Study Analyzes Impact of Ozone Pollution on Crop Yields in China and effects from COVID-19

Statistical analysis of data reveals that rising ozone pollution has drastically affected crop yields in China, advocating the urgent need for emission control

Rice, wheat, and maize are the most important staple crops in the world and account for 60% of the world’s food energy. Researchers have, however, found that rising ozone (O3) pollution levels led to reduction in their national yields in China. These find

BOSTON, MA, UNITED STATES, July 28, 2025 /EINPresswire.com/ -- Tropospheric ozone (O3) is a concerning pollutant, responsible for reduction in yields of major staple crops like rice, wheat, and maze. In this Journal of Environmental Sciences study, researchers from China and the United States of America found that rising O3 pollution led to national-level wheat, rice, and maize yield losses in China between 2005–2019. This trend was largely mitigated during COVID-19 lockdowns in 2020, indicating the need for an effective emission control policy.

Ozone, or trioxygen, is a light blue gas with the molecular formula O3. It is widely known in the form of the ozone layer: a part of the Earth's stratosphere that protects us from the Sun's harmful ultraviolet radiation. Since its discovery over a hundred years ago, scientists have studied the ozone layer extensively. While ozone layer is abundant in the stratosphere, it is also present in trace amounts in the troposphere—the bottommost layer of the Earth’s atmosphere. In troposphere, ozone layer is known as ground-level, surface-level, or tropospheric ozone layer and acts as a secondary pollutant. It is mainly generated via photochemical reactions among nitrogen oxides and volatile organic compounds from natural sources, as well as anthropogenic sources, including biomass burning and fossil fuels.

Tropospheric ozone, a greenhouse gas, contributes to the formation of harmful photochemical

smog, which can lead to severe health issues in humans and animals, cause environmental damage, and negatively impact microorganisms. Alarmingly, the emissions of nitrogen oxides and other related substances have increased over the last century, which has, in turn, elevated the tropospheric ozone levels in the present era. This trend is particularly evident in the extratropical regions of the Northern Hemisphere. In China, the alarming and continuous increase in surface ozone pollution, in conjunction with the impacts of climate change and global warming, poses a serious threat to food security. Recent studies have reported a wide range of yield losses of major staple crops such as rice, wheat, and maize in China, ranging from 4.5% to 33%. In this scenario, there is an urgent need for more extensive and comprehensive research to narrow down this uncertainty arising from the spatiotemporal accuracy of O3 metrics as well as the extrapolation methods used to estimate the effect on crop yield.

Advancing research, an international team of researchers from China and the USA, led by Guangsheng Chen, from the College of Environmental and Resource Sciences, Zhejiang A&F University, and Hanqin Tian, from the Center for Earth Science and Global Sustainability, Schiller Institute for Integrated Science and Society, Boston College, and the Department of Earth and Environmental Sciences, Boston College, has provided a more robust analysis on the impact of O3 pollution in China. Their findings were made available online on February 25, 2025 and will be published in Volume 157 of the Journal of Environmental Sciences, an Elsevier journal, on November 1, 2025.

Talking about the methodology employed in this study, Dr. Chen says, “We analyzed the spatiotemporal patterns of O3 pollution and its impacts on yield, production, and economic losses for wheat, rice, and maize in China during 2005–2020 based on a high spatial resolution of 0.1° hourly surface O3 data.”

The researchers found that the accumulated O3 exposure over a threshold of 40 parts per billion, a metric popularly known as AOT40, recorded a 10% uptick during the period 2005–2019. In contrast, a notable decrease of 5.56% was observed in 2020 due to the COVID-19 lockdowns, highlighting the broad impact of the pandemic on the environment as well. Overall, the rising O3 pollution was found to result in national-level wheat, rice, and maize yield losses of 14.51% ± 0.43%, 11.10% ± 0.6%, and 3.99% ± 0.11%, respectively, in China.

Furthermore, the study utilizes a business-as-usual projection to highlight that the relative yield loss (RYL) is expected to reach 8%–18% at the national scale by 2050 in the absence of a proper emission control policy.

“COVID-19 lockdowns in 2020 led to significantly reduced RYL for maize (0.52%) and rice (2.17%), but not for wheat (0.11%), with the largest reduction (1.88%–9.4%) in the North China Plain, highlighting the potential benefits of emission control,” points out Dr. Tian.

In summary, these findings suggest that rising ozone pollution has drastically affected crop yields in China, leading to production and economic losses. It presents a strong case for the urgent

need to mitigate O3 pollution to ensure food security, especially in densely populated areas.

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Reference
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About Zhejiang A&F University
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About Guangsheng Chen from Zhejiang A&F University
Guangsheng Chen is a Professor (Full) at the College of Environmental and Resource Sciences, Zhejiang A&F University, China. His research focuses on environmental management and impact assessment, ecology and evolution, and spatial statistics and analysis. He has published more than 50 research papers and has been cited approximately 5,000 times.

About Hanqin Tian from Boston College
Dr. Hanqin Tian is the Schiller Institute Professor and Director of the Center for Earth System Science and Global Sustainability at Boston College, USA. His research interests include

terrestrial ecosystems and global biogeochemical cycles. He has authored over 400 peer-reviewed journal articles and has received approximately 60,000 citations.

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Hanqin Tian
Boston College
+1 617-552-3664
hanqin.tian@bc.edu
