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Grain Yield and Yield Variability of Rainfed Lowland Rice with "Good Agriculture Practices" in the Kilombero Floodplain of Tanzania

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Abstract

Rainfed lowland rice is commonly produced by smallholder farmers in the floodplains of Tanzania. Erratic rainfall and uncontrolled flooding by spill-over of the river create conditions of unpredictable hydrology. Combined with a low N content of the predominant Fluvisols, N deficiency and unfavorable hydrology are major factors limiting rice production in floodplain environments, and can result in large yield variabilities. The variable and hence unpredictable outcome of farmers' investments is a major disincentive for adopting improved agronomic practices. We investigated rice crop management strategies that improve the use efficiency of water while adding the limiting N regrading rice grain yield and yield variability. Field trials were conducted in three hydrological zones (drought-prone fringe, middle and flood-prone centre positions) of the Kilombero floodplain in 2015, 2016 and 2017. We compared farmers' management (no field leveling and bunding, and no mineral or organic amendments) with different "good agricultural practice" (GAP), which is a set of recommeded crop, soil, water and weed management practices including field bunding, land levelling, application of mineral fertilisers or organic amendments, and combinations thereof with no application of herbicide and pesticide. Grain yield and yield variability between positions, years and replications were assessed.

Rice grain yields were highly variable, ranging between 2.1 and 11 t ha^{-1}. Yields were generally higher in 2015 and 2017 than in 2016, and more so in the drought-prone fringe and the middle than in the flood-prone centre positions. Farmers practice resulted in lowest yield and highest yield variability between years and positions. The simple bunding of the plots and the leveling of the fields increased water retention, particularly in fringe positions, significantly reducing yield variability between years and positions and increasing grain yields by up to 40 % above farmers' practice. While not always being yield effective, organic amendments (here incorporation of Lablab as pre-rice and *Stylosanthes* as post-rice green manure or application of farmyard manure) tended to reduce yield variability and hence farmers' production risk. Mineral fertilisers produced highest grain yields but resulted also in high yield variability. We suggest that a successful adoption of different components of GAP in floodplain wetlands is not only site-specific (bunding and levelling in fringe and middle positions), but also depends on farmers' priorities to either maximize yields (apply mineral fertilisers) or to minimize variation and hence risk (apply organic amendments).

Keywords: Farmyard manure, field bunding, floodplain, green manure, mineral fertiliser, urea

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