Role of INM for Sustainable Agriculture

Frank Notes

Dr. Suresh Kumar Chaudhari

There has been good growth in agriculture over the years inspite of stagnant net cropped area. Improving or maintaining such a growth in future would be a challenging task as the intensive agriculture which primarily relied on increased use of inputs and exploitation of natural resources has started showing signs of fatigue. Dwindling land and water resources; plateauing crop yields; declining soil organic carbon and crop response to fertiliser use; sub-optimum use of secondary-and micro-nutrients; widening $N:P_2O_5:K_2O$ use ratio; appearing multi-nutrient deficiencies; mining of nutrients due to mismatch between absorption and addition; decreasing population of microorganisms in soil; emerging environmental concerns in the form of climate change; shrinking biodiversity; and looming energy crisis may pose a serious threat to agricultural sustainability and food security.

With only 2.3% of the world's land and 4% of global freshwater resources, 16% of human, and 17% of cattle population, yearly growth in agricultural production should be around 4% on sustainable basis to meet the growing need of burgeoning population without damaging the agro-ecological system. Soil is the most valuable resource on the Earth. Quote a large number of crops are cultivated on the soil to meet the demand of food, feed, fuel and fibre for the ever-growing population and to provide raw materials to the agri-input-based industry. Soil comprises of three properties namely physical, chemical & biological and sustenance of soil health is linked to these properties. Soil health is the capacity of the soil to function as a vital living ecosystem that sustains plants, animals and human race. A healthy soil allows the crops to grow to realize the full productivity potential.

Use of fertilisers is indispensable for agricultural development in the world. India is no exception. It has played and will continue to play pivotal role in enhancing agricultural production. Emerging soil health degradation threats pose serious concerns. Abysmally low soil organic carbon (<0.5%), emerging multi-nutrient deficiencies (N, P, K, S, Zn, B and Fe), low nutrient use efficiencies (30-50% N, 15-25% P, 50-60% K, 8-12% S and 2-5% micronutrients) and declining fertiliser responses (<5 kg kg^{-1} NPK) are major issues threatening growth in agriculture production on sustainable basis. Abysmally low nitrogen use efficiency in India is responsible for unutilized N contributing to accelerated greenhouse gas emissions (climate change), groundwater contamination with nitrates, eutrophication, soil acidification, etc. Data from the developed countries shows that N use efficiency can be enhanced by resorting to the 4R Principle-based applications of effective N fertiliser products and synchronizing their application with plant demand following the modern techniques like soil-test based site-specific N management, real time N management, decision support systems, etc.

Food security has always been the national priority since independence to rapidly growing population. It has been documented that 50% increase in food grain production is on account of fertiliser use. Food grain production showed an increase of 4.48 times from 1966-67 to 2023-24 and outpaced the growth of population which went up by 3.2 times during the period. Production of crops such as horticulture comprising of fruit and vegetable, oilseed, sugarcane, cotton, jute & mesta also showed remarkable growth. There are challenges as enumerated in ensuring food and nutrition security on sustainable basis but there is no room of complacency except to face them.

Consumption of fertilisers increased by 27.8 times in terms of nutrients in 1966-67 to 2023-24. Realizing the vital contribution of fertilisers in growth of agriculture, Government of India promulgated Fertiliser (Control) Order, 1957 under Essential Commodities Act, 1955 to regulate the sale, price and quality of fertilisers. In view of about 70 amendments in the order, a comprehensive revised order with effect from 25th September, 1985 known as FCO 1985 was issued. The Indian soils are deficient in 95%, 95%, 50%,

Concerted and coordinated efforts are necessary to promote INM for sustainable agriculture by all stakeholders

41%, 36%, 23% and 12-13% in case of N, P, K, S, Zn, B and Fe-Mo, respectively. Such deficiencies should be addressed properly with application of fertilisers in balanced proportion. $N:P_2O_5:K_2O$ use ratio during 2023-24 was 10.9:4.4:1.

Balanced fertilization that leads to balanced crop nutrition is linked to concepts of fertiliser use efficiency and efficient nutrient management and it is more focussed towards N, P and K due to removal of these nutrients in large quantities and it has considerable economic implications to the farmers. Every nutrient be it primary or secondary or micronutrient plays a vital role in plant metabolism. Therefore, secondary (S) or micronutrients (Zn, B, Mo, Fe, Mn, etc.) wherever deficient, the same needs to be addressed properly with fertilisers containing such nutrients, thereby resulting in further improvement in overall nutrient use efficiency. Therefore, the need of the hour is to have a holistic approach to nutrient application through various sources inclusive of organic-based fertilisers as per need of the crop to ensure maintenance of soil health along with long-term food and nutrition security and environment protection.

Integrated nutrient management (INM) system refers to maintain and improve soil physical, chemical and biological properties of soil and plant nutrient supply at optimum level to sustain the desired productivity by optimizing benefit from all possible sources of plant nutrients through organic and inorganic fertilisers in an integrated manner. The concept of INM comprises of use of chemical fertilisers, organic fertilisers, bio-fertilisers, recycling of agri-wastes, green manuring, inclusion of legume crops in the cropping systems, etc. Government of India is encouraging the INM concept, involving admix of mineral, organic and biological nutrient sources, to improve the soil health. Soil health cards have been provided to all the farmers and on the basis of these cards, the farmers are being advised to apply fertilisers and other agri-inputs.

The objective of PM Program for Restoration, Awareness Generation, Nourishment and Amelioration of Mother-Earth (PM PRANAM) notified by the Government of India is to restore fertility of the Mother Earth. The scheme is to promote balanced and sustainable use of fertilisers along with organic manures, alternative fertilisers, Nano fertilisers, bio-fertilisers, etc. Market development assistance scheme of Rs. 1500 per MT to support marketing of fermented organic/liquid fermented organic manures, produced as by-product from compressed bio-gas plants/ set up under the Umbrella of GOBARdhan initiatives will also help in promotion of these organic-based fertilisers for sustenance of soil health. The scheme will address the on-going issue of management of crop residues and *Parali* burning on one hand and help in minimizing the environmental footprint on the other in addition to providing additional income to the farmers. Phosphate rich organic manures are also being produced and marketed by the companies. Specifications of bio-fertilisers, organic fertilisers and non-edible de-oiled cake fertilisers are given in Schedules III, IV and V, respectively, in FCO. Organic carbon enhancer from compressed Bio Gas Plants have recently been notified in FCO as a separate Schedule VIII. The basic objective is to produce such fertilisers to enhance or maintain the organic carbon in soil. Such products, in addition to supplementing the nutrient needs and quality of the crops, also improve nutrient use efficiency of applied fertilisers, farm productivity and soil health. Fertiliser industry has been performing its onus task of making fertilisers available to farmers and also engaged in production and sale of organic-based fertilisers.

Adverse effects of climate change on agriculture are increasingly becoming a reality. Scientific and technological innovations are essential for maintaining food and nutrition security on sustainable basis. Climate-smart agriculture is a comprehensive approach intended to preserve sustainability, resilience, and mitigation in the agricultural production system. An integrated, evidence-based, and transformative approach to address the food and climate issues requires coordinated efforts at all levels, from research to policies, and across commercial, governmental, and civil society sectors. Identification, creation, and adoption at field levels of suitable location-specific climate-smart agriculture technologies inclusive of promotion of INM by all stakeholders will go a long way in enhancing agriculture production, farmers' income, elevating poverty and ensuring food and nutrition security on sustainable basis. ■