

Multi-agent simulation of deforestation: a subsistence farm-based decision making approach

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(1) Introduction: Several parameters are recognized to influence agents of deforestation's decision making to deforest and in the tropics many of these parameters are agriculture-based. With the majority of the households engaging in charcoal production as a coping mechanism when they fail to produce enough food in the study area, we present an attempt to simulate deforestation trends of Dzalanyama forest reserve using a Java-based multi-agent approach.

(2) Objectives: Using a farming household as the main agent, this study simulated the inefficiencies of the agricultural crop production theories being practiced in the areas surrounding Dzalanyama forest reserve and how they translate into its deforestation.

(3) Data sources and methods: Two field surveys were conducted to determine the main agricultural activities at the household level and how they influence the crop production.

Figure 1 shows the household decision making structure in growing the crops. The field survey revealed that access to hybrid farm inputs (cash endowment), exposure to good farming methods (agricultural extension services) and access to subsidized hybrid farm inputs were the important factors that defined the household's capacity to produce enough food.

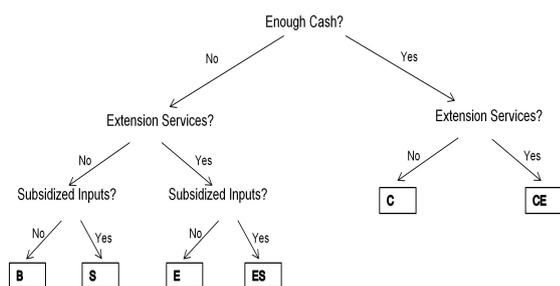


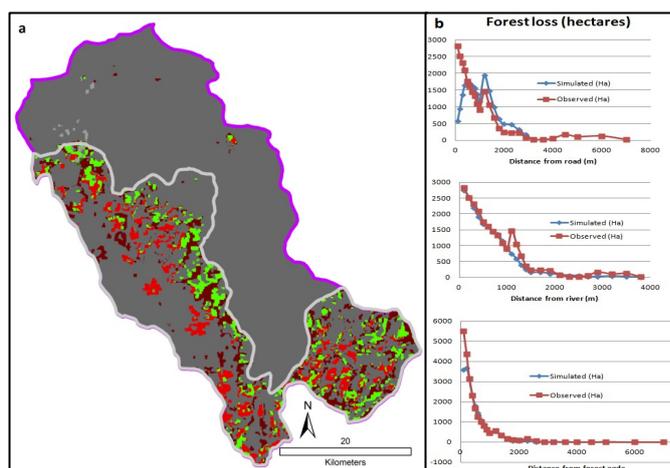
Figure 1. Simplistic heuristic decision making structure to grow maize (corn) by the household

(4) Results: Using status quo conditions, the simulation results compare very well with observed forest loss between 1990 and 2010 (Figure 2). Within that period 20,222ha of forest cover was simulated as lost against 22,734ha observed. Statistically the result stands at 0.629 Kappa with a literary comparable spatial accuracy at 44% (Hits) using the combine tool in ESRI's ArcGIS. In Figure 2b, the result is compared against the spatial driving factors.

The simulation response was then tested with an adjustment in the price of charcoal for which the result indicated a 38% reduction in forest loss

(5) Discussion: The model demonstrates literary comparable results and is encouraging as an alternative approach to modeling tropical deforestation trends. The study has shown that the inefficiencies of the subsistence farming system being practiced contribute significantly to deforestation of Dzalanyama as households, regardless of their production capacity, do not significantly prioritize food production.

The simulation response to an increased charcoal price is not surprising but does reveal the significance of a handsomely rewarding charcoal industry. It is therefore proposed that formalizing the charcoal industry is a viable option to curb the deforestation.



Legend

- Correct due to observed persistence simulated as persistence
- Error due to observed forest loss simulated as persistence (Misses)
- Correct due to observed forest loss simulated as forest loss (Hits)
- Error due to observed forest persistence simulated as forest loss (Misplaced)

Figure 2. Simulated versus observed forest cover distribution for 2010 a) against base map 1990; b) against spatial driving factors