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Multi-agent simulation of farm-based decision making: a deforestation case of Dzalanyama Forest Reserve, Malawi

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Subsistence agriculture continues to be the mainstay activity in most tropical regions and opinions on how it impacts tropical deforestation vary significantly. The sparse literature available on subsistence farm-based models highlights the existing methodological gap in the ability of present day agent-based models (ABMs) to simulate the impact of subsistence agricultural production on frontier tropical deforestation. Though issues concerning agent specification and its variability have been successfully dealt with, gaps exist in the explicit incorporation and articulation of linkages of subsistence production and consumption theories on the one hand, and frontier tropical deforestation on the other. In this paper, the decision making process of tropical subsistence farmers surrounding the Dzalanyama Forest Reserve in the south western part of Malawi's capital Lilongwe is simulated in a multi-agent Java environment to evaluate how it impacts quantities of production and fulfillment of household requirements that include food which is then tested against the need to use forest reserve resources to supplement any deficiencies. This demanded explicit determination of the decision-making process and the objective functions for subsistence farmers. In this particular study area food production depended less on physiographic factors of soil and elevation for instance. However, availability of policy intervention mechanisms that include subsidized inputs and agricultural expertise positively influenced the sustainability of the food production. This study is further aimed at substantiating the hypothesis that over two thirds of all the charcoal produced in Malawi is largely as a coping mechanism against food shortage and/or cash needs. Most of deforestation in Malawi, especially of protected areas, is attributed to charcoal making. In this regard we hope that once the decision making at the household level in far as crop production is concerned is simulated, the trajectories of deforestation and its trigger mechanisms can well be understood. Overall, we also hope to show that farm-based ABMs have the potential to allow insightful understanding of the small and slow individual homogeneous subsistence practices that have resulted in massive deforestation in the tropics, especially in this study area where significant shifting cultivation and commercial logging is nonexistent.

Keywords: Agent-based modeling, Tropical deforestation, Farm-based decision making, GeoComputation, Subsistence farming