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Stabilizing Smallholder Farmers' Incomes by a Crop Model Based Yield Insurances Scheme for Tanzania

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Abstract

In Tanzania, smallholder farmers produce most of the food, but their food production is highly vulnerable to climate variability and change. Crop insurance solutions are addressed by the IPCC, G7 and G20 leaders as well as at the last climate conferences as important tools to enhance Sub-Saharan Africa's resilience to climate change and altered weather perils. Weather-related yield losses endanger food security and inhibit establishing a resilient farming system for more than 30 million people in the agricultural sector of Tanzania. If these weather-related yield losses could be efficiently quantified, this information could be used to determine crop insurance loss claims to indemnify smallholder farmers and stabilise their incomes. We show that a combined application of a process-based and statistical crop model improves the robustness of the yield assessments with an efficient use of observed yield information. Furthermore, it allows to separate weather-related yield losses (covered by insurance) from the management-related losses (not covered by insurance). While our process-based model reproduces the plant-physiological impacts of weather, agronomic management, and soil conditions, our statistical model captures the yield impacts of farmers' decisions in the face of changing agronomic and socio-economic conditions. As a result, the combined application of both model types significantly improves the reproduction of actual yield variability from a correlation of r = 0.05 to r = 0.86. Moreover, using our approach, we calculate that only 27 % of the actual yield variability in Tanzania is directly attributable to weather. By considering our approach and its model uncertainty, a potential insurer could save one third — 71 million US$ p.a. (23 US$/ha) — of the insurance claims by identifying weather-related yield losses in the Tanzanian maize production. The implementation of such insurance schemes can contribute to stabilise smallholder farmers' incomes, indemnify their livelihoods and increase their food security.

Keywords: Climate risk, crop model, insurance, maize yield, Tanzania

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