which is based on changes in the paired comparisons. On the basis of overall averages, SOC and SON were 8 to 10% higher with commercial fertilizer N than with zero-N (**Figure 1**). These gains were statistically different from zero-N ($p < 0.05$). In general, SOC and SON declined over time from the initial to final sampling period. However, the declines in SOC and SON were lessened (or smaller) with commercial N fertilization.

Among the three subgroups of land use, flooded soils showed a marginal increase in SOC and SON, respectively, in both zero-N (3 to 9%; 1 to 4%) and commercial N treatments (9 to 15%; 8 to 12%) using the TR ratio approach. Both flooded dryland soils and dryland soils showed significant losses of SOC (4 to 19%) and SON (3 to 23%), with and without the application of commercial fertilizer N. The TNR ratios indicated that commercial N led to a relative increase in SOC. For TNR, the commercial fertilizer N response ratios more than doubled in flooded dryland (17% for SOC and 20% for SON) compared with flooded (7% for SOC and 8% for SON) and dryland (7% for SOC and 9% for SON) agro-ecosystems. This indicates that flooded soils and dryland soils are likely to respond less to commercial fertilizer N than will flooded dryland agro-ecosystems.

The general decline in SOM content across a wide range of agricultural production systems (**Figure 1**) will probably have long-term repercussions on the soil's ability to store and regulate the supply of plant-available nutrients (especially N) and ability to improve soil structure. Maintaining SOM levels will therefore remain a key component in sustainable agricultural systems (Swift and Woomer, 1993). To meet crop N demand, the decline in the N-supplying capacity of the soil will need to be compensated by an increase in commercial or organic fertilizer N use. An increase in commercial or organic fertilizer N use to sustain crop yield, however, will lead to potential increases in N losses to the environment, with reactive N becoming part of a cascade effect through the biogeochemical pathway. Therefore, new and advanced management practices should focus on maintaining or increasing SOM levels.

In conclusion, SOM content generally declined over time at virtually all of the long-term sites. However, the use of commercial fertilizer N led to a slower decrease in SOM content and not to a further additional decrease as suggested by Mulvaney et al. (2009). The primary function of commercial fertilizer N is to provide the crop with an immediately available source of N; often the nutrient most limiting plant growth. The secondary function, as shown in this analysis, is that commercial fertilizer N can reduce the decline in SOM content; or cause a small increase after a new equilibrium in SOM content has been reached following a change in management practices, such as; converting grassland to cereal cropping or the implementation of zero-tillage (no-till). BC

Dr. Ladha is Principal Scientist and IRRI Representative for India, located in New Delhi, India; e-mail: j.k.ladha@irri.org; Dr. C.K. Reddy, Retired Principal Scientist, Directorate of Rice Research, Hyderabad, Andhra Pradesh, India; Agnes T. Padre; Post Doctoral Fellow, IRRI India Office, New Delhi, India; Chris van Kessel, Professor, College of Agricultural and Environmental Sciences, Department of Plant Sciences, University of California-Davis, USA.

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