Study quantifies ecological restoration effectiveness on greenhouse gas emissions

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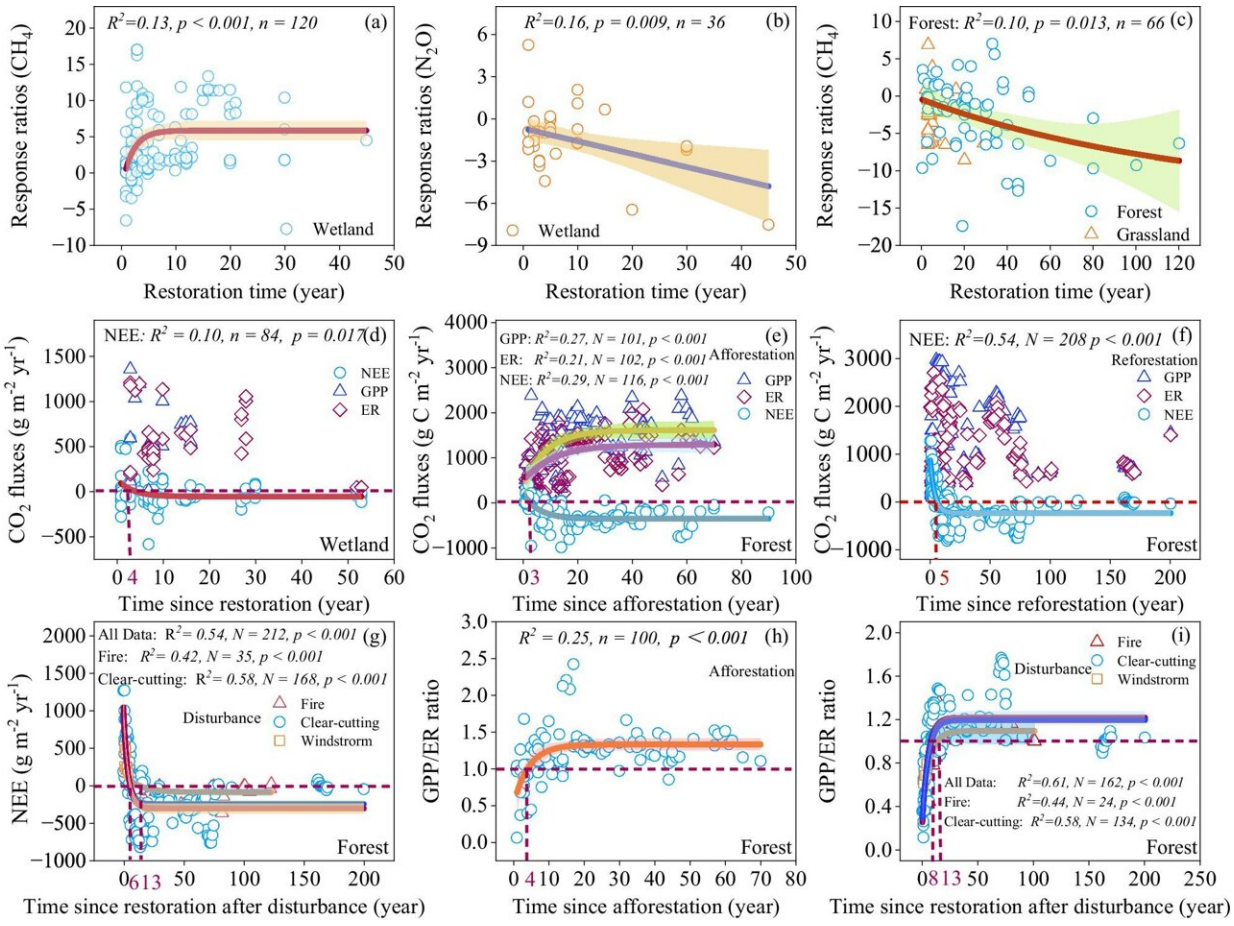

Relationships of the response ratios of CH_4 and N_2O fluxes, and the annual CO_2 fluxes with restoration age. Credit: WBG

Increasing atmospheric concentrations of greenhouse gases (GHGs) are

having irreversible consequences for the future of the Earth. However, the general pattern of the impacts of ecological restoration on the three major GHGs on a global scale has not yet been analyzed.

Land-use change and ecosystem degradation have caused massive anthropogenic emissions of GHG, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), leading to irreversible consequences for the future of the Earth.

In a recent study published in *Nature Communications*, researchers from the Wuhan Botanical Garden (WBG) of the Chinese Academy of Sciences (CAS) have found that restoration of forests, grasslands and wetlands can enhance carbon sink, reduce the global warming potentials, and serve as strategies to mitigate GHG emissions.

This study is a meta-analysis of a global dataset of 253 peer-reviewed articles. The results provide valuable insights for policymakers to select effective ecological restoration measures.

Forests, grasslands, and wetlands are the three major ecosystems that are critical to the global GHG budget, but there are multiple factors (restoration types, methods and age, etc.) that affect GHG.

"Although many studies have investigated the effects of ecological restoration on the emission of one or a few GHGs at the plot or regional level, the general pattern of the impacts of ecological restoration on the three major GHGs at the global scale has not yet been analyzed," said Prof. Zhang Kerong of WNG.

To gain a global perspective, the researchers analyzed data from 235 studies to quantify the impact of ecological restoration on GHG emissions.

They found that forest and grassland restoration significantly increased CH_4 uptake by 90% and 30.8%, respectively, while, wetland restoration significantly increased CH_4 emissions by 544.4%. Forest and grassland restoration had no clear effect on N_2O emissions, while wetland restoration significantly reduced N_2O emissions by 68.6%.

"This study highlights the importance of restoration age in regulating GHG emissions in restored ecosystems," said Dr. He Tiehu of WBG.

Net ecosystem CO_2 exchange (NEE) in wetlands was exponentially and negatively correlated with restoration age, and the transition time from net CO_2 sources to net CO_2 sinks was estimated to be about four years.

The NEE of the restored forests decreased with the age of afforestation and reforestation, and the estimated switchover time from CO_2 sources to net sinks was about three to five years, and about six years for the clear-cut sites and 13 years for the post-fire sites.

Taken together, the study suggests that forest, grassland and wetland restoration could serve as an effective strategy for mitigating GHG emissions and reducing global warming potential.

More information: Tiehu He et al, Meta-analysis shows the impacts of ecological restoration on greenhouse gas emissions, *Nature Communications* (2024). DOI: 10.1038/s41467-024-46991-5

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