

Integrated Nutrient Management and its Importance in Agriculture

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Over the years, crop yields have grown due to the continuous and excessive application of chemical fertilizers, but at the same time soil organic carbon has been decreasing, micronutrient deficiency increased, fertilizer utilization efficiency decreased. INM can be seen as solution and it refers to the application of mineral fertilizers, organic fertilizers, bio-fertilizers and crop residues in accordance with the 4R principles in the right proportion, source, time and place as suggested by soil analysis. Principal aspects of INM and its effect on soil fertility, crop yield stability, nutrient-use efficiency, economic efficiency of agriculture, environmental friendliness, and quality of products are presented. It is compared with just the application of chemical fertilizers and the main difficulties of implementation of INM are discussed; such as lack of organic fertilizers, farmers' ignorance and variation in bio-fertilizer quality. Recommendations like Soil Health Card based recommendations, promoting farmer training and composting at village level are suggested to promote its adoption. INM is determined to be a sustainable method which not only can help secure food but also protect the environment and soil.

Keywords: Integrated nutrient management, Soil quality, Organic manure, Biofertilizers, Fertilizer-performance efficiency, Sustainable agriculture, Importance in Agriculture

Introduction

For last fifty years, Indian agriculture has predominantly depended upon chemical fertilizer for meeting food requirements of the growing population. Due to chemical fertilizers application, soil organic carbon content is diminishing rapidly and fertilizer efficiency along with micronutrient deficiency in soils is increasing. INM is a feasible remedy to overcome these challenges. The balanced and integrated application of chemical fertilizers, organic manures, biofertilizers and crop residues to satisfy crop nutrient requirement and to ensure soil fertility and productivity (FAO, 1998; Gruhn et al., 2000).



Components of INM

INM is based on four pillars

No.	Component	Examples	Main Advantage
1	Chemical fertilizers	Urea, DAP, MOP, zinc sulphate	Quick availability of nutrients to plants
2	Organic manures	Farmyard manure, compost, vermicompost, green manure	Improved soil structure and organic carbon content in Soil
3	Bio-fertilizers	Rhizobium, Azotobacter, PSB, mycorrhizae, Blue-green algae etc.	Nitrogen fixation and phosphorus solubilization
4	Crop residues and rotation	Crop rotation with legumes, residue mulching	Nutrient recycling

This section gives an overview of the potential for nutrient recycling from crop residues and legumes in rotation.

- 1. Chemical Fertilizers:** The use of chemical fertilizers at once may lead to excessive leaching and volatilization. The amount of fertilizer used should be based on N:P:K ratio and the soil test results.
- 2. Organic Manures:** Good farmyard manure, compost and vermicompost provides nutrients and also increases the level of organic matter, beneficial for the water holding capacity, microbial and physical condition of the soil. Green manure crops like dhaincha and sunnhemp provide biomass and nitrogen.
- 3. Biofertilizers:** They are cultures based on living microbes that contribute to making nutrients available inexpensively. The Rhizobium are examples of nitrogen-fixing bacteria that assist in fixing atmospheric nitrogen in legumes, and phosphate-solubilizing bacteria (PSB) help to solubilize available phosphorus.
- 4. Crop rotation and residue management:** The addition of legumes (green gram) or green manure crops to cereal crops (rice-wheat) helps to enhance nitrogen and carbon in the soil. Instead of burning the residues, the residues must be incorporated or mulched.

Principles of INM: The 4R Approach

Principle	Meaning
Right Source	Fertilizer suited to the crop and soil
Right Rate	Dose based on soil test results
Right Time	Split applications matched to crop demand
Right Place	Placement near the root zone instead of broadcasting

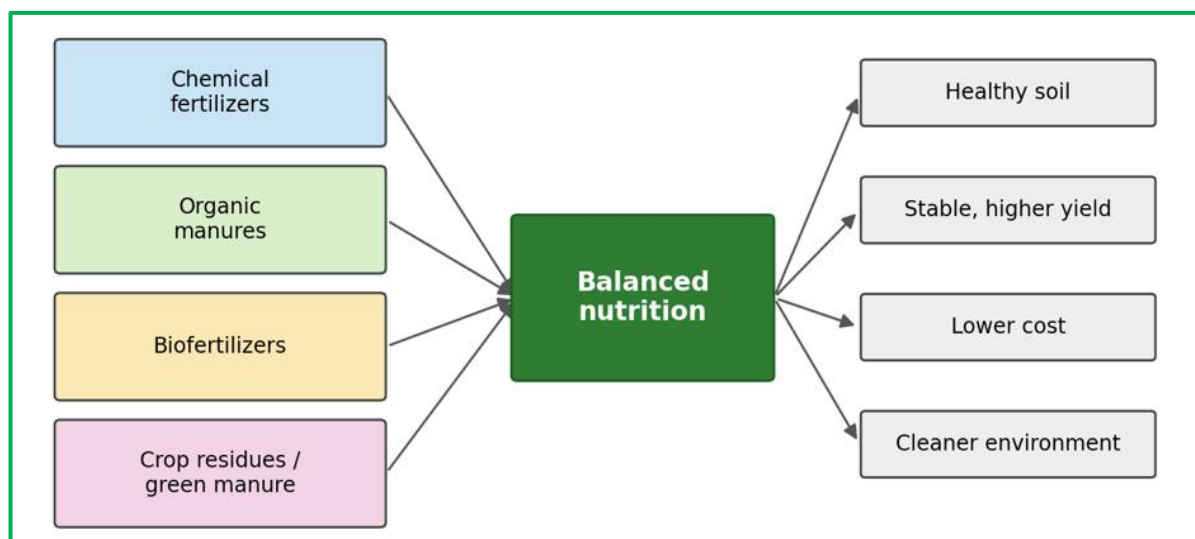


Figure: Simple INM Flow

The significance of Integrated Nutrient Management in Agriculture

1. Qualitative and quantitative soil characteristics: Regular introduction of organic substances improves the soil quality, its ability to retain moisture and variety of microorganisms.
2. Yield consistency: Results of long-term experiments prove that application of organic and inorganic nutrients gives more homogeneous yield than application of chemicals alone.
3. Much better efficiency of fertilizer utilization: Organic inputs reduce nutrient losses and allow to use fertilizers optimally by crops.
4. Lower costs: The usage of biofertilizers is economic since it reduces the usage of chemical fertilizers.
5. Environmental protection: INM enables to reduce the amount of nitrates leached into underground water and the amount of greenhouse gases released.
6. Better products: Meeting the nutritional needs improves the nutritional quality and taste of crops like grain or legumes.

Chemical fertilizers alone vs. INM

Parameter	Chemical Fertilizers Alone	INM
Soil organic carbon	Gradually decreases	Stays constant or increases
Micronutrients	Risk of deficiency	Better supply
Fertilizer-use efficiency	Low	Higher
Long-term yield	Decline probable	Stable or increasing
Adverse environmental	Increased leaching and pollution	Less pollution than chemical fertilizers
Financial impact in the long term	Rising	Lower than chemical fertilizers

Barriers to Implementing INM

- Lack of availability of organic manure, since dung is used for cooking
- Low supply of nutrients in manures thus requiring their high quantities and transport and labour expenses
- Lack of farmer awareness and training
- Inconsistent quality and short shelf life of biofertilizers

Way Forward

1. Fertilizer recommendations based on the Soil Health Card
2. Promotion of village-level compost and vermicompost units
3. Demonstrations and training through Krishi Vigyan Kendras
4. Quality control of biofertilizers
5. Machines as well as motivation for the management of crop residues

Conclusion

Integrated Nutrient Management is essential for contemporary agriculture. However, it is not limited to an increase in crop production; it also preserves soil and the ecosystem and ensures profitability of agricultural production. By efficiently using chemical fertilizers along with organic sources, we can provide both food and sustainable agriculture.

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