



## Human Disease: A Consequence of Forest Loss

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Available online at: [www.isca.in](http://www.isca.in), [www.isca.me](http://www.isca.me)

Received 19<sup>th</sup> August 2015, revised 22<sup>nd</sup> August 2015, accepted 7<sup>th</sup> September 2015

### Abstract

Forest loss has always been associated with climate change, biodiversity loss and environmental degradation. But it has also led to the emergence of many diseases in different parts of the world. A study of literature reveals that deforestation has triggered the occurrence of several infectious diseases by initiating series of mechanisms. These mechanisms operate through effects on vectors, disease reservoirs and so on. It is thus important to recognise the fact that spreading of disease can occur due to forest loss.

**Keywords:** Human-disease, deforestation, forest-loss, infection, human-population.

### Introduction

Forests not only preserve biodiversity and absorb carbon dioxide emissions but also protect human health by preventing the emergence of infectious diseases<sup>1</sup>. It was an established belief that deforestation reduces the infection hazard but research has revealed that it can actually render socially marginalized human populations more vulnerable to infection<sup>2</sup>. Forest loss and other land use changes have an important part in emergence of disease<sup>3</sup>. Due to forest clearance, many viruses, which remain hidden in forests (e.g. interiors of rainforests) suddenly, all of a sudden are exposed to large human populations. However, there are a number of ways through which ecological changes trigger the transmission and virulence of infectious diseases<sup>4</sup>. Alterations in forest cover give rise to changes in biodiversity which in turn exerts effects host species composition and this can profoundly alter disease dynamics within a community<sup>5</sup>. In addition to increasing vector-borne diseases such as malaria, filariasis and arboviral infections, forest loss can also affect diseases transmitted primarily by fecal contamination of potable water such as bacterial, cryptosporidial, amoebic, and helminth bowel infections, and hepatitis A<sup>6</sup>.

### Vector borne diseases

As a result of deforestation there is a greater contact between humans and vectors at edges between forests and human settlements<sup>7</sup>. In fact, loss of forests resulting due agricultural expansion at borders of new forests and farmlands brings humans and domesticated animals into the contact of new vectors, pathogens and arthropods<sup>4</sup>. A vector-borne disease associated with deforestation is Malaria. This is apparent in the context of Sri Lanka where forest clearance for establishment of tea estates caused the inception of severe disease epidemics<sup>8</sup>. Habitat modification due to forest clearance that increases mosquito breeding and migration as well as the loss of preferred

host wild animals arising from deforestation that forces mosquitoes to shift to domestic animals and humans for food accelerates malarial transmission<sup>6</sup>. Further, due to forest loss existing inferior vectors of malaria (*Anopheles koliensis*) may get replaced with superior ones (*Anopheles punctulatis*)<sup>6</sup>. The appearance of more efficient vectors due to deforestation also occurs in case of loa loa (tropical eyeworm) and onchocerciasis (river blindness)<sup>7</sup>. On the other hand, a wide range of free-living parasite forms are consumed by predators and their loss due to forest loss would definitely facilitate disease transmission<sup>9</sup>. Communities in deforested areas could be poor in diversity with a high density of highly competent host species and this can also facilitate transmission<sup>5</sup>.

Forest loss has also been responsible for the spreading of Kyasanur Forest Disease that was first documented from India<sup>10</sup>. When trees in forests were cut down, the resulting clearings were rapidly occupied by profusely by growths of the lantana vine that provided a suitable habitat for small mammals and birds which in turn served as hosts for immature ticks. Grazing cattle carried the ticks, which are vectors of this arboviral disease, to humans<sup>6</sup>. Similarly, leishmaniasis, malaria as well as African and American trypanosomiasis can increase as their arthropod vectors tend to increase after the replacement of native plants by exotic plants<sup>7</sup>. On the other hand, filarial infection of *Wuchereria bancrofti* was documented to increase in the hilly parts of Malaysia due to forest clearance that increased the breeding habitat of *Anopheles maculatus* which is the an important vector of the germ<sup>11</sup>. In addition, forest loss has been also responsible for causing changes in the distribution of other insect vectors like black flies, tsetse flies and anopheles mosquitoes in West Africa<sup>7</sup>.

### Disease reservoirs

The abundance of some animal reservoir hosts increases near

forest edges due to forest loss and this also facilitates human exposure to pathogens<sup>7</sup>. For instance, in South America, forest clearance for the purpose of cattle ranching led to elevated populations of vampire bats which are a natural host for rabies<sup>12</sup>. On the other hand, forest loss in Malaysian rubber estates caused monkeys, which act as reservoirs to *Brugia malay* (transmitted by *Mansonia* mosquitoes), to move further closer to human settlements in pursuit of food and this in turn resulted into a greater infection of the filarial worm<sup>10</sup>. Another example of disease emergence due to deforestation is that of the Nipah virus. In 1997, tropical forests covering an area of about 5 million hectares in Malaysia were burnt down for pig farming which gave rise to a severe haze. The haze in combination of a drought reduced the number of fruit trees and hence bats in the region shifted to orchards near the pig farms for food. The virus was transmitted to pigs when they ate fruits contaminated with bat urine and saliva and henceforth through direct contact to farm workers. The virus that was unknown, later on spread across Malaysia as sick pigs were sold all over the country and later on to Singapore. The virus not only caused several human deaths but also resulted in severe economic losses to the pig farming industry in Malaysia. This virus for which there is neither any vaccine nor cure is also transmitted human to human and has spread to many new locations. In fact, there have been several outbreaks of the virus in South-east Asia since the first outbreak in Malaysia<sup>1</sup>.

Forest loss can also trigger the spreading of diseases through its indirect effects. An extensive network of roads has been built through forests due to the logging industry has facilitated the proliferation of bush-meat trade. This in turn humans more vulnerable to the risk of cross-species transmission of documented and undocumented viruses. In fact it is probable that the HIV virus was first transmitted to humans during hunting of chimpanzees and handling of chimpanzee meat in Cameroon and Gabon in Africa<sup>4</sup>. Next, flooding due to deforestation-related river silting initiates soil changes that enables hookworm transmission<sup>13</sup>. There is also a complex connection of forest loss with El Niño Southern Oscillation (ENSO), which is a periodic fluctuation of ocean and atmosphere in the Pacific Ocean that not only causes global inter-annual climate variability but also affects disease cycles. The socially marginalized human populations of countries which are heavily deforested countries are more vulnerable to ENSO's effects, and occurrence of disease is higher<sup>2</sup>.

### The dilution effect

Biodiversity exerts a dilution effect which is not only confined to vector-borne microparasites but also many complex-cycle parasites having medical, veterinary and conservation importance<sup>5</sup>. Additional species reduce the probability of parasite transmission target hosts, as a result, parasite loads decrease with increasing diversity. But the dilution capacity varies widely among species<sup>14</sup>. In fact there are five hypothetical mechanisms due to which alterations in species

richness could have an impact on risk of infection: lower host-parasite contact, decrease in transmission (after an encounter), elevated rate of recovery of from infection, elevated rates of deaths in infected hosts, and lower density of susceptible hosts<sup>9</sup>. This is evident in case of the Lyme disease. Communities which are rich in species accommodate a larger proportion of hosts that are less competent. As a result, ticks, which are the vectors of the bacterium *Borrelia burgdorferi* (germ of Lyme disease), tend to feed upon blood from hosts that are not likely to harbour adequate infections. This leads unsuccessful transmission and a decrease of infected ticks relative to communities that are poorer in species-poor<sup>5</sup>. Deforestation can bring about biodiversity loss, thereby destroying this dilution effect.

In addition to the above, some of the other diseases associated with deforestation are chagas disease, dengue fever, lassa virus, ebola, marburg virus, oropouche fever, plague and schistosomiasis<sup>12</sup>.

### Conclusion

Forest loss triggers loss in community diversity. The diversity of communities has a profound effect on parasite transmission and pathology and biodiversity loss can indirectly promote emergence of disease. It is a fact that infection risk inversely related to vertebrate host diversity<sup>5</sup>. In addition, deforestation accompanied by other factors such as climate change has not only boosted the spread of microbes, which has led to the incidence or repeated incidence of various diseases but has also made humans more vulnerable to infection<sup>4</sup>. There has been varying relationships between emergence of disease (mostly vector borne) and deforestation but in most of the cases, the latter has been found to accelerate the former. However, local conditions need to be analysed to assess or predict the consequence of changes in land cover on human health<sup>12</sup>. Hence, among impacts of deforestation, environmentalists and policy makers should also take into account the impacts on human health and economic losses due to emerging infectious diseases. Thus it is understood that preservation of world forests protects not only secures biodiversity but also human lives<sup>1</sup>.

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