UPDATING ESTIMATES OF METHANE EMISSIONS: RISING EMISSIONS IN AFRICA FROM RICE AGRICULTURE

Background

Methane has a short atmospheric lifetime — only 10 years, compared with over 100 years for carbon dioxide (CO_2). It also has a much higher global warming potential than CO_2. Therefore, although the absolute quantities of human-caused methane emissions are much less than those of CO_2, methane-emissions abatement can significantly reduce concentrations, temperature, and damages from climate change in the short term, which is crucial to achieve U.S. and global targets for 2030. Indeed, according to the Intergovernmental Panel on Climate Change (2023), fully one-third of warming during 2010–2019 (relative to 1850–1900) is due to historical anthropogenic emissions of methane.[1] Reducing methane emissions would give the world time to "bend the curve" on CO_2 emissions, conduct research on carbon removal, and, more generally, implement longer-term strategies to mitigate and adapt to climate change.

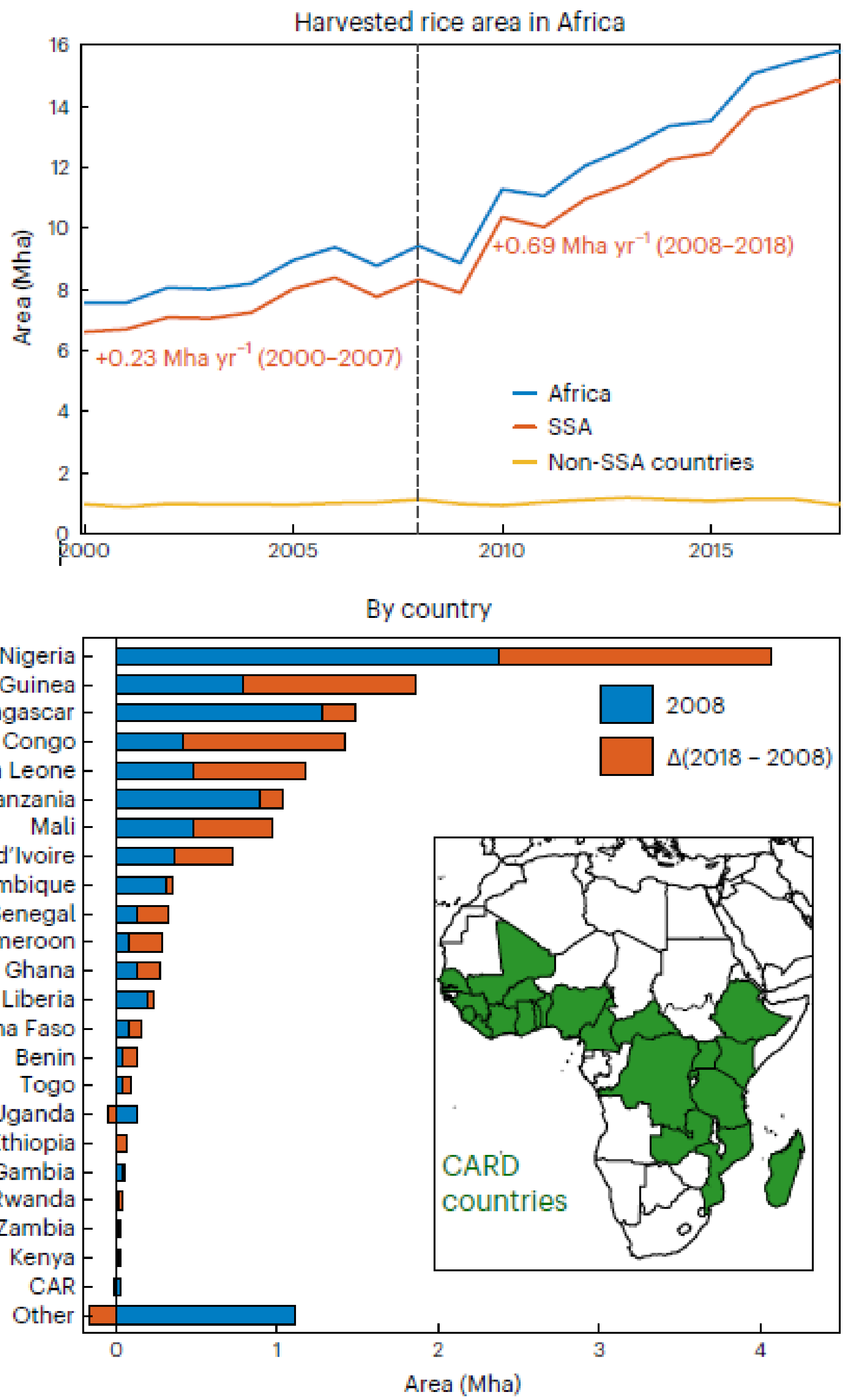
Analyses of atmospheric observations identify Africa as a major driver of recent observed increases in atmospheric methane concentrations.[2] This increase has generally been attributed to emissions due to rapidly increasing livestock populations, as cattle are a major source of methane. Increasing wetland extent in Africa in response to severe flooding is also thought to have exacerbated the increase of methane emissions in recent years, reflecting La Niña conditions but also possibly long-term climate change.[3] However, increase in lowland rice cultivation could also be a major driver.

Overview

Atmospheric scientists at Harvard University, led by Professor **Daniel Jacob** and, in the case of the paper summarized here,[4] postdoctoral fellow **Zichong Chen**, have found that rapidly increasing lowland rice agriculture in Africa could be contributing significantly to the current methane rise. Rice cultivation emits methane when rice paddies are flooded and the organic material decays in the absence of oxygen (that is, anaerobically).

In response to the 2007–2008 world food price crisis, the Coalition for African Rice Development (CARD) was founded in 2008 as an international initiative to promote rice agriculture in 23 countries of sub-Saharan Africa (SSA). This resulted in a doubling of rice production in Africa from 2008 to 2018, partly from area expansion and partly from conversion from upland to irrigated rice cultivation. (Upland rice cultivation does not involve flooding of fields and anaerobic decay.) Most of the increase has been in West African countries, notably Nigeria. CARD aims to double African rice production yet again, with the goal of achieving rice self-sufficiency as a major staple food by 2030.

Chen *et al*. estimated rice emission from Africa using databases of rice-cultivation area and accounting for recent trends in rice-cultivation practices. They found that African rice emissions, presently estimated to be 2.6 teragrams per year, are rising at a rate of 8% per year. This would represent 30% of the total rise in African emissions and 7% of the global rise in methane, over the period 2008–2018.



The Global Methane Pledge aims to reduce aggregate global methane emissions by 30% from 2019 levels by 2030, but feeding the rapidly growing population in Africa is expected to drive more aggressive expansion and intensification of rice cultivation in the years ahead. This trend will require an even greater reduction of methane emissions from other sectors.

Endnotes

1 Intergovernmental Panel on Climate Change. 2023. Sixth Assessment Report (AR6) Synthesis Report (SYR) Summary for Policy Makers (SPM), page 4, footnote 8. https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf.

2 Zhang, Yuzhong, *et al.*, Attribution of the accelerating increase in atmospheric methane during 2010–2018 by inverse analysis of GOSAT observations, *Atmospheric Chemistry and Physics, 21*, 3643–3666, 2021. https://acp.copernicus.org/articles/21/3643/2021/acp-21-3643-2021.pdf.

3 Qu, Zhen, *et al.*, Attribution of the 2020 surge in atmospheric methane by inverse analysis of GOSAT observations, *Environmental Research Letters, 17*, 094003, 2022. https://iopscience.iop.org/article/10.1088/1748-9326/ac8754.

4 Chen, Zichong, *et al.*, African rice cultivation linked to rising methane, *Nature Climate Change*, 2024. https://www.nature.com/articles/s41558-023-01907-x. For a near-final manuscript that does not require a subscription, see: https://acmg.seas.harvard.edu/sites/projects.iq.harvard.edu/files/acmg/files/africa_rice_to_submit.pdf.

About the Program

The Reducing Global Methane Emissions Research Cluster seeks meaningful and sustained progress in reducing global emissions of this very important greenhouse gas — through research and effective engagement with policymakers and key stakeholders. This Cluster is supported by the Salata Institute for Climate and Sustainability at Harvard University. The Institute funds interdisciplinary research focused on producing practical solutions to some of the toughest climate challenges. The five currently-supported Clusters comprise interdisciplinary teams of researchers from across Harvard's schools, whose varied expertise is required to address the complexity of the problems that they seek to solve. Robert N. Stavins, A.J. Meyer Professor of Energy and Economic Development at Harvard Kennedy School, directs the Methane Cluster. The findings, views, and conclusions in this publication are those of the authors alone.