Nutrient Imbalance and Mining

Rice and wheat are heavy users of nutrients. Nutrient imbalance and mining by these cereal crops had led to nutrient deficiencies and poor soil quality in some areas. In many areas, most of the crop residues are removed for animal feeding especially in the eastern Indo-Gangetic Plains (IGP).

Nutrient Problems and Some Solutions

Application of organic and/or inorganic fertilizers can correct the deficiency of nitrogen and phosphorus, the two most important macronutrients that are becoming limiting in the rice-wheat soils. Potassium is usually present in adequate amounts in the IGP soils. When farmers remove the entire crop residue and do not apply potassium, the imbalance leads to potassium deficiency. Boron deficiency leads to sterility in cereals (e.g., wheat), legumes (e.g., chickpea), oilseeds (e.g., sunflower) and vegetable crops (e.g., cauliflower). Zinc fertilization is essential for rice yield in most areas, having calcareous alkaline soil.

Decline in soil organic matter is also a serious problem in the rice-wheat system. Farmers can use a combination of organic and inorganic fertilizers to overcome this problem. However, there is a shortage of organic manures as they are mostly used as fuel, and their transportation to the fields is costly.

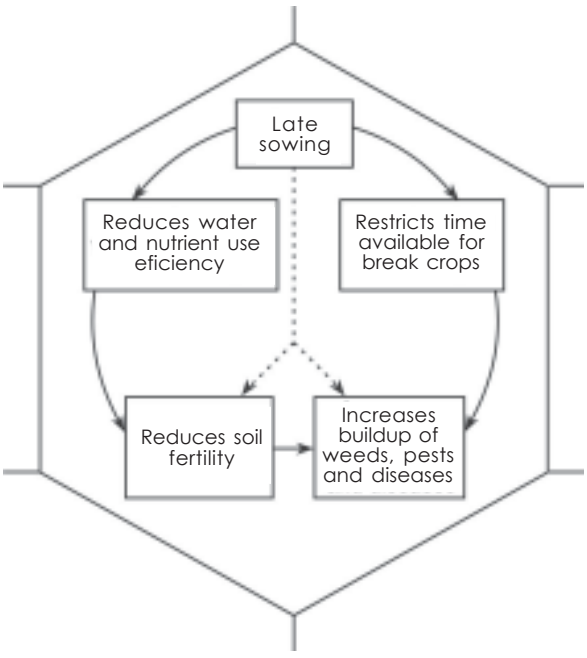
A system is needed to maintain a balance between nutrient inputs and removal. The nutrient supplying capacity of individual soils should be determined. Based on this, the amount of external nutrients needed to obtain a certain yield level can be calculated. The recommended dosage should not cause an imbalance in soil nutrients. The decline in productivity of the rice-wheat system is due to a shortage of resources, and changes in physical and chemical properties of the soil thereby reducing nitrogen-supply capacity of the soil. Increase in crop productivity can be sustained by conserving the natural resource base and increasing the quantity and quality of nutrient inputs used.

Macronutrients
Nitrogen
Phosphorus
Potassium

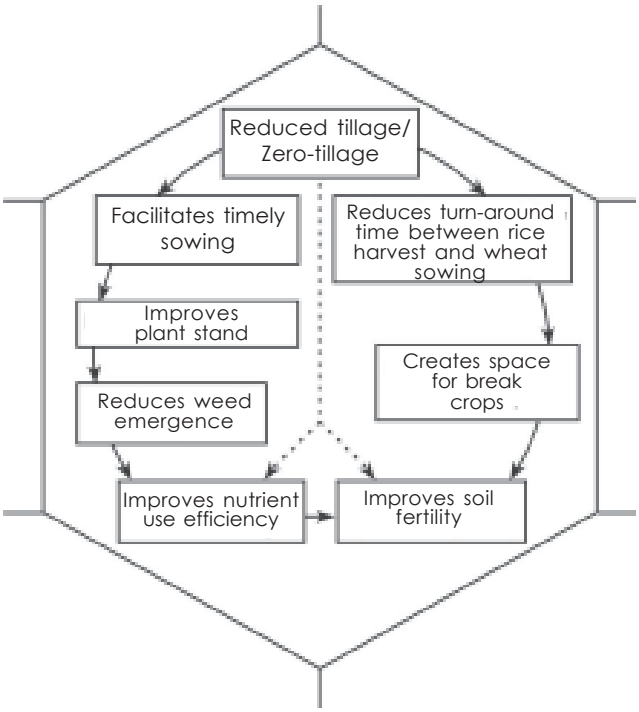
Micronutrients
Boron
Calcium
Iron
Sulfur
Zinc
Magnesium
Manganese
Molybdenum
Copper
Silicon

A Web of Interactions

Rice-wheat systems in the IGP appear simple, but in reality they are enormously complex, with numerous productivity and sustainability problems. Some of these problems are late sowing, low water and nutrient use efficiency, groundwater depletion (in some areas) or waterlogging (in other areas), salinity and sodicity (in specific areas), and buildup of weeds, pests, and diseases. These problems are closely linked through system interactions; e.g., late sowing (Harrington, 2001).



Reduced and zero tillage improve timelines of sowing and through the same system interactions, help farmers cope with crop production problems. These practices improve nutrient use efficiency and reduce weed germination (Harrington, 2001).



Low soil fertility in the rice-wheat systems is due to the increasing micronutrient deficiencies, imbalanced fertilizer use, and decreased use of organic manures. These problems are varied but the causes are similar:

- Reduced levels and frequency of farmyard manure applications to crop fields is attributed to changes in livestock herd size and composition; and increased use of manure for household fuel.
- Fewer crop residues (incorporated into the soil or used as surface mulch) are attributed to their increased use for livestock fodder (due to reduction in grazing/ pasture area); and increased burning of crop residues.
- Increased reliance on continuous rice-wheat rotations and a decline in the attractiveness of break crops are attributed to low yields and profits from break crops; and market access problems and associated policy issues.
- Intensive nutrient mining in the surface soil is attributed to restricted root growth associated with the plow pan created during puddle rice culture.
- Low application levels of inorganic fertilizers, insufficient to replace nutrients extracted during crop production.
- Use of inorganic fertilizer sources that do not contain secondary elements or micronutrients (Harrington, 2001).

Reference

Harrington, L. 2001. Synthesis of Systems Diagnosis: "Is the Sustainability of the Rice-Wheat Cropping System Threatened?" -An Epilogue. pages 119–132 *In:* The Rice-Wheat Cropping System of Asia: Trends, Constraints, Productivity and Policy (Kataki, P.K., ed.). Food Products Press, New York, USA.

Adapted from:
Kataki, P.K., P.R. Hobbs and B. Adhikary. 2001. The Rice-Wheat Cropping System of South Asia: Trends, Constraints and Productivity - A Prologue. pages 1-26. *In:* Kataki, P.K. (ed). The Rice-Wheat Cropping Systems of Asia: Trends, Constraints, Productivity and Policy. Food Products Press, New York, USA.

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