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Feed the Future Innovation Lab for Food Security Policy

Policy Research Brief 29 March 2017

Nigeria Agricultural Policy Project

Towards a Systemic Analysis of the Impacts of Climate Change on Agricultural Production in Nigeria

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Climate change and the negative consequences it has on agriculture is already evident in Nigeria and other Sub-Saharan African countries. Mean annual rainfall in the Sahel region is declining and becoming more erratic while the growing season s. The impacts of climate change on the agricultural sector in Nigeria going forward are expected to be severe, but so far there is a dearth of systemic analysis of how these impacts would develop over time, or how they would interact with other drivers impacting Nigerian agriculture. Such a systemic analysis could contribute to adaptation efforts by identifying policy mechanisms that serve as system 'levers' to effect change given the considerable uncertainty associated with both the socio-economic and ecological aspects of climate change. This study begins to provide a systematic analysis of the impact of climate change on agricultural production in Nigeria using a participatory research method. We convened a workshop of key stakeholders with diverse and in-depth knowledge of Nigerian agriculture in Ibadan, Nigeria, in June, 2016. Using a causal loop diagramming (CLD) technique, we grouped these stakeholders by region and led them through an exercise in which they drew diagrams depicting the barriers to, and opportunities for, Nigerian agricultural development. CLD is a method used in system dynamics modeling, and it is effective for identifying causal relationships between variables as well as feedback mechanisms.

As expected, there were interesting differences across the 6 geopolitical zones of Nigeria reflecting their agro ecological differences. However, all groups identified at least one reinforcing feedback loop linked to agricultural productivity (Figure 1). This indicates a current 'low productivity trap'—low productivity levels reinforcing a state of low productivity—which could potentially turn into self-reinforcing productivity gains with some systemic interventions. There was also a clear indication of other environmental factors (separate but linked to climate change) affecting Nigerian agriculture. Across the groups, a total of nine reinforcing feedback loops were identified that are currently keeping the agricultural sector in a 'low productivity trap'. Groups also identified a total of four balancing feedback loops which could limit growing agricultural productivity through pollution, soil degradation, land pressure, and deforestation. According to stakeholders, climate change impacts agricultural productivity via a number of pathways, including variable rainfall, drought and flooding, pest and disease incidence, heat, and desertification.

While climate change was held up by some stakeholders as an important factor in limiting future productivity, other stakeholders pointed to the multiple drivers maintaining the low productivity trap, and to other types of environmental degradation, as more important. This study suggests the need for a quantitative modeling exercise to tease out the relative impacts of these different drivers on the trajectory of agricultural productivity in Nigeria. It also indicates that care should be taken on the part of policy-makers and scientists not to over-emphasize the relative importance of climate change in the context of all other drivers currently limiting agricultural productivity.

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Going forward, we intend to develop a quantitative simulation model using system dynamics methods, based on the causal structure of the CLDs drawn by stakeholders, and focusing on Nigerian staple crops from different regions of the country (maize, rice, sorghum, yam, and cassava).

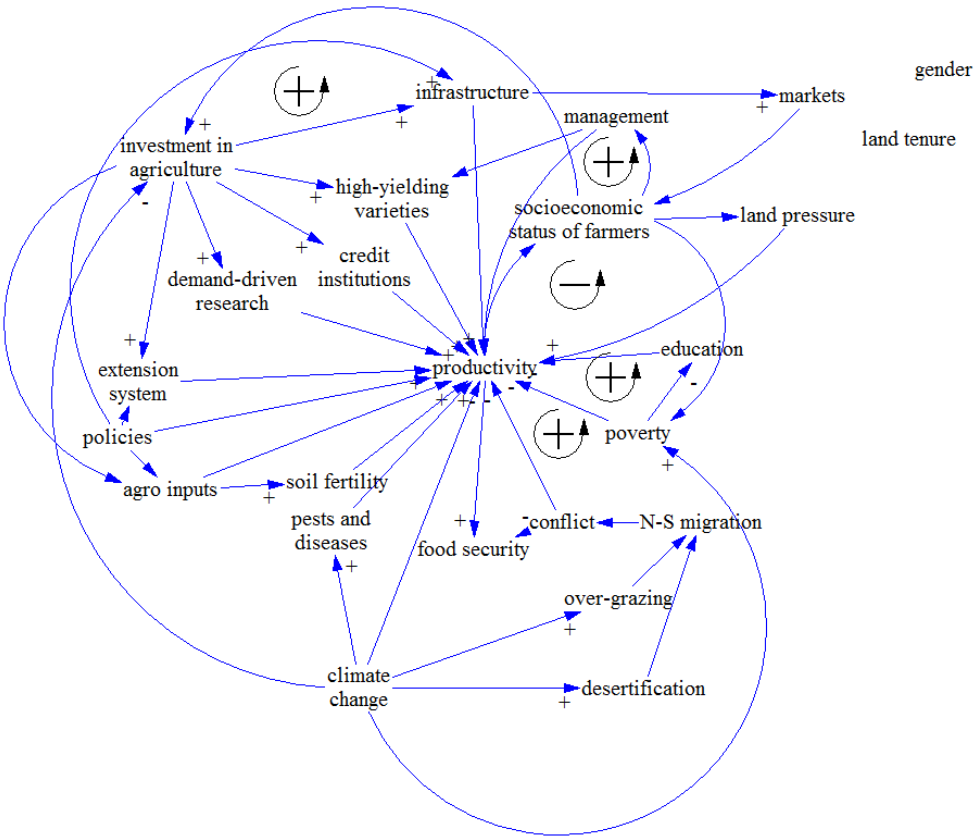

Figure 1: Causal loop diagram generated by stakeholders from Southeastern Nigeria, depicting five feedback loops (four reinforcing and one balancing) involving agricultural productivity. As the socio-economic status of farmers increases, farm management improves, which further improves productivity (R4). However, as the socio-economic status of farmers improves, farms expand and fallow periods reduce, thereby degrading productivity, forming a balancing loop (B1).

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* This brief is based on Schmitt Olabisi, L., S. Liverpool-Tasie, and A. Olajide. Towards a Systemic Analysis of the Impacts of Climate Change on Agricultural Production in Nigeria. Feed The Future Nigeria Agricultural Policy Project Research Report No. 21 September 2016. East Lansing: Michigan State University,

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This Research Paper was prepared for USAID/Nigeria by Michigan State University (MSU), Federal Ministry of Agriculture and Rural Development (Nigeria), and the International Food Policy Research Institute (IFPRI) under the USAID/Nigeria funded Food Security Policy Innovation Lab Associate Award, contract number AID1-620-LA-15-00001.

This research is made possible by the generous support of the American people through the United States Agency for International Development (USAID) under the Feed the Future initiative. The authors wish to thank Patricia Johannes of MSU for her formatting and editing assistance. The contents are the responsibility of study authors and do not necessarily reflect the views of USAID or the United States Government.

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Published by the Department of Agricultural, Food, and Resource Economics, Michigan State University, Justin S. Morrill Hall of Agriculture, 446 West Circle Dr., Room 202, East Lansing, Michigan 48824