Urea problem in India Agriculture

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Why in News: In May 2015, the Centre made it mandatory to coat all indigenously manufactured and imported urea with neem oil. This was followed by replacing 50-kg bags with 45-kg ones in March 2018, and the launch of liquid ‘Nano Urea’ by the Indian Farmers’ Fertiliser Cooperative (IFFCO) in June 2021.

None of the above measures — checking illegal diversion for non-agricultural use, smaller bags, and increasing nitrogen use efficiency — have succeeded in reducing urea consumption.

Status of Urea utilisation in India

Sales of urea crossed a record 35.7 million tonnes (mt) in the fiscal year ended March 31, 2023.

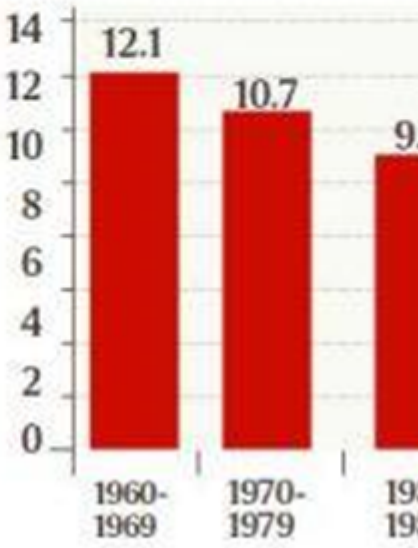
Consumption did dip in the initial two years after neem-coating was fully enforced from December 2015, seemingly making it difficult for the heavily subsidised fertiliser to be used by plywood, particle board, textile dye, cattle feed and synthetic milk makers.But that trend reversed from 2018-19. Urea sales in 2022-23 were about 5.1 mt higher than in 2015-16 and over 9 mt than in 2009-10, before the introduction of the so-called nutrient-based subsidy (NBS) regime in April 2010. All other fertilisers, barring single super phosphate (SSP), have registered much lower increases or even declines

ALL-INDIA USE OF FERTILISER PRODUCTS

	UREA	DAP	MOP*	NPKS	SSP
2009-10	266.73	104.92	46.34	80.25	26.51
2010-11	281.13	108.7	39.32	97.64	38.25
2011-12	295.65	101.91	30.29	103.95	47.46
2012-13	300.02	91.54	22.11	75.27	40.3
2013-14	306	73.57	22.8	72.64	38.79
2014-15	306.1	76.26	28.53	82.78	39.89
2015-16	306.35	91.07	24.67	88.21	42.53
2016-17	296.14	89.64	28.63	84.14	37.57
2017-18	298.94	92.94	31.58	85.96	34.39
2018-19	314.18	92.11	29.57	90.28	35.79
2019-20	336.95	101	27.87	98.57	44.03
2020-21	350.43	119.11	34.25	118.11	44.89
2021-22	341.8	92.72	24.57	114.79	56.81
2022-23	357.25	105.31	16.32	100.73	50.18

*For direct application, excluding supply to complex fertiliser units.
Source: Fertiliser Association of India. (in lakh tonnes)

CROP YIELD RESPON



Source: J.C.

The failure of NBS

Under NBS, the government fixed a per-kg subsidy for each fertiliser nutrient: Nitrogen (N), phosphorus (P), potash (K) and sulphur (S). This was as against the earlier product-specific subsidy regime.

Linking subsidy to nutrient content was intended to promote balanced fertilisation by discouraging farmers from applying too much urea, di-ammonium phosphate (DAP) and muriate of potash (MOP).

These are fertilisers with high content of a single nutrient: Urea (46% N), DAP (46% P plus 18% N) and MOP (60% K).

NBS was expected to induce product innovation, besides more use of complex fertilisers (having lower concentrations of N, P, K and S in different proportions) and SSP (containing only 16% P but also 11% S)

However, the data reveals worsening of nutrient imbalance, with urea consumption rising by over a third since 2009-10. This has been largely courtesy of its maximum retail price (MRP) going up by a mere 16.5% – from Rs 4,830 to Rs 5,628 per tonne – post the introduction of NBS.

The Narendra Modi government has, in the last one year, also brought back price controls on DAP, with companies not allowed to charge more than Rs 27,000 per tonne. It has led to the sales of both fertilisers soaring in 2022-23, at the expense of NPKS complexes and SSP.

The cost of imbalanced fertilisation

Fertilisers are essentially food for crops. They, like humans, need nutrients – primary (N, P, K), secondary (S, calcium, magnesium) and micro (iron, zinc, copper, manganese, boron, molybdenum) – for plant growth and grain yield.

During the Green Revolution, scientists bred semi-dwarf crop varieties that did not bend or fall over ("lodge") when their ear heads were heavy with well-filled grains. These could, then, "tolerate" fertiliser application and produce more grain with higher doses.

Over time, though, crop yield response to fertiliser use has more than halved: 1 kg of NPK nutrients yielded 12.1 kg of cereal grains in India during the 1960s, but only 5 kg during the 2010s (see chart). The underlying reason has been the disproportionate application of N by farmers.

More recent research – by Bijay Singh from the department of soil science at Punjab Agricultural University, Ludhiana – has established a decline in nitrogen use efficiency (NUE) itself. NUE refers to the proportion of N applied mainly through urea that is actually utilised by crops to produce harvested yields.

Singh, in a 2022 paper, has estimated the NUE in India to have fallen from 48.2% in 1962-63 to 34.7% in 2018. The 34.7% NUE was below the global average of 45.3% and 53.3% for North America in 2018.

When Indian farmers are applying 100 kg of N, hardly 35 kg is now being utilised, with the balance 65 kg unavailable to the plant. Some of the unutilised N may convert into organic form and become part of the soil nitrogen pool.

This soil organic nitrogen may then undergo mineralisation (reconvert into inorganic ammonium form) and become available to the subsequent crops.

The remaining unutilised N, however, escapes from the soil-plant system through hydrolysis (breakdown of urea into ammonia gas and its release into the atmosphere) and nitrification (below-the-ground leaching after conversion into nitrate).

The solutions

If applying more urea is counterproductive – manifested in diminishing crop yield response to fertilisers and a rising share of applied N getting "lost" through ammonia volatilisation or leaching into the groundwater as nitrate is the obvious solution is to reduce its consumption and promote products containing other nutrients in desired (crop- and soil-specific) combinations.

There are two approaches to cut urea consumption. The first is raising prices. The current per-tonne MRPs – Rs 5,628 for urea, Rs 27,000 for DAP and Rs 34,000 for MOP are nowhere compatible with a 4:2:1 NPK use ratio generally considered ideal for Indian soils. But since increasing urea prices isn't politically easy, a second approach is to improve NUE enabling farmers to harvest the same or more grain yields with fewer bags.

Fertiliser industry expert G. Ravi Prasad believes that the government should make incorporation of urease and nitrification inhibitors compulsory in urea. These are chemical compounds that inhibit the activity of urease (a soil enzyme that breaks down urea into ammonium and further to ammonia) and nitrifying bacteria (that convert ammonium to nitrate), making more N available to the crops.

The government can bear a part of the cost of these chemicals, which are proprietary formulations of global plant nutrient solutions companies such as Koch and BASF.

Nano Urea is also primarily aimed at boosting NUE. The ultra-small size of its particles (20-50 nanometers, as against 1-4 millimeters for normal prilled/granular urea; 1 mm=1 million nm) is said to allow easier penetration

through the stomatal pores of leaves. IFFCO claims that a single 500-ml Nano Urea bottle containing just 4% N can effectively replace “at least” one 45-kg bag of regular 46% N urea.

Nano Urea’s limitation is that, being a liquid fertiliser, it can only be sprayed after the crop has developed leaves. It cannot replace normal urea for basal application at sowing time or even for the early crop growth stages. “Farmers are used to broadcasting fertilisers (uniformly spreading over the field). If the government wants to promote Nano Urea (for foliar application directly to the leaves), it may have to subsidise the cost of spraying