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Modelling choices and social interactions: adoption of mixed-mangrove aquaculture systems in Bangladesh

Stijn Reinhard, Chloë de Vries, Maria A. Naranjo, Wil Hennen and Nico Polman

1 Wageningen Economic Research, Wageningen University & Research, the Netherlands,

2 Wageningen Environmental Research, Wageningen University & Research, the Netherlands

Shrimp farming practices negatively impact the deltas' landscape by deteriorating water quality, ecosystem degradation, biodiversity loss, and enhanced coastal erosion. Sustainable alternatives are required to reduce the negative impacts of shrimp farming while offering a profitable alternative to shrimp farmers to significantly offset the negative impacts of shrimp cultivation in the region. Mixed-Mangrove Aquaculture (MMA) integrates the production of shrimp with the cultivation of mangroves and can potentially reduce the negative environmental impacts of cultivation while also offering additional income opportunities to farmers from mangrove products. This paper aims to analyse the adoption of MMA in Bangladesh by modelling the decision-making process of farmers. Grounded on a Theory of Change and validated by key stakeholders, we characterise farmers' decisions based on their individual characteristics, biophysical suitability, and awareness of MMA. We test for hypothesis on potential influencers of adoption using an agent-based model (ABM) looking at changes in farmers' income with and without MMA, and the area changed to mangroves over a period of time. The ABM is based on the CONSUMAT approach in which farmers compare their own income with that of the neighboring farmers to emphasize the importance of interaction effects between farmers for technology dissemination. Our overall goal is to explore how agent-based modelling can be used as a tool to understand technology adoption by farmers. By means of empirical data (secondary data from the Mangrove-Polders Project), the applicability of the ABM is assessed while testing four hypotheses. First, the effect of changing the ponds' physical suitability via re-excavating the primary canals and a nursery manual towards introducing MMA. Second, we test the effect of farmers' training to raise awareness towards the implementation of MMA. Third, we explore the interaction effects of both changes in the biophysical characteristic and an awareness campaign towards MMA. Finally, we test the effect of different climate change scenarios reflected the risk of shrimp disease.

Keywords: mixed-mangrove aquaculture, adaptation, agent-based model, Bangladesh