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Future scenarios of the African Rice System: Climatic and Socio-economics Pathways

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Between 1990-2018, annual rice consumption in Africa has quadrupled to around 40 Mt. This surge can be attributed to an interplay between rapid population growth and dietary shifts. Despite recent yield advances, rice production increases are lagging behind the growing demand, making the region increasingly import-dependent. Even after the 2008 food crisis, succeeding which many African policymakers presented rice as a flagship for food security by boosting domestic rice-production capacity, Africa's reliance on the international market remains large. Currently, increases in production capacity are driven by acreage extensification rather than intensification, putting pressure on land and jeopardizing sustainable development. How the production of rice will further develop in Africa, and how sustainable this development will be in terms of food security and available land under changing socio-economic and climatic conditions is uncertain.
This research assesses future developments of the African rice system under different socio-economic and climatic scenarios by combining biophysical crop model projections (EPIC) with a spatial economic partial-equilibrium model (GLOBIOM) through the Representative Concentration Pathways (RCP) and Shared Socioeconomic Pathways (SSP) frameworks.

Our results suggest that by 2050, socioeconomic pressures will have a larger impact on future production levels than long-term climate changes on the African rice system. This is mainly explained by strong differences in population estimates between SSP scenarios and by a limited effect of climate change on yields as negative climatic effects including heat- and water stress are projected to be largely outbalanced by CO_2-fertilization effects for rice in Africa. Our simulations do suggest that the expected increase in climatic variability will result in increasing fluctuations in annual yields and production levels in comparison to historical variability. Regions dominated by rainfed systems are particularly vulnerable to such climate shocks, leading not only to variations in production but also in import and consumption levels. Our results also show that disruptions in production have effects beyond the climate-affected region due to bilateral trade. Particularly production shocks in Southeast Asia could have a strong impact on rice availability in Africa

because of the vast import dependency of Africa. The magnitude of the effect of a climate-induced production shock in Southeast Asia on rice consumption levels in some African regions is even comparable to the effect of a similar climate shock on domestic production. Since the robustness of the analysis is strongly linked to the performance of the biophysical crop model, we also present a comparison of these preliminary results to other existing biophysical global gridded crop models (GGCMs).

In summary, we demonstrate that future socio-economic pathways have a more important impact on the African rice system than climate changes in the long term, but that increases in the short-term climate variability strongly affect production and consumption. While trade may partially offset a negative effect of a climate-induced production shock on rice consumption in Africa through increased imports, trade and Africa's import dependence make the continent as vulnerable to climate-induced production shocks in Southeast Asia as in Africa itself.