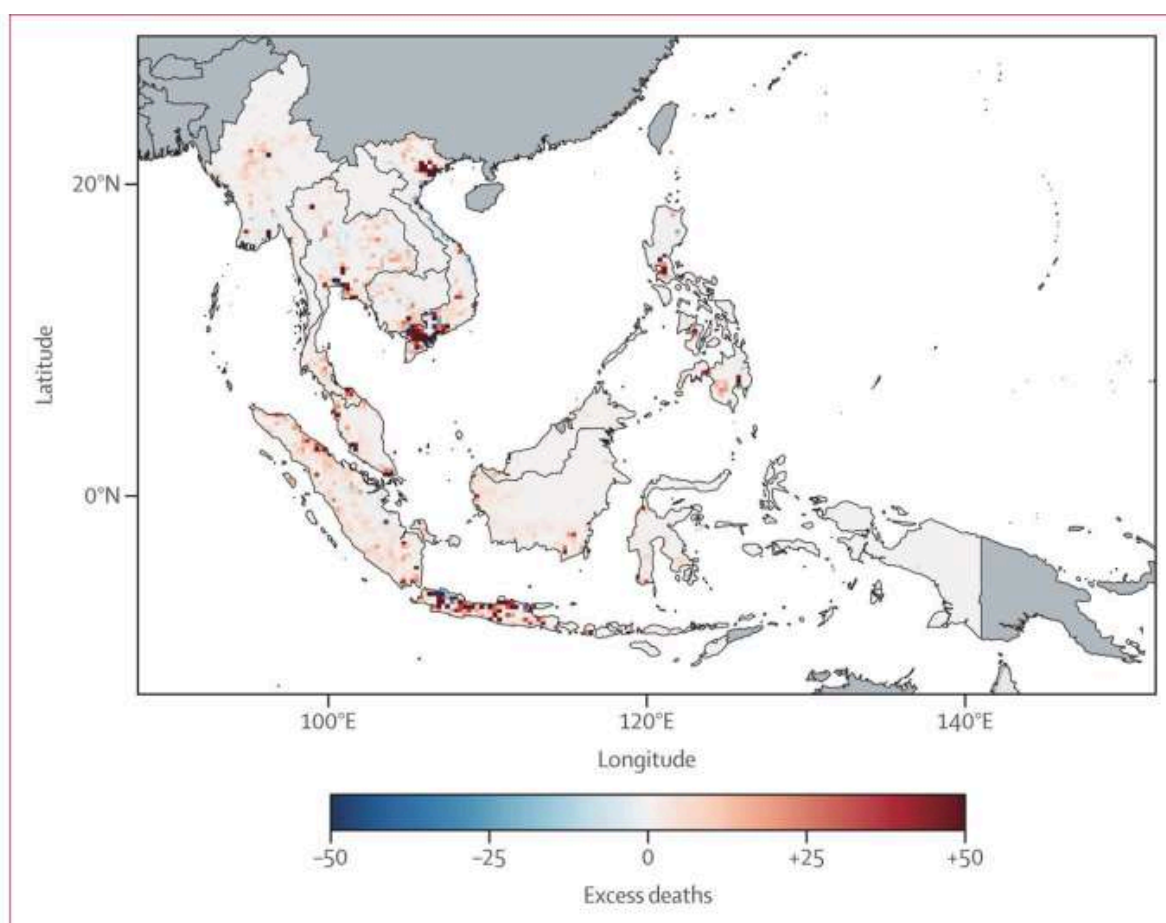


MAY 25, 2026

Southeast Asia's changing landscape is fueling a deadly air crisis that costs billions

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Annual PM_{2.5}-related and O₃-related excess deaths due to LULCCs in the 2001–18 period in Southeast Asia. Credit: *The Lancet Planetary Health* (2026). DOI: 10.1016/j.lanplh.2026.101457

Changes in land-use across Southeast Asia over the past 15 years are worsening air quality and contributing to thousands of excess deaths each year, according to a study led by researchers from Nanyang Technological University, Singapore (NTU Singapore).

The study estimates that land-use and land-cover changes in the region were linked to about 13,000 excess deaths in 2018 alone, which represent the extra number of people who died compared to what would be expected in a year without the land-use and land-cover changes. This is alongside economic losses of about US\$7.8 billion due to the health impacts of worsening air pollution.

Published in the May issue of *The Lancet Planetary Health*, the [study](#) was led by scientists from NTU Singapore's Center for Climate Change and Environmental Health (CCEH), in collaboration with researchers from NTU's Asian School of the Environment (ASE), Lee Kong Chian School of Medicine (LKCMedicine), Earth Observatory of Singapore (EOS) and Nanyang Business School, as well as from Macao Polytechnic University and City University of Macau.

The findings highlight how land development decisions, including deforestation, agricultural expansion and urban growth, can have far-reaching consequences for air quality, public health and economic productivity across Southeast Asia.

Principal investigator of the study, ASE's and LKCMedicine's Professor Steve Yim, Director of CCEH, said, "Land-use change is often discussed in terms of climate or economic development, but its impacts on air quality and public health are less well understood."

Prof Yim, who specializes in environmental health, added, "Our study shows that land-use changes can significantly worsen air pollution in Southeast Asia, leading to substantial health impacts and economic losses."

Forest loss and damage are major contributors to air pollution impacts

Using computer models, the researchers analyzed land-use changes across Southeast Asia between 2001 and 2018, including forest degradation and deforestation, cropland expansion, reforestation and urban development.

The team examined how these changes affected levels of two major air pollutants linked to cardiovascular and respiratory diseases: fine particulate matter (PM_{2.5}) and ground-level ozone (O₃).

The results showed that the estimated 13,000 excess deaths in 2018 were linked to land-use and land-cover changes. [Forest degradation](#) and deforestation were the largest contributors, accounting for nearly 30% of these deaths.

Co-first author of the study, Dr. Tingting Fang, research fellow at NTU, said, "Forests are one of nature's most effective air filters. When forests are removed or degraded, our atmosphere loses an important natural sink that helps remove pollutants, allowing pollutants like PM_{2.5} and O₃ to build up more easily. As a result, forest loss can significantly worsen air quality and increase health risks for millions of people across Southeast Asia."

Changing landscape carries a hefty price tag for Southeast Asia

The health impacts linked to land-use changes also carry substantial economic costs. Using Value of Statistical Life (VSL) and Cost-of-Illness (COI) methods—widely used approaches for estimating the economic impact of pollution-related deaths—the study found that in 2018 alone, land-use change-related air pollution resulted in US\$7.8 billion in economic losses across Southeast Asia.

This is equivalent to about 0.1% of the region's GDP, including US\$1.07 billion in productivity losses and US\$34 million in health care costs.

Among Southeast Asian countries, Indonesia and Thailand experienced the largest economic burdens.

The researchers found that the largest increases in excess deaths occurred in Indonesia, Vietnam and Thailand, reflecting both extensive land-use changes and their impacts on air pollution. Major health impacts were concentrated in densely populated regions such as Java, the Mekong River Delta, and the Red River Delta.

The study also found that more than 60% of the damage was driven by biogeophysical effects, meaning that land-use changes altered the local climate in ways that made air pollution more harmful to human health.

Supporting better land management and environmental policy

The researchers say the findings highlight the need to consider air quality and public health impacts when planning land-use policies and development strategies across Southeast Asia.

The study also suggests that forest conservation and more sustainable land management could deliver multiple benefits, including improved air quality, better public health outcomes and stronger economic resilience.

Prof Yim said, "Our findings show that better land management can deliver important co-benefits. Protecting forests and carefully planning land development can help improve air quality, safeguard public health and support sustainable economic development across the region."

Publication details

Yefu Gu et al, Air quality, health, and economic effects of land use and land cover changes in southeast Asia in the 21st century: a modelling study, *The Lancet Planetary Health* (2026). DOI: [10.1016/j.lanplh.2026.101457](https://doi.org/10.1016/j.lanplh.2026.101457)

Journal information: [The Lancet Planetary Health](#)