COVID-19 and environmental change:

The social and environmental factors contributing to the rise of zoonotic diseases

Over the past century, the world has experienced dramatic ecological change. Forests have been cut down, agriculture and livestock production has rapidly intensified, and climate change has caused shifts in species' traditional ranges.

While these ecological changes have caused damage to natural ecosystems, there have also been impacts on humans. In the past few decades, zoonotic diseases—diseases transferred from animals to humans—have increased in frequency and severity. Diseases like Ebola, bird flu, SARS, West Nile, Zika, Lyme disease, and most recently COVID-19 have been transmitted from animals to humans and spread within human populations, resulting in thousands of deaths and billions in economic losses.

Reducing the risks posed by zoonotic diseases will require a global effort that considers humanity's role in their spread and anticipates how climate change could impact future transmission.

What's fueling the emergence of new diseases?

According to researchers, more than 70 percent of zoonotic diseases have originated in wildlife in recent decades. Scientists attribute this trend to three main types of change: environmental change, changes in hosts and their behavior, and changes in the pathogen.

Land use and climate changes

Resource exploitation, such as deforestation, has rapidly altered natural ecosystems, and increased development has eliminated buffer zones between humans and wild animals. These changes create more opportunities for pathogens to spillover from wild animals to people. **Changes to forest composition, invasive species, and single species plantings** for agriculture have reduced the diversity of ecosystems, making it easier for diseases to spread through ecosystems. **Changes in temperature and precipitation** accelerate ecosystem collapse, forcing species to migrate into new regions and expanding the ranges of some disease vectors. Species that traditionally inhabited the tropics are **moving into new areas** and bringing non-native diseases. Additionally, **warmer winter temperatures and more spring precipitation** are allowing disease-carrying vectors, such as ticks and mosquitoes, to proliferate and transmit pathogens to people.

Human activities

Increased demand for food has led to more **intensive livestock farming**, creating more opportunities for spillover and exposure. Intensive agriculture and livestock production places genetically similar animals closer together, conditions that facilitate disease spread. To keep up with demand for livestock products, **more land is being converted into production,** further removing natural buffer zones between wilderness and human habitation and increasing contact between livestock and disease-carrying animals. **Wet markets**—markets selling fresh meat, fish, produce, and other perishable goods—and wildlife trafficking also places humans in situations that can lead to spillover. Furthermore, **global transportation and trade** facilitates human-to-human disease transmission at unprecedented speed. This is perhaps best illustrated by the COVID-19 pandemic, which affected almost every country in the world in three months.

Antimicrobial resistance

Frequent use of **antimicrobial drugs** is resulting in drug-resistant pathogens. Antimicrobial resistance can be built up in livestock, so by the time the pathogens reach humans, antibiotics are no longer effective.

75 percent
of all emerging infectious diseases are zoonotic. On average, one new infectious disease emerges every four months.[1]

$80 billion
spent worldwide on combating emerging zoonotic diseases from 1997 to 2009.[2] This is less than 1 percent of the estimated costs of COVID-19, projected to be $8.5 trillion for the 2020-2021 time period.[3]

420 million hectares
of forests have been converted to other land uses between 1990 and 2020. Ten million hectares per year were lost between 2015 and 2020.[4]

3 months
between the first reported cluster of COVID-19 cases and when the disease was declared a pandemic.[5] Three months after that, a total of 6.5 million cases and more than 386,000 deaths had been reported across 180 countries.[6]

1 UNEP Frontiers 2016 Report: Emerging Issues of Environmental Concern

2 People, Pathogens and Our Planet: The Economics of One Health

3 World Economic Situation and Prospects as of mid-2020

4 FAO and UNEP. The State of the World's Forests 2020

5 World Health Organization COVID-19 Timeline

6 Johns Hopkins University COVID-19 Dashboard

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What can be done to slow or stop zoonotic diseases?

Slowing or stopping the emergence of zoonotic diseases will require collaboration at a global scale to address the root causes of disease emergence and to coordinate response measures when a new disease takes hold.

Improve ecosystem health
Good ecosystem integrity fosters a diversity of species that makes it more difficult for pathogens to rapidly spread or dominate. Furthermore, buffer zones help reduce contact between wild animals and humans.

Monitoring
Increased monitoring of human and wildlife health will help researchers gather baseline health data, improve understanding of and preparedness for outbreaks, and inform strategies to minimize the risks to human health and nature.

Strengthen and implement programs to reduce greenhouse gas emissions and wildlife trade
Significant reductions in emissions of greenhouse gases from agriculture, industry, and transportation that will slow ecosystem and land use changes are needed to help reduce the transmission of diseases from wild animals to humans and decrease the rate of spread. Technological innovation, smart investment, incentive programs and regulations can all contribute to lower emissions and more sequestration of these pollutants. Protection of natural areas and strict rules on wildlife trade with better enforcement will also help reduce the transmission of zoonotic disease.

Increased interdisciplinary collaboration
Experts in the fields of public health, environmental health, animal health, and other areas must work together to better understand zoonotic diseases and coordinate prevention strategies.

How ERI is working to protect human health

ERI researchers are collaborating across disciplines to understand the risks posed by disease-carrying species and to better protect human communities from disease vectors such as ticks and mosquitoes.

Tracking bird migration and disease dynamics

ERI researchers are studying the role birds play in spreading pathogens such as Lyme disease and working to predict future disease distribution.

Tracking and testing ticks and mosquitoes

Multiple ERI projects are investigating the presence and distribution of disease-carrying ticks and mosquitoes in Indiana. In addition to tracking their geographic range, researchers are looking into how ticks and mosquitoes transmit infectious diseases in hopes of identifying strategies to prevent disease transmission to humans.

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