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Crop Yield Variability and Risk Aversion as Barriers to the Adoption of Fire-free Land Preparation in the Eastern Brazilian Amazon?

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Abstract

In the Brazilian Amazon and at many other forest margins in the humid tropics, small-scale farmers depend primarily on low-input agriculture. The mechanisation of land preparation is often proposed as a profitable and climate-friendly alternative to the traditional fallow-based slash-and-burn practice. Yet, adoption rates remain rather low.

Although the high economic performance of mechanical land preparation in experiments is primarily due to fertilisation, many proponents tacitly assume that chemical fertilisers are being adopted together with the mechanisation method. The question that motivates this paper is therefore: Why don't farmers use fertilisers to increase the productivity of the traditional production system in the first place?

Based on farm-household data from 270 smallholders in the Eastern Brazilian Amazon we find that factors, such as income, liquidity constraints, labour endowment and social connectedness have little or no explanatory power with respect to fertiliser use. Instead, fertilisers seem to be used only for crops that are clearly unprofitable without fertilisation.

In a further step we simulate a set of production functions that identify expected yield and yield variance of important annual and perennial crops as a function of fertiliser use. The production functions are integrated into a quadratic farm-household optimisation model that accounts for production and price risks. The model suggests that risk aversion can induce farmers to increase or decrease fertiliser use intensity depending on how crop yield variance responds to fertiliser application.

We use the model to assess the potential of a technology-specific crop-yield insurance scheme to induce the adoption of fire-free mechanical land preparation methods that require fertiliser applications. A final section elaborates on the implications of the results for the design of agricultural research and agro-environmental policies in the humid tropics.

Keywords: Optimisation, simulation, slash-and-burn, small-scale agriculture