3%)." We redo this analysis using the latest Cost of Cultivation data to show this not to be true. He claims that deregulation would lead to large price increases making agriculture unprofitable. Sharma's stance is another form of the "subsidy as social protection" argument that Chirwa and Dorward (2013) refute. They show that, in the context of Malawi, compared to cash transfers, social protection benefits of fertilizer subsidies are significantly lower. Sharma concludes by asking for better targeting and rationing, which we attempt to address in this paper.

Sharma and Thaker (2009) argue against direct cash transfers to the farmer as the money may be not be used to buy fertilizer, lowering crop yields. They support this with little evidence. This would be true if farmers were unaware of the true benefits of fertilizer use, which is highly unlikely given that the use of chemical fertilizers has been common practice for almost 50 years.

The issue of reduction in yields due to overuse of urea is addressed by Tiwari (2001). He shows that using just urea, and not other fertilizers, leads to declines in yields over time as naturally occurring nutrients in the soil are exhausted. He pushes for policies that recognize this problem and incentivize balanced fertilizer usage. The Nation Academy of Agricultural Studies (NAAS 2009) paper on crop response and nutrient ratio goes even further. It argues that the classicial 4:2:1 ratio for application of N, P, and K may no longer be valid. The paper suggests that even higher levels of P and K may be necessary in some regions. This strengthens our case even further for encouraging use of P and K over N.

Barnwal (2014) documents the effect of a policy that made biometric-authentication mandatory for receiving cooking gas (LPG) subsidy. By improving targeting, the policy reduced black market supply and increased commercial sales. It also reduced 11% of total sales, which he suggests are from a reduction in subsidy diversion. This paper provides strong evidence for biometric authentication as a viable solution to improve targeting.

5 Data sources

The Ministry of Fertilizer records the monthly movement, availability, and sales of urea and DAP at the district level on the **Fertilizer Management System (FMS)**. This data is publicly available on www.urvarak.com. I scraped data from this website for the last 8 years.

The **agriculture input survey** is done every 5 years and captures the quantities of fertilizer used by farms of various sizes at the district level. The latest available dataset is from reference years 2006-7. Data for reference years 2010-11 is expected to be released later this year.

DATAMYNE publishes trade data for a number of countries. I use data on **imports of urea** into India. I also sourced data for the US, the largest importer of urea after India, to consider the impact of decanalization on prices.

The **Cost of Cultivation survey** is done each year by the Department of Agriculture. It collects data on various inputs from a regionally representative sample. The data is primarily used to determine the minimum support price (MSP) set by the government. Here we utilize this data to understand the de-facto prices paid by farmers for urea.

I also conducted **qualitative surveys of farming communities** east of Udaipur in Rajasthan. The intent was to better understand context and hear directly from farmers on how they make decisions on the fertilizer usage. Though not a representative sample of farmers, it provided me with new insights into the problems currently faced by farmers.

6 Issues in the urea market

The urea market has numerous distortions that make it a unique and complex problem. Though the scope of this paper remains limited to the three issues presented in Section 3, understanding all the factors in play are necessary to develop an effective response.

The following section splits the issues into those of supply or production, and demand or sales. Finally, we consider the political economy of the market.

6.1 Supply of urea

6.1.1 Domestic production

To meet the needs of the Green Revolution, the government had to ensure sufficient supply of fertilizer[5] and establish numerous fertilizer plants. Today, there are 30 manufacturing units with varying levels of efficiency. The government's desire to be self-sufficient in urea has meant that shutting down units, no matter how inefficient, is not acceptable. This has led to a model where the subsidy amount given to a firm is calculated based on their cost of production[6]. As a consequence, inefficient firms with a high cost of manufacturing thrive and have little incentive to lower costs.

Figure 4 depicts this practice. It plots the production cost of a firm against the subsidy it receives. The fit is perfect, signifying that the more inefficient the firm, the more it receives

[5] see Posgate(1974) for early industrial policy for fertilizer plants

[6] Under the 'New pricing scheme', the government estimates the cost of production for units based on the feedstock, technology, and age.

by way of subsidies. Last year the government revised its policy, but the essential features of being firm-specific and inversely related to efficiency remain.[7]

Further, even the efficient firms are hurt. Any efficiency gains made accrue to the government, not the firm, as subsidy amounts are adjusted downwards. The slim margins offered to domestic firms mean that production of fertilizer is not very profitable. A number of plants have stopped production, while some big conglomerates like Tata Chemicals, which owns one of the most energy-efficient urea units, have threatened exit (Jauhari 2015). To add to this, there have been large delays in the payment of subsidy by the government. The industry is currently owed Rs. 400 billion (USD 60 million) and claims that it is being forced to borrow to cover the gap between expenditure and revenues.

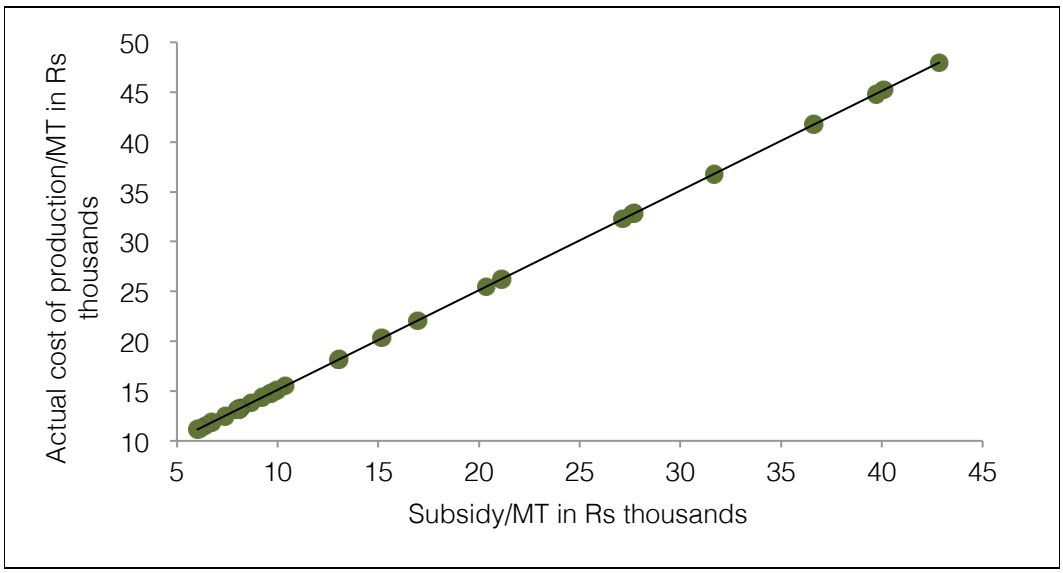


Figure 4: Incentivizing Inefficiency: Comparing Production Cost Versus Subsidies (CREDIT: Team CEA)

It has also been questioned if India should be manufacturing urea. The primary feedstock for urea is natural gas, of which India has very little. Instead of paying the high cost of supporting inefficient plants, it may be better off importing urea from other countries. But this comes with the political costs of laying off the workers in those plants. One indirect way of guessing the employment consequences of allowing highly inefficient firms to exit would be to check whether the inefficient plants have relatively high employment. In Figure 5 below, we plot production costs per ton (an indicator of inefficiency) against number of employees.

Figure 5 shows that there is no correlation between number of employees and total production costs. However, it appears that most of the inefficient firms have fewer

[7] Under the most recent policy, subsidies are still firm-specific, although the range of subsidies has been reduced by essentially assuming that there will be more efficient use of energy going forward: the assumed/hoped for improvement in efficiency reduces the variation in energy use and hence also in subsidies.

employees. This implies that shutting down inefficient plants would have limited lay-off consequences.

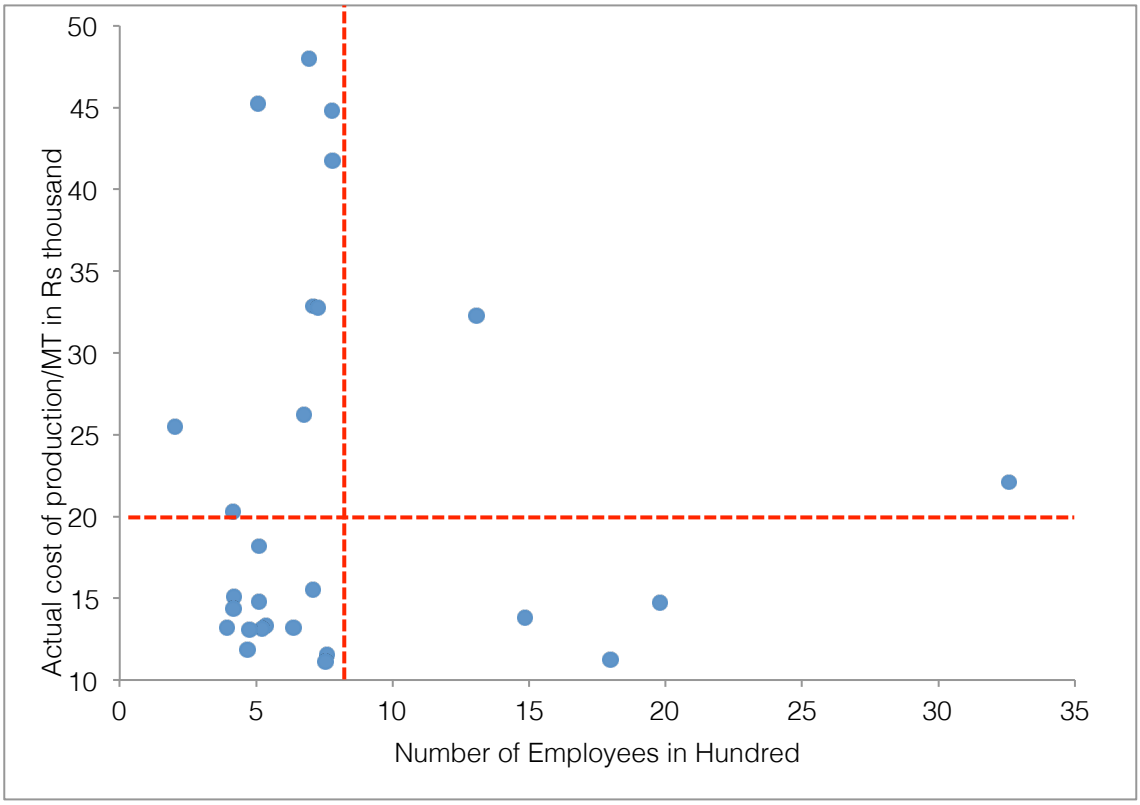


Figure 5: Inefficient Firms are not Employment-Intensive (Actual Cost of Production per MT against Number of Employees) (CREDIT: Team CEA)

An alternative is to promote joint ventures with countries with sufficient stock of natural gas. One such collaboration between IFFCO and Oman established in 2005 allows India to import fertilizer at around $135 per metric tonne (MT)[8] - almost 50% cheaper than world price and cheaper than the cost of production of most domestic manufacturers. The ministry of fertilizer is pursuing one such joint venture with Iran with a commitment to purchase 127 thousand MT of urea per year[9].

A large source of variability in production costs is the cost of the primary input, natural gas. The government has taken a bold step in reducing this variability by implementing gas-pooling. It will enter into long term agreements with natural gas producing countries and supply low-cost feedstock to all domestic manufacturers.

[8] http://fert.nic.in/node/1424
[9] http://fert.nic.in/page/joint-ventures-under-implementationconsideration

6.1.2 Imports

Imports were primarily seen as a way to meet excess demand after domestic supply had been exhausted. It was important to ensure that imports would not displace domestic units in the market. In order to achieve this, imports were *canalized*. Only four firms were allowed to import fertilizer, and quantity was controlled.

When demand estimation is incorrect (see 6.2.1) or there are shortages in domestic supply, importers should respond by bringing in excess stock to close the gap. Canalization ties the hands of these importers, and the cost of this is borne by farmers. Unable to source subsidized fertilizer, farmer are forced to purchase urea in the black market where they often pay as much as 50% more than MRP.

Another impact of this policy is an increased subsidy bill. Every time a canalizing agent floats a tender, it increases the world price of urea (Sharma, Thaker 2009). Though India has been able to leverage its large volumes to negotiate lower prices in some cases, it is starting off at a higher base market price.

6.2 Demand for urea

6.2.1 Demand estimation

Since urea movement in controlled, the Ministry of Fertilizer needs to estimate the demand for urea in each district. Before each cropping season, monthly demand for urea is projected by the Department of Agriculture and Cooperation along with the state governments. The Department of Fertilizer issues a monthly supply plan and uses the Fertilizer Management System (FMS) to direct fertilizer to various districts.

Estimating the demand for urea in a given month for a district is not a trivial task. As with any effort at estimating demand, it is prone to errors. Such errors lead to significant shortages. Lacking access to the demand estimation results and supply plan, I used data from FMS to see how tightly sales of urea and DAP are bound by availability.

The following specification allows us to see how tightly sales are bound to availability:

$$Sales_{i,t} = \beta_0 + \beta_1 \cdot Availabilty_{i,t} + \beta_2 \cdot Price_t + \gamma_{i,m}$$

where *i* is the district, *t* is the month in a given year, and m is the month of the year. $\gamma_{i,m}$ allows us to consider variation within a given district between years.

Table 1 shows that the coefficient on *Availability* is higher for urea than DAP. The result is also robust against different specifications. This result is suggestive that sales of urea are

highly correlated with availability and move almost one to one, i.e. a 1% increase in availability increases sales by around 0.9%.

One theory for the overuse of fertilizer is that farmers substitute urea for DAP when price of DAP increases. In columns 5 and 6 of Table 1, we test this theory and find little evidence for it in the 2008 to 2015 period[10]. It may be possible that those most likely to substitute DAP for urea have already done so, and very few such farmers now exist at the current margin[11].

Another theory to explain this finding is that the government perfectly estimated demand. The next section, however, reveals the existence of a secondary market that supports our diagnosis of limited availability.

6.2.2 Inclusion errors, siphoning, smuggling, and the black market

Because the urea subsidy is universal, even rich farmers benefit from it. Figure 6 shows that farmers who own more than 2 hectares of land – the top 30% of landholders – also receive subsidized fertilizer.

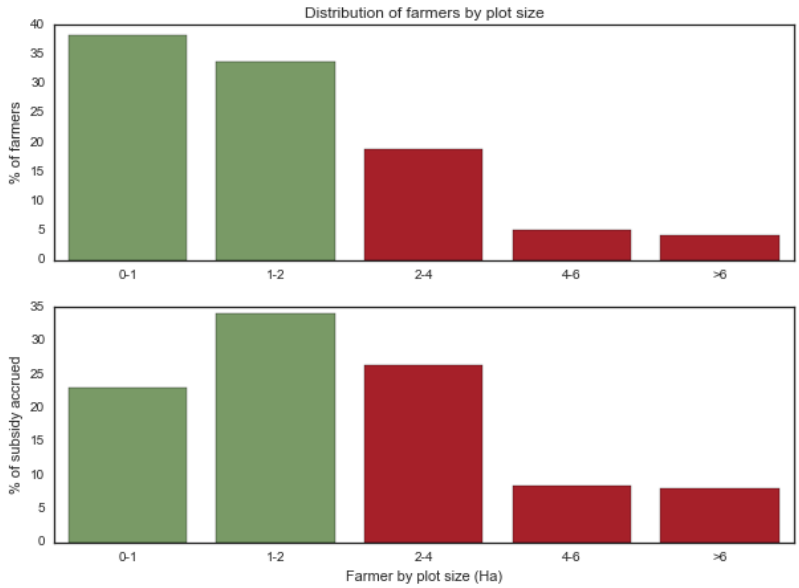


Figure 6: Distribution of farmers and subsidy by size of plot

India implemented the Fertilizer Management System (FMS)[12] in 2008 to track availability and sales of urea at the district level. Mobile FMS (mFMS) tracks further down the supply chain to the wholesaler and retailer level.

Though the FMS and mFMS systems track fertilizer down to the retailer level, the final sale to the farmer is not captured. Retailers often have monopoly power in the village and artificially reduce availability in order to redirect farmers to the black market. Using the Cost of Cultivation data, we show that farmers on average buy fertilizer at prices 60% higher than the government mandated price of Rs. 5390/MT.

[10] The specification looks at the effect of a price variability between years for a given district, month combination.
[11] Our results agree with the finding of Dholakia and Majumdar (1999) who show that demand for fertilizer is highly inelastic.
[12] Can be accessed at www.urvarak.co.in

Sales of urea and DAP based on availability and price						
	(1)	(2)	(3)	(4)	(5)	(6)
	Sales_Urea	Sales_DAP	Sales_Urea	Sales_DAP	Sales_DAP	Sales_Urea
Availability_Urea	1.02***		0.91***		0.01***	0.91***
	[0.00]		[0.00]		[0.00]	[0.00]
Availability_DAP		0.99***		0.86***	0.86***	0.02***
		[0.00]		[0.00]	[0.00]	[0.00]
Price of DAP (Rs/MT)					0.00***	-0.00***
					[0.00]	[0.00]
Month District FE			yes	yes	yes	yes
Year District FE	yes	yes				
Number of Obs.	59276	59275	59276	59275	59275	59275
R-sq	0.790	0.785	0.780	0.724	0.724	0.784
Method						

Standard errors in brackets. Availability and sales variables are in logs of metric tonnes.
* p<0.10 ** p<0.05 *** p<0.01

Table 1: Regression of sales of urea and DAP against availability

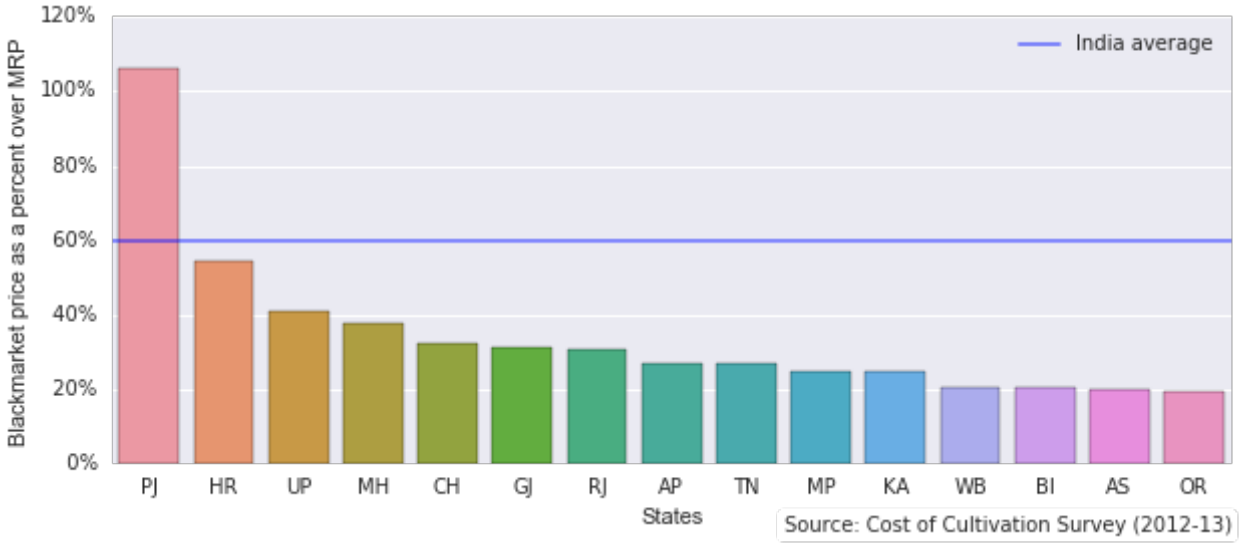


Figure 7: Additional amount paid by farmers in the black market for urea (CREDIT: Team CEA)

Conversations with farmers revealed why such a black market exists. Bags of urea arrive through the cooperatives at the local Panchayat twice a year, usually before harvest. In many villages, these are sold out within a day or so. Entrepreneurial farmers and local shops buy large quantities, as they know they will be in high demand and can resold for a profit. Most farmers are also not aware when urea will arrive. Therefore only those well connected and living close to the Panyachat are able to secure urea.

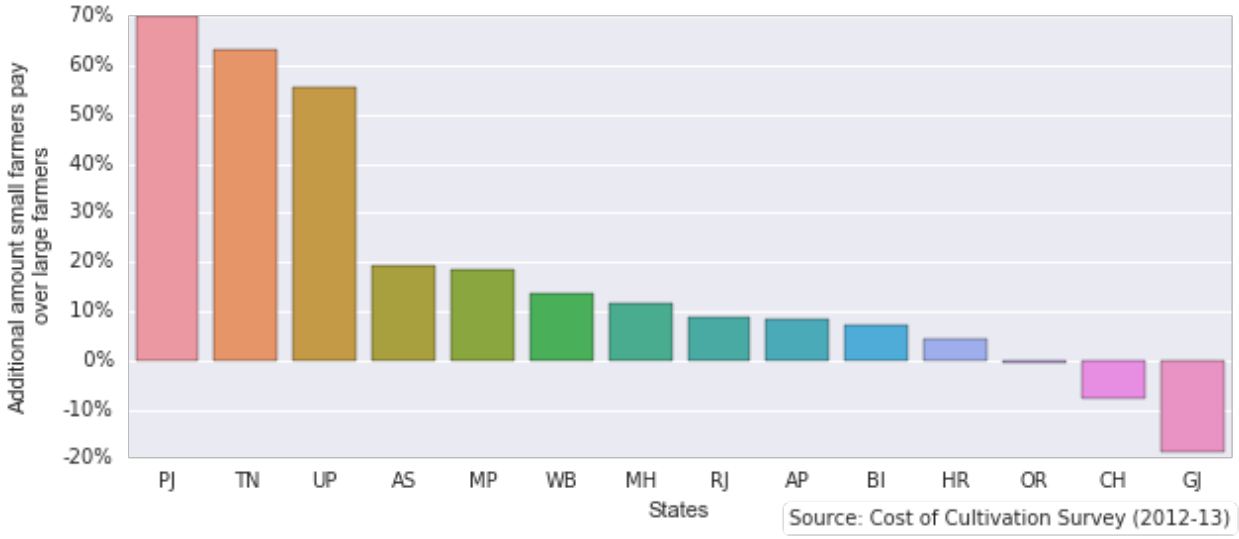


Figure 8: Additional amount paid by small farmers over rich farmers (CREDIT: Team CEA)

This black market hurts small and marginal farmers[13] more than large farmers, as a higher percentage of them buy fertiliser from the black market. Figure 8 shows that poor farmers, on average, pay higher prices for fertiliser than rich farmers, probably because large farmers

[13] These are defined as farmers will less than 2 ha of land

are typically better connected and therefore able to secure scarce subsidised urea[14]. This regressive nature is characteristic of rationed goods and the black markets that result.

The more serious leakage, however, occurs from agriculture to industry and across country borders. Agricultural urea is almost a third of the price of industrial urea, and a similarly large price differential exists across the India-Bangladesh and India-Nepal borders[15]. Since the subsidy is universal – anyone can purchase any amount – these large price differentials create a thriving black market where subsidized fertilizer is resold to industry or abroad.

How big is the leakage? Micro-level data from the Cost of Cultivation survey can be used to determine the ratio of urea to DAP consumption. Similarly, the ratio of urea to DAP sales can be calculated at the national level using domestic sales volumes[16]. This gives us two measures of the ratios of urea to DAP: sales and consumption. The difference in these figures must be due to leakage.

Calculating leakages	
Urea ('000 MT)	30610
DAP ('000 MT)	7626
MOP ('000 MT)	2853
Urea:DAP (sales)	4.0
Urea:MOP (sales)	10.7
Urea:DAP (consumption)	2.4
Urea:MOP (consumption)	5.4
Urea:DAP (diff)	1.6
Urea:MOP (diff)	5.3
Implied leakage (using DAP)	**40%**
Implied leakage (using MOP)	**49%**

Table 3: Calculating rate of leakage for urea

This analysis assumes that there is no leakage of DAP. This can be justified on two accounts. First, there is no leakage to industry as it is not an input for any manufacturing process. Second, the price differential between India and neighboring countries is small[17] creating little incentive for leakage. If we do assume that there is some leakage for DAP, then our figure provides an underestimate of the leakage for urea.

Using this analysis, we estimate 40% leakage. A similar analysis using MOP gives a figure of 49%. These results are summarized in Table 3.

Note that the Cost of Cultivation survey was done in 2012/13 whereas the total sales volumes are from 2014/15. Therefore, the estimates are not exact but provide a rough sense of how great the leakage might be.

[14] See Appendix for how regressivity was calculated
[15] 50kg of urea in India is Rs. 300 while in it is Tk 800 (Rs. 685) in Bangladesh and NPR 996 (Rs. 622) in Nepal.
[16] Data shared by the Fertilizer Association of India
[17] 50kg of DAP in India is Rs. 1200 while it is Tk 1350 (Rs. 1155) in Bangalesh and NPR 2250 (Rs. 1402) in Nepal.

We calculate similar leakage figures by state to see if leakage is indeed higher in border states and states with industries that use urea[18].

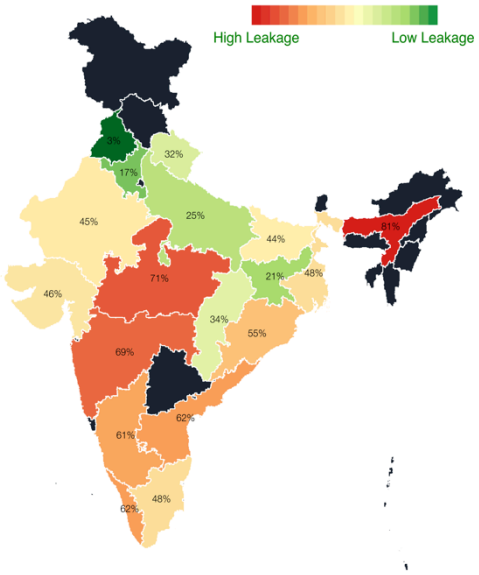


Figure 10: Urea leakages by state

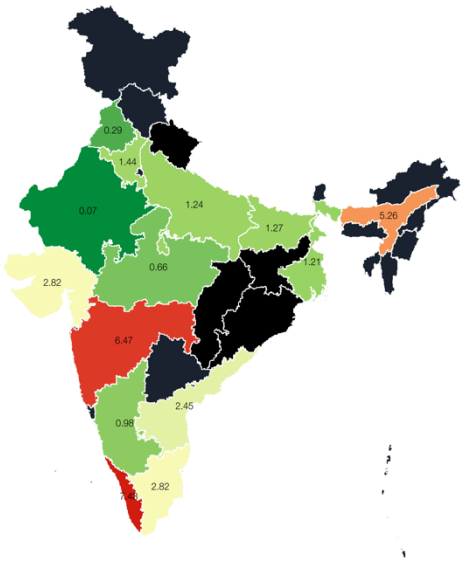


Figure 9: Employment in industries using urea

Figure 9 shows the states with high leakages. Border states do not seem to have substantially higher rates of leakage. Uttar Pradesh, which borders Nepal, has one of the lowest leakages in the country at 25%. West Bengal, bordering Bangladesh has around 48% leakage, slightly higher than the national average.

The highest concentration of farming is in the Ganga-Yamuna belt, which runs across the Northern states of Punjab, Haryana, and Uttar Pradesh. Interestingly, these states have the lowest levels of leakage. It is plausible that in areas where the population is predominantly farmers, it is more difficult to smuggle urea.

Figure 10 shows the intensity of industries that consume urea. Each state is labeled by the number of people per ten thousand employed in such industries, a rough proxy for the size of urea-consuming industry. Note that states with high intensity of manufacturing (such as Maharashtra, Kerala, and Assam) tend to have higher rates of leakage.

Madhya Pradesh is puzzling, with 71% leakage and low intensity of industry. This may be caused by leakage to industry in its neighboring state of Maharashtra.

Though far from rigorous, this analysis suggests that leakage to industry might be a bigger problem than across borders[19].

---

[18] The main industries that use urea in manufacturing are plastics, particle board or plywood manufacturing, and chemicals. NIC3 codes for these are 313, 271, and 309 respectively.

[19] Regressing percent leakage by percent working in these industries and a dummy for border state, gives a statistically significant coefficient on percent working.

Putting all the leakages and inefficiencies together, Figure 11 shows that only 33% of the fertilizer subsidy accrues to the small and marginal farmers. The greatest losses are from leakages across borders and to industry, and through subsidies for the rich farmers (inclusion errors). Any reform will need to address these two causes to be truly effective.

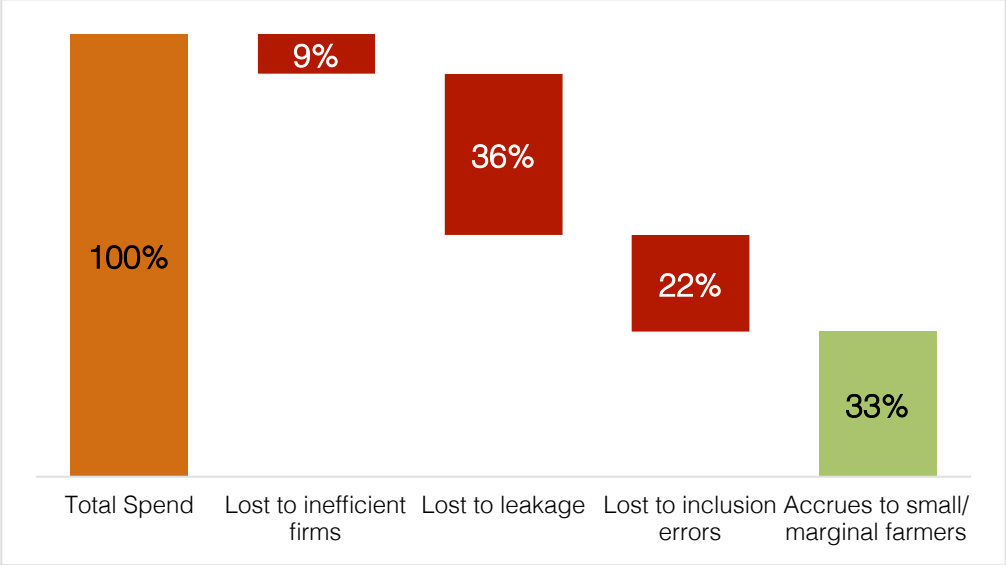


Figure 11: Lost subsidy

6.2.3 Overuse of urea

The optimal ratio of consumption of N, P, and K in India is 4:2:1 with regional variation. Over time the consumption ratio has worsened to 8:3:1. Chemical fertilizers need to be used at the right ratio to restore the nutrient balance of the soil. Fertility of the soil is compromised if any of the nutrients are depleted.

Prices for DAP and MOP increased substantially after they were decontrolled in 2010. One theory suggests that the overuse of urea is because it is substantially cheaper than DAP or MOP. Talking to farmers in the villages outside Udaipur does somewhat support this theory. Most farmers knew of DAP and that it should be used to in conjunction with urea. Farmers in the village of Suron Ka Gurha recounted how their harvest of peas was 50% larger when they applied DAP. When asked why they didn't use it this year, they complained of insufficient funds when it was time to buy fertilizer. This suggests that there may be some behavioral factors underpinning the imbalanced use of these fertilizers (see Duflo, Kremer, Robinson 2009).

Note that this theory is in contrast with the results in Table 1 which show no impact of price on sales of DAP or urea. It is quite possible that all the price changes were infra-

marginal; the price differential between the two fertilizers is so large that marginal variation in DAP prices does not affect purchasing behavior.

A second reason provided was knowledge. The amount of fertilizer used is based on experience and habit. In order to ensure that the farmer applies the correct balance of fertilizer, the government has provided free soil testing (see Box 3). Though some of the farmers had received the result from the soil tests, the implications of the results were not clear. The sample card in the Box 3 shows a soil that is highly deficient in phosphate and recommends a higher application of DAP than urea. The farmer, though in possession of this card, was unaware of the costs and benefits of not following the recommendation.

Box 3: Soil Heath Cards

Soil Health Card Scheme is a scheme launched by the Government of India in February 2015. Under the scheme, the government plans to issue soil health cards to 140 million farmers to improve productivity through judicious use of inputs.

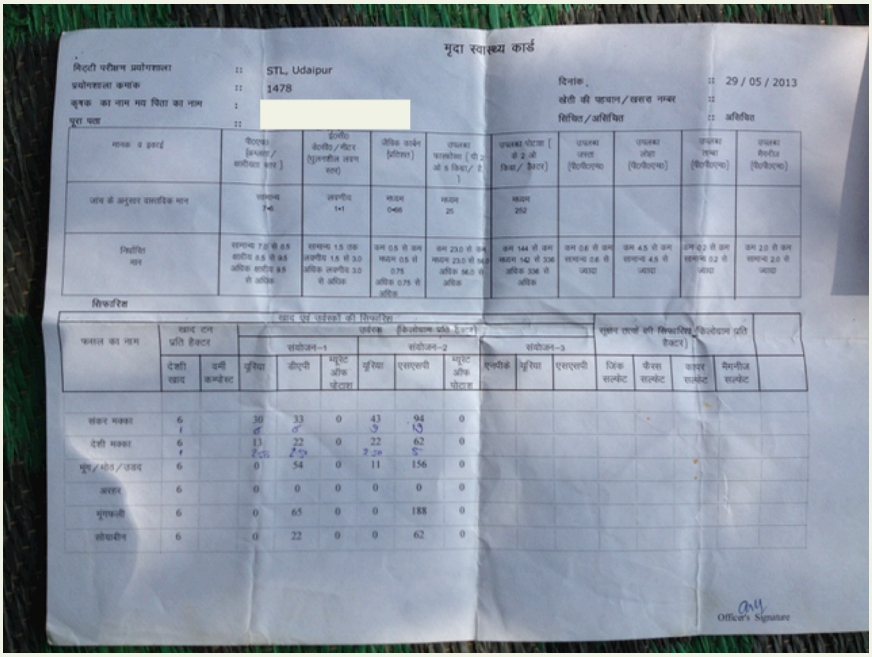
From FAQ on http://www.soilhealth.dac.gov.in/:

What is a Soil Health Card (SHC)?

SHC is a printed report that a farmer will be handed over for each of his holdings. It will contain the status of his soil with respect N,P,K (Macro-nutrients) and other nutrients.

How can a farmer use a SHC?

The card will contain an advisory based on the soil nutrient status of a farmer's holding. It will show recommendations on dosage of different nutrients needed. Further, it will advise the farmer on the fertilizers and their quantities he should apply, and also the soil amendments that he should undertake, so as to realize optimal yields.


मृदा स्वास्थ्य कार्ड

(sample soil health card from a farmer in Rajasthan)

6.3 Political landscape

The national narrative in India represents the farmer as the foundation of society. In addition, 47% of the voting base is employed in agriculture. These facts make agriculture policy politically very sensitive. It is difficult to garner support for any reform that reduces farmer welfare while pro-farmer policies are received favorably.

6.3.1 Bureaucracy

The bureaucracy, primarily the Indian Administrative Service (IAS), is responsible for the implementation of any policy change. In his book, "*Unwritten Flaws of Indian Bureaucracy*", Barun Kumar Sahu, a member of the IAS, describes why the service is highly risk averse:

> *"Performance is adjudged not by results he achieves, but by his adherence to rules. He may not be praised for the thousands of good works he does… But he will be taken to task for a single mistake he makes."*

Therefore, policy reform tends to be in small cautious steps instead of bold leaps. This was discovered to be quite true when discussing reform with the Ministry of Fertilizer. The secretary, the highest-level bureaucrat within the Ministry, was quite hesitant to push any change unless every contingency was accounted for. Endorsement from the Minister of Fertilizer was necessary to relieve the pressure of decision-making and to bring legitimacy to bureaucrats' efforts.

6.3.2 The political masters

With over a year in office, the current government has been criticized in the media (Pratap Bhanu Mehta, Aug 2015) for not undertaking any bold reforms. The Prime Minister (PM), Narender Modi, hopes to respond with some key reforms, and urea policy may be low-hanging fruit. The next union elections are in 2019. A sense of urgency needs to be created; the PM may need to be reminded that the window of opportunity for reform is slipping through his fingers.

'Make in India' is a flagship scheme of the Modi government to increase manufacturing in India. A policy that results in closure of or loss of market share for inefficient firms, even if technically sound, will be seen as counter to 'Make in India' and might not obtain his support.

The Minister of Fertilizer, Ananth Kumar, like all career-politicians wants to leave his mark. Though keen to implement new reforms, he is aware than he may have to bear the burden of any failure alone. With the PM pushing for reform, he has the legitimacy required

to take bold steps. The media has been vocal is demanding urea reform policy, and any reform would be lauded by them.

In an interview in 2015 (Prashant Mukherjee, Indian Express) Mr. Kumar said that the government was *kishan* or farmer-centric, and there would be no increase in the price or decontrol of urea for the next 4 years. Any policy reform will need to be less direct.

The Minister of Finance, Arun Jaitley, is quite possibly the second most powerful member of the government after the PM. He has promised fiscal consolidation and hopes to reduce expenditure to meet fiscal targets. He may be open to any policy that reduces leakages through better targeting of subsidies. In meetings, he has also conveyed that he is acutely aware of costs of even small levels of exclusion errors. To gain his support, the policy will need reduce expenditure but not at the cost of increased exclusion errors.

6.3.3 JAM – the flavor of the year

Subsidy reform is currently in vogue. Jan-Dhan, Aadhaar, and Mobile banking (JAM) have been path-breaking in how subsidies are transferred to the poor (see Box 4). The government received high praise for scaling direct benefit transfer (DBT) for cooking gas (LPG). Recently the government announced that the kerosene subsidy would also be transferred through the same mechanism. Uttar Pradesh has been attempting to leverage prevalence of Aadhaar cards to transfer subsidy for seeds directly to farmers.

Box 4: Jan-Dhan, Aadhaar, and DBT

Jan-Dhan: Pradhan Mantri Jan-Dhan Yojana (PMJDY) is a scheme started by the government for financial inclusion that makes access to banking services easier and affordable. Under this scheme, over 200 million bank accounts have been opened.

Aadhaar: Government of India aims to issue a unique identification number (termed as Aadhaar) to every resident of India. The number is linked to the person's basic demographic and biometric information such as photograph, ten fingerprints, and two iris scans. As of December 2015, 950 million Aadhaar numbers have been issued.

DBT: Aadhaar project has been linked to some public subsidy and unemployment benefit schemes like the domestic LPG scheme and MGNREGS. In these Direct Benefit Transfer schemes, the subsidy money is directly transferred to a bank account which is Aadhaar-linked (wiki).

The ubiquity of DBT in subsidy reforms is a double-edged sword. Any policy reform that suggests DBT would be quickly understood. There may also be little resistance to it as it seen as a logical next step for disbursement of all subsidies. A corollary of this is that any

reform that does not recommend DBT may be seen as out of date. As we will discuss later, fertilizer sector may not be ready for DBT.

6.3.4 Producers and importers

As discussed above, the balance sheets of domestic production units are highly stressed due to thin margins allowed by the policy and delays in payment of subsidies. It was not surprising that during our conversation with them, the Fertilizer Association of India[20] (FAI) was very supportive of a policy reform. Under a DBT system, they would receive their payment upfront as the farmer would pay full price and the government would transfer the subsidy amount directly to her account.

Domestic manufacturers form one of the strongest lobbies. One of the key reasons urea was not decontrolled along with DAP and MOP was the opposition faced from these manufacturers. A policy that is seen to hurt domestic manufacturing may face stiff opposition.

7 Experience from other countries

Large-scale input subsidy programs were phased out in most countries in the 1990s as part of World Bank and IMF imposed structural adjustment programs (Ricker-Gilbert, 2012). A few countries like India and Indonesia continued to have substantial subsidies throughout. Bangladesh briefly experimented with liberalizing the fertilizer sector but returned to subsidizing and controlling sales. Similarly, large-scale fertilizer subsidies re-emerged in sub-Saharan Africa in the late 2000s. This section looks at the subsidy policies in some of these countries.

7.1 Indonesia

This section borrows from the excellent summary of the Indonesian fertilizer sector by Osoria et al (2011). There are numerous parallels between fertilizer policy in India and Indonesia. As in India, subsidizing fertilizer was critical to encouraging its adoption along with high-yield crop varieties in the 1970s. Since then, the subsidy bill has expanded to 50 percent of the agriculture and irrigation sector budget and is almost double the budget for the Ministry of Agriculture. Fertilizer production is a monopoly controlled by five state-owned companies. The government also controls sales of fertilizer; it is responsible for

[20] The Fertiliser Association of India (FAI) is a non-profit and non-trading company representing mainly the fertiliser manufacturers, distributors, importers, equipment manufacturers, research institutes, and suppliers of inputs.

estimating demand and directs urea producers to sell in mandated areas. As with India, there are large shortages when the demand estimation is wrong, and a sizeable black market emerges (Reuters, 2016).

The subsidy regime is also similar to India. The government provides subsidies to cover the difference between the MRP and the breakeven point for the fertilizer firms as determined by the State Ministry for State-Owned Enterprises.

The subsidy scheme only allows for farmers with 2 hectares or less to access government-subsidized fertilizer. The government has experimented with several instruments such as 'smart cards' and providing the subsidy only to farmers certified by village authorities. Osoria et al (2011) show that targeting was ineffective and that the largest farmers captured a disproportionate share of the subsidy.

7.2 Malawi

In 2005, Malawi attempted to distribute fertilizer subsidies through a voucher system. Vouchers were distributed to targeted households and allocated to districts in proportion to maize and tobacco cultivation. Tenders were issued for import and distribution of fertilizer.

The allocation criteria varied widely between districts in terms of priority and selection of beneficiaries, and the number of coupons per beneficiary. The process for coupon redemption also varied between the years. The government continually worked to improve program performance based on informal management and evaluation reviews, discussions with stakeholders, and changing economic and political environments (Dorward, 2008). Despite these adjustments, there seems to be little evidence of improved targeting, and political considerations appear to dominate others. Chirwa et al (2013, pg. 266-267) make an argument for a universal subsidy, as it would reduce opportunities for diversion and fraud that arise from lack of transparency and accountability in the current targeting processes.

7.3 Bangladesh

Barkat et al (2010) document Bangladesh's experience with liberalizing the fertilizer industry. In the early 1980s, Bangladesh decontrolled the price of fertilizer, allowing private traders to sell at any price. In 1992, fertilizer was decanalised, allowing the private sector to import fertilizer. Shortly after, in December 1992, subsidy on fertilizer was withdrawn completely and the marker was fully liberalized.

The effect of these reforms was dramatic. Previously, the government estimated demand and directed fertilizer sales in districts. The introduction of private distributors and increased competition forced distributors, dealers, and retailers to reduce margins and offer lower prices to farmers. As a result, farm-level prices decreased substantially. In addition,

availability increased substantially in all regions. The removal of all subsidies and distribution through the private sector saved the government Tk 3,809 million (USD 50 million) annually.

Bangladesh's open market system experienced a substantial setback in 1995 when, following a severe crisis[21] of domestically produced urea, the government decided to bring the market back under its control. In 1996, when a new government came into power, subsidies for fertilizers were reintroduced and a maximum retail price was fixed.

Though the government experimented with improved targeting by introducing a 'Farmers' Register' and printing 'Fertilizer Distribution Cards', it was not a success. The system was time-consuming for the farmer and could only be used in certain shops where availability fluctuated substantially. Farmers preferred to pay higher prices and purchase fertilizer on the black market. Since the 'Farmers' Register' was maintained at the dealer, it created opportunities for rent-seeking and diversion to the black market. The card system was scrapped soon after when the government declared free sale of fertilizer in the market.

8 Designing the solution

This section presents some plausible solutions and discusses the technical correctness, political supportability, and administrative feasibility of each of them. Again, we consider interventions on the supply side and the demand side.

8.1 Supply side interventions

8.1.1 Change from firm-based subsidy to fixed subsidy

The current domestic subsidy regime does not incentivize innovation. Subsidy is based on the cost-plus basis, i.e. calculated based on the following:

$$Subsidy_{i,t} = Cost\ of\ production_{i,t} \times (1 + Margin_t) - MRP_t$$

Rearranged:

$$Margin_t = \frac{Subsidy_{i,t} + MRP_t}{Cost\ of\ production_{i,t}} - 1$$

Note that margin or profit is fixed for time t and there is no incentive for firm i to reduce costs. Paying a flat subsidy would change the profit margin to:

$$Margin_{i,t} = \frac{Subsidy_t + MRP_t}{Cost\ of\ production_{i,t}} - 1$$

[21] There are varying perception of the causes of the crisis. Barkat (2010) suggested that government exported urea in excess amounts spurred by favourable market conditions. At the same time, domestic demand increased substantially resulting in large shortages.

Now subsidy amount is fixed and reducing the cost of production increases the profit margin.

8.1.1.1 Technical correctness

From the simple analysis above it is clear that economic efficiency will be increased as firms would be incentivized through higher profits to reduce costs. Let us consider its impact on the three issues of interest:

1. *Availability:* UNCLEAR. It is unclear what impact this policy will have on availability in the short-term. It will increase if efficient firms are able to scale up production faster than inefficient firms exiting the market. In the long-term, there will be new entrants into the market incentivized by the higher level of profit.
2. *Utilization ratio:* NO CHANGE. Since MRP remains unchanged, farmers would observe the same price. This would have no impact on the utilization ratio.
3. *Fiscal burden:* SMALL IMPROVEMENT. This policy will be weakly better that the status quo. The fixed subsidy amount can be set at a level that makes expenditure neutral with respect to the current policy. Figure 12 shows that inefficient firms supply less volume than efficient firms. If we replace the volumes from firms whose cost of production is higher than world price, with imports instead, the saving would be only 9%.

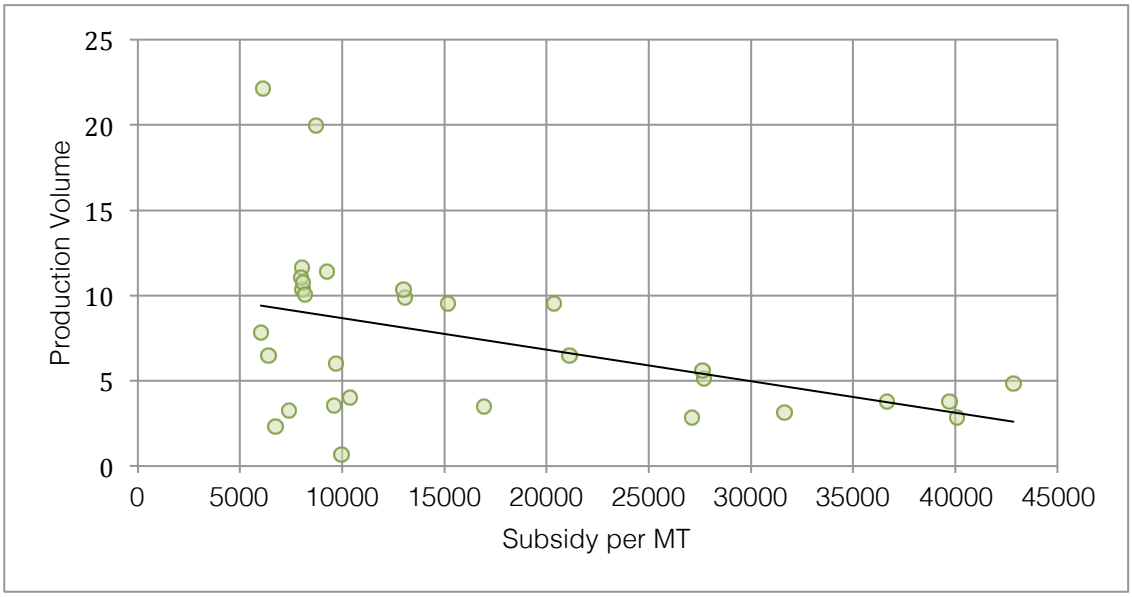


Figure 12: Production of firms by efficiency

8.1.1.2 Politically supportable

Shutting down firms, albeit inefficient ones, will not be an easy task. It will be portrayed as going against government's flagship scheme, 'Make in India'. At best, the government will be seen as being inconsistent. At worst, it will be shown to be scuttling an established

industry. Modi's government is aware of this and will be hesitant to support such a policy. With the recent election losses in Delhi and Bihar and the upcoming elections in Tamil Nadu, Kerala, and West Bengal, the government may not have the appetite for anything that can create bad publicity.

8.1.1.3 Administratively feasible

This has already been done for other fertilizers. The Nutrient Based Subsidy (NBS) policy for DAP and MOP provides a fixed subsidy based on the amount of active nutrient in the fertilizer and is blind to the cost of production. Adopting this for urea will not require any new administrative capacity or infrastructure.

8.1.1.4 Conclusion

The savings from this scheme are small while the political costs are relatively high. It is unlikely that such a policy will successfully pass through the current cabinet.

8.1.2 Decanalize imports

Currently, only four firms are allowed to import urea at set times. Decanalization would allow any firm to import urea under an Open General License (OGL). Subsidy is fixed and indexed to market price.

8.1.2.1 Technical correctness

The benefits of a fixed subsidy are similar to those mentioned in the previous section. The more efficient firms are rewarded through higher profits, driving down the total cost of imports.

The four firms float tenders twice a year for very large amounts. This has two effects in opposite directions. First, India, being the largest importer of urea, moves the world price up by floating a very large tender. Second, since India imports large amounts, it has substantial negotiating power and is able to secure a competitive price.

Figure 13 compares import prices in India to the US, who has an open market and is the second largest importer of urea.

Figure 13: Import price India vs. USA

India and US prices, on average, seem to track quite closely, though India has done marginally better in recent years. As expected, there is a large variation in US prices. Though it is quite possible that by fragmenting the market we reduce the negotiating power of each importer, the impact on average price seems to be minimal.

Let us consider how it impacts the three key problems we are attempting to address:

1. *Availability:* IMPROVE. By freeing firms to decide on quantity and timing of imports, they are able to better respond to demand signals. Both excess stock on shelf and cases of stock-outs would reduce.
2. *Utilization ratio:* WORSEN. As shown above, sale of urea is constrained by availability. Unless demand for urea is controlled, greater availability of urea would lead to further overuse and worsening of this problem.
3. *Fiscal burden:* WORSEN. A similar argument can be made here. If the availability constraint is loosened, sale of urea and leakages would increase proportionally, increasing the subsidy burden. Demand-side measures (see next section) are necessary to ensure the subsidy bill does not become untenable.

8.1.2.2 Politically supportable

Given that imports for DAP and MOP were decontrolled in 2010, the Ministry of Fertilizer is comfortable with the administrative requirements to implement this. There is a general agreement at the joint secretary level that this can be piggybacked off the systems established for DAP and MOP.

The Minister of Fertilizer, Ananth Kumar, has also expressed his support and urged his secretary to push this further. The major political roadblock seems to be from the secretary

himself, Anuj Bishnoi. Mr. Bishnoi has expressed numerous concerns, some of which have been addressed previously. It is possible that Mr. Bishnoi is simply risk-averse and hopes to end his tenure as Fertilizer Secretary without event.

FAI and some of the current canalizing agents have expressed support for decanalization. This is in part because the importers feel that the tender process ties their hands. With decanalization, they would be able to buy when the market price is low and in sufficient quantities. A fixed subsidy would also mean that the importers get to keep the surplus from establishing long-term deals with suppliers.

8.1.2.3 Administratively feasible

The policy would be very similar to DAP and MOP. Since urea is the only fertilizer not under OGL, this reform would in fact simplify the administration of fertilizer subsidies. The department needs to decide on how to phase in this new policy. DAP and MOP's switch to OGL was done as a 'big-bang', but urea, politically sensitive as it is, might need to be done in a few states before scaling.

8.1.2.4 Conclusion

This policy option is politically a lot more supportable, and the government has the skills and experience required to implement it. But without a demand-side intervention, this may result in worsening of the subsidy burden and the utilization ratios. We consider demand-side interventions in the next section.

8.2 Demand-side interventions

As is intuitive and well-known in economic theory, regulations that create multiple prices for essentially the same commodity are likely to fuel black markets. Technology, however, allows one to curtail black marketing, and to improve the targeting of fertiliser subsidies. The government's policy of neem-coating urea is a step in exactly this direction. Neem-coating makes it costlier for black marketers to divert urea to industrial consumers.

Aadhaar and Jan Dhan offer the government additional tools to reduce the extent of these distortions. Here we consider the relevance of these tools specifically for urea.

There are two dimensions for designing an improved subsidy transfer mechanism: *Targeting* and *Transfer mechanism* (Table 2).

Targeting	**Universal with biometric authentication**
	+ No need for land/tenancy records
	+ Lower exclusion risk
	- Rich farmers receive subsidy
		Targeting poor farmers
		+ Reduced leakage
		- High exclusion risks
		- Need to identify farmer
		  - Need land records
		  - Need tenancy records

Transfer mechanism	**Limited physical off-take** + Can utilize current supply chain	**DBT** - Farmers must have bank accounts - "Last-mile" problem: farmer must be able to easily access bank account - Cash flow problem

Table 2: Demand-side policy options

8.2.1 Targeting

Fertiliser subsidies are justified on the grounds of making fertiliser affordable for the poor farmer. Hence, arguably, the subsidy should be targeted at poor farmers – just like food and kerosene subsidies are not universal, but targeted at the poor. Targeting should be assessed against three criteria:

1. *Exclusion errors:* Genuine beneficiaries (poor farmers) who are incorrectly excluded.
2. *Inclusion errors*: Rich farmers who end up receiving the subsidy.
3. *Leakage:* Subsidy that is not consumed by any farmers and is diverted to industry or across the border.

There is often a trade-off between these three metrics. Biometric authentication and other administrative requirements may reduce inclusion errors and leakages – but there is a risk that some genuine beneficiaries might not be able to negotiate the system and end up excluded. Exclusion errors usually hurt the poorest farmers, while inclusion errors are inequitable and impose fiscal costs on the government. Exclusion errors are therefore of greater concern and also politically riskier.

8.2.1.1 Status Quo: Universal

Currently, there is no targeting. Any person, farmer or other, can go to the local retailer or cooperative and purchase fertiliser at the subsidised price. The result is large inclusion error – 25% of the subsidy accrues to large farmers. This is in addition to the leakage that results from agri-industry and cross-border price differentials.

Prima facie, a universal subsidy scheme ought to have no exclusion errors. When there are shortages, fertilizer is rationed and if often secured by well-networked, typically rich, farmers. Poor farmers are pushed to the black market where they pay significantly higher

prices. By paying more than the subsidized price, poor farmers only get part of the benefit. These distortions combine to exclude poor farmers from what should be a universal subsidy. The lost benefit actually goes to the black marketer and should be chalked up as an additional inclusion error.

8.2.1.2 Option 1: Targeting the SMF directly

A Rawlsian government would want to identify poor farmers and target fertiliser subsidies at them. The ideal way of doing that would be to link some identity proof – ideally Aadhaar – with an indicator of wealth – land size, say, which comes from land records. This would allow the government to confidently say that a given person is poor, and to target subsidies accordingly. Farmers would simply present their Aadhaar cards and would be eligible for a set amount of subsidized fertilizer based on their landholdings.

8.2.1.2.1 Technically correct

Figure 6 showed that the gains from excluding the larger farmers (greater than 2 hectares) are around 40%. There are significant savings to be earned.

If a targeting instrument is available that allows us to accurately identify the intended recipient without significant exclusion errors, it should be adopted. In the 'administratively feasible' section, we consider some of these instruments.

8.2.1.2.2 Politically supportable

There has been substantial discussion on improved targeting, and the government is eager to realize the benefits of Aadhaar. The success of the LPG subsidy has also spurred the government to seek similar solutions for other subsidies.

8.2.1.2.3 Administratively feasible

An immediately apparent problem here is the existence of land records. The National Land Records Modernization Programme reports the number of computerized land records (CLRs) on their website. The progress report can be found in the Appendix 11.2. With the exception of a few large states like Karnataka and West Bengal, most of the states have very low numbers of CLRs.

But CLRs also need to be linked to an identity proof – like a person's Aadhaar card – and only a few states like Telangana, Andhra Pradesh, and Haryana are attempting this seeding. Without Aadhaar cards, the task of verifying identify would fall on the retailer who has no incentive to deny a sale. An additional layer on monitoring will be required to ensure that the 160 thousand retailers of fertilizer only sell after witnessing land records, and then only in proportion to land-holding size.

A second problem emerges with targeting tenant farmers and sharecroppers. The Situational Assessment Survey of Agricultural Households reveals that a little over 10% of all farmers are not tilling their own land. It can be argued that it is these land-less 10% who need the subsidy the most. In order to include these farmers, instead of land records, official tenancy records would be required. Very few of these farmers are likely to have such documents. And again, these would need to be linked to Aadhaar card to be administratively feasible.

Technically, identifying the small and marginal farmers remains the gold standard. States with a high number of digitized and Aadhaar-seeded land records should indeed target using these. But for most states, it may be premature to shift to this policy given the current infrastructure, as it would lead to large exclusion errors.

8.2.1.3 Option 2: Universal subsidy with Aadhaar authenticated

A second option is to allow anyone with an Aadhaar card to purchase fertilizer.

8.2.1.3.1 Technically correct

Currently, the purchaser of fertilizer is not tracked, allowing smugglers and black marketers to buy large amounts. By requiring an Aadhaar or other form of biometric authentication we can track large or frequent purchases. If implemented along with limiting the number of bags (discussed in the next section), it would stymie siphoning to industry and smuggling over borders.

Note that though such a policy would remove all exclusion errors, it does not eliminate inclusion errors. Larger farmers still get subsidized fertilizer. Therefore the savings from this option are not as high as in Option 1.

8.2.1.3.2 Politically supportable

The Supreme Court recently ruled that the government cannot make Aadhaar mandatory for government benefits. Therefore, other forms of identification like land records or PDS card may also need to be accepted. The Ministry of Fertilizer may also wish to issue their own form of identification, say "Fertilizer card", as an alternative.

But as Aadhaar penetration increases this may become a moot point. Aadhaar usage is ubiquitous in a number of states, and beneficiaries prefer the convenience of having a single form of identification. Though other forms are now accepted for LPG and PDS, Aadhaar is the most commonly used form of identification.

8.2.1.3.3 Administratively feasible

This option does not required land records to be verified, making it a far simpler to administer. Monitoring of retailers would not be required and payment to them would be based on the number of Aadhaar numbers electronically collected. Appendix 11.4 lists Aadhaar penetration for all the states. Most of the states have high prevalence of Aadhaar cards.

8.2.2 Transfer mechanism

8.2.2.1 Option 1: Direct deposit into bank account

Direct transfer of subsidy would remove price distortions as buyer and sellers would transact at market price instead of the subsidized price. The price differential between agricultural and industrial urea would be closed, effectively ending the leakage to industry. Similarly, the smuggling across borders would also reduced.

The key reason this was successful for LPG was that the target population is largely urban or, when rural, not in the poorest decile[22]. A large percentage of this population had bank accounts and could easily access banking services.

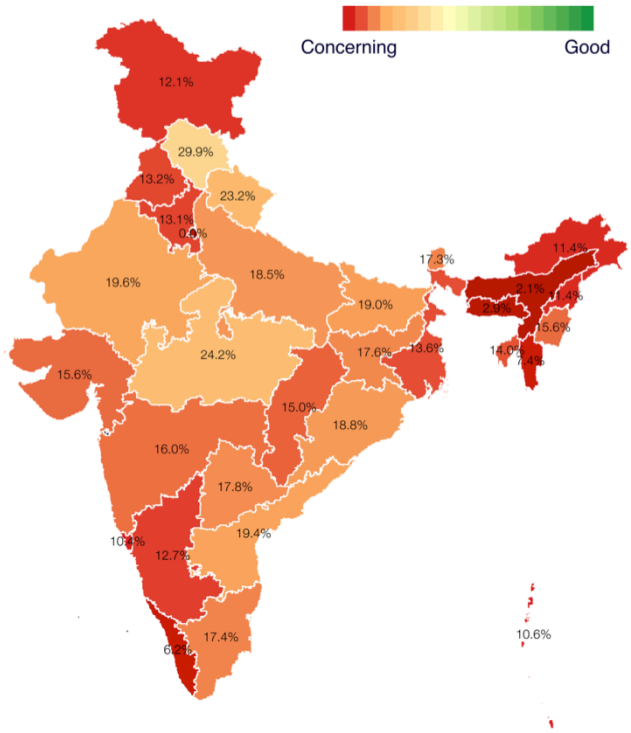


Figure 14: Readiness index for bank transfers in rural India (0-100%)

[22] Poorest rural household still use charcoal or wood as fuel source. Gas is expensive even after the subsidy.

The target population for the fertilizer subsidy is predominantly rural. Even though a large number of accounts have been created under PMJDY (see Box 4), the number of people with bank accounts remains low. In the breadbasket states of Punjab and Uttar Pradesh, only 49% have bank accounts. Appendix 11.3 shows this for all states.

Even if one has a bank account, access to banking services remains low in most of the country. In the 2016 Indian Economic Survey, we constructed an index for readiness for direct bank transfers in rural India. It has been recreated here as Figure 14.

8.2.2.2 Option 2: Limited physical off-take

Though direct bank transfer for subsidy would be a technically sound solution, the infrastructure required is not currently available. Bank accounts and access to banking services are steadily increasing, and in a few years we may be ready to switch to such a system.

A second option would be to limit the number of bags that a person can purchase at the subsidized price.

8.2.2.2.1 Technically correct

Figure 15 shows the average number of bags consumed by farmers with different landholding amounts. The red dotted line shows the limit set for each type of fertilizer per customer. The light blue shows the need that will be covered by the subsidy, while the green shows the reduction in inclusion errors.

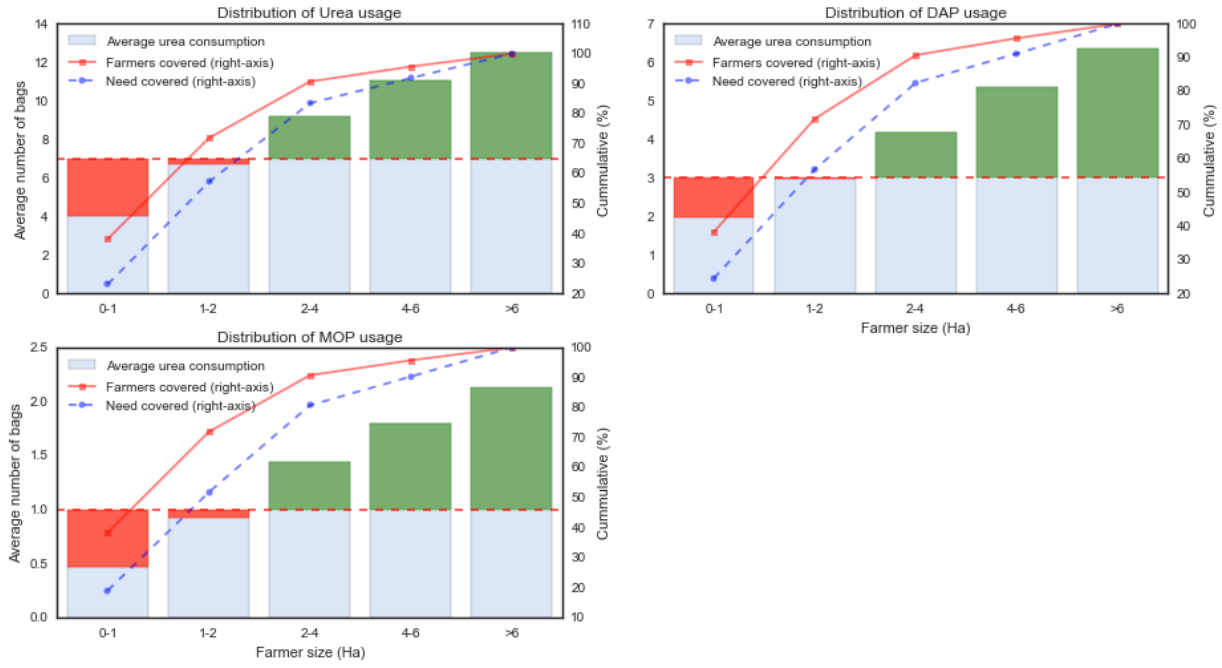


Figure 15: Giving a fixed number of bags of subsidized fertilizer

Poor farmers are now entitled to more bags than they were previously consuming. It is possible that they may choose to buy their maximum allotment and resell it to larger farmers at a higher price. This is shown in red in Figure 15. The LPG experience has shown that the incidence of this would be quite low. But even if it does occur, it can be seen as an effective cash transfer as before with one key difference – instead of the benefit of the black market going to the retailer or the rich farmer, it now accrues to the poorest.

In the figure above, we have restricted the number of bags per year to the following:

Fertilizer	*Maximum bags per year per Aadhaar card*
Urea	7 bags
DAP	3 bags
MOP	1 bags

The savings to the government from such a mechanism could be around 26%[23].

The numbers above are based on what the farmers are currently consuming as revealed by the Cost of Cultivation survey. The analysis can be done at a state level and state-specific limits can be set. We may also wish to use a different metric than current consumption to construct these limits. It is well established that the ratio of urea to DAP and MOP is higher than optimal. One option might be to restrict the number of bags of fertilizer to the normative ratios in which they should be consumed. By balancing the number of bags that can be bought at a subsidy, we may be able to shape the utilization ratios by nudging them in the right direction.

8.2.2.2.2 Politically supportable

It is quite possible that there may be some resistance from larger farmers and the farmer lobby to this policy. In such a scenario, we may wish to set the limit for the number of bags to higher than 7 and reduce it gradually over time. Even if the limit is set to 12 bags, sufficient for the average farmers in the highest size bracket, the savings would be large. Note that a large source of leakage is to industry and across borders. Even setting the limit to 12 bags would curtail this leakage.

8.2.2.2.3 Administratively feasible

The key requirement for this option would be the presence of Point-of-Sale (POS) devices. These devices would electronically read Aadhaar cards and return available allowance of subsidized fertilizer. Appendix 11.4 shows the prevalence of these POS devices by state.

[23] Calculated as the total reduction in inclusion error minus the loss through smaller farmers reselling the excess bags.

States like Gujarat and Andhra Pradesh have a high number of these devices and may be ready for a pilot immediately. Other states are in the process of scaling up access to these devices for PDS, the food subsidy delivery program, and could easily transition to this system.

8.2.3 Putting the options together

Biometric authentication with limited physical off-take would be the ideal demand-side reform for fertilizer subsidies. A number of states, like Andhra Pradesh and Gujarat, with a high Aadhaar penetration and presence of POS[24] devices, are ready to trial it. Appendix 11.2 shows these metrics for the various states.

Though as a starting point, current consumption level of small and marginal farmers might be a good number, states may wish to experiment with different metrics to determine the bag limits. Depending on the soil requirements, the states may even wish to customize the number of bags for each agricultural zone. This may require a higher administrative capacity but would result in improvements in yields.

States that are able to target farmers using land records may wish to experiment with 'multi-packs' that provide subsidized fertilizer in optimal ratios. Plot size and agricultural zone can both be determined using the land records, then used to determine the optimal mix of fertilizer for a given farm. Another benefit of such multipacks would be to increase the cost of smuggling, since lucrative urea will need to be bought along with expensive DAP and MOP. This would also reduce incidence of smuggling at the margin.

8.3 The policy package

With the numerous distortions in place, any policy reform needs to address supply- and demand-side issues. On the demand side, we argue that giving a fixed amount of fertilizer universally conditional on Aadhaar authentication is an optimal policy given the administrative constraints.

On the supply side, we presented decanalization as best way to ease the availability constraint. We also discussed how a demand-side intervention is almost a pre-requisite (or a co-requisite) for decanalization, else it would worsen imbalance in fertilizer usage and increase subsidy burden.

[24] Point of Sale device. It is required for Aadhaar authentication and usually has a finger print scanner for biometric authentication.

9 Implementation

9.1 Decanalization

Decanalization policy implementation can either adopt a 'big-bang' approach that opens up the market for imports overnight, or a more gradual phased approach. A phased approach may be done in two ways:

- *Phased in time:* Open market but increases number of licenses slowly. Initially only the four current canalizing agents would get licenses.
- *Phased in space:* Open market only in a few states initially.

The main reason for a phased rollout of decanalization is political. Urea differs from DAP and MOP, which were both decanalized overnight, in two critical aspects:

1. **Volume**: Urea volumes are almost three times those of DAP. The Ministry of Fertilizer is concerned that any negative shock to availability would make headlines.
2. **Domestic suppliers:** Most of urea is domestically supplied. Though this policy is not expected to hurt the domestic industry, the Ministry of Fertilizer feels that they should move cautiously as additional imports may reduce demand for domestic urea.

Phasing in the number of licenses gradually would not directly affect availability or the subsidy bill. The subsidy will be provided based on prevailing market price that importers cannot influence. The incumbent firms would import sufficient fertilizer to meet the domestic demand. If there were a larger number of firms, the volume would be divided between them. It may be harmless (if also ineffectual) to use this strategy.

Phasing in the number of states may be administratively difficult. It would require monitoring the supply chain of importers to ensure urea is not sold in other states. A parallel supply-chain will need to be set up to separate "OGL urea" from "Canalized urea". Bags would need to be marked for sale only within a given state.

Since the government is insistent on a phased approach, using the number of licenses may be the less deleterious option.

9.2 Biometric-authenticated limited off-take

Unlike decanalization, regulating the demand side has a number of options that can be explored. We discussed some of these while developing the solution options. States may wish to experiment with the number of bags of subsidized fertilizer a person is entitled to. In states where there is underuse of DAP and MOP, additional discounted bags than the amount suggested above may encourage usage. Similarly, states with overuse of urea may wish to reduce the subsidy allotment. States could also experiment with multipacks where urea, DAP, and MOP are sold in optimal ratios.

Though no states are quite ready to implement subsidies using land and tenancy records, the door to this option should be left open. Haryana may be the first state to computerize all their land records and connect them to Aadhaar accounts. In a year, it may be ready to transition to targeted subsidies and lead the way for other states.

Similarly, the problems with direct bank transfers noted above do not apply universally to all states and all farmers. In discussions with farmers, most were happier with payments from the National Rural Employment Guarantee Act (NREGA) going straight to their bank accounts. If a sufficient number of such farmers are willing to wait for their fertilizer subsidy, a state may wish to allow direct bank transfers as an option.

10 Conclusion

We showed that a lack of availability constrains sale of urea and creates a black market where farmers pay 60% higher prices on average. This lack of availability is due to over-regulation of the urea market and the untargeted nature of the subsidy. We showed that a large amount of the subsidy is lost through inclusion errors and siphoning to industry.

Before any supply-side deregulation, leakages need to be stymied. Since targeting farmers is not administratively feasible, we recommend a second-best approach of limiting the amount of subsidized fertilizer available per Aadhaar card. Aadhaar penetration is very high in most states and a number of them have deployed point-of-sale devices for authentication.

The deregulation must begin with import decanalization. By switching to an open general license (OGL) policy, we allow importers to respond to unmet demand and increase supply. India is the biggest importer of fertilizer and shifts world prices with each tender. Under OGL, importers will no longer be directed on how much and when to import and can take advantage of low market prices.

The order of implementation is important. Deregulation should follow demand-side reform to avoid the already high fiscal costs from worsening. Further, states should be allowed to experiment with policy parameters. The limits on subsidized fertilizer can be set based on either normative guidelines or a function of current usage. Smaller states that have homogenous soil types, like Punjab, can sell “multipacks” that combine the critical fertilizers in optimal ratios.

Urea policy is politically sensitive. Solutions like reducing rate of subsidy or deregulating prices will not gain political support in the absence of a crisis. Therefore, we must look for second-best solutions like the ones presented to gradually transition to the desired end state.

11 Appendix

11.1 Calculating regressivity

The Cost of Cultivation Survey uses five different classifications: less than 1 ha., between 1 and 2 ha., between 2 and 4 ha., between 4 and 6 ha., and greater than 6 ha. In Figure 8, we compare the percentage share of additional expenditure incurred due to black market prices for first two size classes (defined as small farmer) with the last two size classes (defined as large farmers). In other words:

$$Share\ of\ additional\ expenditure_i = \frac{Total\ expenditure\ on\ urea_i - Expenditure\ on\ black\ market\ urea_i}{Total\ expenditure\ on\ urea_i} * 100$$

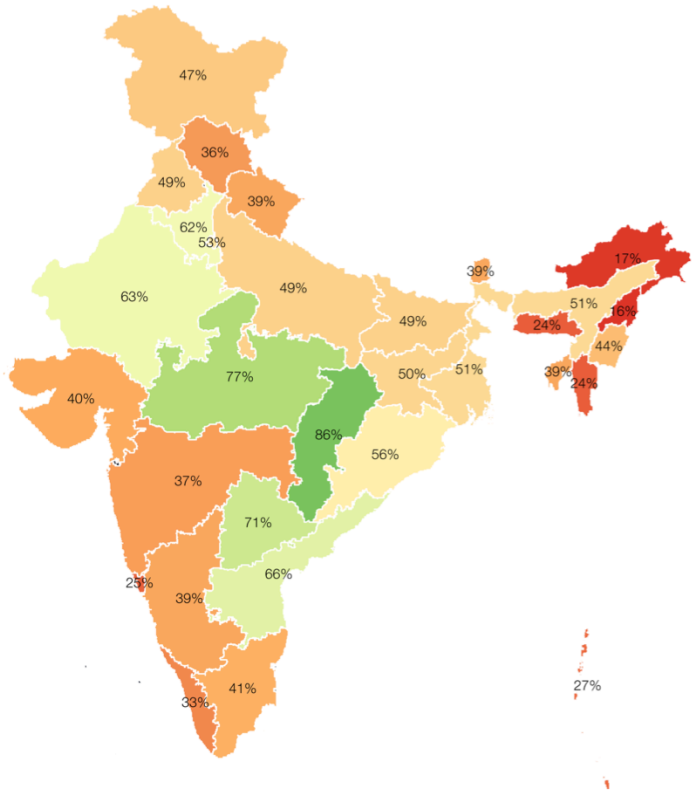
$$Regressivity = Share\ of\ additional\ expenditure_i(i = small\ farmer) - Share\ of\ additional\ expenditure_i(i = larger\ farmer)$$

11.2 Computerized land records by state

State	Number of Villages	% CLR Completed	% CLR In progress
KARNATAKA	**29523**	**100%**	0%
TRIPURA	**891**	**99.44%**	0%
WEST BENGAL	**41006**	**84.53%**	0.15%
GUJARAT	**18529**	**76.42%**	0%
MAHARASTRA	**44032**	**47.24%**	19.12%
SIKKIM	**459**	**23.97%**	0%
UTTARAKHAND	**16998**	**15.44%**	0.01%
HARYANA	**6918**	**9.67%**	0.39%
PUDUCHERRY	**136**	**8.09%**	0%
CHATTISGARH	**20131**	**6.17%**	3.85%
TELANGANA	**10877**	**4.66%**	3.17%
HIMACHAL PRADESH	**20694**	**2.77%**	0%
MADHYA PRADESH	**55070**	**2.21%**	0.01%
ASSAM	**26549**	**1.73%**	0%
ANDAMAN & NICOBAR	**556**	**0.54%**	0.18%
GOA	**396**	**0.25%**	0%
TAMILNADU	**16371**	**0.01%**	0%

State	Number of Villages	% CLR Completed	% CLR In progress
KERALA	**1489**	**0%**	0.07%
ANDHRA PRADESH	**17151**	**0%**	0%
ARUNACHAL PRADESH	**5590**	**0%**	0%
BIHAR	**44936**	**0%**	0%
CHANDIGARGH	**12**	**0%**	0%
DADRA & NAGAR HAVELI	**70**	**0%**	0%
DAMAN & DIU	**25**	**0%**	0%
JAMMU & KASHMIR	**5733**	**0%**	0%
JHARKHAND	**32598**	**0%**	0%
LAKSHADWEEP	**27**	**0%**	0%
MANIPUR	**2598**	**0%**	0%
MEGHALAYA	**6822**	**0%**	0%
MIZORAM	**829**	**0%**	0%
NAGALAND	**1435**	**0%**	0%
NCT OF DELHI	**222**	**0%**	0%
ODISHA	**34495**	**0%**	0%
PUNJAB	**12674**	**0%**	0%
RAJASTHAN	**44800**	**0%**	0%
UTTAR PRADESH	**106974**	**0%**	0%

11.3 Percentage of people with bank accounts



11.4 The presence of Aadhaar and POS devices

States	% with Aadhaar	% fair price shops with POS
Andhra Pradesh	99%	97%
Assam	2%	0%
Bihar	60%	0%
Chhattisgarh	91%	42%
Dadra and Nagar Haveli	86%	0%
Gujarat	75%	98%
Haryana	99%	0%
Himachal Pradesh	98%	0%
Karnataka	86%	19%
Madhya Pradesh	83%	28%
Maharashtra	91%	0%
Odisha	75%	0%
Punjab	99%	0%
Rajasthan	79%	21%
Tamil Nadu	79%	3%
Telangana	105%	0%
Uttar Pradesh	67%	0%
Uttarakhand	76%	0%
West Bengal	77%	0%

12 References

"A Fertile Mess." *The Indian Express*. Accessed December 30, 2015. http://indianexpress.com/article/opinion/columns/a-fertile-mess/.

Anand, Geeta. "Green Revolution in India Wilts as Subsidies Backfire." *Wall Street Journal*, February 22, 2010, sec. World News. http://www.wsj.com/articles/SB10001424052748703615904575052921612723844.

Arijit Barman, Ramkrishna Kashelkar & Baiju Kalesh. "http://economictimes.indiatimes.com//articleshow/47887591.cms." *The Economic Times*, July 1, 2015. http://economictimes.indiatimes.com//articleshow/47887591.cms.

"A Soil Health Card Not Enough for Balanced Fertilizer Use." *Http://www.livemint.com/*. Accessed November 10, 2015. http://www.livemint.com/Politics/1xM0dNr7g9BLYw5Rx45tvK/A-soil-health-card-not-enough-for-balanced-fertilizer-use.html.

Bank, The World. "New Approaches to Input Subsidies." The World Bank, January 1, 2007. http://documents.worldbank.org.ezp-prod1.hul.harvard.edu/curated/en/2007/01/8667742/new-approaches-input-subsidies.

Barkat, Abul, Rushad Faridi, Syed Naimul Wadood, Subhash Kumar Sengupta, and SNM Ehsanul Hoque. "A Quantitative Analysis of Fertilizer Demand and Subsidy Policy in Bangladesh." *Food and Agriculture Organization of the United Nations (FAO), USA*, 2010. http://bdresearch.org/home/attachments/article/446/Barkat.pdf.

Barnwal, Prabhat. "Curbing Leakage in Public Programs with Biometric Identification Systems: Evidence from India's Fuel Subsidies." *Manuscript. I*, 2014. http://www.med.uio.no/helsam/english/research/news-and-events/events/conferences/2015/vedlegg-warsaw/subsidy-leakage-uid.pdf.

Chirwa, Ephraim, and Andrew Dorward. *Agricultural Input Subsidies: The Recent Malawi Experience*. OUP Oxford, 2013.

Dholakia, Ravindra H., and Majumdar Jagdip. "Estimation of Price Elasticity of Fertilizer Demand in India." IIMA Working Paper. Indian Institute of Management Ahmedabad, Research and Publication Department. Accessed March 11, 2016. http://econpapers.repec.org/paper/iimiimawp/wp01273.htm.

Dorward, Andrew. "Rethinking Agricultural Input Subsidy Programmes in Developing Countries." SSRN Scholarly Paper. Rochester, NY: Social Science Research Network, 2009. http://papers.ssrn.com/abstract=1808847.

Dorward, Andrew, and Ephraim Chirwa. "The Malawi Agricultural Input Subsidy Programme: 2005/06 to 2008/09." *International Journal of Agricultural Sustainability* 9, no. 1 (2011): 232–47.

Dr. Ashok Gulati, Pritha Banerjee. "Rationalizing Fertilizer Subsidy in India: Key Issues and Policy Options," 2015.

Duflo, Esther, Michael Kremer, and Jonathan Robinson. "Nudging Farmers to Use Fertilizer: Theory and Experimental Evidence from Kenya." Working Paper. National Bureau of Economic Research, July 2009. http://www.nber.org/papers/w15131.

Ellis, Frank. *Agricultural Policies in Developing Countries*. Wye Studies in Agricultural and Rural Development. Cambridge England ; New York: Cambridge University Press, 1992.

"EY to Study Nutrient-Based Subsidy Impact on Fertilizer Price." *Http://www.livemint.com/*. Accessed December 21, 2015. http://www.livemint.com/Politics/deY7aSKol9AVNEdi6zPToM/EY-to-study-nutrientbased-subsidy-impact-on-fertilizer-pric.html.

Fan, Shenggen, Ashok Gulati, and Sukhadeo Thorat. "Investment, Subsidies, and Pro-Poor Growth in Rural India." In *International Food Policy Research Center*, 2007.

"Fertiliser Industry Wants de-Canalisation of Urea Imports." Accessed September 25, 2015. http://www.business-standard.com/article/companies/fertiliser-industry-wants-de-canalisation-of-urea-imports-115020401410_1.html.

"Fertiliser Ministry Seeks Additional Rs 30,000 Crore to Clear Subsidy Arrears | Latest News & Updates at Daily News & Analysis." *Dna*. Accessed January 2, 2016. http://www.dnaindia.com/money/report-fertiliser-ministry-seeks-additional-rs-30000-crore-to-clear-subsidy-arrears-2064123.

"Fertiliser Subsidy Dues May Cross Rs 45K Cr by March 2016." *The Indian Express*. Accessed January 15, 2016. http://indianexpress.com/article/business/business-others/fertiliser-subsidy-dues-may-cross-rs-45k-cr-by-march-2016/.

Gautam, Madhur. "Agricultural Subsidies: Resurging Interest in a Perennial Debate *." *Indian Journal of Agricultural Economics* 70, no. 1 (March 2015): 83–105.

Gulati, Ashok, and Anil Sharma. "Subsidy Syndrome in Indian Agriculture." *Economic and Political Weekly* 30, no. 39 (September 30, 1995): A93–102.

Hedley, Douglas D., and Steven R. Tabor. “Fertilizer in Indonesian Agriculture: The Subsidy Issue.” *Agricultural Economics* 3, no. 1 (1989): 49–68.

“http://economictimes.indiatimes.com//articleshow/47075692.cms.” *The Economic Times*. Accessed December 30, 2015. http://economictimes.indiatimes.com//articleshow/47075692.cms.

IMF. “India: 2015 Article IV Consultation-Staff Report,” March 11, 2015.

IMF. “India: 2016 Article IV Consultation-Staff Report.” Article IV. IMF, March 2016. http://www.imf.org/external/pubs/cat/longres.aspx?sk=43758.0.

“India: 2016 Article IV Consultation-Press Release; Staff Report; and Statement by the Executive Director for India.” Article IV. IMF, March 2016. http://www.imf.org/external/pubs/cat/longres.aspx?sk=43758.0.

“India’s Flawed Fertilizer Policy.” *Http://www.livemint.com/*. Accessed November 8, 2015. http://www.livemint.com/Opinion/XCCJwEzbzwiyWFYfK1wRdO/Indias-flawed-fertilizer-policy.html.

“In Fact: The Case for Liberalising Urea Imports.” *The Indian Express*. Accessed November 8, 2015. http://indianexpress.com/article/explained/in-fact-the-case-for-liberalising-urea-imports/.

Jauhari, Ujjval. “Tata Chemicals: Exit from Fertilisers Will Be Positive.” Accessed February 6, 2016. http://www.business-standard.com/article/opinion/tata-chemicals-exit-from-fertilisers-will-be-positive-115070700431_1.html.

Kapur, Rakesh. “LONG TERM SUSTAINABLE UREA POLICY-NEED OF THE HOUR.” Accessed September 25, 2015. http://125.19.12.220/applications/Brihaspat.nsf/95d7dbaa18e0fd5fe52565690024f923/2abf004802ee65cb65257ad2001c1597/$FILE/Article_FAI%20_JMD_%20IFFCO_291112.pdf.

Kaur, Rajwinder. “Agricultural Subsidies in India Boon or Curse.” *IOSR Journal of Humanities and Social Science* 2, no. 4 (2012): 40–46. doi:10.9790/0837-0244046.

K.N. Tiwari. “The Changing Face of Balanced Fertilizer Use in India,” 2001. http://www.ipni.net/publication/bci.nsf/0/B4EEDC01C4FCACD585257BBA006868BD/$FILE/Better%20Crops%20International%202001-2%20p24.pdf.

“MCF Set to Produce 380,000 Tonnes Urea in FY16 on Continued Naphtha Subsidy.” Accessed January 2, 2016. http://www.business-standard.com/article/companies/mcf-set-to-produce-380-000-tonnes-urea-in-fy16-on-continued-naphtha-subsidy-115061100775_1.html.

NAAS 2009. “CROP RESPONSE AND NUTRIENT RATIO,” n.d. http://naasindia.org/Policy%20Papers/policy%2042.pdf.

“Natural Gas: The Achilles’ Heel of India’s Energy Security.” *Www.bcgperspectives.com*. Accessed November 6, 2015. https://www.bcgperspectives.com/content/articles/energy_environment_natural_gas/.

Niti Aayog. “Raising Agricultural Productivity and Making Farming Remunerative for Farmers,” Task Force on Agricultural Development, December 16, 2015. http://niti.gov.in/mgov_file/Raising%20Agricultural%20Productivity%20and%20Making%20Farming%20Remunerative%20for%20Farmers.pdf.

“Nutrient Facts.” *The Indian Express*. Accessed November 18, 2015. http://indianexpress.com/article/india/india-others/nutrient-facts/.

Osorio, Camilo Gomez, Dwi Endah Abriningrum, Enrique Blanco Armas, Muhammad Firdaus, and others. *Who Is Benefiting from Fertilizer Subsidies in Indonesia?* World Bank, 2011. https://openknowledge.worldbank.org/bitstream/handle/10986/3519/5758.pdf?sequence=4&isAllowed=y.

Panning, Alyssa, and Kishore G. Kulkarni. “Technology for Growth: Indian Green Revolution.” *SCMS Journal of Indian Management* 8, no. 3 (September 2011): 49–62.

Pinstrup-Andersen, Per, and Peter B. R. Hazell. “The Impact of the Green Revolution and Prospects for the Future.” *Food Reviews International* 1, no. 1 (January 1, 1985): 1–25. doi:10.1080/87559128509540765.

Prashant Mukherjee. “Gas Pooling Is the Way Forward For the Fertiliser Industry.” *The New Indian Express*, June 7, 2015, sec. Business. http://www.newindianexpress.com/business/news/Gas-Pooling-is-the-Way-Forward-For-the-Fertiliser-Industry/2015/06/07/article2852987.ece.

Pratap Bhanu Mehta. “Loud but Silent: Modi’s Actions Are Opposite to the Mythology Surrounding Him.” *The Indian Express*. Accessed January 18, 2016. http://indianexpress.com/article/opinion/columns/loud-but-silent/.

Ricker-Gilbert, Jacob, Thomas Jayne, and Gerald Shively. “Addressing the ‘Wicked Problem’ of Input Subsidy Programs in Africa: A Review.” *American Agricutural Economists Association, Seattle*, 2012. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.244.8370&rep=rep1&type=pdf.

Sahu, Barun Kumar. *Unwritten Flaws of Indian Bureaucracy: Ground Rules of Inscrutable Public (and Private!) Bureaucracies, Why You Will Falter in the Bureaucratic Maze and How You Can Get the Better of It*. Pustak Mahal, 2004.

Sharma, Vijay Paul. “Dismantling Fertilizer Subsidies in India: Some Issues and Concerns for Farm Sector Growth.” Working Paper, September 2012. http://vslir.iimahd.ernet.in:8080/xmlui/handle/123456789/11384.
Sharma, Vijay Paul, and Hrima Thaker. “Fertilizer Subsidy in India: Who Are the Beneficiaries?” Working Paper, July 15, 2009. http://vslir.iimahd.ernet.in:8080/xmlui/handle/123456789/10851.
“Soil Testing Costs,” n.d.
“Subsidy Sham: Fertilizers Reach Indonesia Plantations, Not Small Farmers.” *Reuters*, February 15, 2016. http://www.reuters.com/article/us-indonesia-fertilizers-idUSKCN0VN127.
“Unique Identification Authority of India.” *Wikipedia, the Free Encyclopedia*, January 30, 2016. https://en.wikipedia.org/w/index.php?title=Unique_Identification_Authority_of_India&oldid=702387992.
“UPA’s Import Obsession Destroyed India’s Growth Story (Part II Fertilizer).” *Times Of India Blogs*. Accessed November 8, 2015. http://blogs.economictimes.indiatimes.com/Whathappensif/upa-s-import-obsession-destroyed-india-s-growth-story-part-ii-fertilizer/.
“UP Shows Way in Direct Subsidy Payment to Farmers.” *The Indian Express*. Accessed January 18, 2016. http://indianexpress.com/article/india/india-news-india/up-shows-way-in-direct-subsidy-payment-to-farmers/.
“Urea Price Hike – Put in Deep Freezer.” *UttamGupta.Com*, June 1, 2015. http://www.uttamgupta.com/fertilizers/urea-price-hike-put-deep-freezer/.
“Why No ‘Make in India’ for Urea?” *The Hindu Business Line*, December 14, 2014. http://www.thehindubusinessline.com/opinion/columns/why-no-make-in-india-for-urea/article6691060.ece.