2019 Aug

AMAZON FIRES: WHAT WE KNOW AND WHAT WE CAN DO

Daniel Nepstad | Executive Director & President

The fires now burning in Brazil's Amazon, which have prompted international outcry, are a classic example of a "chronic emergency". Brazilian President Jair Bolsonaro, after casting blame for the fires on international NGO's, acknowledged his administration is ill-equipped to battle the flames and soon after called in Brazil's armed services to assist in that fight. But to truly address the situation, what is needed is a systemic, long-term strategy for prevention that feeds into a broader regional development plan. The current focus on Amazon fire —within Brazil and internationally—opens an opportunity to make that shift and to postpone or even avoid what scientists refer to as the Amazon forest "tipping point", whereby the forest is no longer able to sustain itself.

This blog draws on 30 years of research on Amazon fire, including the world's largest tropical forest fire experiment, to propose eight recommendations for Brazil and the international community, to fight fires in the short-term and prevent them in the long-term.

Fire and drought: The biggest long-term threats to the Amazon forest

The biggest threat to the Amazon forest is large-scale displacement by scrub vegetation driven by increasingly frequent extreme drought events and associated forest fire. During years of normal rainfall, the Amazon forest extends like a giant firebreak across the landscape. Fires set by landholders to improve grass cover in cattle pastures or to burn felled trees in preparation for crops or pasture are usually extinguished when they reach the floor of neighboring forests, where the damp layer of leaves, twigs and branches in the forest's deep shade does not readily burn. But that same fire resistance of the forest is lost during years of severe drought, when the forest's fuel layer dries out. And when the fuel layer catches fire, the likelihood of another fire becomes greater, as we explain below. As the forest burns repeatedly, grasses invade, and a once fire-resistant forest can be replaced by fire-prone scrub vegetation, as we described recently for our long-term forest fire experiment in Mato Grosso.

Interactions between drought, fire, logging and climate change could drive a large scale replacement of Amazon forest by fire-prone scrub vegetation. (Source: Climate Change 2014: Impacts,Adaptation, and Vulnerability, Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press)

The loss of forest itself can also provoke drought and forest fire. This is because the rainfall of the Amazon depends upon water released into the atmosphere by its deeply-rooted trees. As we've demonstrated, the rainfall reduction from deforestation could even be enough to render inviable major Amazon hydropower plants, like the Belo Monte Dam. The "tipping point"—the area of forest clearing beyond which reduced rainfall and severe drought push the forest to fire-prone scrub vegetation regionally, is not known precisely. The safest plan for the Amazon—to prevent fires, to secure rainfall, to sustain energy production in hydropower plants, and to increase our chances of avoiding catastrophic climate change—is to assume that Brazil is close to the limit now, with roughly 20% of the forest cleared. Reforesting cleared land that is only marginally productive would further secure the Amazon rainfall regime, reducing the risk of crossing the tipping point.

Getting the story straight: We don't know how much of the Amazon forest is burning

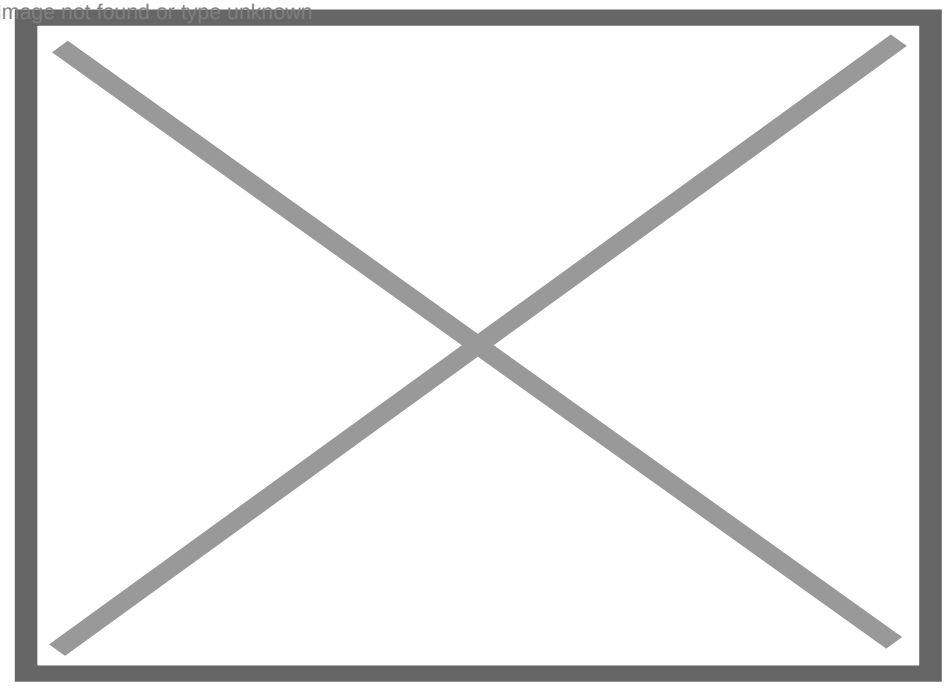
We know far less about Amazon fire than we do about Amazon deforestation and this hampers efforts to prevent and control forest fires. When a satellite detects a fire, it does not tell us if that fire is burning a degraded pasture or an overgrown field or a patch of forest felled to make way for crops or cattle. Satellites do NOT detect most fires that are burning beneath the canopy of standing forests. And it is these low fires, that rarely reach the knee, that do the most damage, burning slowly across the forest floor, killing giant trees with thin bark. Once these trees die, they fall to the ground, opening up huge gaps in the forest canopy that allow more sunlight to reach the forest floor, drying the fuel layer and making the forest more prone to further burning. During years of severe drought, such as those that usually accompany El Niño events, the area of standing Amazon forest that catches fire can far exceed the area cleared with chainsaws.

What we know about the current Amazon fire emergency is that in 2019, from January 1st through August 31st, there have been about 7% more fires in Brazilian Amazon states than average since 2010 (see graph). We do not know with confidence how the area of fire compares with previous years.

It is important to bear in mind that the fire season has just begun, with most fires occurring from September to December. With forecasts of a long dry season, the number of fires could continue to be greater than usual.

We also know that it is a particularly smoky burning season. This is probably related to the large number of “deforestation fires”—fires set to burn patches of forest that have been felled to make way for cattle pasture or crop fields. The smoke released from a fire that burns a hectare of felled forest releases far more smoke than a fire that burns a hectare of degraded pastureland.We do not know the area of standing forest that has burned. Forest fires, however, usually happen late in the dry season.

Image not found or type unknown



Graph of number of “hot pixels”(fires) counted by NASA from MODIS satellites from January through August, 2010-2019 (average and standard deviation), 2019 and 2018 for the Brazilian Amazon. The trends seen here are similar for the Brazilian Space Agency’s (INPE’s) hot pixel estimates for the Brazilian Amazon.

Recommendations for Brazil

1. Expand Brazil's global forest-monitoring leadership to include annual assessments of forest fire scars

There is an urgent need for annual maps of the standing forests that have caught fire to accompany the annual maps of deforestation produced by the Brazilian Space Agency's (INPE's) PRODES program. It is essential that these annual assessments continue to be made freely available, without political interference. The algorithms for mapping Amazon forest scale, such as "CLASfire" developed by Ane Alencar and Greg Asner, could be used for this purpose.

2. Short-term: better fire management, early warning and fire brigades

The tipping point can be postponed by putting out forest fires before they do much damage. We know how to do this. The fire brigade of *Aliança da Terra*, in Brazil, puts out fires by detecting them early through a voluntary network of landholders and communities and then putting out these fires through a rapid response brigade. They have trained hundreds of fire fighters, including indigenous peoples and farm staff. Since forest fires tend to be low—knee-high or lower—they can be contained by clearing away the fuel layer in a narrow firebreak along the forest floor.

This year, FUNAI, the Brazilian Indigenous peoples' federal agency, did not authorize *Aliança* to put out fires in the indigenous park of the Xingu River headwater, and forest fires burned longer as a result.

With the high number of fires detected so early in the year, Brazil should be on heightened fire alert, preparing to detect and extinguish fires that escape their intended boundaries. Financial support is urgently needed for the *Aliança Brigade* and similar approaches across the Amazon region.

3. Short-term: public education on fire management

Fire is an essential land management tool for many Amazon farmers; in the near term, it is the most cost effective, efficient way to prepare land for planting crops or pastures. Typically, patches of forest or fallow vegetation are cleared, allowed to dry, then set on fire. These fires release a pulse of nutrients into the soil for young crops as they reduce populations of insect and plant pests. In most of the rural tropics, farmers will continue to use fire for the foreseeable future. By educating farmers in fire prevention and management techniques, including

when and where not to burn, how to control fires, and how to reduce the risk of accidental fire, the occurrence of fires could be greatly reduced in tropical landscapes.

4. Long-term: low-fire rural development

Long-term strategies for postponing the tipping point by reducing the incidence of forest fires should focus on the production systems of the region's farms. When fire-sensitive orchards and agroforestry systems for producing coffee, açaí, cocoa, timber, rubber, fruits and other products are established on farms, landholders tend to invest more in fire prevention and they tend to use fire less as a land management tool. These crops can also provide higher incomes. Their adoption at a larger scale will depend upon greater investment in technical assistance, rural extension, market development and commercialization. These investments are essential to allow Brazil to continue its track record of success, that is now threatened, in slowing deforestation while increasing agricultural and livestock production.

5.Long-term: Translate Brazil's enormous carbon emission reductions into value propositions for communities, farmers and governments

Brazil is better positioned than any other nation to lead the pathway to the low-carbon economy. Its 7+ billion tons of carbon dioxide emissions that have been avoided through Brazil's enormous and successful effort to slow Amazon deforestation are now poised to be monetized. The "pay-for-performance" contracts between the Brazilian national government and both Norway and Germany—both recently suspended because of changes made to the Amazon Fund structure—and more recently, with the Green Climate Fund are just one manifestation of this valuation. Germany and the UK recently began a similar pay-for-performance agreement with the States of Mato Grosso and Acre. All of these contracts depend upon Brazil's continued success in slowing deforestation—an outcome that will be hard to achieve if budget cuts to, and weakening of, critical law-enforcement agencies are maintained and if President Bolsonaro's rhetoric continues to encourage impunity among farmers.

If Brazil succeeds in maintaining deforestation rates low, the scope for valuation will become much larger. With the completion of the Brazilian REDD+ Strategy in 2017, the path is now clear for translating emissions reductions into carbon-neutral commodities, into voluntary carbon credits, and eventually into

compliance credits

Image not found or type unknown

This book cover is a photograph of a typical Amazon forest fire. Once a forest is burned, subsequent fires become larger and more intense. As trees die and grasses move into the forest understory, recurrent burning transforms the forest into carbon- and species-poor scrub vegetation.

Recommendation for the international community

1. Short-term: California should approve its Tropical Forest Standard

The California Air Resources Board will vote on the TFS September 19th. It has been developed, discussed, debated and refined for the last eleven years. Once it is finalized, the pathway will be clear to set a very high bar for the social and environmental performance of Brazilian states that are seeking to monetize their emissions reductions and in other ways attract investments in their forest and low-carbon development strategies. The TFS, applied to states in Brazil, would provide a powerful linkage between the flow of payments for emissions reductions and continuous improvement in the social and environmental performance of these states.

2. Short-term: An emergency strategy to recognize and reward compliance with the Forest Code

Brazil has set the highest bar for forest conservation in the world for its farmers. An Amazon farmer is required by law to set aside at least 80% of his or her farm for forests. This forest requirement was 50% until 1996. This radical change in the mandatory forest cover on farms has been difficult to implement and imposed enormous opportunity costs on producers.

The Forest Code is at risk and could be weakened or gutted by the Brazilian government with strong support from the farm sector. Alternatively, an emergency agenda to recognize and reward farmers who succeed in complying with the Forest Code—despite the inefficiencies of government agencies—could help defend the Forest Code. These rewards could include greater access to finance, markets and technical assistance, and streamlined licensing procedures. Farmers who have more forest than legally required deserve compensation for forgone profits associated with forest conversion to soy or

cattle production. Such a mechanism is under development for Brazil's *Cerrado* region.

3. Long-term: Do business in states that are making the transition to forest- and community-friendly, low-carbon development

Advocacy campaigns have been very successful in forcing companies to adopt commitments to tackle tropical deforestation. In some ways, these campaigns have been too successful. Progressive Amazon governments that are striving to expand agricultural production while slowing the loss and speeding the recovery of tropical forests have found it difficult to attract corporate partners and investors in their strategies. Mato Grosso's "Produce, Conserve, Include" Strategy is just one example. The goals of this strategy alone—if achieved—would keep four billion tons of forest carbon out of the atmosphere and in tree trunks. However, the strategy will require a higher level of private investment and market recognition if it is to be successful.

The "Tropical Forest Champions" is designed to support state governments, like Mato Grosso, to win greater recognition and to attract the investments and partners that they need to advance their low-carbon, low-fire development strategies.

Acknowledgements: Matt Warren, Claudia Stickler, Jonah Busch, João Shimada, Peter Schurmann, Elsa Mendoza, Toby McGrath and Olivia David contributed to this blog. Supported by a grant from the Norwegian Development Agency to the Earth Innovation Institute.

LITERATURE:

- Balch, J.K., Brando, P.M., Nepstad, D.C., Coe, M.T., Silvério, D., Massad, T.J., Davidson, E.A., Lefebvre, P., Oliveira-Santos, C., Rocha, W. and Cury, R.T., 2015. The susceptibility of southeastern Amazon forests to fire: insights from a large-scale burn experiment. *Bioscience*, *65*(9), pp.893-905. https://academic.oup.com/bioscience/article/65/9/893/1995791.
- Bowman, M.S., Amacher, G.S. and Merry, F.D., 2008. Fire use and prevention by traditional households in the Brazilian Amazon. *Ecological Economics*, *67*(1), pp.117-130. https://www.sciencedirect.com/science/article/pii/S0921800907006040.
- Brando, P.M., Silvério, D., Maracahipes?Santos, L., Oliveira?Santos, C., Levick, S.R., Coe, M.T., Migliavacca, M., Balch, J.K., Macedo, M.N.,

Nepstad, D.C. and Maracahipes, L., 2019. Prolonged tropical forest degradation due to compounding disturbances: Implications for CO2 and H2O fluxes. *Global Change Biology*, *25*(9), pp.2855-2868. https://www.researchgate.net/publication/334007751_Prolonged_tropical_forest_degradation .

- De Mendonça, M.J.C., Diaz, M.D.C.V., Nepstad, D., da Motta, R.S., Alencar, A., Gomes, J.C. and Ortiz, R.A., 2004. The economic cost of the use of fire in the Amazon. *Ecological Economics*, *49*(1), pp.89-105. https://www.sciencedirect.com/science/article/pii/S0921800904000424.
- Nepstad, D. 2019. Case Study 6 Postponing the Amazon Tipping Point. In: T. E. Lovejoy and L. Hannah (Eds.), *Biodiversity and Climate Change: Transforming the Biosphere* (208-210). Yale University Press. http://localhost/eiisite/publications/postponing-the-amazon-tipping-point/.
- Nepstad, D., Carvalho, G., Barros, A.C., Alencar, A., Capobianco, J.P., Bishop, J., Moutinho, P., Lefebvre, P., Silva Jr, U.L. and Prins, E., 2001. Road paving, fire regime feedbacks, and the future of Amazon forests. *Forest ecology and management*, *154*(3), pp.395-407. https://www.sciencedirect.com/science/article/pii/S0378112701005114.
- Nepstad, D., McGrath, D., Stickler, C., Alencar, A., Azevedo, A., Swette, B., Bezerra, T., DiGiano, M., Shimada, J., da Motta, R.S. and Armijo, E., 2014. Slowing Amazon deforestation through public policy and interventions in beef and soy supply chains. *Science*, *344*(6188), pp.1118-1123. /uploads/2014/10/2014-SlowingDef_Nepstad_Science.pdf/.
- Nepstad, D.C., Stickler, C.M., Filho, B.S. and Merry, F., 2008. Interactions among Amazon land use, forests and climate: prospects for a near-term forest tipping point. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *363*(1498), pp.1737-1746. https://royalsocietypublishing.org/doi/full/10.1098/rstb.2007.0036.
- Nepstad, D.C., Verssimo, A., Alencar, A., Nobre, C., Lima, E., Lefebvre, P., Schlesinger, P., Potter, C., Moutinho, P., Mendoza, E. and Cochrane, M., 1999. Large-scale impoverishment of Amazonian forests by logging and fire. *Nature*, *398*(6727), p.505. https://www.nature.com/articles/19066.
- Nepstad, Daniel C.; Moreira, Adriana G.; Alencar, Ane A. 1999. *Flames in the rain forest : origins, impacts and alternatives to Amazonian fires (English)*. Conservation and development of Brazil's tropical forest regions. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/522521468013876752/Flames-in-the-rain-forest-origins-impacts-and-alternatives-to-Amazonian-fires.

- Stickler, C.M., Nepstad, D.C., Azevedo, A.A. and McGrath, D.G., 2013. Defending public interests in private lands: compliance, costs and potential environmental consequences of the Brazilian Forest Code in Mato Grosso. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *368*(1619), p.20120160. https://royalsocietypublishing.org/doi/full/10.1098/rstb.2012.0160.
- Stickler CM, Coe MT, Costa MH, Nepstad DC, McGrath DG, Dias LC, Rodrigues HO, Soares-Filho BS. 2013. The dependence of hydropower energy generation on forests in the Amazon Basin at local and regional scales. *Proc Nat Acad Sci* USA. doi: 10.1073/pnas.1215331110. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3677497/.