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Spatial incentives to upscale the benefits of tree islands in small oil palm plantations in indonesia: evidence from a spatially explicit coordination game

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Abstract

Biodiversity loss in tropical agricultural landscapes is accelerating, driven in part by the expansion of oil palm monocultures. Integrating conservation into these systems is therefore a key challenge. Tree islands—small patches of natural vegetation within plantations—have been shown to enhance biodiversity and ecosystem functioning while maintaining economic viability. However, their effectiveness depends not only on adoption by individual farmers but also on spatial coordination across individual farms, as many ecosystem services exhibit greater benefits from connectivity. This study investigates how different types of payments for ecosystem services (PES) schemes influence both, conservation behaviour and spatial coordination among smallholder farmers. We conduct a framed lab-in-the-field experiment with oil palm farmers in Jambi, Indonesia, using a spatially explicit coordination game. Participants repeatedly decide whether to maintain monoculture production or establish tree islands on stylized plots. The experiment includes three stages: 1) a baseline without incentives; 2) a PES stage in which payments are offered either regardless of the number of tree islands established (action-based), or contingent upon the establishment of a minimum number of tree islands that ensures environmental outcomes (results-based); and 3) a final stage in which a spatial agglomeration bonus is offered to reward the establishment of a minimum number of tree islands grouped into a single cluster. Results show that offering PES increases the establishment of tree islands overall, with results-based payments being more effective than activity-based payments in achieving environmental outcomes. However, neither scheme induces spatial coordination. The introduction of a spatial bonus significantly increases both the number and clustering of tree islands across both types of payments, indicating improved coordination among participants. These findings highlight that conventional PES designs may be insufficient to generate ecologically effective landscape patterns when spatial externalities are present. Incorporating spatial incentives, such as agglomeration bonuses, can substantially enhance coordination and environmental outcomes. The results provide practical insights for designing policies that promote sustainable land-use transformation in smallholder oil palm systems and similar tropical agricultural landscapes.

Keywords: Payments for ecosystem services, smallholders

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