# **Resources for the Future: 'Time Satellite Information for Monitoring Deforestation in the Brazilian Amazon'**

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**Body**

Resources for the Future issued the following working paper (No. 22-22) on Oct. 19, 2022, entitled "Estimating the Value of NearReal-Time Satellite Information for Monitoring ***Deforestation*** in the Brazilian ***Amazon***":

The working paper was written by Katrina Mullan, Trent Biggs, Jill Caviglia-Harris, Jime Rodrigues Ribeiro, Thais Ottoni Santiago, Erin Sills and Thales AP West.

Here are excerpts:

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8. Discussion and conclusions

In 2004, Brazil began using near-real-time satellite information through the DETER program to detect and report illegal ***deforestation***. This was the start of a substantial drop in rates of ***deforestation*** in the Brazilian ***Amazon*** that coincided with a period of overlapping public and private ***deforestation*** and development policies. Multiple changes in the macroeconomic and policy environments occurred simultaneously, including an expansion in protected areas, increases in the rate of use and enforcement of environmental fines, and changes in commodity prices. To account for and control for these factors, we estimate the change in ***deforestation*** after 2004 while conditioning on the other changes that occurred simultaneously to separate the effects of DETER from other influences on ***deforestation***. It is also possible that real-time satellite monitoring changed the effectiveness of fines and protected areas while also altering the incentives for ***deforestation*** provided by high commodity prices or regional development policy. We use interactions within our empirical model to account for ways that DETER itself changed the drivers of ***deforestation***, and incorporate this in our estimates of counterfactual ***deforestation*** in the absence of DETER. Our DAG highlights the assumptions that are made when including policies on or off the causal path and illustrates the two counterfactuals that we estimate as our upper and lower bounds on avoided ***deforestation***.

We find that the initially positive relationship between commodity prices and ***deforestation*** and the positive relationship between areas of INCRA settlement and rates of ***deforestation*** no longer exist after 2004. Our results indicate that DETER has a large direct, and immediate, effect on ***deforestation*** in 2004 and that DETER alters the estimated future rates through indirect effects on other factors that influence ***deforestation***. In total, annual ***deforestation*** is substantially higher in the counterfactual scenarios where DETER was not introduced, with the difference increasing towards the end of the study period. In total we estimate the amount of avoided ***deforestation*** is approximately 652,000-677,000 km2 between 2001-2015 according to our lower and upper bounds identified in Counterfactuals 1 and 2. This is an area that is similar to the size of Alaska, larger than the combined area of the next three largest states in the U.S. (California, Montana, and New Mexico) and 2.3 times larger than the amount of ***deforestation*** recorded in that region in the same time period (282,341 km2). We also estimate the amount of CO2 emissions avoided and find these totals to be about 1.6 trillion tons.

Our benefit-costs analysis suggests that the net benefits of satellites are substantial (US$733 million/year-US$4.2 trillion/year) when estimating benefits using the WTP to preserve ***Amazon*** rainforest, but that the net benefits range between negative (US$-384 million/year) and lower positive values (US$582 million/year) when estimating the benefits of avoided CO2 emissions. The negative estimates result when the current US government SSC of $51/tCO2 is used in the estimation.

Brazil was an early adopter of near-real-time satellite ***deforestation*** alerts, but high-frequency satellite data has become more widely available to tropical countries in recent years. For example, Global Forest Watch has worked with varied partners in the tropics to provide GLAD rapid ***deforestation*** alerts since 2014, and in 2020, Norway's International Climate and Forest Initiative offered freely available high-resolution monthly ***deforestation*** data to any user. Our findings suggest that this type of data can make important contributions to reducing ***deforestation***, but these contributions will depend on how the satellite data are used, made public, and the corresponding support (or lack of support) by public and private agencies. We found that public and private forest conservation policies that were implemented after the introduction of DETER significantly reduced ***deforestation***. However, we cannot determine how effective they would have been in the absence of DETER. Certainly, these policies relied on satellite information, but they used both low- and high-frequency data. We therefore estimate lower and upper bounds based on the assumptions that the policies would have been equally effective without DETER or totally ineffective without DETER. The reality is likely to lie between these bounds, which would indicate that the combination of access to near-real-time satellite data and the motivation to use the data in novel ways can be even more effective than using the data for pre-existing policies and enforcement.

Finally, we estimate the benefits of satellites using a time period of declining ***deforestation***. ***Deforestation*** started to increase in the Brazilian ***Amazon*** after 2012, and has been at decade highs in recent years. Actually, rates in 2021 were the highest since 2006 (INPE 2021) and are on target to be higher in 2022. This reversal highlights that the effectiveness of ***deforestation*** alerts and satellite data depends on the willingness to enforce existing forest laws and penalize violations. In the absence of political will to constrain ***deforestation***, the increasing public availability of high-frequency data raises global awareness of increases in ***deforestation***. This can generate external pressures for conservation, for example through supply chain initiatives developed through global commodity markets, and external pressure from NGOs, international organizations and individual foreign governments to enforce and strengthen policy.

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