



BRIEFS

Stopping Deforestation: What Works and What Doesn't

5/29/14 (<http://www.cgdev.org/publication/stopping-deforestation-what-works-and-what-doesnt>)

Jonah Busch and Kalifi Ferretti-Gallon

CGD Climate and Forest Paper Series #3

Summary

A new Center for Global Development meta-analysis of 117 studies has identified the key factors that drive or deter deforestation. Some findings confirm conventional wisdom. Building roads and expanding agriculture in forested areas, for example, worsen deforestation, whereas protected areas deter deforestation. Encouragingly, payments for ecosystem services (PES) programs that compensate people who live in or near forests for maintaining them are consistently associated with lower rates of deforestation.

But contrary to popular belief, poverty is not associated with greater deforestation, and the rising incomes brought about by economic growth do not, in themselves, lead to less deforestation. Community forest management and strengthening land tenure, often thought to reduce deforestation while promoting development, have no consistent impact on deforestation.

These findings have important implications for Reducing Emissions from Deforestation and Forest Degradation (REDD+), the global movement to offer tropical countries performance-based payments for protecting their forests. The findings provide the best evidence yet that deliberate policies coupled with financial incentives can slow, halt, and eventually reverse the loss of the world's remaining tropical forests.

This brief is based on Kalifi Ferretti-Gallon and Jonah Busch, "[What Drives Deforestation and What Stops It? A Meta-Analysis of Spatially Explicit Econometric Studies](#)," CGD Working Paper 361 (Washington: Center for Global Development, 2014).

The Many Benefits of Forests

Forests provide a wealth of public and private goods and services, including carbon storage, biodiversity, water filtration, storm mitigation, timber and nontimber products, wild foods and medicines, and tourism. Yet despite its inherent value, forested land is being cleared for other uses such as farming, pasturing, mining, and urban development. Every year claims a net forest loss of 125,000 square kilometers—an area the size of Greece or Mississippi—and that rate is increasing by 2,000 square kilometers per year.^[1] Of the current net forest loss, 58 percent is in the tropics, where forests are being converted to cropland and pasture for the production of soy, beef, palm oil, and timber.

A variety of deliberate policies have been devised to slow the rate of deforestation. Forested countries have designated protected areas, increased law enforcement, and set up programs to pay for ecosystem services; consumer countries have placed import restrictions on illegal tropical timber; and private supply-chain actors have introduced eco-labeling, certification, and sustainable sourcing measures. As international concern about climate change has grown, attention has intensified on reducing the 10–15 percent of global greenhouse gas emissions resulting from deforestation and forest degradation (REDD+).

Investigating Drivers of Deforestation

All efforts to safeguard forests benefit from research on the factors that drive deforestation and the policies that can stop it. Dozens of individual spatially explicit econometric studies of deforestation have investigated drivers of deforestation in particular places at particular times. Several previous articles have reviewed this literature (see further reading), but until now, no systematic and comprehensive review of these studies has been produced. By examining all such studies collectively, we are able to quantify and compare the relative influence on deforestation of dozens of commonly studied factors.

We compiled a comprehensive database of all spatially explicit econometric studies of deforestation that met five prespecified criteria.^[2] This resulted in a database of 117 studies published in peer-reviewed academic journals from 1996 to 2013, spanning 36 countries, and covering two-thirds of all tropical forests. These studies collectively contained 1,159 uniquely named explanatory variables, which we grouped into 40 categories. We counted the number of times that variables in each category were shown to be positively associated with deforestation, negatively associated, or neither (see figure 1). Understanding which factors are consistently associated with higher or lower rates of deforestation can assist public agencies seeking to conserve forests for their many public and private values (see box 1 for a summary of the most promising approaches).

Four Promising Approaches for Stopping Deforestation

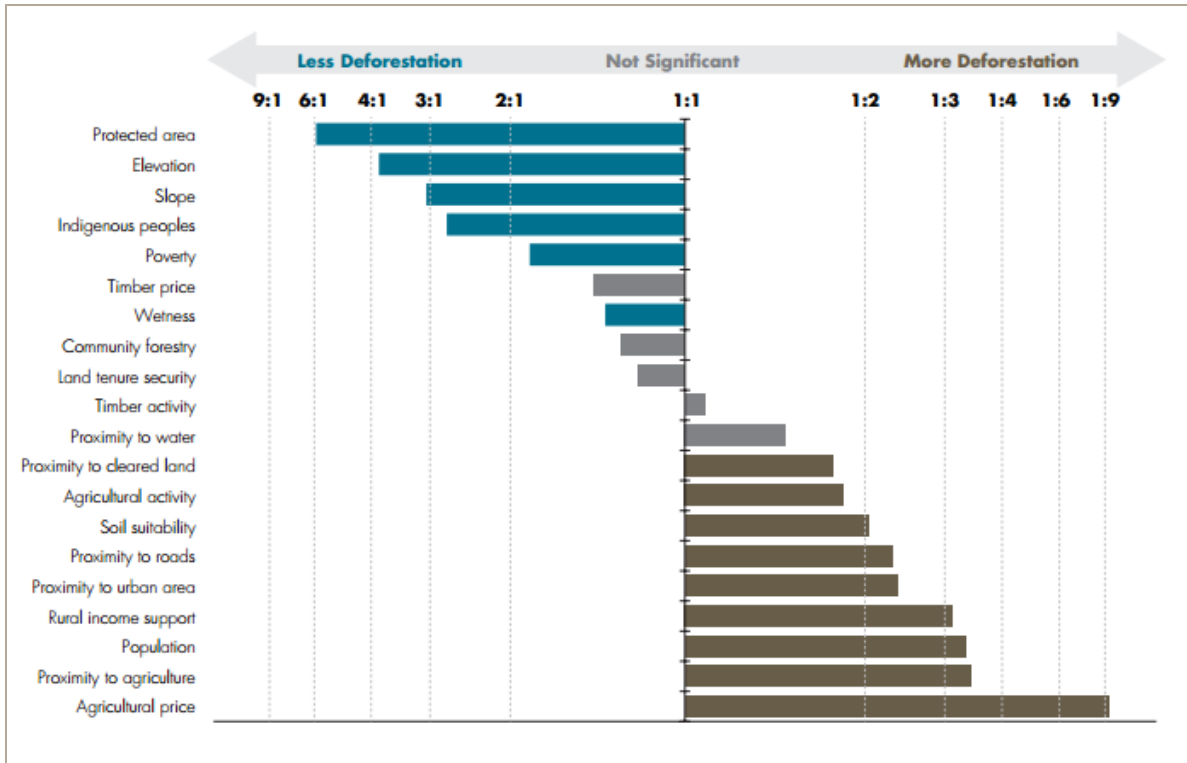
For decision-makers seeking to curtail deforestation, our meta-analysis of 117 spatially explicit econometric studies suggests four promising approaches:

- **Roads:** Forest countries and investment banks should plan road networks to minimize intrusion into remote forested areas.
- **Protected areas:** Forest countries should target protected areas and regions where forests face higher threat.
- **Payments:** Forest countries should make payments for ecosystem services (PES), tying support for rural incomes to the maintenance of forest resources.
- **Agriculture:** Forest countries and agricultural companies should insulate forested areas from demand for agricultural commodities.

As an overarching policy, rich countries should finance international performance-based payments to forest countries for reducing emissions from deforestation and forest degradation (REDD+) in order to increase the rewards for successfully undertaking any of the above interventions.

Several frequently proposed “win-win” approaches for forests and development are not consistently associated with lower rates of deforestation. These include **economic growth**, greater **land tenure security**, and **community forest management**.

Figure 1: What Drives Deforestation and What Stops It? A Meta-Analysis



Ratio of regression coefficients showing significant negative association with deforestation to regression coefficients showing significant positive association with deforestation, based on 5,605 regression coefficients in 117 spatially explicit econometric studies. “Not significant” denotes not statistically significantly different from 1:1 in a two-tailed t-test at the 95 percent confidence level. Results displayed for the 20 most commonly included meta-variables only; meta-variables with fewer than 55 coefficients are not displayed.

What Drives Deforestation, and What Stops It?

Agricultural variables are consistently associated with higher deforestation. This is not surprising since most forestland is cleared for agriculture and pasture. However, agricultural effects vary across mechanized agriculture, small-scale agriculture, and cattle ranching. (Evidence base: 17 countries on 5 continents)

Biophysical variables (physical characteristics of the land and forest) have a clear impact on deforestation by affecting accessibility, clearing costs, and agricultural productivity. Deforestation is consistently lower at higher elevations, on steeper slopes, and in wetter areas, whereas it is consistently higher on soil that was more suitable for agriculture. Proximity to water is not significantly associated with higher or lower deforestation. (Evidence base: 34 countries on 5 continents)

Built infrastructure is consistently associated with higher deforestation. Proximity to roads and

urban areas increases deforestation by lowering transportation costs to markets, by making frontier land more accessible to new migrants, and by enabling remote economies to transform from local subsistence agriculture to market-oriented farming systems. (Evidence base: 33 countries on 5 continents)

Community forest management is not consistently associated with either higher or lower deforestation. (Evidence base: El Salvador, Ethiopia, Guatemala, Mexico)

Demographic variables, such as age, education, gender, or property size, have no consistent association with either higher or lower deforestation. (Evidence base: 17 countries on 4 continents)

Indigenous peoples are consistently associated with low deforestation in areas with both low and high levels of baseline threat. (Evidence base: Bolivia, Brazil, Mexico)

Land-tenure security shows no consistent association with either higher or lower deforestation. While more secure property rights for indigenous peoples is sometimes associated with lower deforestation, more secure land tenure can also increase investment, leading to greater deforestation. The converse is sometimes true: insecure property rights can reduce the present value of standing forests and encourage owners to convert the land to benefit from more productive uses and to reduce the risk of expropriation. (Evidence base: 9 countries on 3 continents)

Law enforcement outside of protected areas is consistently associated with lower deforestation. (Evidence base: Brazil, Indonesia)

Payments for ecosystem services are consistently associated with lower rates of deforestation. While early research found little effect of PES on deforestation rates in Costa Rica, subsequent studies found PES in Costa Rica to have had a positive effect on total forest cover, which includes forest regrowth in addition to deforestation. (Evidence base: Costa Rica, Mexico)

Population shows a strong association with greater deforestation, though endogeneity makes a causal link difficult to infer. Population can increase deforestation by increasing the supply of labor and the local demand for agricultural products, but population growth occurs simultaneously with other rural economic expansion that increases deforestation pressure, and an increase in cleared land can support a greater population. (Evidence base: 26 countries on 5 continents)

Poverty is consistently associated with lower rates of deforestation, but no consistent evidence shows that higher income is sufficient on its own to slow and reverse deforestation without additional deliberate policy interventions. In the absence of careful study design, the changes in deforestation that can be directly attributed to poverty or to changes in income or wealth are difficult to separate from concurrent geographical or temporal trends that also affect deforestation. Increased income from rural support programs is consistently associated with increased rates of deforestation. (Evidence base: 17 countries on 5 continents)

Protected areas is the variable most consistently associated with lower deforestation. Lower deforestation in protected areas is often due to the geographical remoteness of those areas, in addition to their legal status. (Evidence base: 19 countries on 4 continents)

Proximity to cleared land is consistently associated with greater deforestation. This may be a consequence of either increased access and reduced clearing costs or omitted variables that are

correlated with a greater likelihood of deforestation. (*Evidence base: 19 countries on 5 continents*)

Timber variables (timber activity and timber price) are not consistently associated with either higher or lower deforestation. The mixed relationship between timber variables and deforestation suggests that the economic returns that forests provide through timber harvest may be forestalling more rapid conversion of these forests to agriculture, even while logging activity can degrade forests and increase access into remote areas, which can lead to later deforestation. (*Evidence base: Bolivia, Brazil, Indonesia, Mexico, Myanmar, Panama, Thailand*)

Further Reading

- Angelsen, A., and Kaimowitz, D. 1999. "Rethinking the Causes of Deforestation: Lessons from Economic Models." *The World Bank Research Observer* 14: 73–98.
- Angelsen, A., and Rudel, T. K. 2013. "Designing and Implementing Effective REDD+ Policies: A Forest Transition Approach." *Review of Environmental Economics and Policy* 7, no. 1: 91–113.
- Choumert, J., Combes-Motel, P., and Dakpo, H. K. 2013. "Is the Environmental Kuznets Curve for Deforestation a Threatened Theory? A Meta-analysis of the Literature." *Ecological Economics* 90: 19–28.
- Ferretti-Gallon, K., and Busch, J. 2014. "What Drives Deforestation and What Stops It? A Meta-analysis of Spatially Explicit Econometric Studies." CGD Working Paper 361. Washington, DC: Center for Global Development.
- Geist, H. J., and Lambin, E. F. 2002. "Proximate Causes and Underlying Driving Forces of Tropical Deforestation." *BioScience* 52: 143–150.
- Hansen, M. C., et al. 2013. "High-Resolution Global Maps of 21st-Century Forest Cover Change." *Science* 342: 850–853.
- Miteva, D. A., Pattanayak, S. K., and Ferraro, P. J. 2012. "Evaluation of Biodiversity Policy Instruments: What Works and What Doesn't?" *Oxford Review of Economic Policy* 28: 69–92.
- Pattanayak, S. K., Wunder, S., and Ferraro, P. J. 2010. "Show Me the Money: Do Payments Supply Environmental Services in Developing Countries?" *Review of Environmental Economics and Policy* 4, no. 2: 254–274.
- Pfaff, A., Amacher, G. S., and Sills, E. O. 2013. "Realistic REDD: Improving the Forest Impacts of Domestic Policies in Different Settings." *Review of Environmental Economics and Policy* 7: 114–135.
- Rudel, T. K., et al. 2009. "Changing Drivers of Deforestation and New Opportunities for Conservation." *Conservation Biology* 23, no. 6: 1396–1405.

The Center for Global Development is grateful for contributions from the Norwegian Agency for Development Cooperation in support of this work.

[1] Hansen, M., et al. (2013). *Science*, 342:850–853.

[2] The full database of spatially explicit econometric studies of drivers of deforestation (the SEED Database) is available for free download at <http://www.cgdev.org/doc/seed.xlsx>. We plan to update this database periodically as new studies that fit our inclusion criteria are published.

