Harmful Impact of Excess Urea on Environment and Human Health

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ABSTRACT

Fertilizers are essential for crop growth, but their overuse, particularly of urea has created severe environmental, soil, and health problems in India. Farmers often apply excess urea while neglecting other nutrients, leading to imbalance, soil degradation, eutrophication, greenhouse gas emissions, and nitrate-contaminated groundwater linked to serious diseases. Easy availability and uncontrolled subsidies further worsen the issue by encouraging overuse and diversion for non-agricultural purposes. Solutions lie in balanced subsidies, farmer-specific limits, neem-coated urea, and the promotion of sustainable alternatives such as organic inputs, biofertilizers, nanofertilizers, and slow-release formulations to safeguard soil, environment, and human health.

INTRODUCTION

"There is a common saying among people: 'Since urea was introduced into the market, many diseases have emerged.' While this may hold some truth, it begs the question: who is truly responsible for this situation: urea or ourselves?"

No doubt, fertilizer plays an important role in agriculture. But problem arises when these chemicals instead of being used judiciously, are applied in excess amount by the farmers. So, the problems we are facing today are only because of the result of our negligence and we solely are responsible for it.

Plant requires major nutrients, NPK, for growth and development. Nitrogen in particular is an essential nutrient for the growth of every organism on Earth. Nitrogen is all around us and makes up about 78% of the air you breathe. However, plants and animals cannot use the nitrogen gas in the air. To grow, plants require nitrogenous compounds from the soil which can be produced naturally (either through biological nitrogen fixation and decomposition of organic matter) or be provided by fertilizers.

Urea is the chief nitrogenous fertilizer in the market because is easily available and cheap. Government provides a huge subsidy (89%) particularly on the purchase of urea (**The current maximum retail price (MRP) for a 45 kg bag of urea is ₹242, but the actual cost is around ₹2,200)**. Also, there are no restrictions on who can buy the **subsidized fertilizer,** or on how much they can buy. This leads farmer to preferentially apply urea to the field & in a higher quantity with a staunch feeling that adding only urea to the crop will give better yield while neglecting potassic and phosphoric fertilizers. Such an ease of availability also has resulted into the diversion of urea to other industries like dairy, textile, paint, fisheries, etc.

In addition, farmers often overuse fertilizer since they don't evaluate their soil and don't stick to the appropriate dosage. According to reports, NPK consumption in India is 8:4:2, whereas the standard was 4:2:1 ratio and the result is one and the same. Unawareness among the farmers about the toxic effect of the overuse of this fertilizer is also one of the reasons of their overconsumption.

Consumption/ Sale of Major Fertilizers in India

Year	Urea (in lakh tonnes)	DAP (in lakh tonnes)	MOP (in lakh tonnes)
2013-14	306	73.57	22.8
2014-15	306.1	76.26	28.53
2015-16	306.35	91.07	24.67
2016-17	296.14	89.64	28.63
2017-18	298.94	92.94	31.58
2018-19	314.18	92.11	29.57
2019-20	336.95	101	27.87
2020-21	350.43	119.11	34.25
2021-22	341.8	92.72	24.56
2022-23	357.25	104.18	16.32
2023-24	357.8	108.12	16.45
Apr-Jan '23-24'	317.5	101.47	13.96
Apr-Jan '24-25'	345.73	87.13	18.76

(Source: The Fertilizer Association of India)

Harmful effects of the overconsumption of urea:

- The use of chemical fertilizers on crops can have adverse effects on waterways **caused by chemical run off of the excess fertilizer.** In waterways, the addition of external nutrients (like excess nitrogen) is called eutrophication which therein promotes the growth of algae, plants and microorganisms, just like the fertilization of soil. However, the fast growth of microorganisms and algae can use up all

the oxygen in these waterways and turn them into so-called dead zones, because aquatic animals cannot live without oxygen. Eutrophication can also lead to the growth of algal species that produce toxic chemicals, called harmful algal blooms (Vilmin *et al*., 2018).

- Applying excessive amounts of urea leads to the release of harmful greenhouse gases into the atmosphere such as **nitrous oxide.** Nitrous oxide has a warming potential ~300 times greater than the most commonly mentioned greenhouse gas, carbon dioxide (CO_2). Soil microorganisms can transform nitrogen provided in fertilizers into nitrogen-containing gases, which get released into the atmosphere as nitrous oxide (N_2O). Gases that trap heat in the atmosphere much like the roof of a greenhouse that traps heat to protect the plants growing in it from cold weather and frost. Greenhouse gases are one of the main factors accelerating global warming.

- Urea has an acidic residual nature. So prolonged and continual over use of urea can lead to **soil acidification.**

- After urea is applied to soil, ammonia is released through hydrolysis, which is subsequently converted to nitrate by nitrifying bacteria present in the soil. This highly mobile nitrate then enters ground water along with percolating water, posing significant health risks when consumed by people. Prolonged exposure to high nitrate levels in drinking water has been linked to conditions such as methemoglobinemia, colo-rectal cancer, thyroid disorder (WHO, 2017) and neural tube defects (a type of birth defect). In India, groundwater contamination with high nitrate levels has been observed in several regions. For example, nitrate concentrations reached **2,000 mg/L** in Muktsar, Haryana (Pant *et al*., 2020), **1,923 mg/L** in Najafgarh, Delhi (Adhikary *et al*., 2012), **896 mg/L** in Nalgonda, Andhra Pradesh (Brindha and Elango, 2014), and **700 mg/L** in Southern Haryana (Kumari and Rai, 2020). These values far exceed the **World Health Organization's** (WHO, 2017) recommended maximum permissible limit (MPL) of **50 mg/L** for nitrate in groundwater. Given the potential health hazards, the **Bureau of Indian Standards** (BIS) recommends an even stricter limit of **45 mg/L** for nitrate in drinking water in India.

- The extensive overuse of urea, has resulted in an increased farm production cost and falling crop response to fertilizers, which, in turn, has caused farmers' profitability to be adversely affected.

- Imbalance in the consumption of fertilizers have resulted in worsening of soil quality that has resulted in decreased soil fertility and productivity.

- Overconsumption also have resulted in the wastage of a lot of fertilizers, which generate burden on fertilizer industries.

Initiative to reduce overconsumption of urea:

- The government needs to get sensible, else the health of the soil, citizens (including farmers) and the industry will suffer greatly.

- The first step would be to draw up a list of all farmers who are eligible for the fertilizer subsidy, and to set a limit on how much they can obtain. Such a list and limits don't exist today.

- The government should also provide sufficient subsidies on non-urea fertilizers

to ensure they are priced at "reasonable levels".

- The government has taken a number of measures to reduce urea consumption. It introduced neem coated urea to reduce illegal diversion of urea for non-agricultural uses.

- The adverse effect of these synthetic chemicals on human health and environment can only be reduced or eliminated by adopting new agricultural technological practices such as shifting from chemical intensive agriculture which includes the use of organic inputs such as manure, biofertilizers, biopesticides, slow-release fertilizer and nanofertilizers etc. which would improve the application efficiency as well as use efficiency of the fertilizers.

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