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The role of anthropogenic climate change in shaping food security: An explicit assessment of 16 West African countries

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Abstract

Climate change poses a significant threat to food security, particularly through its impacts on agricultural productivity and on livelihoods. Food security is a combination of multiple factors including socio-economic dynamics affecting food access and consumption. Several studies quantify the impacts of climate change on yields, disentangling the effects on other dimensions of food security remains unexplored. We develop a spatially explicit framework for West Africa to evaluate the impacts of hu-man-induced climate change on food security at the grid-cell level. This framework inte-grates crop model simulations with socioeconomic data. Crop yields for key staple crops - maize, sorghum, and peanut are generated using the APSIMx model under two scenarios: one that includes human-induced emissions (factual) and another that excludes them (coun-terfactual). To assess food security, we adopt the FAO framework, focusing on three core pillars: availability, stability, and access and utilisation. Food availability is measured through per capita calorie supply derived from simulated crop production. Stability is eval-uated by analysing interannual variability in yields and the probability of crop failure. Food access is represented using spatially detailed indicators of household income and food af-fordability, capturing the economic capacity of populations to obtain food.

Preliminary results show significant anthropogenic climate impacts on crop yields across the region. While elevated atmospheric CO enhanced yields for certain crops through CO fertilisation, these gains only partially offset the adverse impacts associated with increasing temperatures and rainfall variability. Moreover, the magnitude and direction of these effects are spatially heterogeneous and crop-specific. Importantly, the potential benefits from CO fertilisation are frequently counterbalanced by increased interannual yield variability, a higher incidence of unfavourable growing conditions, and rising food demand driven by population growth. As a result, localised improvements in food availability do not necessarily translate into gains in overall food security. This decoupling is particularly evident in areas with structural socioeconomic constraints, underscoring the multidimensional nature of food security. This study provides a novel framework for analysing food security in impact attribution studies without reducing food security to agricultural production, and quantifies the historical burden of anthropogenic climate impacts on nutrition-relevant food availability in vulnerable regions.

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