

# The Limits of Livability

The emerging threat of smoke impacts on health from forest fires and climate change

'At this time we are living in a very critical situation due to the Coronavirus. All health units are full, all full because of coronavirus. When the fire period begins we do not know how much capacity there will be for additional care for patients affected by the fire smoke.'

Jerrimar Soares Montenegro, a nurse with SINDERON, the professional nurses association in the state of Rondônia



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# Climate Change, Forest Fire and Smoke Pollution

In 2019, extensive forest fires in the Amazon sparked international reaction, eliciting widespread concern about the destruction of the Earth's largest and most biodiverse rainforest.<sup>1</sup> Smoke from the fires was recorded as having circumnavigated the globe. In 2020, the fires were reported to be just as bad, but global attention had shifted, as nations grappled with the COVID-19 pandemic.

Forest fires in the Amazon are largely deliberate, driven by land clearing for intensive agriculture and ranching, and contribute to climate change by damaging this globally significant carbon store and sink.<sup>2</sup> This country brief accompanies a report by the Global Climate and Health Alliance released in June 2021. The report finds that there is limited preparation and response to address either short- or long-term health impacts of forest fire smoke exposure.

Photo: Sérgio Vale  
Amazônia Real 20/08/2020



## Biomass burning and air pollution monitoring

Biomass burning (the burning of trees during land clearing) mainly takes place during the Brazilian Amazon dry season from June to October, also known as the *queimadas* season. Atmospheric monitoring has been carried out in the region since 1992 by the Amazon Biosphere and Atmosphere Large Scale Experiment of the University of São Paulo. The first national survey on forest fires was carried out in 1983 when 227 fires were recorded.<sup>3</sup> Air quality standards in Brazil, established by the National Environment Council, set limits for PM<sub>10</sub> only, not PM<sub>2.5</sub>. The Brazilian daily average guideline is set at 60 µg/m<sup>3</sup> which is higher than the WHO daily average of 50 µg/m<sup>3</sup> for PM<sub>10</sub>. Levels of particulate matter usually exceed the WHO guidelines during the *queimadas* season.<sup>4</sup>

These man-made fires can affect urban air quality when particulate matter, trace metals and greenhouse gases travel to urban areas.<sup>5</sup> In the Amazon, particles emitted by biomass burning remain in the atmosphere for at least a week and can be transported over long distances.<sup>6</sup>

The majority of forest fire hotspots in the region are recorded in the Arc of Deforestation which lies from Para in the north to Mato Grosso in the south and the Brazil-Peru-Bolivia area in the southwest.<sup>7</sup> Two areas, Alta Floresta and Tangará da Serra are priority areas for assessing the impacts of biomass burning from air pollution in the Brazilian Amazon.<sup>6,7</sup>

Human Rights Watch has reported that while plans to implement air quality monitoring have been in place for three decades through the National Environmental Council (CONAMA) which represents government, the private sector and civil society, these have not been widely implemented.<sup>8</sup>



Photo: Cícero Pedrosa Neto  
Amazônia Real 26/09/2020

## Forest fire smoke and health impacts

Forest fires can cause episodes of extremely poor air quality which may affect very large populations. Landscape fire smoke causes an estimated 339,000 premature deaths per year worldwide, many more deaths than those lost directly,<sup>9</sup> yet smoke from such fires receives relatively little attention.

The smoke contains a range of pollutants including particulate matter, carbon dioxide, nitrogen oxides and volatile organic compounds.<sup>10</sup> Wildfire particulate matter may be more harmful to health than urban particulate air pollution.<sup>11</sup>

Exposure to any incremental increase in air pollution can cause adverse effects on human health, especially in children, the elderly and those with existing chronic medical conditions.<sup>12</sup> Health impacts increase in step with increases in air pollution with no safe minimum level, so modest rises in pollution can have huge population health impacts if enough people are exposed or the smoke persists for a long time.<sup>13</sup>

Short-term impacts from forest fire smoke include coughing and shortness of breath. Wildfire smoke is a trigger for asthma presentations and is associated with an increase in emergency hospital attendance after short-term exposure and particularly for children.<sup>14</sup> Recent studies have found associations with ambulance callouts for respiratory, cardiovascular and diabetic problems.<sup>15</sup>

## Amazon forest fires, climate change and smoke related health impacts

Brazil is home to around 60% of the Amazon forest, the largest rainforest on Earth.<sup>16</sup> Approximately 27 million people live in the Amazon basin,<sup>17</sup> and some 10 million of these live in areas of poor air quality.<sup>18</sup>

Several studies from cities in the Amazon basin have shown that particulate matter from forest burning is associated with low birth weight,<sup>5</sup> increased risk of respiratory disease among children and elderly people, and higher rates of hospital admissions.<sup>4, 19-21</sup> Studies of children and older people in the Arc of

Deforestation have shown increases in outpatient and emergency room visits as well as hospital admissions, alongside decreases in peak expiratory flow (PEF) used to measure lung function.<sup>6</sup>

In 2005, following a prolonged drought in the Amazon, more than 400,000 people were exposed to smoke from the fires with economic losses estimated at US\$ 50 million.<sup>22</sup> A time series analysis of patients in Rio Branco, Brazil showed that the number of hospital emergency visits increased with exposure to fine particulate matter. Of 2,922 patients treated, the most frequent clinical symptoms were: cough (79%), fever (51%), dyspnea (difficulty breathing) (39%), chest pain (15%), wheezing (8%) and irritation in the throat (4%).<sup>7</sup>

In the devastating fires of August 2019, health impacts in Porto Velho, the state capital of Rondônia included increased cases of respiratory problems among its residents, particularly among children. The World Health Organisation (WHO) warned that the forest fires were a threat to children, the elderly and those with pre-existing respiratory and cardiovascular conditions.<sup>23</sup>

The number of children treated at the local Cosme e Damia hospital more than doubled between the first and second

10 days of August. 'The kids are affected the most. They're coughing a lot,' said Elane Diaz, a nurse in Porto Velho, 'They have problems breathing. I'm concerned because it affects their health.'<sup>24</sup>

## Indigenous communities and smoke pollution

Many communities were evacuated in the 2019 fires but Indigenous people living in forest areas remained exposed to air pollution. In 2020 the Instituto Socioambiental (ISA) carried out the first national study of the link between forest fires and Indigenous health and showed a 25% increase on average in hospitalisations of Indigenous people over 50 years old, due to respiratory problems.<sup>25</sup> In Mato Grosso, there was an increase of 33.6% in hospitalisations of Indigenous people over 49 years old in the period of burning compared to the previous three months.

The concentration of PM<sub>2.5</sub> exceeded WHO safe standards in 81% of 616 municipalities where air quality data were collected. PM<sub>2.5</sub> levels were highest in Rondônia, north-central of Mato Grosso, southwest of Pará, southeast of Amazonas, and in the region of Manaus and Roraima. In Novo Progresso (PA), PM<sub>2.5</sub> was recorded at 570 µg/m<sup>3</sup>, some 23 times more than the WHO safe standard.

The study concluded that 'long-term exposure to air pollution increases the vulnerability of Indigenous peoples to the most serious effects of COVID-19'. This is of particular concern as the death rate from Covid is 250% higher among Indigenous people than the national average.<sup>26</sup> This connection between air pollution and vulnerability to COVID-19 symptoms has been suggested by several other studies.<sup>27,28</sup>

Forest fires in the Amazon threaten Indigenous peoples' lives and livelihoods through the impacts of smoke on health, as well as the invasion of their territories through illegal deforestation, which damages crops, materials and medicines and land used for hunting and fishing.<sup>8</sup> The impacts of colonisation are severe and wide ranging. Indigenous resilience

Photo: Marizilda Cruppe  
Amazônia Real  
Amazon Watch 17/09/2020





and survival stem from an interconnectedness with nature and there is a growing recognition that Indigenous knowledge systems may help address the twin climate and biodiversity emergencies.<sup>29</sup>

Water sources may also be contaminated by ash from the fires. Indigenous people in the Brazilian Amazon are especially vulnerable to smoke because there is a high prevalence of preventable respiratory diseases such as tuberculosis in the community compared to the national average.<sup>30</sup>

Dr Fabio Tozzi, a vascular surgeon originally in São Paulo, Brazil was interviewed in connection with the project 'Health and Happiness', an NGO which provides healthcare to riverside villages and Indigenous communities. He described how during the fires the whole sky was sometimes filled with smoke. In the 2018 fire season the airport was closed for a week because the dense smoke meant that it was not safe to land aircraft. He reported that the fires intensified in each of the years from 2014 to 2017 and the smoke had a negative impact on people's health including increased levels of asthma, bronchitis and bronchiolitis.

Children were particularly affected. Dr Tozzi worked in 150 communities every month treating 30,000 people.

## Health services

Human Rights Watch in its report on air pollution during the 2019 Amazon fires noted that many people had limited access to health facilities so data on numbers of patients hospitalised in Brazil can only give an incomplete picture of the impact of the fires on health.<sup>8</sup> Many more people will have experienced respiratory problems, but did not require hospitalisation. It was estimated that nearly three million people were exposed to harmful levels of PM<sub>2.5</sub> during the 2019 fires.

Patients may have to rely on aircraft or boats to reach distant health services. "The uneven distribution of health services [in the Brazilian Amazon] restricts access for care for people whose health suffers due to the forest fires and who are unable to travel the distance between their home and the nearest healthcare centre. While the national average distance to access complex care is 155 km in Brazil, for some Amazon states it exceeds 400 km".<sup>23</sup>

Photo: Bruno Kelly  
Amazônia Real 12/08/2020

# Conclusions and recommendations

Reducing smoke emissions from forest fires will benefit both human health and climate change since most of the air pollutants from fire smoke overlap with the pollutants that cause climate change. Reducing tropical deforestation fires will result in fewer greenhouse gas emissions by protecting these vast carbon stores and avoiding conversion to crops and livestock while also protecting communities and biodiversity.

## Key Policy Recommendations

- 1) Tropical deforestation fires are largely linked with land clearance for agriculture. A moratorium on deforestation and fires for clearing land, combined with strong supervision, is urgently needed to reverse the destruction of the Brazilian Amazon.
- 2) The Brazilian government must take practical steps to prevent forest fires and reduce their impact on health.
  - a) More effective actions should be taken to prevent fires and tougher legislation is needed to reduce land occupation conflicts.
  - b) Air quality monitoring systems should be used to inform air quality standards.
  - c) When it is clear that pollution will become hazardous, authorities should issue public advisories recommending that people stay indoors and reduce outdoor physical activity.
  - d) Closing schools and local businesses might also be considered as well as evacuating at-risk populations to emergency shelters.<sup>32</sup> However, staying indoors may not provide much protection to Indigenous people whose homes may have windows without glass, making it difficult to get away from smoke.
- 3) Health secretaries of regions affected by forest burning should plan ahead for the return of smoke induced illnesses while health services continue to battle with the Covid-19 pandemic.
- 4) International cooperation to achieve the Paris Agreement on climate change, including addressing the contribution of Amazonian deforestation and burning to global warming, is urgently needed to protect the health of all the people of Brazil against the longer term impacts of climate change itself.

# References

1. Hirschlag A. The long distance harm done by wildfires. 2020.
2. Deforestation Patterns in the Amazon [Internet]. NASA Earth Observatory; 2004 [cited 2021 May 20]. Available from: <https://earthobservatory.nasa.gov/images/4385/deforestation-patterns-in-the-amazon>
3. Soares RV. Profile of forest fires in Brazil from 1984 to 1987. In: Forest 1988. 1988.
4. WHO. WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide : global update 2005 : summary of risk assessment. World Health Organization; 2006.
5. Cândido da Silva AM, Moi GP, Mattos IE, Hacon Sde S. Low birth weight at term and the presence of fine particulate matter and carbon monoxide in the Brazilian Amazon: a population-based retrospective cohort study. *BMC Pregnancy Childbirth*. 2014 Sep 6;14:309.
6. Jacobson L da SV, Hacon S de S, Castro HA de, Ignotti E, Artaxo P, Saldiva PHN, et al. Acute Effects of Particulate Matter and Black Carbon from Seasonal Fires on Peak Expiratory Flow of Schoolchildren in the Brazilian Amazon. *PLOS ONE*. 2014;9(8):e104177.
7. Ignotti E, Hacon S de S, Silva AMC, Junger WL, Castro H. Efeitos das queimadas na Amazônia: método de seleção dos municípios segundo indicadores de saúde. *Rev Bras Epidemiol*. 2007;10:453-64.
8. Human Rights Watch. "The Air Is Unbearable" Health Impacts of Deforestation-Related Fires in the Brazilian Amazon. 2020.
9. Johnston FH, Sarah B. Henderson, Yang Chen, James T. Randerson, Miriam Marlier, Ruth S. DeFries, et al. Estimated Global Mortality Attributable to Smoke from Landscape Fires. *Environ Health Perspect*. 2012;120(5):695-701.
10. Urbanski SP, Hao WM, Baker S. Chemical composition of wildland fire emissions [Internet]. In: Bytnerowicz, A.; Arbaugh, M.; Riebau, A.; Andersen, C., eds. *Developments in environmental science, Volume 8: Wildland fires and air pollution*. The Netherlands: Elsevier: 79-107. 2009 p. 79-107. Available from: <https://www.fs.usda.gov/treesearch/pubs/33764>.
11. Xu R, Yu P, Abramson MJ, Johnston FH, Samet JM, Bell ML, et al. Wildfires, Global Climate Change, and Human Health. *N Engl J Med*. 2020;383(22):2173- 81.
12. Floss M, Barros E. *Lancet Countdown 2018: Briefing for Brazilian Policy Makers*. The Lancet. 2018.
13. Borchers Arriagada N, Palmer AJ, Bowman DM, Morgan GG, Jalaludin BB, Johnston FH. Unprecedented smoke-related health burden associated with the 2019-20 bushfires in eastern Australia. *Med J Aust*. 2020;213(6):282-3.
14. Melody SM, Johnston FH. Coal mine fires and human health: What do we know? *Int J Coal Geol*. 2015 Dec 1;152:1-14.
15. Jiayun Yao, Michael Brauer, Julie Wei, Kimberlyn M. McGrail, Fay H. Johnston, Sarah B. Henderson. Sub-Daily Exposure to Fine Particulate Matter and Ambulance Dispatches during Wildfire Seasons: A Case-Crossover Study in British Columbia, Canada. *Environ Health Perspect*. 2020;128(6):067006.
16. The Amazon Rainforest [Internet]. Mongabay. [cited 2021 May 20]. Available from: <https://rainforests.mongabay.com/amazon/>
17. SUDAM. Boletim Amazônia. Superintendência do desenvolvimento da Amazônia; 2016 p. 152.
18. de Oliveira Alves N, Vessoni AT, Quinet A, Fortunato RS, Kajitani GS, Peixoto MS, et al. Biomass burning in the Amazon region causes DNA damage and cell death in human lung cells. *Sci Rep*. 2017 Sep 7;7(1):10937.


19. Ignotti E, Hacon Sde S, Junger WL, Mourão D, Longo K, Freitas S, et al. Air pollution and hospital admissions for respiratory diseases in the subequatorial Amazon: a time series approach. *Cad Saude Publica*. 2010 Apr;26(4):747–61.
20. Nunes KVR, Ignotti E, Hacon S de S. Circulatory disease mortality rates in the elderly and exposure to PM2.5 generated by biomass burning in the Brazilian Amazon in 2005. *Cad Saude Publica*. 2013;29:589–98.
21. Silva PR de S, Ignotti E, Oliveira BFA de, Junger WL, Morais F, Artaxo P, et al. High risk of respiratory diseases in children in the fire period in Western Amazon. *Rev Saúde Pública*. 2016;50.
22. Brown IF, Schroeder W, Setzer A, de Los Rios Maldonado M, Pantoja N, Duarte A, et al. Monitoring Fires in Southwestern Amazonia Rain Forests. *EOS Trans*. 2006 Jun 1;87:253.
23. Nebehay S. Amazon fires pose health risks to children: WHO. Reuters [Internet]. 2019 Aug 30 [cited 2021 May 20]; Available from: <https://www.reuters.com/article/us-brazilenvironment-wildfire-who-idINKCN1VK1FM>
24. Health crisis as Amazon fires burn out of control [Internet]. *The London Economic*. 2019 [cited 2021 May 20]. Available from: <https://www.thelondoneconomic.com/news/worldnews/health-crisis-as-amazon-fires-burn-out-of-control-158194/>
25. Fumaça de incêndios impulsiona interações de indígenas, mostra estudo [Internet]. ISA - Instituto Socioambiental. [cited 2021 Mar 11]. Available from: <https://www.socioambiental.org/pt-br/noticias-socioambientais/fumaca-de-incendios-impulsiona-internacoes-de-indigenas-mostra-estudo>.
26. Zuker F. Indigenous land intrusions help drive higher virus death toll in the Amazon. Reuters [Internet]. 2020 Aug 14 [cited 2021 May 20]; Available from: <https://www.reuters.com/article/us-health-coronavirus-brazil-amazon-anal-idUSKCN25A2BX>
27. Henderson SB. The COVID-19 Pandemic and Wildfire Smoke: Potentially Concomitant Disasters. *Am J Public Health*. 2020 Aug 1;110(8):1140–2.
28. Pozzer A, Dominici F, Haines A, Witt C, Münzel T, Lelieveld J. Regional and global contributions of air pollution to risk of death from COVID-19. *Cardiovasc Res*. 2020;116(14):2247–53.
29. Redvers N. The determinants of planetary health. *Lancet Planet Health*. 2021 Mar 1;5(3):e111–2.
30. PAHO. Tuberculosis in the Americas. 2018.
31. UNEP, WHO, WMO. Health Guidelines for Vegetation Fire Events, World Health Organization, 1999. 1999.

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The Global Climate and Health Alliance (GCHA) is the leading global convener of health professional and health civil society organizations addressing climate change. We are a consortium of health and development organisations from around the world united by a shared vision of an equitable, sustainable future, in which the health impacts of climate change are minimized, and the health benefits of climate solutions are maximised. GCHA works to elevate the influential voice of the health community in policy making to address the climate crisis.

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