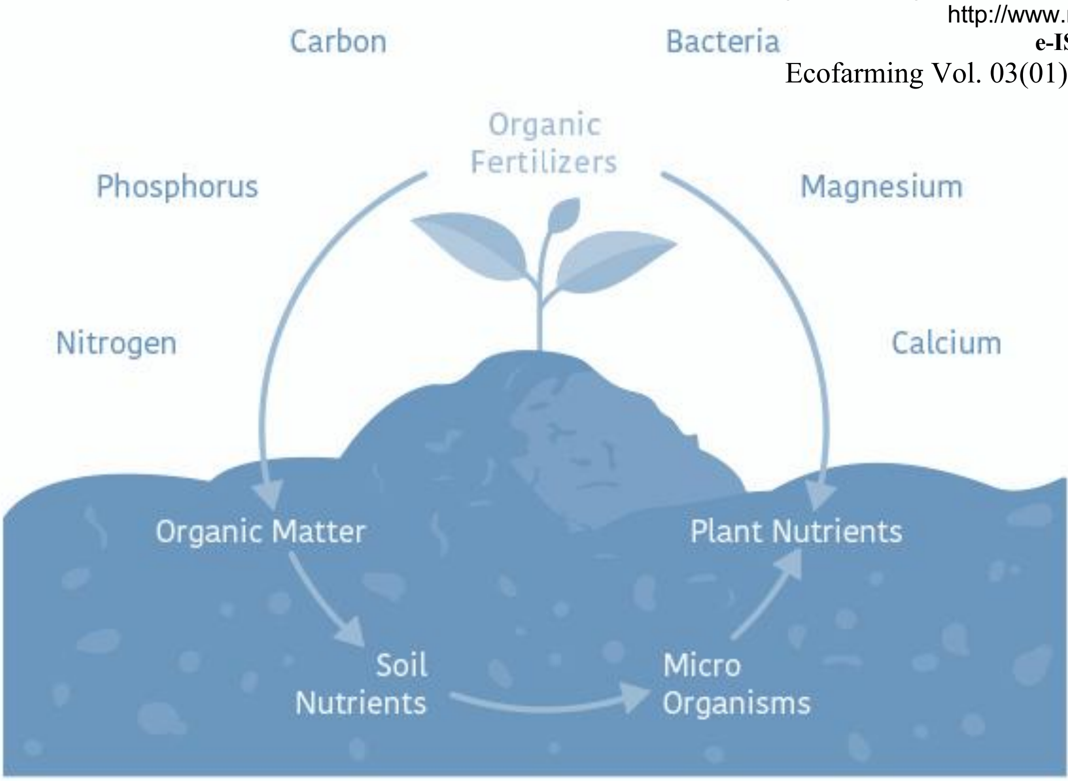
Ecofarming
e-Magazine for Agriculture and Allied Sciences
http://www.rdagriculture.in
e-ISSN: 2583-0791
Ecofarming Vol. 03(01): 46-49, 2023



Role of Integrated Nutrient Management in Crop Production

Priyanka, Dhram Prakash, Sunita Sheoran, Parmod Kumar Yadav and Deepti

Department of Soil Science
CCS HAU, Hisar, Haryana, India

Received: **Nov 10, 2022;** ***Revised:*** **Nov 12, 2022** ***Accepted:*** **Nov 12, 2022**

Integrated nutrient management (INM) is the best approach for better utilization of available nutrient resources and produce crops with less expenditure. INM uses manures, biological agents and chemical fertilizers to improve soil health and sustain crop production. With the aim of coordinating nutrient demand by the crop and its release into the environment, it optimizes all aspects of nutrients cycle including macro- and micronutrient inputs and outputs. Adoption of INM methods reduces nutrient losses via runoff, leaching, volatilization, emissions and immobilization, while, maximizing the nutrient utilization. Additionally, it also aims to enhance the physical, chemical, biological and hydrological aspects of the soil to increase farm productivity and reduce land degradation. Combining the use of organic manures with other management techniques, like incorporating crop residues and advancing conservation tillage (no-tillage or reduced-tillage practices) can also significantly lower greenhouse gas emissions and enhance carbon sequestration which ultimately contributes to high crop yields. INM is also advantageous to small-scale farmers who cannot afford to provide all of the crop's nutritional needs through expensive chemical fertilizers.

Objectives of Integrated Nutrient Management

There are several environmental benefits that can be achieved using integrated nutrient management. The main objectives of integrated nutrient management are:

- Maintain economic yield
- Improve rain-water management to avoid soil and nutrient erosion
- Introduction of conservation farming practices: tillage, agro-forestry, and crop rotation
- Promote the use of organic manures
- Application of bio-fertilizers
- Development and introduction of better-quality genotypes
- Promote balanced use of fertilizers
- Reduce environmental pollution
- Integrate soil fertility restoring crops and livestock
- Crop residue recycling
- Improve nutrient cycling
- Improve soil physical properties
- Enhance soil production efficiency
- Inspiring farmers to adapt less environment harming technique
- Promote nutrient restoration

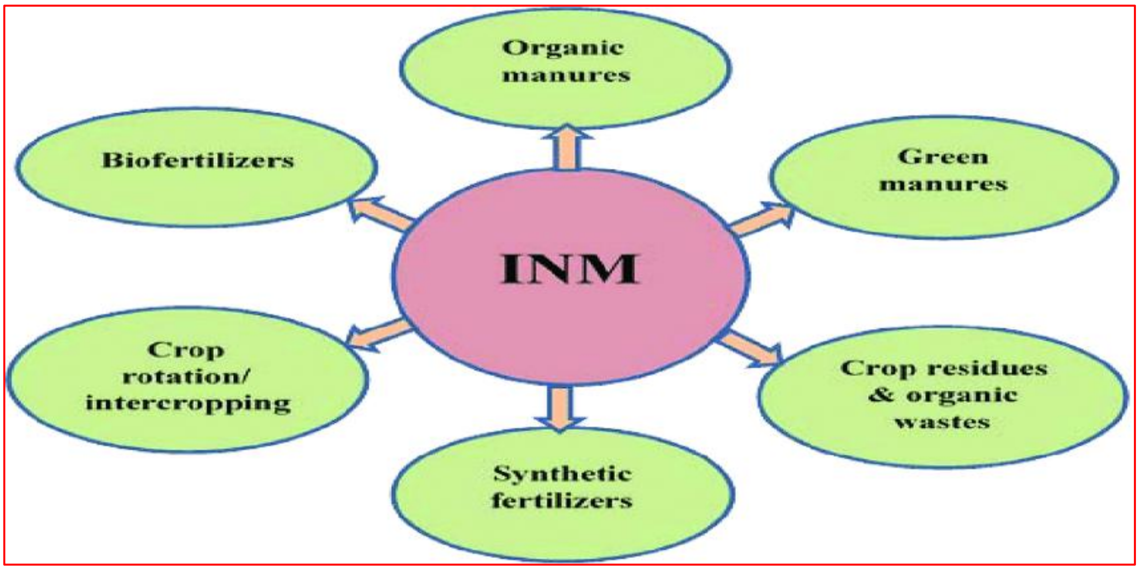
Principles of INM System

Six basic principles of sustainable INM system laid out by Dennis Greenland include:

i. Nutrients removed by crops must be returned to the soil
ii. The physical state of the soil should be improved and maintained
iii. Organic carbon levels of soils should be maintained and enhanced
iv. Build-up of abiotic stress should be minimal
v. Degradation of land occurring due to soil erosion must be controlled
vi. Soil quality with respect to soil acidity, salinity and sodality or toxic elements build-up must be minimized

Components of INM

Major components of integrated nutrient management are (i) integration of soil fertility restoring crops like green manures or legumes *etc*. (ii) recycling of crop residues or other organic wastes (iii) utilization of biological agents *i.e.* bio-fertilizers (iv) use of organic manures like FYM, vermin-compost, biogas, compost, slurry, poultry manure, press mud cakes, biological composts and phospho-compost *etc.* (v) balanced use of chemical fertilizers as per crop requirement or target yields (vi) crop rotation or efficient genotypes.



Fertilizers: Intense cropping with high productivity requires a lot of nutrients, which has led to an increase in fertilizer dependence. So, the most crucial component of INM has continued to be fertilizers. More focus needs to be placed on fertilizers' effective application in bridging the nutrient supply gap. Crops utilize only 30-50% nutrients of applied N fertilizer, about 15-20% of P fertilizers and in terms of micronutrients it is less than 5%. Thus, a large segment of administered nutrients is lost via a variety of channels. Therefore, improving NUE should be a top priority to restore or improve soil health and reduce crop production costs.

Organic nutrient sources: Organic sources of plant nutrients include growing of legumes in the cropping system, organic manures (biogas slurry, phospho-compost, bio-compost, press mud, FYM, compost, vermin-compost and oil cakes *etc.*), green manures, crop residues and bio-fertilizers.

Legumes and green manures: Due to their capacity to absorb N from the atmosphere in symbiosis with Rhizobia, legumes have a long history of restoring soil fertility. When planted for grain or fodder in a cropping system or when introduced for green manuring, legumes may be a crucial component of INM. The rice-wheat cropping system (RWCS) was more productive when legumes were cultivated as green manure, pasture or grain crops and soil fertility was restored. Except for soybean, grain or fodder legumes and green manures can fix atmospheric N to the extent of 50–500 kg N ha^{-1} prior to the plant's onset of flowering (about 40–60 days of growth). Due to their optimal lignin concentration, the residues of legumes left over after grain harvest contains 25 to 100 kg N ha^{-1}, which is released steadily.

Crop Residues: Crop residues have a number of competing uses and may not always be available as a component of INM, but in areas like North-West India where mechanical harvesting is used, a sizable amount of residues is left in the field, which can function as a source of nutrients. There are a lot of leftovers from other crops, such as potatoes, sugarcane, and vegetables etc., which are typically practically squandered. Although cereal crop wastes make excellent cattle fodder, but can also be utilized to replenish fertilizers when they are available in abundant. Stubbles left in the field in traditional harvesting methods range from 0.45 to 1.5t/ha in case of different crops. When mechanical harvesting is done, this amount is much greater. Stubbles of coarse cereals like sorghum, maize, pearl millet etc. are normally collected and burnt during land preparation causing significant loss of plant nutrients.

Crop rotation: Crop rotation is the process of producing a variety of crops in the same place over the course of several growing seasons. It lessens dependency on a single source of nutrients, insect and weed pressure, and the likelihood that resistant weeds and pests may emerge. In order to ensure the best possible biological functioning of the tropical soils, adding pulses to crop rotations may be a long-term sustainable strategy.

Bio-fertilizers: Bio-fertilizers are the materials containing living or latent cells of agriculturally beneficial microorganisms that play an important role in improving soil fertility and crop productivity due to their capacity to fix atmospheric N, solubilize/mobilize P and decompose farm waste resulting in the release of plant nutrients. The extent of benefits from these microorganisms depends on their number and efficiency which, however, is governed by a large of soil and environmental factors.

Advantages

- Increases both applied as well as native soil nutrients availability
- Improves and sustains the physical, chemical and biological functioning of soil

- Minimizes the deterioration of soil, water and ecosystem by promoting carbon sequestration, reducing nutrient losses to ground and surface water bodies and to atmosphere
- Synchronizes the crop's nutritional requirements with the availability of nutrients from both natural and applied sources
- Provides balanced nutrition to crops and minimizes the antagonistic effects resulting from hidden deficiencies and nutrient imbalance

Strategies for further development of INM

By reviewing numerous research reports, here we have synthesized some strategies and recent opportunities that can be accessed and further enhanced by modification and adjustments in the adoption of site-specific INM practices. Future strategic development of INM under following points (i) combination of soil and plant analysis (ii) mechanization due to serious labor scarcity (iii) conservation tillage and rainwater-harvesting technologies (iv) adaptation to the local environmental conditions (v) recycling of organic nutrient flows (vi) new technology advancements and (vii) appropriate policy interventions.

The practice of INM includes utilizing all available nutrient sources to optimize nutrient inputs, matching soil nutrient supply and crop demand spatially and temporally, and minimizing losses. They also improve the sustainability of soil, plants, microbes, and environment through the careful application of mineral and organic fertilizers with higher resource use efficiency. Thus, in order to maximize crop output and address environmental issues, INM methods should priorities the balanced use of organic manure.