Frank Notes

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Changing Face of Indian Agriculture

Green Revolution model of agricultural intensification launched in mid-1960s involved growing high yielding varieties (HYVs) of rice and wheat under assured supply of water, fertilizers and plant growth/protection chemicals. It helped India tide over the food shortage crisis of early 1960s and the country become self-reliant. Today, country is a net exporter of the food grains. In fact, India is the largest exporter of rice feeding large part of the world population. This became possible because of the miracle HYVs evolved by the Plant Breeders, best agronomic practices developed by the agronomists (what is today known worldwide as 4R principles) to harness full potential of these varieties, and unstinted government support in making timely availability of production inputs and farm machinery.

Recognizing the fact that fertilizer is the most critical input to realize the full yield potential of HYVs, Government of India (GOI) encouraged the use of chemical fertilizers right from mid-1960s. Steep escalation in prices of fertilizers and raw materials in international market following the oil crisis engineered by the Arab–Israel War in mid-1970s threw a first challenge to the Government in making more and more fertilizer available to the farmers at reasonable/affordable prices. Taking cognizance of these developments, GOI formulated policies to promote this objective. Government introduced the Retention Price Scheme (RPS) for i) nitrogenous fertilizers (except ammonium chloride) in 1977, ii) complex fertilizers in 1979, iii) SSP in 1982, and iv) ammonium chloride in 1985 to serve the twin objectives of making fertilizers affordable to farmers and ensuring viability of fertilizer production. Farmers were provided fertilizers at the subsidized prices. The difference in cost of production and sale price was reimbursed to the manufactures, which is famously called *fertilizer subsidy*.

The impact of RPS was dramatic. The fertilizer production increased from 1.83 million tonnes (Mt) in 1975-76 to 9.04 Mt in 1990-91. During this period, fertilizer consumption showed a rise from 2.89 Mt to 12.55 Mt. This increase in fertilizer consumption led to remarkable increase in food grain production, for example, from 121.0 Mt in 1975-76 to 176.4 Mt in 1990-91. Country became self-sufficient in the food grain production by 1990-91, with fertilizers playing a leading role. However, the two policy decisions taken by GOI namely, i) the sudden decontrol of P&K fertilizers in August 1992, and ii) selective implementation of Nutrient Based Subsidy (NBS) on P&K fertilizers in 2010 struck hard on the very concept of balanced fertilization. These policies created distortion in prices of P&K fertilizers *via-a-vis* urea which ultimately distorted the NPK consumption ratio. This in turn led to poor nutrient (in particular N) use efficiency with alarming environmental footprints, steep decline in the crop response to application of fertilizers, and low crop yields. It was expected that urea will also be brought under NBS to correct the inter-product price distortion and restore the balance in use of primary nutrients. But it still remains to be done.

Green Revolution which was primarily based on increased use of agri-inputs (HYV seeds, fertilizers, irrigation water, pesticides), started showing signs of fatigue in 1980s. The imbalanced use of fertilizers and over-exploitation of natural resources led to the emergence of second generation problems such as soil health degradation, depleting water tables in tube-well irrigated areas and secondary salinization and waterlogging in the canal-irrigated areas, expanding multi-nutrient deficiencies, declining partial factor productivity, lowering/stagnating crop yields, and environmental pollution. Green Revolution era witnessed a paradigm shift in favour of accelerated use of machinery, which edged out the role of animal power in cultivation practices. Rising menace of residue burning has engulfed the entire north-western parts of the country with worst air pollution, besides causing colossal loss of plant nutrients and deterioration of soil health. With burgeoningly declining availability of organics triggered by mechanization-induced agricultural intensification, there has occurred a decrease in soil organic carbon (SOC). Fall in SOC, which is central to soil fertility, poses a direct threat to the sustainability of agriculture itself. Impact associated with the leakage of carbon and reactive nitrogen to atmosphere including climate change and human sufferings cannot be quantified.

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Poor crop productivity continues to be the bane of Indian agriculture. Low rate of adoption of improved farm practices/technologies and unscientific use of agri-inputs are largely responsible for poor crop yields and produce-quality. Bringing in efficiencies in farming practices has become all the more essential to feed the growing population and make farming economically viable. Now, the focus is being given worldwide on hi-tech precision agriculture. It has a potential to bring increase in yields of up to 5 to 8 times and have significant savings in key inputs like water (up to 50%), fertilizers (up to 25%), and pesticides. Important hi-tech activities include soil-less agriculture, protected cultivation under green house, hydroponics, aeroponics, and vertical farming. It involves the use of drones, sensors, big data management, environmental control, and farm management software. The hi-tech agriculture requires precise nutrient management using more and more new/novel innovative products.

Nitrogen use efficiency in India remains abysmally low in the range of 35-40%. As shown in the developed countries, this can be easily increased to 80% with adoption of better enhanced efficiency N fertilizer products and following modern techniques like site-specific N management (SSNM), real time N management, decision support systems (DSS), etc. The prevailing fertilizer pricing and subsidy policies do not encourage the development and use of innovative fertilizer products which include specialty fertilizers, nano-fertilizers, bio-stimulants and plant growth regulators. Introduction of innovative products is hampered by heavy subsidy on conventional bulk fertilizers. In addition to adverse impact on agriculture productivity and farm-income *per se*, present policies are also hurting environment, industry and government itself. Nitrogen pollution has become a major environmental issue at the world stage. Therefore, it becomes even more urgent that reforms in fertilizer policies are put in place without any further delay.

It is gratifying that the Government of India is seized of the problems of fertilizer sector. It established five high level Working Groups even during pandemic. The Working Group-II constituted for promotion of new/alternative fertilizers has underlined the need of promoting innovative/alternate fertilizers, such as nano, slow/controlled release, coated, fortified, customized, chelated, liquid fertilizers, bio-stimulants. As a follow up, a number of fortified, customized, chelated and liquid fertilizers were added in FCO in 2020. Bio-stimulants and nano urea (liquid) fertilizer, have been included for the first time in the FCO in February, 2021. The Working Group-IV on promoting balanced and sustainable use of chemical fertilizers and reduce diversion of urea has recommended to rationalize the current policy of heavily subsidizing urea by bringing it under NBS. It has also recommended that the Direct Benefit Transfer (DBT) in real sense should be the ultimate goal of pricing policy to promote balanced and integrated use of fertilizers. The acceptance of these two recommendations by GOI would, hopefully, go a long way in introduction, development, and use of innovative fertilizers in the country.

While judicious use of chemical fertilizers is important, adopting the strategy of integrated nutrient management (INM) is critical to make the country both food and nutrition secure. The INM involves use of organic and bio-fertilizers in combination with chemical fertilizers. The organic carbon status of Indian soils has been low due to tropical and sub-tropical climate. The decreasing availability of traditional sources of plant nutrients namely FYM, compost, crop residue and green manure has aggravated this problem associated with low soil organic carbon contents. Government is also promoting organic farming wherein use of organics is a must and not an option. It has been established that the use of chemical fertilizers in conjunction with organic source sustains the health of soil and improves the quality of crops grown thereon.

Globally fertilizer contributes 50% to the food production and India is no exception. Chemical fertilizers, complemented with organic and biological nutrient sources, will continue to be central to prove the Malthusian theory wrong that food production will not be able to keep up growth in the human population, resulting in disease, famine, war and calamity. Sustainable agriculture development for food, nutrition and livelihood securities will continue to depend upon judicious use of fertilizers and conservation of soil and water resources through scientific, eco-friendly, socially acceptable, and cost-effective technologies. ■