Topic- Integrated Nutrient Management

Manures, Fertilizers and Soil Fertility Management (SAC-311)

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COURSE SEMINAR (0+1)

On

Integrated Nutrient Management in Crop Production

By

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HIGHLIGHTS

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- DEFINITION
- CONCEPTS OF INM SYSTEM
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- IMPORTANCE OF INTEGRATED NUTRIENT SUPPLY AND MANAGEMENT
- KEY OBJECTIVES OF INM
- CONSTRAINTS OF INM SYSTEM
- ADVANTAGES OF INM IN CROP PRODUCTION
- STRATEGIES FOR INM ACTIVITIES
- CONCLUSIONS

INTRODUCTION

Integrated nutrient management (INM) or integrated nutrient supply (INS) system aims at achieving efficient use of chemical fertilizers in conjunction with organic manures. Long term fertilizer experiments involving intensive cereal based cropping systems reveal a declining trend in productivity even with the application of recommended levels of N, P and K fertilizers. The crop productivity increases from the combined application of chemical fertilizers and organic manures. Such combination contributed to the improvement of physical, chemical and biological properties and soil organic matter and nutrient status.

Definition

INM is the maintenance and possibly increase soil fertility for sustaining increased crop productivity through optimizing all possible sources (organic and inorganic) of plant nutrients required for crop growth and quality in an integrated manner appropriate to each cropping system and farming situation in its ecological possibilities.

CONCEPT OF INM SYSTEM

The basic concept of INM system is the maintenance of plant nutrients supply to achieve a given level of crop production by optimizing the benefits from all possible sources of plant nutrients in an integrated manner, appropriate to each cropping system and farming situation. If the soil fertility has already eroded to a high degree by inappropriate management practices, one major task of INM system will be to atleast stop the ongoing loss of surface or top soil nutrients.

NEED OF INM SYSTEM IN MODERN AGRICULTURE

INM system is an age-old concept. Its importance was not realized earlier as nutrient removal by the crops was very low due to subsistence farming. At present, INM system has a great significance because of intensive farming. Its need in modern agriculture has arisen due to:-

(i) High price of chemical fertilizers
(ii) Imbalance between consumption and domestic production
(iii) Deterioration of soil health
(iv) Pollution hazards of chemical fertilizers
(v) Deterioration in soil physical properties
(vi) Deterioration in biological activity
(vii) Additive effect of organic and mineral fertilizers
(viii) Organic materials as a source of secondary micronutrients
(ix) Interaction benefit crops and reduction in crop productivity

Why integration?

- Multiple nutrient deficiencies
- Higher productivity and cropping intensity in irrigated areas
- Organic sources insufficient for nutritional needs of HYVs
- Organic sources with mineral fertilizers became necessary
- Organic sources- no of animals a farmer posses
- 50 per cent of dung used as fuel
- Alternative source of energy for farmers
- Green manuring- loose one crop
- Lack of soil moisture for its decomposition
- A need of integrating organic sources with mineral sources
- FYM, green manure, crop residues, N-fixing bacteria, BGA
- Organic sources supplement plant nutrients need

IMPORTANCE OF INTEGRATED NUTRIENT SUPPLY AND MANAGEMENT

- The integrated nutrient supply and use of plant nutrients from chemical fertilizers and organic manures has been shown to produce higher yield crop yields than when each is applied alone.
- The increase in soil productivity results from their combined effect, the synergistic effect , that helps:

1. Improve chemical, physical and biological properties of soil,
2. Improve the soil organic matter and nutritional status, and
3. Balanced nutrient supply to crops of cropping systems.

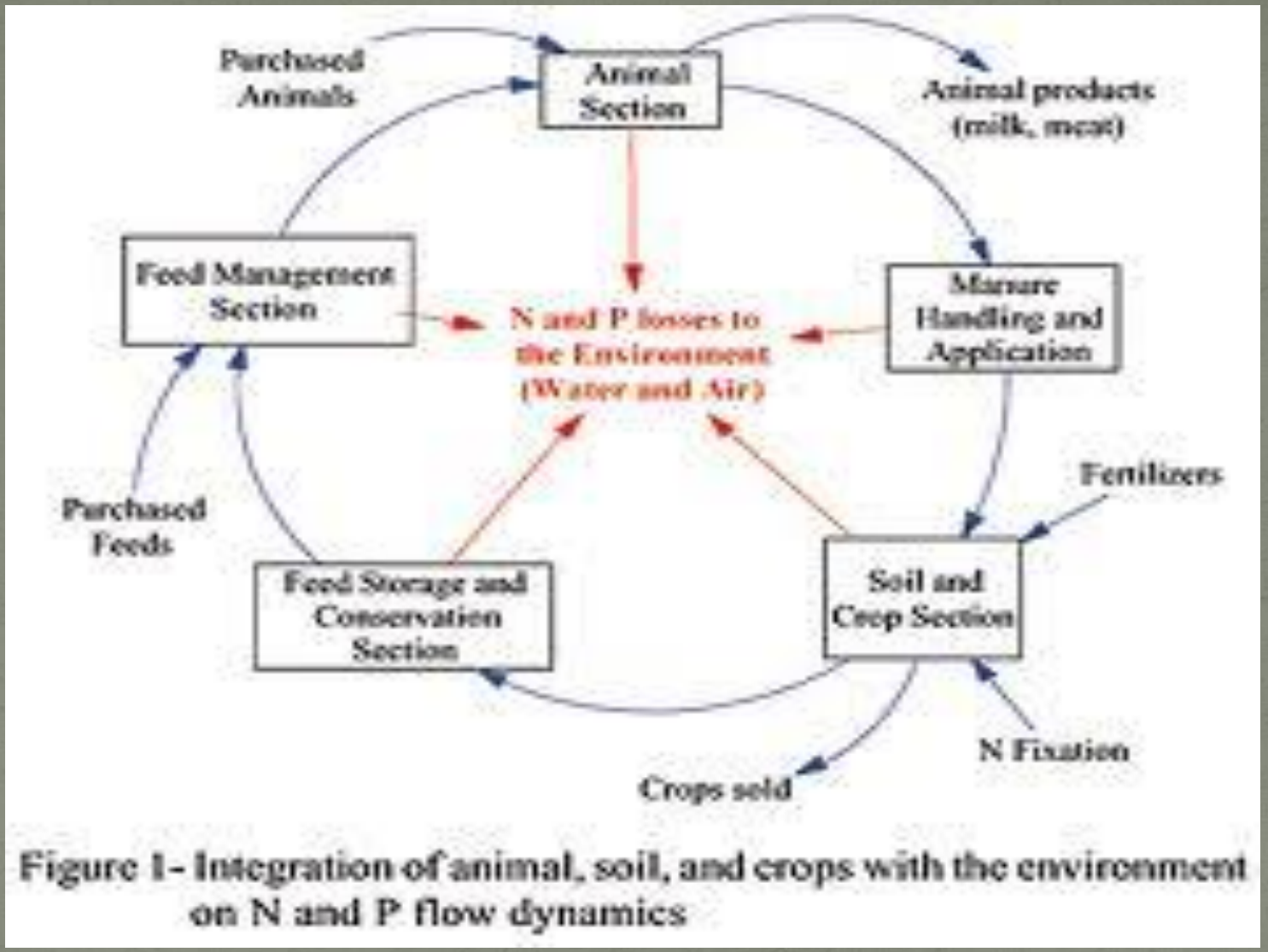


Figure 1- Integration of animal, soil, and crops with the environment on N and P flow dynamics


Climate
Feeding crop needs!
Inorganic fertilizer
Indigenous nutrient supply
Irrigation water
Crop residue
Soil
Manure

Consumption of major fertilizers (in lakh tonnes)

Fertilizer	2002-03	2003-04	2004-05	2005-06
urea	184.93	197.67	206.65	222.97
DAP	54.73	56.24	62.56	67.64
MOP	19.12	18.41	24.06	27.31
N	104.74	110.77	117.13	127.23
P	40.19	41.24	46.24	52.04
K	16.01	15.98	20.61	24.13
N+P+K	160.94	167.99	183.98	203.40

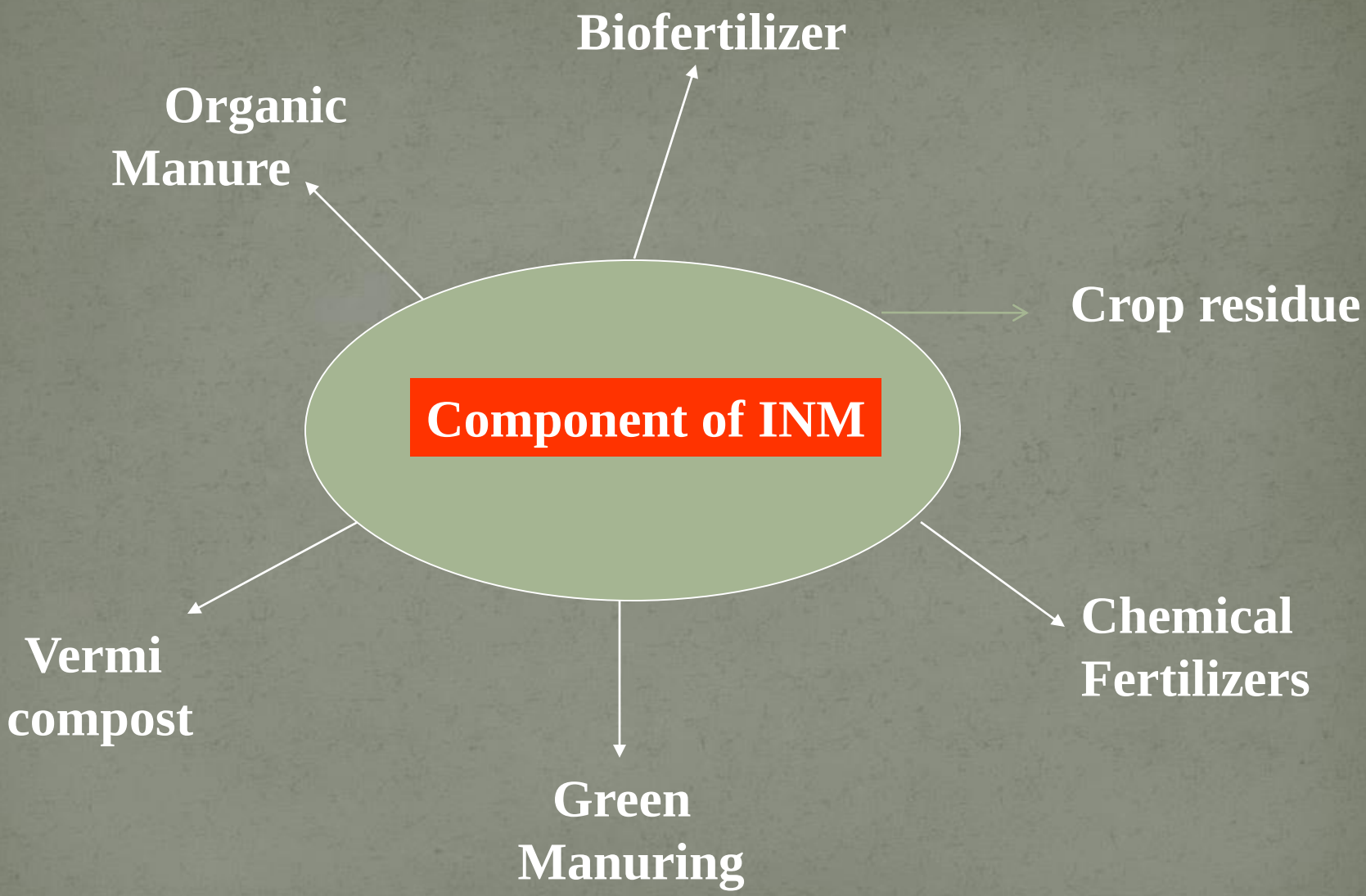
The key objectives of INM

- To maintain or enhance soil productivity through balanced use of mineral fertilizers combined with organic and biological sources of plant nutrients
- To improve the stock of plant nutrients in the soil
- To improve the efficiency of plant nutrients, thus limiting losses to the environment
- To improve physical conditions of soils

Role of INM component in Crop Production

In the past research mineral fertilizers boosted the rice-wheat yield in the IGP, but their rising cost and diminishing resources led to search for alternative sources of plant nutrients. Complementary use of the available renewable sources of plant nutrients (Organic/biological) along with mineral fertilizers led to the development of INM system. The role and contribution of INM from each of its components in rice-wheat cropping is discussed under the following heads:

1- Chemical fertilizer
2- Organic manures
3- Vermicompost
4- Crop residues
5- Green manures
6- Bio-fertilizers


Biofertilizer
Organic Manure
Crop residue
Component of INM
Vermi compost
Green Manuring
Chemical Fertilizers

Chemical Fertilizer

- Fertilizer contributed to about 50 per cent increase in food grain production of India. About three-fourth of the fertilizer is consumed in rice and wheat.
- In rice-wheat system, recommended dose of N should be applied to both crops as there is no residual effect on succeeding crops.
- Due to increased availability of native soil P under submergence, rice generally responds to applied P than wheat. Therefore P application to wheat should be preferred over rice.
- Rice is more responsive to K than wheat and it should be added as per soil test based recommendation.

ORGANIC MANURES

- Organic manures are the important component in the INM. The rice-wheat system of the IGP had been traditionally dependent on organic manurial sources.

- The inclusion of FYM regulates nutrients uptake, improves crop yields and physical and chemical properties of soils and produces a synergistic effect.

- Organic manures improve soil aeration, permeability, water holding capacity and biological properties of soils which enhances the fertilizer use efficiency.

- Organic sources increased the availability of micronutrients by preventing their fixation, oxidation, precipitation and leaching.

VERMI-COMPOST

- Compost that is prepared with the help of earthworm is called vermi-compost.
- Vermi-compost is a rich source of major and minor plant nutrient. On an average it contains 3% nitrogen, 1% phosphorus, 1.5% potash.
- Earthworm is physically an aerator, crusher, mixer, chemically a degrader and biologically stimulator in the decomposer system. The organic waste disposal by earthworm is aimed as reducing bulk, upgrading nutritional value in-situ and to obtain final product free of chemical and pollutants for safer use in crop.

GREEN MANURE

- Green Manuring is the cheapest locally available resource for building up soil fertility and supplementing plant nutrients, especially N. The practice of ploughing in of un-decomposed green plant material into the soil for improving the physical condition as well as fertility of the soil is called as “green manuring.”

- In rice-wheat cropping system on loamy sand soil indicated that significantly higher yield of rice was obtained when 25 per cent N substitution was done with green manure.

CROP RESIDUES

- Residues left out after the harvest of the economic portion is called as crop residues.

- It contains 0.5 per cent N, 0.6 per cent P_2O_5 and 1.5 per cent K_2O.

- Crop residues improve the soil properties, micro nutrient supply and productivity.

- Major advantage of incorporation of rice/wheat residue is the increases of the soil organic carbon, total N, and available K .

BIO-FERTILIZER

- Bio-fertilizers have been recognized as important inputs in INM system and their use is of recent origin. They are eco-friendly, low cost and non-bulky agricultural inputs which play a significant role in plant nutrition as a supplementary and complementary factor to mineral nutrition. Some of the organisms used as bio-fertilizers-:

A. Nitrogen-fixing Bacteria

1. Symbiotic Nitrogen-fixation with nodule forming legume - e.g. Rhizobium.
2. Non symbiotic Nitrogen-fixers - e.g. Azotobacter, Azospirillum, Azolla and Blue Green Algae (BGA).

B. Nutrient Solubilizing Bacteria -

1. Phosphorus Solubilizing Bacteria (PSB)
2. Vesicular Arbuscular Mycorrhiza (VAM)

CONSTRAINTS OF INM SYSTEM

- Increasing compulsion to use cowdung as a source of fuel in rural India, leaving very little for composting. Rice straw is also used as livestock bedding, thatching for huts and temporary dwellings in villages.

- Although organic residues of rice and wheat straw can be used to make up the plant nutrients need yet they require their complete decomposition due to having wide C: N ratio. If they are not fully decomposed and added as such, will cause immobilization of nutrients, especially of N. Thus, the crop yields will be affected badly.

- Delay in timely preparation of field due to incorporation and decomposition of agricultural waste and green manures.

- Growing of green manuring crops have not been adopted widely because of needs for additional labour/inputs. Extra cost and time required in raising green manure crops.

ADVANTAGE OF INM IN CROP PRODUCTION

- It supply all the nutrient required to crop.
- It improve plant growth and physiological activity of crop plant.
- It improve physical and chemical property of soil.
- INM is believed to provide more healthy nutritional superior quality of grains.
- INM produce optimum condition in soil for high yield and good quality of grains.
- INM minimize attack of insect, pest and disease.

STRATEGIES FOR INM ACTIVITIES

- NPK chemical fertilizer should be applied in right ratio of 4:2:1 and organic manures and bio-fertilizers are considered as complementary and not substitutive.

- Cowdung burning should be totally banned like China. Agroforestry development (Gupta, 2005), quick growing leguminous trees and installation of biogas plants are needed to enhance fuel and plant nutrients.

- Develop technology for in situ incorporation, rapid decomposition of crop residues and inoculation of suitable micro-organisms, particularly for the intensive rice-wheat system.

- Develop of technology for speedy decomposition of crop residues with use of cellulolytic micro-organisms like *Trichoderma viridie.*

Some key points regarding integrated nutrient supply

- **Fertilizers and manures contribute about 50-60% increase in productivity of food grains irrespective of soil and agro-ecological zone.**
- **For the land short countries like India, use of fertilizers provide the best strategy for land saving.**
- **In soils of low pH, nitrogen fertilizer application alone further increase the soil acidity.**

CONCLUSION

- Sustainable crop production is essential for food security, nutritional security and environmental safety.
- For achieving sustainability, INM is inevitable due to rising cost of fertilizers, declining fertility of soil and degrading soil quality.
- Models of INM for well defined agro ecological zones and cropping system should be developed to provide guide line for rational and efficient fertilizer use.
- Country have sufficient potential of organic resources to fulfill about 25 % of nutrient demand of crops.
- The direct, residual and cumulative effects of added manures and fertilizers should be considered While formulating the nutrient management programme in the given cropping system.