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Scaling-up sustainable intensification practices for rice production in East Africa

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Food security has long been a challenge for East Africa region and is becoming a pressing issue for the coming decades because food demand is expected to increase considerably following rapid population and income growth. Agricultural production in the region is thus required to intensify, in a sustainable way, to keep up with food demand. However, many challenges face the sustainable intensification of the agricultural production including low productivity, inadequate management, small scale operations, and large climate variability. Several pilot initiatives, that involves a bundle of land and water management practices, have been introduced in the region to tackle such challenges. However, their large-scale implementation remains limited. In the framework of a research project which is jointly implemented by the International Institute for Applied System Analysis (IIASA), the Lake Victoria Basin Commission (LVBC) and the International Crops Research Institute for Semi-Arid Tropics (ICRISAT), we analyse up scaling opportunities for water and land management practices for the sustainable and resilient intensification of rice and fodder production systems in the extended Lake Victoria Basin in East Africa. The expected outcome of this project is to provide an improved understanding of up scaling of such practices through model simulations and integrated analysis of political economy aspects, governance and social and gender dimensions.

This paper presents an integrated upscaling modeling framework that combines biophysical suitability analysis and economic optimization. Several production system options (i.e., management practices) for rice intensification are examined at high-spatial resolution (0.5°x0.5°) in the extended Lake Victoria basin. The suitability analysis identifies suitable area for the production system options based on a combination of various biophysical factors such as climate, hydrology, vegetation and soil properties using the Global Agroecological Zones (GAEZ) model and the Community Water Model (CWaTM). The economic optimization identifies the optimal combination of those production systems that maximizes their overall contribution to agricultural economic benefits having satisfied various technical and resource constraints including commodity balance, land availability and suitability, water availability, labor availability and capital constraints. A set of socioeconomic (e.g., impact of population and income growth on food

demand and agricultural productivity) and climate change (e.g., impact on water resources availability) scenarios based on combinations of the Shared Socioeconomic Pathways (SSPs), Representative Concentration Pathways (RCPs), and co-developed bottom-up policy scenarios, through stakeholders' engagement with the Basin Commission (LVBC), have been utilized to simulate the modeling framework. Results of this study show the existence of significant opportunities for the sustainable intensification of rice production in East Africa. Moreover, the study identifies the key biophysical and economic factors that could enable the upscaling of sustainable land and water management practices for rice production in the region. Overall, this study demonstrates the capacity of the proposed upscaling modeling framework as a system approach to address the linkages between the intensification of agricultural production and the sustainable use of natural resources.