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WHY HAS PUBLIC POLICY NOT REDUCED AMAZON FIRES? AN ASSESSMENT OF EVIDENCES AND RESULTS FROM AGENT-BASED SIMULATIONS

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Why has public policy not reduced Amazon fires? An assessment of evidences and results from agent-based simulations

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Abstract

Fires are expected to increase in Brazilian Amazon due to ongoing climate and forest change. Even under intensified pro-environment policy and increased diffusion of fire-free agriculture, the level of fires has still not mimicked the downward trend of deforestation. Seeking to understand why, the paper relies in literature review, survey data and policy simulations from a stylized agent-based model. It concludes that some limitations of the current policy could be overcome by shifting to a sticks-and-carrots mix of payment for forest environmental services and effective sanction of reckless fire use. This would yield the double-dividend of forest conservation and fire reduction, by avoiding both incentivizing farmers to leave fire containment to forests and also compromising their incomes.

Extended abstract

The future science forecast to Brazilian Amazon is of increased exposure to fires, owing to deforestation and ongoing regional climate. Environmental policy has proved effective in containing regional deforestation in the past ten years, one of the drivers of Amazon fires which are exclusively of anthropogenic source. However, this success has no parallel in fire activity, whose level has been fluctuating around a flat time average. Why current policy could not foster yet a systematic reduction of Amazon fires? To answer, the paper relies on a review of current environmental and agricultural policies coupled with policy simulations based on a stylized agent-based model.

In what regards to current policies, it is argued that national-level and state-level fire prevention and control actions are limited by scarce funding, excessive focus on fire-fighting in detriment of prevention, ineffective burn licensing and the complexity of tracking down illegal fire users. Deforestation policy, albeit successful to the goal it was designed, curbs incentives to fire use only indirectly having negligible impact on fire use in already deforested land. Agricultural policy targeted at supporting alternatives to fire-based agriculture is bottlenecked by insufficient provision of rural extension and its impact on smallholders is weakened by their low degrees of capitalization and market-integration.

Taking as basis the new economic geography concept of agglomerative and dispersive forces, an innovative land use agent-based model bridging parcel-scale and farm-scale perspectives of land allocation is built. Forces driving land use allocation operate though neighborhood effects at parcel-scale having two main sources. Forest provides environmental services of support to agriculture and also contains accidental fires. Agricultural land uses tend to agglomerate within farms owing to scale economies.

Agents interact with nature learning about the true generating process behind accidental fires. Along time, they search for the best land use portfolio by following a genetic algorithm in which new portfolios, selected in basis of their expected profit, are introduced. During this process of land use management improvement, farm-wide profit is increased and the risk of accidental fires reduced.

The agent-based model is employed to simulate the effects of three policy instruments, incentivizing forest conservation through sustainable management, subsidizing fire-free agriculture and sanctioning high-risk (or reckless) fire use.

Programs of payments for forest environmental services and incentives to sustainable forest management still attend a small proportion of Brazilian Amazon farmers. Even so, simulations results are potentially useful for a reflection on how the expansion of forest incentive programs should be pursued. Large incentives might encourage farmers to leave fire containment to expanded forests, abandoning costly fire control practices. Additionally, a larger and less fragmented forest area means a larger supply of services which support agriculture and also the replacement of agriculture by forest. This triggers a chain-reaction of fire-free agriculture (FFA) deagglomeration because the profitability of this LUT is more sensitive to agglomeration than to the availability of environmental services. In parallel, fire-based agriculture (FBA), which is more sensitive to support from forests, have their profitability increased. The two effects combine to revert the transition from FBA to FFA. The lesson to be learned is that large pecuniary incentives to forest conservation may encourage reckless fire use and part of the gains of afforestation and defragmentation would be sacrificed by increased fire-induced forest degradation.

Incentives to fire-free agriculture imply in the reduction of local forest area (Figure 1) and, thus, in a diminished local supply of the environmental service of fire containment. This side-effect leads to an increase in accidental fire risk whose magnitude may compensate, at least partially, the reduction in accidental fire risk yielded by the shift of fire-based to fire-free agriculture.

Sanctioning of high risk fire (HRF) use proves to be the most cost-effective way to reduce both high risk fires and accidental fires, even under limited ability to identify transgressors (Figure 1). Why, then, in practice, the sanctioning of non-authorized high risk fire use does not seem to have fostered a decline in fire detections? First, the model does not incorporate the possibility that farmers may resist to the full implementation of a policy based on imposing them economic losses. As simulations show, fines to HRFs drive aggregate profit systematically below the level that would prevail whether fines were not applied. In the second place, the model assumes that the monitoring apparatus is fully precise to identify reckless and, thus, unauthorized, fire use, but, in reality, the information regarding fire use permits granted is not completely linked with the information of fire detections.

Considering the effects and limitations of policies evaluated, the shift to a sticks-and-carrots mix of payment for forest environmental services and sanction of reckless fire use looks promising. This would yield the double-dividend of forest conservation and fire reduction, by avoiding both incentivizing farmers to leave fire containment to forests and also compromising their incomes.

Figure 1 Cost (horizontal axis) and benefit (vertical axis) of policies, red = sanctions to high risk (reckless) fire use, green = incentives to forest, blue = subsidies to fire-free agriculture