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Nitrogen Use Efficiency for Agriculture Crop Production

Roopali Patel[1*], I.S. Naurka[2], Priyanka Sharma[3]

[1,3]Assam Agricultural University, Jorhat, 785013
[2]Agriculture University Jodhpur

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*Corresponding Author
Roopali Patel*

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INTRODUCTION

Nitrogenous fertilizers have contributed much to the remarkable increase in food production that has occurred during the past 50 years Globally, however, N fertilizers also account for 33% of the total annual creation of Nr or 63% of all anthropogenic sources of reactive nitrogen (Nr)). Reactive nitrogen is defined as all biologically, photochemically, and/or radiatively active forms of N -- a diverse pool of nitrogenous compounds that includes organic compounds (e.g. urea, amines, proteins, amides), mineral N forms, such as NO3- and NH4+ as well as gases that are chemically active in the troposphere (NOx, NH3, N2O) and contribute to air pollution and the greenhouse effect Asia alone accounts for more than 50% of the global N fertilizer consumption as well as 37% for the global Nr creation. estimated that only about half of all anthropogenic N inputs to cropland are taken up by harvested crops and their residues, with the remainder contributing significantly to Nr enrichment of the atmosphere, ground and surface waters.

Regardless of what the true societal costs of accumulation of Nr in cultivated and natural ecosystems are, it is clear that Nr creation associated with human activities must slow down. Mitigation options include:

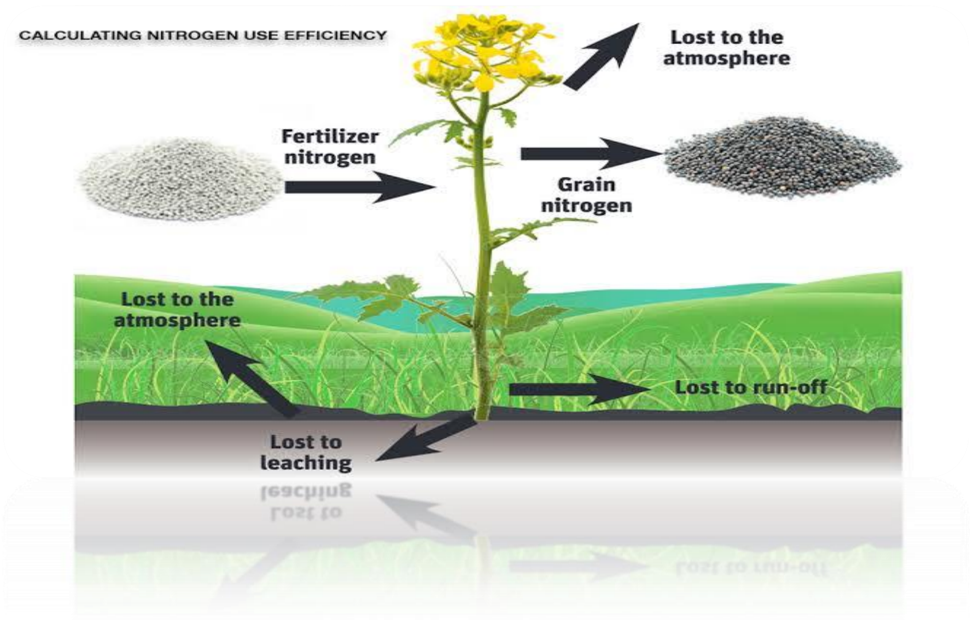
(i) Reduction of Nr emissions from fossil fuel combustion,

(ii) Transformation of Nr to non-reactive N forms (e.g., denitrification to N2 or sequestration of N in soil organic matter),

(iii) Changes in human diet and associated changes in food, feed, and fertilizer demand, and

(iv) Improvements in fertilizer nitrogen use efficiency (NUE) in agricultural systems: less N fertilizer per unit food produced. Many of these mitigation strategies are of long-term nature and they are closely linked to policy decisions that need to be made. However, improving NUE in agriculture has been a concern for decades and numerous new technologies have been developed in recent years to achieve this.

Therefore, fertilizers and their management will be at forefront of measures to improve the global N balance over both the short- and long-term. Definition and measurement of nitrogen use efficiency Nitrogen budgets Nitrogen budgeting approaches are often used to evaluate system-level N use efficiency and to understand N cycling by estimates of input, storage and export processes by mass balance. A surplus or deficit is a measure of the net depletion (output > input) or enrichment (output < input) of the system, or simply of the 'unaccounted for' N. This approach is used in research studies that aim at the identification of the fate of N surpluses or inlong-term assessment of N flows and their respective impact and soil and the environment in managed or natural ecosystems. Unlike many of the agronomic indices of NUE described below, N budgeting approaches are also suitable for systems that are not at a relative equilibrium in terms of N, i.e., systems in which either significant accumulation or losses of N from indigenous sources occur. Nitrogen budgets can be constructed for a different time periods at any scale, ranging from an agricultural management unit to regional and continental scales. The degree of detail depends on the purpose of budgeting and on the resources available to collect the information



Agronomic indices of nitrogen use efficiency

Various indices are commonly used in agronomic research to assess the efficiency of applied N (mainly for purposes that emphasize crop response to N . In field studies, these indices are either calculated based on differences in crop yield and total N uptake with aboveground biomass between fertilized plots and an unfertilized control ('difference method'), or by using 15N-labeled fertilizers to estimate crop and soil recovery of applied N. Time scale is usually one cropping season. Spatial scale for measurement is mostly a field or plot. Because different interpretation value, research on fertilizer-N efficiency should include measurements of several indices in order to assess causes of variation in NUE. The agronomic framework is most useful for understanding the factors governing N uptake and fertilizer efficiency, to compare short-term NUE in different environments, and to evaluate different N management strategies or technologies. The 'difference method' is simple and t, which makes it particularly suitable for on-farm research. However, measurement of NUE requires careful experimentation and interpretation must consider potentially confounding factors. Agronomic efficiency (AEN) and recovery efficiency (REN) are not appropriate indices of NUE when comparing cropping practices such as crop establishment methods or different water management regimes when the crop yield in control treatments (Y0) differs

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significantly because of these management practices.

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