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"Reconcile land system changes
with planetary health"

Trajectories of crop intensification in rice-based systems of coastal Bangladesh

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Abstract

Understanding dynamics in farmers' adopting agricultural practice is crucial for designing site-responsive intensification strategies, especially in climate-vulnerable regions such as coastal Bangladesh. While land use intensification has been reported in some districts, there is little knowledge regarding associated changes in agronomic practices. We assessed temporal shifts in crop management practices across eight districts of coastal Bangladesh using a diachronic approach (2011 vs 2021). Based on field survey data from 120 farmers, a change detection analysis compared recent changes between favourable and marginal sites, providing a dynamic and site-specific view of agricultural transitions.

We observed substantial increases in the adoption of intensification-related modern technologies, with largest associated yield gains in Jashore, Khulna, and Barguna districts. Labor-saving strategies such as tractor tillage and herbicide use increased in most districts with labour limitations (Barguna, Jashore, and Narail districts), while investments in irrigation were most prominent in non-saline areas (Gopalganj and Jashore districts). Across districts, we observed an increase in the application of pesticides and non-N mineral fertilisers (P, K and Zn), while use of organic amendments increased by 28 % only in Khulna district.

The change patterns in the recent adoption of intensification-related practices were further substantiated by hierarchical cluster analysis. Strongest and most comprehensive transformation trends were observed in Jashore district. In rural conditions, favourable (i.e., Barishal) and marginal sites (i.e., Patuakhali) clustered closely, suggesting a convergence in adoption trajectories, a trend further supported also by principal component analysis. The first two components explained 56 % of the total variance, with PC1 aligned with laborsaving practices (i.e., machine tillage and pesticide use), and PC2 aligned with yield-increasing practices (i.e., nutrient management and use of modern genotypes). Bagerhat, Satkhira, and Jashore districts aligned closely with multidimensional modernisation, while Narail and Gopalganj districts showed only selective changes in specific practices.

Our assessment reveals heterogeneous recent trends in the adoption of intensification-related practices between and across coastal districts of Bangladesh. The change detection analysis provides critical insights into emerging agricultural systems, highlighting the need for tailored, context-, and location-specific interventions in support of sustainable future intensification of rice-based systems.

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