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Peer Review

# Review of: "A Simple Board Game for Modeling the System Dynamics of Deforestation"

**Hany Akeel Al-hussaniy**[1]

1. University of Baghdad, Iraq

This manuscript presents a creative and pedagogically valuable attempt to translate core system dynamics concepts—particularly modified Lotka–Volterra interactions—into an accessible board game modeling deforestation and reforestation dynamics. The integration of ecological theory, game-based learning, and simplified stock–flow modeling is a clear strength, and the effort to bridge formal differential equation models with experiential learning is commendable. The manuscript is well contextualized within forestry sustainability, tragedy-of-the-commons theory, and serious games literature, and the transparency of rules and model structure enhances reproducibility. The visual representation of stocks (trees, loggers, capital) and the incorporation of feedback loops through player decisions effectively operationalize overshoot–collapse and recovery dynamics in an intuitive format. The sustainable forestry variant is particularly strong in aligning incentives with REDD-like mechanisms, thereby embedding policy relevance into gameplay.

However, several scientific and methodological limitations should be addressed to strengthen the contribution beyond a descriptive proof-of-concept. First, the empirical validation is currently very limited (n=3 runs per variant), and no statistical analysis is presented; claims regarding alignment with Lotka–Volterra dynamics remain qualitative. A more systematic comparison between simulation outputs and gameplay data—e.g., time-to-collapse distributions, mean forest stock trajectories, variance analysis—would considerably enhance rigor. Second, while the model is inspired by Lotka–Volterra equations, the modifications fundamentally alter predator–prey coupling; the theoretical justification for dropping density-dependent tree growth and proportional harvesting should be clarified, especially given that logistic forest growth is well established in ecological modeling. Third, parameter selection ($k_1$–$k_4$) appears pedagogically motivated but lacks sensitivity analysis; exploring the robustness of outcomes

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across parameter ranges would strengthen theoretical grounding. Fourth, behavioral dynamics (e.g., Nash equilibrium claims) are asserted but not experimentally tested—formal game-theoretic analysis or behavioral experiment design would deepen the contribution.

The educational value is strong, yet the manuscript would benefit from clearer separation between three layers: (1) ecological model, (2) mathematical abstraction, and (3) pedagogical simulation. A conceptual diagram explicitly mapping these layers would improve clarity. Additionally, a short learning-outcome assessment (even qualitative student feedback) would support the educational claims.

Overall, this is an innovative and promising interdisciplinary contribution at the intersection of system dynamics, sustainability science, and serious games. With stronger empirical validation, clearer theoretical positioning relative to classical ecological models, and modest statistical analysis of gameplay data, the manuscript could evolve from an interesting educational prototype into a rigorously grounded research contribution in sustainability modeling and environmental education.

## Declarations

**Potential competing interests:** No potential competing interests to declare.