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Title page

Unmasking the impunity of illegal deforestation in the Brazilian Amazon: a call for enforcement and accountability

Marcondes G. Coelho-Junior^{1,2}; Ana P. Valdiones¹; Julia Z. Shimbo^{3,4}; Vinicius Silgueiro¹; Marcos Rosa^{4,5}; Carolina Del Lama Marques^{4,6}; Magaly Oliveira⁴; Suely Araújo⁷; Tasso Azevedo^{4,7}

¹ Instituto Centro de Vida (ICV), Cuiabá, MT, 78043-405, Brazil

² Instituto de Florestas, Universidade Federal Rural do Rio de Janeiro (UFRRJ), Seropédica, RJ, 23897-000, Brazil

³ Instituto de Pesquisa Ambiental da Amazônia (IPAM), Brasília, DF, 70863-520, Brazil

⁴ MapBiomass, São Paulo, SP, 01407-200, Brazil

⁵ ArcPlan, São Paulo, SP, 04026-001, Brazil

⁶ Escola Nacional de Botânica Tropical, Jardim Botânico do Rio de Janeiro (ENBT/JBRJ), Rio de Janeiro, RJ, 22460-030, Brazil

⁷ Observatório do Clima (OC), São Paulo, SP, 13426-420, Brazil

*Corresponding author e-mail: marcondes.coelho@icv.org.br

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2
3 *Main text*
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5 **Unmasking the impunity of illegal deforestation in the Brazilian Amazon: a call**
6 **for enforcement and accountability**
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8 **1. Political negligence boosts Amazon deforestation**
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10 Satellite-based monitoring of the Brazilian Amazon shows that deforestation has been
11 growing in the biome since 2012, increasing by 140% from 2012 to 2020 (INPE 2021).
12 Only between August 2020 and July 2021, the Amazon lost 13,200 km² - the highest
13 deforestation rate in 15 years (INPE 2021). Moreover, the average size of deforestation
14 polygons has increased by 61% in the past 10 years, when strong environmental policies
15 in place forced deforesters to reduce the size of patches cleared to avoid scrutiny
16 (Trancoso 2021). Altogether, these figures reveal a new wave of destruction in the
17 Brazilian Amazon Rainforest, revealing a major challenge for environmental agencies
18 and policymakers.
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Brazil has already proven that combating deforestation in the Amazon is possible and
effective through investments in public policies, private agreements, and monitoring
systems (Nepstad et al 2014). Especially due to the establishment of sector agreements
and the implementation of the Action Plan for the Prevention and Control of Deforestation
in the Legal Amazon (PPCDAm), Brazil achieved an 84% reduction in its deforestation
rate in 2012 (INPE 2021). There is no doubt that the major investments in PPCDAm were
key to strengthen environmental enforcement capacities at governmental agencies
contributing to improving this performance (West and Fearnside 2021). However, it
seems that the successful lessons in fighting illegal deforestation are being ignored by the
current federal government. Besides shutting down PPCDAm in 2019, the government
has significantly reduced environmental agencies budget and changed the procedures for
ensuring liability and assigning responsibilities to offenders. As predicted, these changes
undermine the effectiveness of command and control action, leading to a drop in
infraction notices in the Amazon region (Rajão et al 2021).

On the other hand, during the Leaders' Summit on Climate, held in April 2021 by the US
government, Brazilian representatives promised to double the budget for enforcement
capacities and reaffirmed the commitment to eliminating illegal deforestation by 2030.
To that end, the Amazon Plan 2021/2022 was launched, which establishes guidelines for
enforcement actions and fighting illegal deforestation, forest fires, and other

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3 environmental crimes. However, according to the Brazilian Climate Observatory
4 (Observatório do Clima 2021), this Plan downgrades the country's commitment, as it
5 establishes goals that will allow 16% more devastation than what was recorded under the
6 previous government. Additionally, government-authorized military operations in the
7 Amazon, which required a large number of public investments, did not yield expected
8 results. On the contrary, these operations worked as "smokescreens", diverging efforts
9 and weakening environmental protections (Ferrante and Fearnside 2021).
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16 Another government plan, the National Plan for Controlling Illegal Deforestation and
17 Recovering Native Vegetation 2020-2023, presented as a policy of zero tolerance for
18 illegal deforestation, has also been criticized as insufficient and unclear by national
19 authorities. The Federal Court of Accounts (TCU) states that the federal government has
20 failed at environmental management in the Amazon and that the Plan has very imprecise
21 goals and does not establish specific deadlines for implementation (TCU 2021).
22 Therefore, the combination of threats that include exempting environmental offenders,
23 aggravating forest fires and clearing the way to major infrastructure projects, in addition
24 to weakening environmental agencies and command and control have boosted
25 deforestation. In this letter, we share perspectives on the dynamics of deforestation alerts
26 in the Brazilian Amazon and the action of public enforcement agencies, to draw attention
27 to the urgency of supporting these entities for resuming the fight against deforestation.
28 Combating the current sense of amnesty for offenders and assigning responsibility for
29 illegal deforestation is crucial, given that the country already has in place the tools for
30 monitoring and detecting qualified deforestation alerts for orienting rapid and efficient
31 remote and on-the-ground action.
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45 **2. Tracking environmental enforcement actions for Amazon deforestation**

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47 We analyzed herein two sets of databases on deforestation and enforcement in the
48 Brazilian Amazon, a region that includes nine Brazilian states (Figure 1): i) deforestation
49 alerts from 2019 to 2020 from the MapBiomas Alert platform
50 (<http://alerta.mapbiomas.org/>), a system that validates and refines deforestation alerts
51 (generated by DETER-INPE, SAD-IMAZON, GLAD-University of Maryland and
52 SIRAD-X-ISA) with daily high-resolution images (3 meters) in Brazil; and ii) liability
53 lawsuits and infraction notices brought by public agencies.
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The analyses were done at two scales. Firstly, we used federal databases for all the Brazilian Amazon states to access official information about enforcement actions in illegally deforested areas and also about legally deforested areas (with permits). Secondly, we performed an in-depth investigation into the state of Mato Grosso. According to the public statements, the Mato Grosso state government is committed to eliminating illegal deforestation, securing transparency of environmental databases and engaging in actions to fight deforestation in the state listed as second in the rank of deforestation rates (INPE 2021) (<http://www.sema.mt.gov.br/transparencia>). We take the state of Mato Grosso, a world leader in producing agricultural and ranching commodities while safeguarding a rich biological and cultural diversity - 43 ethnic indigenous peoples and various other traditional communities' groups, as a case study to verify whether public policies have indeed led to a better performance in terms of responses to combat deforestation.

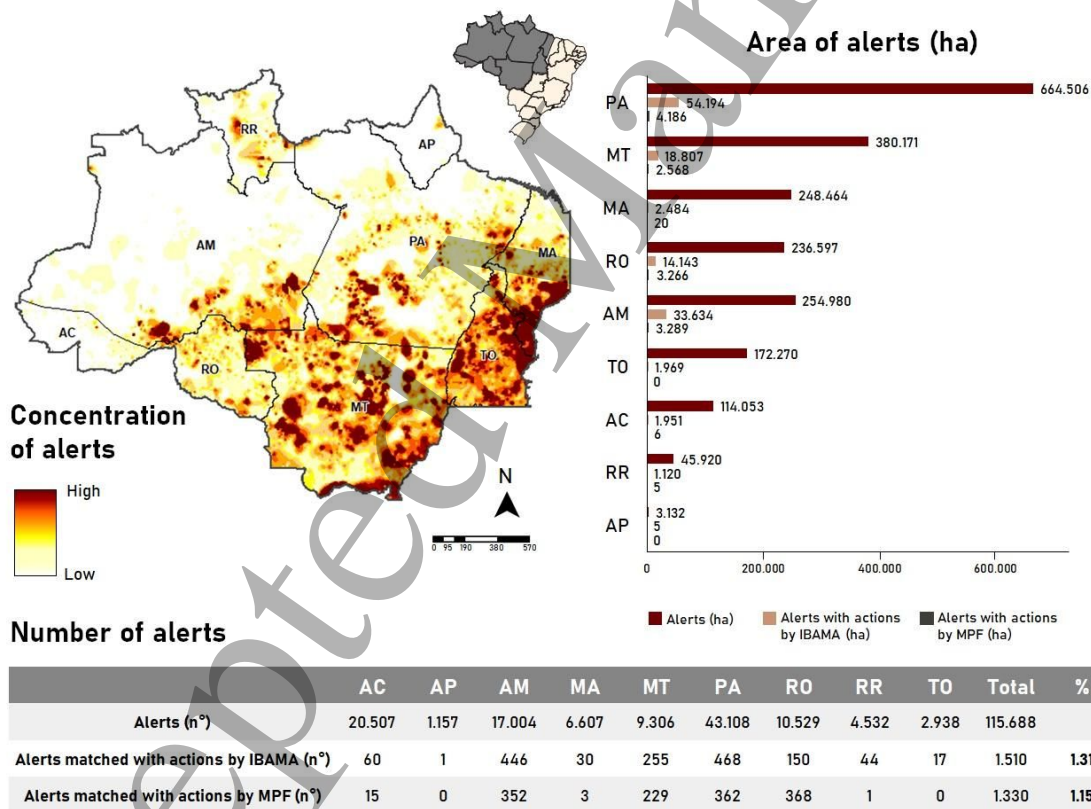


Figure 1. Concentration interpolated from the area of 12 points (minimum area: less than 5 ha; maximum area: more than 100 ha) using an inverse distance weighted (IDW) technique, number and area of deforestation alerts detected in the Brazilian Amazon, in 2019 and 2020, crossed with enforcement actions by IBAMA and MPF. The state abbreviations are: Pará (PA), Mato Grosso (MT), Maranhão (MA), Rondônia (RO), Amazonas (AM), Tocantins (TO), Acre (AC), Roraima (RR), Amapá (AP).

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3 We used a data triangulation approach, crossing data from deforestation alerts with
4 infraction notices and embargoes by the Brazilian Institute of the Environment and
5 Renewable Natural Resources (IBAMA) and public interest lawsuit brought by the
6 Federal Public Prosecutor's Office (MPF). For the state of Mato Grosso, we also
7 performed a geometric intersection between those databases and data from deforestation
8 permits, embargoes, and infraction notices issued by the State Environmental Secretariat
9 (SEMA) and investigations performed by the State Public Prosecutor's Office (MPMT).
10 This way, we were able to identify if the deforestation was previously authorized and if
11 the areas were inspected by state agencies on the ground. The detailed method used, as
12 well as further information on the subject, can be accessed in the Annual Report on
13 Deforestation in Brazil 2020 (Azevedo et al 2021).
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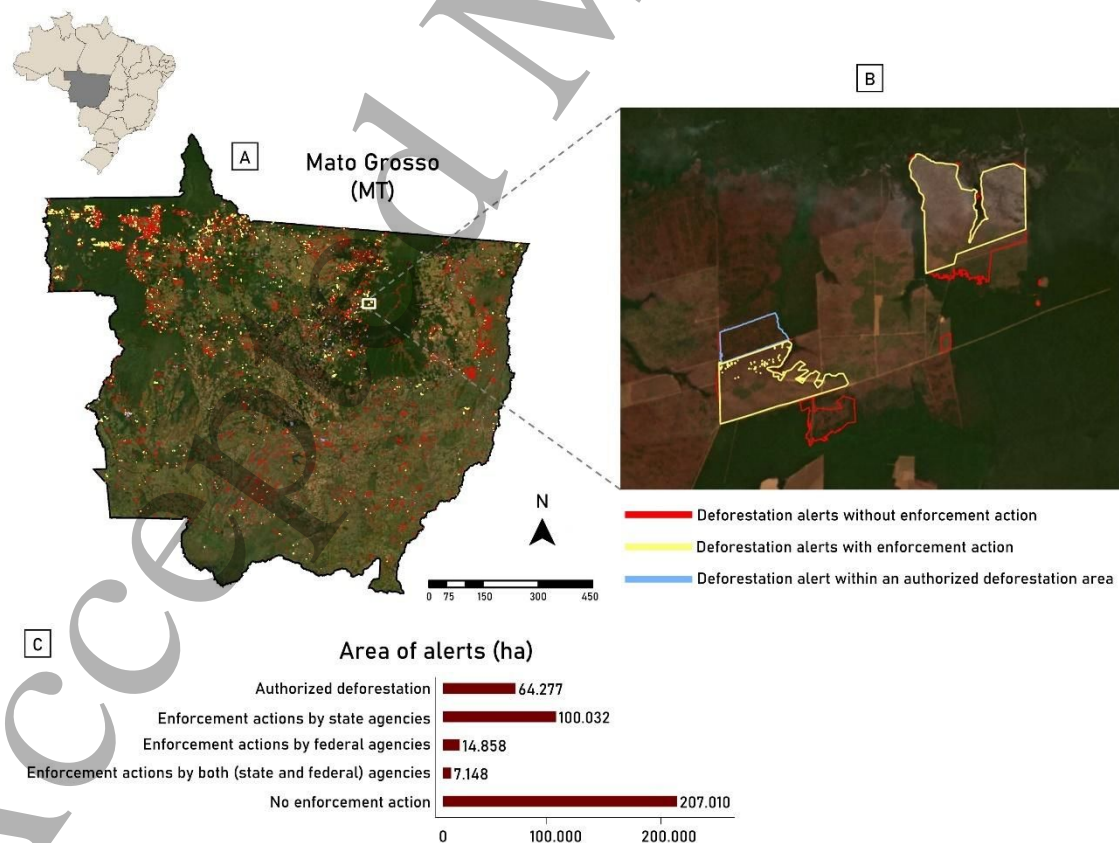
23 **3. Enforcement actions to combat illegal deforestation**

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25 Our analysis shows that only 1.3% of the deforestation alerts in the Brazilian Amazon
26 published by MapBiomas Alert match with IBAMA's infraction notices and/or
27 embargoes (Figure 1). This represents only 6.1% of the total deforested area detected, an
28 extremely low level for enforcement activities. Not even the 11 municipalities defined by
29 the National Council for the Amazon as priorities for receiving military operations show
30 satisfactory enforcement - only 3% of the 22,583 alerts detected received infraction
31 notices and/or embargoes from IBAMA, which represented 12% of the area deforested.
32 This is worrisome, given that almost 99% of deforestation alerts in Brazil still show signs
33 or evidence of illegality, or at least the corresponding permits are not recorded in publicly
34 available databases (Azevedo et al 2021)
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43 Poor results such as these reflect the reduction in IBAMA's actions in recent years. The
44 reasons noted by the TCU for the lack of enforcement by IBAMA include the reduction
45 in the number of inspectors over the years and deficiencies in the nomination process for
46 strategic positions in the enforcement team (TCU 2021). Changes in procedures for
47 administrative and criminal penalties for infraction notices, which in practice end up
48 freezing environmental penalty procedures, also hinder the agency's effectiveness (Lopes
49 and Chiavari 2021). Even though IBAMA has reduced the number of infraction notices
50 for illegal deforestation in the Amazon (Rajão et al 2021), there is already a backlog of
51 more than 17,000 infraction notices awaiting conciliation hearings (Spring 2021).
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Other agents besides IBAMA are involved in tackling deforestation, such as the MPF. Through the Amazônia Protege Program (<http://amazoniaprotege.mpf.mp.br/>), the MPF brings legal action against those responsible for illegally deforesting more than 60 hectares. From this initiative, we found that 318 public interest lawsuits were brought for deforestation between August 2017 and December 2019, for a total of 91,506 hectares. Of those, 13,340 hectares matched deforestation alerts for 2019, which represents 1.3% of the area of the alerts. Nevertheless, the MPF's action has been strategic in promoting a dissuasive effect. As an example, an unprecedented lawsuit brought by the MPF against an invader of public lands demanded indemnification for climate damages for the deforestation of 2,400 ha between 2011 and 2018 (Bragança et al 2021).

At the state scale, we found that 16% of the deforested area detected in the state of Mato Grosso (MT) matched valid deforestation permits for the alert detection period (Figure 2). Another 25% of the deforested area matched actions by state agencies (SEMA and MPMT) (Figure 2). This area corresponds to more than 100 thousand hectares with embargoes, notices or investigations, and is almost six times larger than that identified for federal agencies, which matched 4% of the area for alerts, including actions by IBAMA and MPF.



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3 **Figure 2.** (A) Deforestation alerts in the state of Mato Grosso, Brazilian Amazon; (B) Image from the
4 Planet satellite showing deforestation alerts validated by MapBiomas Alert, indicating areas without
5 enforcement actions (red line), areas matching enforcement actions (yellow line), and areas matching
6 deforestation permits (blue line); (C) Total area (ha) of deforestation alerts in Mato Grosso, according to
7 the five analysis categories (y-axis). Other areas showing no vegetation identifiable on the image were
8 cleared before the analysis time scale (2018-2020).
9

10 In 2020, after an increase in enforcement actions, notices from SEMA led to more than
11 USD 190 million in fines for environmental violations. Supported by the use of near-real-
12 time monitoring technologies, the state agency has been strengthening actions against
13 illegal deforestation since the second semester of 2019. In 2020, that strategy led to an
14 increase of 33% in the number of notices and 192% in the area embargoed by the agency
15 (Valdiones et al 2020). Even though enforcement data from the state government illustrate
16 the relevant role that the subnational level can play in fighting deforestation, especially
17 in a scenario where federal agencies are being undermined, 53% of the area deforested in
18 Mato Grosso in 2019 and 2020 remains without any action for enforcement or liability
19 identified.
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22 This result shows that urgent and higher impact measures are needed to fight illegal
23 deforestation. Field operations are known to exert a strong dissuasive effect on large-scale
24 deforestation violations, but such actions are not universally effective (Börner et al 2015).
25 Therefore, we emphasize that besides intensifying enforcement in the field, technological
26 tools, and remote monitoring must be promoted as the basis for administrative
27 notifications. These tools and systems coupled with transparency mechanisms can
28 contribute towards identifying the "rotten apples of Brazilian agribusiness" (Rajão et al
29 2020), that jeopardize Amazon conservation. Thus, adding efforts to prevent the trade of
30 commodities linked to deforestation would not only avoid the aggravation of other
31 problems besides forest loss, such as land grabbing (Brito et al 2019), but also the
32 violation of the rights of traditional peoples (Urzedo and Chatterjee 2021).
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48 **4. Urgent action required to avoid collapse**

49 Along with forest loss, numerous consequences reported by scientists illustrate the
50 impacts of neglecting criminal activities in the Amazon (Science Panel for the Amazon
51 2021). Part of the Amazon has already become a net source of carbon for the atmosphere
52 (Gatti et al 2021); the drop in rainfall due to deforestation can indicate the loss of billions
53 of dollars for agricultural production in the region (Leite-Filho et al 2021); impacted
54 livelihoods of local populations compromise sustainable use of the forest (Fearnside
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2017); and the Amazon's own capacity for bearing all those impacts is threatened and may reach a tipping point of no return, turning the world's most biodiverse tropical forest into a degraded ecosystem (Lovejoy and Nobre 2018).

Our analysis calls for federal agencies to resume their powers, and for state agencies to recognize their role in environmental reinforcement and assigning liability. We already know the main drivers of deforestation in the Amazon, and thus have a clear path to follow for a zero-deforestation agenda. Therefore, we list five key factors for reestablishing enforcement actions by public agencies for fighting deforestation and improving dissuasive effects: i) investment in capacity building and technology uptake to strengthen technical teams in public agencies; ii) restructuring IBAMA legal regulations to ensure proper procedural steps for enforcement and bringing offenders to justice; iii) integrating state and federal enforcement systems to promote strategic planning for actions and transparency by the agencies; iv) field operations based on artificial intelligence and satellite monitoring to enable rapid and effective response, and v) support for community-based initiatives for territorial monitoring and strengthening relations between public agencies and local partners. Furthermore, improving traceability of commodities through transparency and international pressure for reestablishing control of illegal activities in the Amazon, e.g., the Organization for Economic Cooperation and Development (OECD) the EU-Mercosur Trade Agreement must continue to be a part of global solutions for protecting the Amazon.

Data availability statement

The data that support the findings of this study are openly and freely available at the following URL/DOI: <https://plataforma.alerta.mapbiomas.org/>

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Author Contributions

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3 All authors: Conceptualization, Methodology, Data curation, Investigation, Formal
4 analysis. M G C J: Writing - original draft. A P V, J S, V S, M R, and T A: Validation,
5 Supervision, Writing - review & editing, Funding. C D L M, M O, S A: Validation,
6 Writing - review & editing.
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10 **Conflict of interest statement**

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12 No competing interest.
13
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15 **Ethics statement**

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17 All authors have read and agreed to the published this version of the manuscript.
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21 **References**

22
23
24 Azevedo T, Rosa M R, Shimbo J Z and Oliveira M G 2021 *Annual report on deforestation*
25 *in Brazil 2020* (São Paulo: MapBiomas) p 93
26

27
28 Börner J, Kis-Katos K, Hargrave J and König K 2015 Post-crackdown effectiveness of
29 field-based forest law enforcement in the Brazilian Amazon *PLOS One* [10 e0121544](#)
30

31 Bragança A C H, Moutinho P, Silva Rocha R, Alencar A, Laureto L, Castro I, and
32 Azevedo-Ramos C 2021 Climate lawsuits could protect Brazilian Amazon *Science* [373](#)
33 [403-404](#)
34

35 Brito B, Barreto P, Brandão Junior A, Baima S and Gomes P H 2019 Stimulus for land
36 grabbing and deforestation in the Brazilian Amazon *Environ. Res. Lett.* [14 064018](#)
37

38
39 Fearnside P 2017 Deforestation of the Brazilian Amazon *Oxford Research Encyclopedia*
40 *of Environmental Science* ed H Shugart (Oxford, EN: Oxford University Press) p 53
41

42
43 Ferrante L and Fearnside P 2021 Military forces and COVID-19 as smokescreens for
44 Amazon destruction and violation of indigenous rights *Die Erde* [151 258-263](#)
45

46 Gatti L V, Basso L S, Miller J B, Gloor M, Domingues L G, Cassol H L G, Tejada G,
47 Aragão L E The C, Nobre C, Peters W, Marani L, Arai E, Sanches A H, Corrêa S M,
48 Anderson L, Randow C V, Correia C S C, Crispim S P and Neves R A L 2021 Amazonia
49 as a carbon source linked to deforestation and climate change *Nature* [59 388-393](#)
50

51
52 INPE 2021 *Portal TerraBrasilis* (available at: <http://terrabilis.dpi.inpe.br/>)
53

54
55 Leite-Filho A T, Soares-Filho B S, Davis J L, Abrahão G M and Börner J 2021
56 Deforestation reduces rainfall and agricultural revenues in the Brazilian Amazon. *Nat.*
57 *Commun.* [12 1-7](#)
58
59
60

1
2
3 Lopes C L and Chiavari J 2021 *Análise do novo procedimento administrativo*
4 *sancionador do Ibama and seus reflexos no combate ao desmatamento na Amazônia* (Rio
5 de Janeiro: Climate Policy Initiative) p 30
6

7
8 Lovejoy T E and Nobre C 2018 Amazon tipping point *Sci. Adv.* 4 eaat2340
9

10
11 Nepstad D, McGrath D, Stickler C, Alencar A, Azevedo A, Swette B, Bezerra T, DiGiano
12 M, Shimada J, Motta R S, Armijo E, Castelhão L, Brando P, Hansen M C, McGrath-Horn
13 M, Carvalho The and Hess L 2014 Slowing Amazon deforestation through public policy
14 and interventions in beef and soy supply chains *Science* 344 1118-1123

15
16 Observatório do Clima 2021 O plano “batida in retirada da” Amazônia 21/22 e o discurso
17 ilusionista de Bolsonaro (available at: [https://www.oc.eco.br/nota-de-posicionamento-](https://www.oc.eco.br/nota-de-posicionamento-plano-amazonia-21-22/)
18 [plano-amazonia-21-22/](https://www.oc.eco.br/nota-de-posicionamento-plano-amazonia-21-22/))
19

20
21 Rajão R, Schmitt J, Nunes F and Soares-Filho B 2021 *Dicotomia da impunidade do*
22 *desmatamento ilegal* (Belo Horizonte: Centro de Sensoriamento Remoto/UFGM) p 12
23

24
25 Rajão R, Soares-Filho B, Nunes F, Börner J, Machado L, Assis D, Oliveira A, Pinto L,
26 Ribeiro V, Rausch L, Gibbs H and Figueira D 2020 The rotten apples of Brazil's
27 agribusiness *Science* 369 246-248

28
29 Science Panel for the Amazon 2021 *Executive Summary of the Amazon Assessment*
30 *Report 2021* (New York: United Nations Sustainable Development Solutions Network)
31 p 48
32

33
34 TCU 2021 Relatório de auditoria - Processo TC 038.045/2019-2 (available at:
35 [https://pesquisa.apps.tcu.gov.br/#/documento/acordao-](https://pesquisa.apps.tcu.gov.br/#/documento/acordao-completo/1758%252F2021/%2520/DTRELEVANCIA%2520desc%252C%2520NUMACORDAOINT%2520desc/0/%2520)
36 [completo/1758%252F2021/%2520/DTRELEVANCIA%2520desc%252C%2520NUM](https://pesquisa.apps.tcu.gov.br/#/documento/acordao-completo/1758%252F2021/%2520/DTRELEVANCIA%2520desc%252C%2520NUMACORDAOINT%2520desc/0/%2520)
37 [ACORDAOINT%2520desc/0/%2520](https://pesquisa.apps.tcu.gov.br/#/documento/acordao-completo/1758%252F2021/%2520/DTRELEVANCIA%2520desc%252C%2520NUMACORDAOINT%2520desc/0/%2520))
38

39
40 Trancoso R 2021 Changing Amazon deforestation patterns: urgent need to restore
41 command and control policies and market interventions. *Environ. Res. Lett.* 16 041004
42

43
44 Urzedo D and Chatterjee P 2021 The colonial reproduction of deforestation in the
45 Brazilian Amazon: violence against Indigenous Peoples for land development *J.*
46 *Genocide Res.* 23 302-324
47

48
49 Valdiones A P, Silgueiro V and Bernasconi P 2020 Characteristics of deforestation in
50 Mato Grosso Amazon in 2020 (available at:
51 [https://www.icv.org.br/publicacao/characteristics-of-deforestation-in-mato-grosso-](https://www.icv.org.br/publicacao/characteristics-of-deforestation-in-mato-grosso-amazon-in-2020/)
52 [amazon-in-2020/](https://www.icv.org.br/publicacao/characteristics-of-deforestation-in-mato-grosso-amazon-in-2020/))
53

54
55 West T A P and Fearnside P M 2020 Brazil's conservation reform and the reduction of
56 deforestation in Amazonia *Land Use Policy* 100 105072
57
58
59
60