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Effects of Diversified Rice-based System on Nutrient Balances and Yield Gaps in the Philippines

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Abstract

The green revolution with the development of high-yielding rice varieties in combination with the use of synthetic fertiliser and pesticides, and the provision of irrigation water, allowed for cultivating two crops of rice per year. However, the high water demand for the dry season rice can no longer be met in water-scarce environments, forcing farmers to replace dry season rice with upland crops. The short turn-over times in rice double cropping require the rice straw of the preceding crop to be removed or burnt. Replacing dry season rice with an upland crop will result in seasonal variations of the soil aeration status that may affect soil C and N contents. On the other hand, the return of rice straw by mulching or incorporation before maize can add K and Si. The inclusion of a pre-rice green manure after maize may contribute to conserve native soil N. We hypothesise that the emerging flooded — aerobic cropping systems enhance nutrient cycling and increase yield and nitrogen use efficiency of rice. Such effects may provide new opportunities for sustainably intensifying production while saving water and reducing the existing gaps between potential and actual yields.

In the Philippines, these gaps were quantified at 4.2–7.8 $^{t}/_{ha}$ in rice double cropping systems. With the aim of reducing yield gaps in diversified cropping systems, we compared rice double cropping with rice-maize rotations over two years in three main rice-growing regions of the Philippines, namely Laguna, Tarlac and Pangasinan. We compared the effects of permanent flooding and alternating seasonal drying and wetting of the soil, and assessed the effects of straw return during the wet-to-dry season transition period after the harvest of wet season rice (K and Si cycling) and of including a nitrogen-fixing green manure (*Vigna radiata*) during the dry-to-wet season transition period after maize harvest and the transplanting of rice (N cycling).

Across systems, sites and years, we established partial nutrient balances and N use efficiencies, seasonal soil N dynamics and determined yields, yield gaps in 24 double rice and 24 diversified rice-maize fields. Preliminary findings of the 2016 rotation experiments will be presented and discussed.

Keywords: Nutrient cycling, *Oryza sativa*, Straw management, *Vigna* radiate, *Zea mays*

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