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Multi-level socioecological drivers of agrarian change: Longitudinal evidence from mixed rice-livestock-aquaculture farming systems of Bangladesh

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ABSTRACT

Coastal systems are facing natural and human-driven change coupled with a rising population. With increasing shifts in socioecological conditions during the past several decades, it is important to understand how socio-ecological drivers at different hierarchical levels: -micro, -meso, and -macro affect coastal farming systems, which play a crucial role in the livelihoods of coastal dwellers. Mixed rice-livestock-aquaculture farming in Southern Bangladesh exemplifies the rapid change occurring in many of the world's coastal farming systems in response to these drivers. We used panel data observations from the above study area and modeled trajectories of farm typologies, and the impact of multi-level socioecological drivers by a novel approach. Our approach integrates: (1) a well-articulated conceptual frame of change observed using (2) a temporal view of the potential drivers, change process and farm type outcomes, with the twenty years panel data of 502 households that is analyzed by means of (3) multivariate statistics in conjunction with panel data models that operationalize the conceptual frame. Our approach allows (a) estimating dynamic effects over time that typically cannot be estimated in a cross-sectional data set, (b) distinguishing between time-invariant fixed and time dependent random effects of multi-level socioecological drivers, and (c) controlling for omitted variables to a certain extent. Considering farming systems both within and outside of polder embankment systems intended to protect against oceanic water intrusion, we found a gradual shift from heterogeneous, rice-livestock farm types to more homogenous farms with less livestock and more off-farm activities. Micro-level factors including farm plot fragmentation, farmers' experience in cropping, machinery, salinity and soil fertility were influencing changes in farming systems. Meso-level factors including markets, road infrastructure, labor availability, access to extension and land tenure also affect the trajectory of farming systems change. Among macro-level drivers, increasing population density positively and significantly influenced cropping intensity among farms outside polder systems. Within polders, a positive but non-significant trend was observed for the influence of population density on cropping intensity. Our data also indicate negative and significant influence of cyclonic storms on cropping intensity over time in both areas. Our results underscore the importance of accounting for multiple levels of socioecological drivers of change when developing appropriate policy options for sustainable development in South Asia's coastal farming systems.

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