

Conservation Strategies in Contested Environments: Insights from Dynamic Simulations and a Bolivian Case Study*

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Abstract

Conservation planning studies typically treat threats as exogenous and evaluate siting rules from a planner’s perspective. We argue that conservation is often contested, and develop a sequential land-claim game that models conservation as a dynamic, adversarial contest between conservationists (“Greens”) and developers (“Farmers”). We explore the framework in a *Claims World* that isolates the role of rivalry and leakage, and in a *Budget World* that introduces procurement constraints, decomposing outcomes into a Pure Strategy Effect (PSE)—the intrinsic quality of sites a strategy targets—and a Displacement–Leakage Effect (DLE)—the spillover gains from displacing developers’ preferred sites when leakage is incomplete. Our results generate several counterintuitive patterns. First, the link between threat-weighting and additionality breaks down once developer adaptation is allowed. Second, reducing leakage can paradoxically increase misallocation. Third, the textbook ratio-greedy rule (maximise efficiency) is systematically *dominated* by the simple value-greedy rule (maximise environment): we explore this ‘knapsack reversal’ more formally and show how it can produce a ‘disappointment gap’ between static (Marxan) planning and dynamic implementation. We then transport our dynamic contest to a Bolivia-based planning board constructed from biophysical data and confirm that the qualitative rankings from the simulations carry over, and adversarial outcomes lie well below the static cost-effectiveness upper bound. Tiny-grid equilibria, formal analysis and robustness exercises in the Appendix show that these patterns are consistent with best-response logic rather than artefacts of modelling choices. Together, the results suggest that robust conservation in contested landscapes requires strategies that anticipate adaptation, not just static threats. Replication materials and code are available via GitHub and archived on Zenodo (DOI: 10.5281/zenodo.17114490).

Key words: Conservation strategies, Additionality, Adversarial procurement, Monte Carlo simulation

JEL classifications: Q01, Q57, Q24, C72

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