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Deforestation hotspots, climate crisis, and the perfect scenario for the next epidemic: The Amazon time bomb



Camila Lorenz ^{a,*}, Mariana de Oliveira Lage ^b, Francisco Chiaravalloti-Neto ^a

^a Department of Epidemiology, School of Public Health, University of São Paulo, Sao Paulo, Brazil

^b Scientific Division of Management, Environmental Science and Technology of the Institute of Energy and Environment - IEE of University of Sao Paulo, São Paulo, SP, Brazil

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ABSTRACT

Currently most researchers consider humanity's extermination of biodiversity as the antecedent of ideal conditions for the emergence of new viruses and diseases. Animals lose their natural habitats due to extensive landscape changes, consequently crowding them together and increasing their interaction with humans. Additionally, it is also important to emphasise the increasing concern on climate change because climate can modify the distribution and intensity of other diseases such as vector-borne disease. Unfortunately, the global resources for biodiversity conservation were diluted by government support for activities harmful to the environment. A tragic example is from the Amazon rainforest, that experienced fast environmental depletion and high social inequalities. Extractive systems and extensive land use on a large scale have induced deforestation, great loss of biodiversity, carbon emission, and water contamination, leading to indigenous land dispossession, violence, and rural-urban migration. The deforested areas in the Amazon region increase considerably at an alarming speed each year. The COVID-19 pandemic is an evidence to show how viruses and pathogens move further and faster than before, which means we must also show a quick response. It requires financing and, mostly, changes in human behaviour. The message is simple: we need to rethink our current relationship with nature and with ourselves, which should lead to a social transformation towards the sustainable use of the available resources.

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It is not a coincidence that most dangerous diseases emerge from high biodiversity areas such as tropical rainforests or bushmeat markets in Asian and African regions (Vidal, 2020). Some decades ago, wildlife in undamaged natural environments was reported to pose a threat to human health by harbouring pathogens and microorganisms that cause new diseases in humans, such as Ebola and HIV, due to animal-to-human transmission. However, currently, most researchers consider humanity's extermination of biodiversity as the antecedent of ideal conditions for the emergence of new viruses and diseases (Vidal, 2020; Jones et al., 2008). Animals lose their natural habitats due to extensive landscape changes, consequently crowding them together and increasing their interaction with humans. Those species that survive changes move and mix with other animals and humans. As reported by the US Centers for Disease Control and Prevention (CDC), approximately 75% of "new or emerging" diseases in humans originate from nonhuman animals (Jones et al., 2008; CDC, 2020). Additionally, it is also important to emphasise the increasing concern on climate change because climate

can modify the distribution and intensity of other diseases such as vector-borne disease, possibly invalidating the benefits of control programs and intensifying the threat of emerging diseases in the next years (Mordecai et al., 2020; Tesla et al., 2018).

Unfortunately, this scenario has become worse. According to the United Nations' Fifth Report of Global Biodiversity Outlook (GBO-5) (United Nations, 2020), only six of the 20 targets set by 193 countries in 2010 involving concrete actions to halt the loss of global biodiversity by 2020, have been partially achieved. Insufficient action by nations to reverse the trend of unprecedented decline in species and the degradation of ecosystems can increase the risks of the emergence of new pandemics, compromise the supply of water and food, and exacerbate the impacts of climate change (United Nations, 2020). Partial failure to achieve the targets shows that most countries have failed to involve all sectors to reduce the loss of biodiversity and to promote three main objectives more effectively: conservation, sustainable use, and sharing of benefits from the use of biodiversity. Moreover, the resources for biodiversity conservation in the evaluated period, estimated at US\$ 500 billion, were diluted by government support for activities harmful to the environment. Only in 2015, subsidies for the production of commodities linked to the destruction of forests in Brazil and Indonesia

* Corresponding author.

E-mail address: camilalorenz@usp.br (C. Lorenz).

alone exceeded the amount spent on measures to combat deforestation by a factor of 100 or more (United Nations, 2020).

A tragic example is from the Amazon rainforest, one of the most biologically and culturally diverse ecosystems worldwide, that experienced fast environmental depletion and high social inequalities (Castro et al., 2020). This rainforest is considered the largest tropical forest in the world with a total of 5.5 million km². One third of the world's trees are in the region, in addition to 20% of fresh water. Covering about 40% of South America and encompassing nine countries, it is home to more than 40,000 species of plants and 1300 species of native birds (INPE, 2020). The Amazon summarises the global revolution in human-nature relationships during the last hundred years. Extractive systems and extensive land use on a large scale have induced deforestation, great loss of biodiversity, carbon emission, and water contamination, leading to indigenous land dispossession, violence, and rural-urban migration. Such tendencies are driven by a globalised economy and a new system of consumption that enhances demands for food, energy, and materials from remote areas (Castro et al., 2020). The deforested areas in the Amazon region increase considerably at an alarming speed each year (Fig. 1). The number of fires in 2020 increased by 12% compared to that in 2019 (INPE, 2020). Besides, recent studies showed a positive association between areas of the Brazilian Amazon forest damaged by deforestation and the incidence of malaria: each kilometre square of deforestation produced 27 new malaria cases

(Chaves et al., 2018). Additionally, the Brazilian Amazon area has been majorly affected by policies of the current national government (Castro et al., 2020). Many conflicts and violence in this region have been sustained by the dismantling of environmental supervision and social policies, elimination of environmental agents and indigenous agencies, negation of climate change, and agreement with persons carrying out illegal activities such as gold mining, land grabbing, and deforestation practices (Castro et al., 2020; Ferrante and Fearnside, 2019). Added to this scenario we also have illegal wildlife trade and poaching, activities that can improve the increase parasite sharing and the possibility of spillover, putting millions of people at risk (de Andreazzi et al., 2020).

The COVID-19 pandemic is an evidence to show how viruses and pathogens move further and faster than before, which means we must also show a quick response. It requires financing and, mostly, changes in human behaviour. The message is simple: we need to rethink our current relationship with nature and with ourselves, which should lead to a social transformation towards the sustainable use of the available resources. As Balmford et al. (Balmford et al., 2020) stated, a disease epidemic is, at its heart, a phenomenon of positive feedback, with each new case spawning others. The effects of human activities on our planet are likewise characterised by positive feedback. As it is not possible to predict the onset of the next emergence in terms of time and location, we must develop prevention and mitigation plans

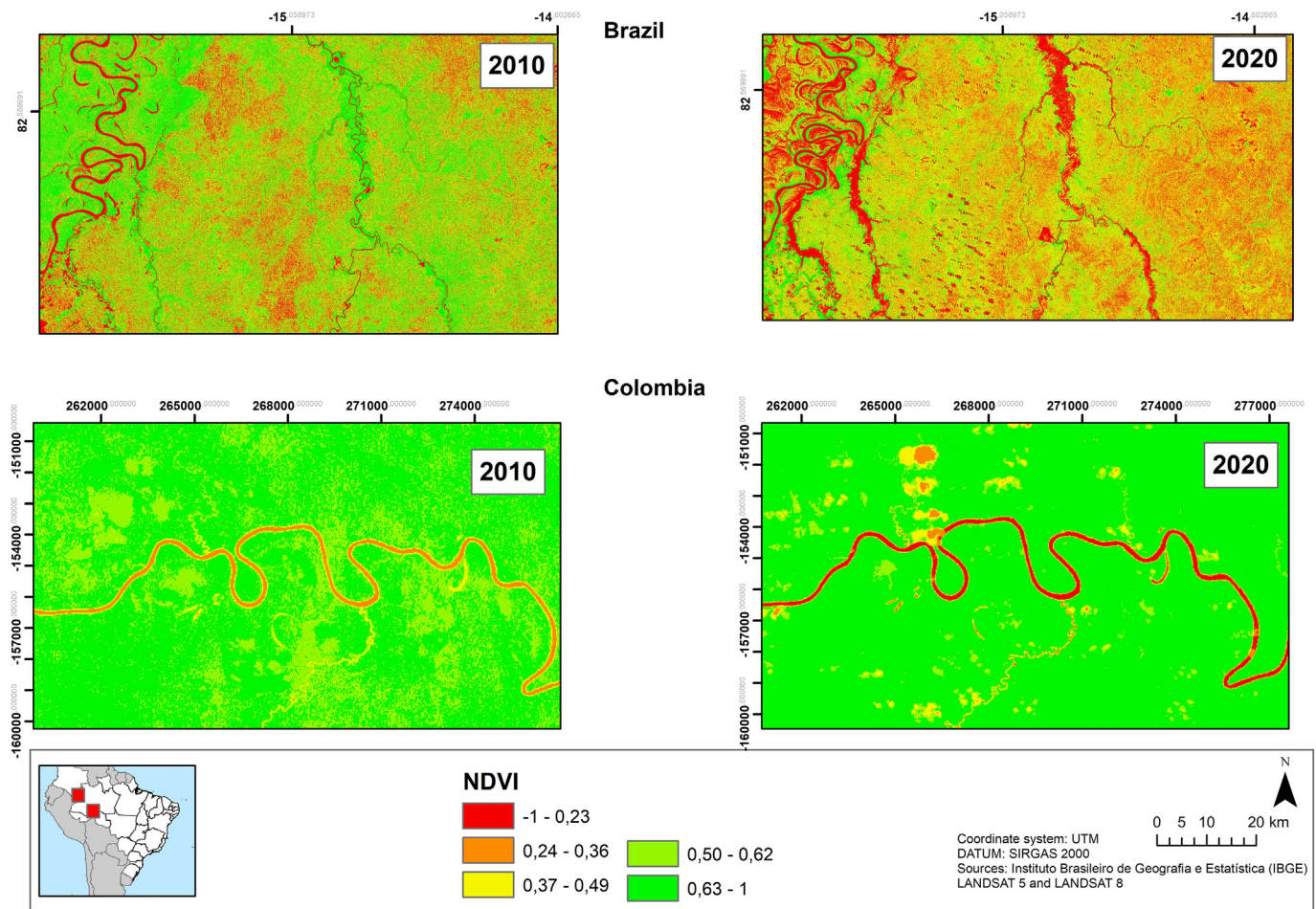


Fig. 1. Normalised difference vegetation index (NDVI) of Brazilian and Colombian Amazon rainforest in 2010 and 2020. This index varies between -1.0 and 1.0 , in which the negative values correspond to water bodies and the ones closest to 1.0 correspond to vegetation with greater biomass density and development vigour. Remote sensing and geoprocessing are extremely efficient tools to assist in monitoring changes in land use and the environment. The changes observed in the two images mainly reflect the intensification of urban expansion and agribusiness in areas that should be preserved. The images are located in orbit 233 point 065, acquired on the INPE website (www.inpe.br), and captured using the LANDSAT 5 sensor (TM) with 30-m spatial resolution (2010) and LANDSAT 8 sensor (OLI) with 30-m spatial resolution (2020).

considering the worst potential scenarios. These measures should be integrative and range from several targets, from local human behaviour (i.e., extractive forest activities) to regional decisions (i.e., health policy) and globalisation (i.e., international movements). One thing is sure: the next pandemic is inevitable.

CRedit authorship contribution statement

Camila Lorenz: Conceptualization, Writing - Original draft preparation. Mariana de Oliveira Lage: Figure preparation, Writing - Reviewing and Editing. Francisco Chiaravalloti-Neto: Supervision, Writing - Reviewing and Editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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