Implementing sustainable nitrogen use in smallholder rice

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Frontiers in Sustainable Food Systems has published the results of a "mini-review" examining 46 peer-reviewed studies that compared site-specific nutrient management (SSNM) approaches for rice against existing farmer fertilization practices. The study's scope included research examples extracted from 11 countries conducted between 2001 and

2020—using 43 studies from Asia and 3 from Africa.

SSNM research strives to develop effective methods of nutrient application that generate more efficient and profitable outcomes, especially for smallholder farmers and their varying agro-ecological landscapes. The concept has grown out of work conducted over the past 30 years within the fragmented smallholder fields of Asia. Today SSNM is a globally recognized approach that is being extended across all scales of farming. SSNM research continues to evolve towards the tailoring of practical field-scale solutions that offer proven alternatives to one-size-fits-all "blanket" fertilization practices that have been more commonplace.

"Comparisons gathered within this recent review clearly shows that SSNM in rice cropping systems increases rice yield, profit, and N use efficiency while reducing N losses and greenhouse gas emissions when compared with the farmer practice," summarize the authors.

Researchers found that SSNM recommendations improved the average rice yield by 644 kg/ha (11.4%). SSNM also created a growing environment wherein 38% more rice was produced per unit of N applied. This enhanced productivity translated into an increased profitability, measured as a 8.6% increase in gross returns above the cost of fertilizer.

These benefits accrued while using 14% less N fertilizer than farmer practice.

According to the study, SSNM generated better outcomes through a more studied consideration of appropriate N application rates and how they should be balanced with other essential nutrients. Most often appropriate amounts of phosphorus and potassium were co-applied to improve N uptake by rice. The authors noted that most studies neglected

micronutrients in their experimental designs. Moving forward, inclusion of micronutrients such as zinc and iron were encouraged in order to better quantify the human nutritional benefits amongst those with rice-based diets.

Timing is almost everything

Farmers also lose yield and nutrient use efficiency by applying large quantities of N fertilizer at early growth stages when the rice plants have not fully developed the root system. Compared to farmer practice, the main impact of SSNM recommendations is from better distribution of N across the growing season, which supplies smaller quantities of N more often. This prevents the buildup of large pools of N in the soil that are susceptible to various types of loss to the surrounding environment.

Despite this evidence, a barrier surrounding widespread implementation of SSNM amongst smallholder rice growers' is last mile delivery of tailored support systems that can ensure sustained success. The ability to transfer SSNM recommendations at scale through digital ICT solutions continues to improve.

The authors noted the challenge of working through the integration of the diverse set of socio-economic, supply chain, and policy-making environments faced by smallholders.

Successful delivery of SSNM at scale requires a pluralistic approach that fosters collaboration among multiple organizations and service providers with support from governments.