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Impacts of protected areas on respiratory health in the Brazilian Amazon

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Final Report: UGP 2020: Impacts of protected areas on respiratory health in the Brazilian Amazon

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Background

There is growing interest in the connection between the conservation of ecosystems and human health. Protection of ecosystems is often presented by opponents to be in direct conflict with human values, on the grounds that it restricts economic opportunities. At the same time, human health is a universal value that cuts across political, economic, and social divisions. To date, the empirical evidence for the extent to which conservation or land-use policy can generate health improvements is minimal. This project contributed by focusing on one large-scale policy, Brazil's Amazon biome Protected Area (PA) network. It provided funds for processing and analysis of data on the impact of PAs on hospitalizations for respiratory illness.

Findings

The main analysis was based on the variation in hospitalizations in months when prevailing winds meant that PAs were largely upwind of population centers compared with months when PAs were largely downwind. There are three key mechanisms through which we expect the impacts of upwind PAs on air quality to operate: to the extent that protection reduces active deforestation, we would expect less of the burning of residual biomass that typically follows deforestation in this region; past protection provided by a PA will also reduce the area of land in use for agriculture and the resulting agricultural fires used for weed control; and finally, protection of intact forest ecosystems inhibits the unintentional spread of fires set for other purposes (Cochrane and Schulze 1999; Libonati et al. 2021). Our results indicate that Brazil's PAs improve air quality and reduce respiratory hospitalizations during months of active biomass burning in the Amazon biome.

The estimated effect of upwind PAs on respiratory hospitalizations depends critically on the size of the downwind population: across the full sample, doubling the area of PA within a single upwind octant is estimated to reduce fire-season hospitalizations by 1.56 hospitalizations per 100,000 people, compared with an average of 22.7 per 100,000; a reduction of approximately 7%. For the relatively small municipal capitals in much of the Amazon region (median population size is 19,299), this would amount to just under one avoided hospitalization for respiratory illness per fire season. In a larger city such as the state capitals of Cuiaba (~600,000), Porto Velho (~500,000) or Rio Branco (~400,000) it would amount to 19-28 fewer hospitalizations per fire season. It is important to interpret these results in relation to hospital capacity, particularly for the remote rural areas that constitute a large part of our study region. On average, communities in the North of Brazil, where the Amazon Biome is located, have 16 infirmary beds and 1 ICU bed per 10,000 people (Silva et al. 2021). However, there is substantial heterogeneity, with 5% of micro-regions having only 6 beds per 10,000 people, particularly in the North and Northeast of Brazil where socioeconomic vulnerability is highest (Coelho et al. 2020). In these settings, hospitalization of even one additional person can have important capacity implications.

When we disaggregate hospitalizations in each municipality by the age of the individual and the type of respiratory condition they were hospitalized for, we find that the results are mainly attributable to effects on children under 15 years old. This cutoff is used because it allows us to match the ages of hospitalized individuals in the SIH/SUS database with ages of the municipality population from the Brazilian census, but it is likely that the majority of these cases are among children considerably younger than 15 years old. Relative to older children, those under five years of age are at highest risk of lower respiratory infections (LRI; Kyu et al., 2022). Globally among children younger than five years old, those younger than six months account for approximately 45% of hospital admissions due to RSV-associated acute LRI (Shi et al.

2017). Infants have a high respiratory rate and lungs that are not yet fully developed, making them particularly sensitive to air pollution exposure (Bateson and Schwartz 2007).

Brazil has an extensive network of PAs, but investments in management and enforcement have declined in recent years. Forest fires have increased dramatically over the same period. We estimate that the value of the health benefits exceed current average expenditures on PA management for the 1/3 of PAs with the largest local populations, although not for PAs in more remote locations. Our findings highlight how quantifying the contributions to the wellbeing of local populations can support conservation objectives, even if global environmental benefits are not a high priority for decision makers.

Project outcomes

This work contributed to research activity and international collaboration in multiple ways. One graduate student, Derek Sheehan, expanded on the data processing and initial analysis from the UGP project for his successfully-defended MA thesis. The findings described above formed the basis for a manuscript that is currently under review, with Derek Sheehan, the graduate student involved, as the lead author.

The second objective of the project was to help develop a new research program on the relationship between forests and health in developing countries with the Environment for Development Initiative, a global network of research centers working in the field of environmental economics. I am currently co-editing a Special Issue on Ecosystems and Health at the journal Environmental and Resource Economics with other EfD collaborators. The manuscript that resulted from the UGP funding is one of the submissions to this special issue.

The UGP project has also supported new cross-campus collaborations. Erin Semmens in the School for Public and Community Health Sciences is a co-author of the journal manuscript. We have expanded this work to examine the relationship between parks and respiratory health in the United States. The new project also involves faculty in the College of Forestry and graduate students in Economics.

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