

TREES AND PANDEMICS

HOW DEFORESTATION CAUSES EMERGING DISEASES

Paige Milson

Medical Geography

📍 What's the situation?

People in makeshift Hazmat suits carrying dead bodies to mass graves, patients lying on the floor because there were already two patients to every bed, doctors trying to ease the pain but didn't have enough medication. This was the Ebola outbreak in 2014. The virus destroyed populations in Sierra Leone, Guinea, and Liberia, but where did this devastating virus come from? Ebola outbreaks had been seen before, but they were on a much smaller scale and with a significantly lower virulence. So, what could be causing the uprising of diseases like Ebola, dengue, and Zika? Public health officials argue that deforestation leads to more human-wild animal interactions that cause zoonotic diseases to spill over into human hosts ([Robbins](#)).

Nearly 90% of the rainforest in West Africa has been destroyed for private and commercial gain—rainforests in Guinea have been cut by 80%, half of Liberia's forests have been sold to loggers, and Sierra Leone will be completely deforested soon ([JA Ginsburg](#)). It doesn't seem coincidental that the Ebola epidemic was the most catastrophic in these nations. Even more than the destruction caused by the modern diseases, epidemiologists suggest another "[big one](#)," like the bubonic plague or the Spanish Influenza, could emerge in the next several years, in part because of the human-animal interactions caused by deforestation.

📍 Bats and Viruses

In West Africa, fruit bats thrive in the forests and, as key pollinators, fill an important ecological role in the environment. The bats spread seeds and, because their diet is mainly composed of insects, they maintain the insect population. However, bats are saturated with viruses. The viruses do not harm the bats, instead they are simply a part of their body, much like the way that bacteria live in human stomachs but do not harm us. These viruses have symbiotically existed in wild animals for thousands of years, but humans have never encountered them so we don't have the immune response needed to attack the viruses ([Doucleff, Greenhalgh](#)).



A fruit bat drinking fruit juice from a micropipette. Scientists search for new viruses in the bodily fluids of bats. Source: NPR

When bats fly, these viruses are spread (via saliva, feces, and blood) across large geographic areas. Bats have a dishonorable reputation of causing disease: they were partially responsible



for the SARS (severe acute respiratory syndrome) pandemic, they spread rabies, and the Marburg virus which is extremely virulent and kills about 90% of those infected ([CDC](#)). These single-stranded viruses are very complex and evolve rapidly, so even if there were vaccines to target them, it would need to be redeveloped all the time like the flu vaccine. Additionally, bats are reservoirs of Nipah virus which many experts believe will cause the next pandemic—more on that later.

When logging and agriculture leave bats homeless, they must search for a new habitat. These new habitats are typically near human settlements and urban areas (e.g. Congress Ave. Bridge in Austin, TX) and further foster the spread of infectious diseases. In addition to bats infecting fruit and livestock, they are also regularly eaten by some West Africans. When the bats live in closer proximity to humans, they are more likely to contaminate food sources, and people are also more likely to eat them because the bats have compacted themselves into small areas ([NPR](#)). Researchers believe the re-emerging Ebola virus originated from a young boy who ate fruit infected by a bat, so there is a definite need for further research into the subject and subsequent action to prevent the horrific losses caused by these viruses.

📍 Mosquitoes and the Zika Forest

Uganda is home to the Zika Forest (also known as Ziika Forest), the namesake of the Zika virus that has caused alarming spikes of microcephaly in Brazil and other parts of the world. The forest is owned by the Uganda Virus Research Institute which finds at least one new virus in the forest every year ([CNN](#)). The virus is named after the forest because the first human cases were transmitted by mosquitoes of the forest. There were few Zika cases in Uganda and none of the patients had severe symptoms, so there was

never much research into the virus because there weren't enough severe cases to necessitate funding for a research project.



Zika Forest in Uganda. Source: Newsweek.

However, similar to the Ebola virus, there was a large time and severity gap between the initial cases and the re-emergence of the virus ([Gaffey](#)). Zika spread to the Pacific Islands (see map below), where it likely mutated, and then to Brazil, where some suspect the original infector was traveling to the World Cup. In Brazil, there have been unprecedented incident cases of microcephaly brought about by infection from *Aedes aegypti*.



Map of Zika transmission around the world. Map does not include original Ugandan cases. Source: [nextstrain.org](#)



Deforestation has been proven to change the behavior of mosquitoes and cause them to bite more frequently. For example, a study of malaria-carrying mosquitoes in the Peruvian forest found that the mosquitoes bit 278 times more often in the deforested area than the intact forest areas ([Morrison](#)). The same study also reported that clearing the forest land for construction of road increased the number of malaria cases that year from 600 to 120,000. Further, researchers in Brazil found that a relatively minor forest decrease of 4% resulted in a 50% increase in malaria incidence. In Brazil, deforestation has brought about a severe drought which causes people to store open water containers at their homes. Mosquitoes are known to breed in open water, so the situation is exacerbated by the deforestation-induced drought. Many of these people are unaware of the hazards of open water containers and are skeptical of public health workers who try to add chemicals to the water. The situation is complex and multi-faceted, but there is an immediate need for vaccine funding because of the distressing number of children diagnosed with microcephaly. Even more, *Aedes aegypti* is a reservoir of yellow fever, dengue, and chikungunya virus in addition to Zika virus.

📍 Malaria in Borneo

The forests of Malaysian Borneo have recently been a goldmine for infectious disease research since an emerging form of malaria has crossed the species barrier from macaques (a primate species), into humans for the first time in history ([Harvey](#)). The palm oil industry has resulted in massive deforestation in Borneo and accompanying habitat loss for macaques that

lived in the forest. Researchers believe that the deforestation has forced macaques to spread *Plasmodium knowlesi*, a malaria-carrying parasite that has previously never infected humans. It is thought that the macaques do not directly spread the pathogen to humans but, rather, mosquitoes act as vectors to transmit the virus from macaques to humans. Deforestation has brought the macaques in closer to contact to humans, therefore, it is easier for the mosquitoes to infect more people.



Trees in Indonesia being cleared for a palm oil plantation. Source: Yale school of Forestry and Environmental studies.

After studying the correlation between deforestation and infectious diseases, researchers suggest that the edge of forests are the most significant when considering this issue because that's where humans and macaques most likely come into contact ([Harvey](#)). This may be intuitive, but it is particularly important information for the regulation of palm oil industries. People who work at palm oil plantations usually work at the edges of the forest, so there's a lot of opportunity for opportunistic pathogens like malaria to spread



from animals to humans. This kind of rapid conversion from dense forest land to bare palm oil plantation is unsustainable and dangerous for human health as well as the health of the environment and native wildlife. However, the development and maintenance of palm oil plantations is not likely to stop any time in the near future since palm oil is ubiquitous—it is found in chocolate, shampoo, lipstick, biodiesel, and ice cream, to name a few ([WWF](#)). More sustainable methods of production are surely available, but they won't be utilized unless people start to see the effects of deforestation on their own health and well-being.

Moreover, these mosquitoes can breed more rapidly when deforestation occurs. A lack of canopy cover causes much more sunlight to reach the forest floor and that heat results in raised groundwater temperatures. This creates an ideal breeding location for mosquitoes ([Robbins](#)). Additionally, another altered dynamic is caused by the lack of leaves in water within the forest. Leaves and bark contain tannin that acidify the water, and when these are gone, the water is less acidic so mosquitoes are more likely to breed there.

📍 The Next Pandemic

Land development in highly biodiverse areas like forests will likely play a significant role in the emergence of the next great pandemic, a disease with the potential to cause more damage than the Spanish Influenza. Effects of globalization have been very positive with respect to certain areas, but it will be a huge catalyst in the next pandemic and is a large part of the reason why researchers believe the next pandemic will be more catastrophic than any other on record. Biodiverse areas are home to many species that co-evolved with the wide array of viruses within

them, the clear majority of which humans are unaware of and have no immune defenses against. Then, the globalization factor allows for a novel pathogen to spread across the globe in only a few hours.



Pygmy elephant in Borneo. Animals like this are forced to live near humans which makes it easy for their viruses to spread. Source: NPR

As huge waves of people continue to migrate into urban areas in search of jobs and better lives, cities in developing nations are ill-equipped to receive them since they often lack the public infrastructure needed to support the people. This is a huge problem internationally—many people live in extremely poor conditions with unhygienic sanitation, food insecurity, and unclean water. Then, an urbanized species like *Aedes aegypti* can cause significant damage since they thrive in landscapes with trash and open water and can also feed off the dense human population, a group that lacks any sort of immunity against the mosquito's diseases.

People that live in areas with abundant deforestation also typically have low access to proper healthcare and, thus, continue to spread the disease to others without seeking treatment. There is a global need for prevention efforts and capacity-building to help developing nations become both more resistant to and resilient



against infectious diseases. Of course, this issue has many different components and no single field will solve the issues. Yet, the combination of powers of the environmental field, public health field, industries involved in deforestation, and global political agents could make significant positive change in the way deforestation is regulated. Cooperation is necessary to prevent the next major pandemic that many experts believe will take place in the next several years.

The most useful, feasible solutions to prevent such a pandemic lie within education about the importance of the environment as it relates to health and consequent policy development to protect forests which leads to the protection of humans. As is the case with most human health issues, prevention is vital and the global population is much more likely to be prepared for and resilient toward a severe pandemic if the population focuses resources and time on prevention rather than treatment. Vaccine and drug development require years of clinical trials and millions of dollars of funding. They are temporary solutions to a much larger, systemic problem.

Overall, there is still a lot we don't know about how deforestation leads to the spread of zoonotic disease, but the information we do know is concerning. Since deforestation is so common and, some might argue, necessary in these developing nations, it is even more troubling to consider how difficult it would be to intervene in these industries. Similarly, many people cut down trees for agricultural purposes and it is unethical and unfair to ask one population to go without food or income in order for another population to be safer. This is a complicated web of interconnected issues, and it certainly requires much more thought and action

by both the public as well as experts in all related fields.

Sources:

CDC. "Marburg hemorrhagic fever (Marburg HF)." *Centers for Disease Control and Prevention*. Centers for Disease Control and Prevention, 01 Dec. 2014. Web. 18 Mar. 2017.

Doucleff, Michaeleen, and Jane Greenhalgh. "Why Killer Viruses Are On The Rise." *NPR*. NPR, 14 Feb. 2017. Web. 10 Mar. 2017.

Gaffey, Conor. "In Uganda's Zika Forest, immunity hints at researchers' next steps." *Newsweek*. N.p., 09 Sept. 2016. Web. 18 Mar. 2017.

Ginsburg, JA. "How saving West African forests might have prevented the Ebola epidemic." *The Guardian*. Guardian News and Media, 03 Oct. 2014. Web. 12 Mar. 2017.

Harvey, Chelsea. "By cutting down forests, humans may be giving themselves malaria." *The Washington Post*. WP Company, 21 Dec. 2015. Web. 10 Mar. 2017.

McKenzie, David. "Zika virus birthplace: Uganda's Zika Forest." *CNN*. Cable News Network, 03 Feb. 2016. Web. 18 Mar. 2017.

Morrison, Jim. "Did Deforestation Contribute to Zika's Spread?" *Smithsonian.com*. Smithsonian Institution, 08 June 2016. Web. 10 Mar. 2017.

Neher, Richard, and Trevor Bedford. *Nextstrain*. NIH, n.d. Web. 05 Mar. 2017.

NPR. "'Pandemic' Asks: Is A Disease That Will Kill Tens Of Millions Coming?" *NPR*. NPR, 22 Feb. 2016. Web. 05 Mar. 2017.

Robbins, Jim. "How Forest Loss Is Leading To a Rise in Human Disease." *Yale E360*. N.p., 23 Feb. 2016. Web. 10 Mar. 2017.

"Which Everyday Products Contain Palm Oil?" *WWF*. World Wildlife Fund, n.d. Web. 18 Mar. 2017.

