GCRFAFRICAP
CLIMATE SMART AGRICULTURE FOR DEVELOPMENT

POLICY TOPIC SUMMARY **March 2022**

Agricultural commercialisation in the context of climate risks

KEY MESSAGES

- iFEED focusses on changes to population-level nutrition security and climate-smart agriculture at the national level. Analysis includes 2050 projections of national food production, nutrition security and emissions for four contrasting scenarios, with resulting implications for national food system policy processes. Subnational simulations of future climate, crops and emissions underpin projected changes at the national level across 16 scenarios for Malawi, South Africa, Tanzania and Zambia.
- In some scenarios there are increases in food production and an increase in crop diversity, but the picture is uneven. Production increases in some scenarios arise through yield gains enabled by intensified production methods, and in some cases this is combined with increasing the area of land used for agricultural production.
- Food production, soil organic carbon and crop diversity generally increase the most in scenarios with high policy implementation/market connectivity/technological transformation/extensive land reform.
- Intensifying production methods, creating monocultures and expanding agricultural land could maximise commercial gains from increasing agricultural production in the short-term, however there are significant risks to this approach.
- Given the significant production, demographic, and environmental challenges for each country over the coming decades, the commercialisation of agriculture as a primary goal without careful consideration could be problematic as it might increase susceptibility to climate impacts, reduce biodiversity, reduce soil organic carbon, increase soil erosion, and increase pollution – thereby increasing the risk of yield losses.
- In the absence of acute climatic shocks, policy decisions, more than climate impacts, are the most significant determinants of agricultural production outcomes. Minimising the adverse impacts and risks of agricultural commercialisation requires a comprehensive and coherent policy approach to enable decision making to be actively informed by and aligned with other social, economic, and environmental objectives from the design stage.

Key findings

- Across all 4 countries, the level of climate risk is less influential on food production outcomes compared to policy implementation (Malawi), market connectivity (Zambia), technological transformation (Tanzania), and land reform (South Africa). Hence, high effectiveness scenarios are likely to significantly mitigate the effects of climate change on production and reduce yield shocks regardless of the level of climate risk.

- Crop yields per unit area more than double on average in effective policy / high technology / connected market scenarios in Malawi, Tanzania and Zambia, where irrigated areas increase and percentage changes to yields match regional percentage increases observed from 1961 to 2010. In the contrasting low change scenarios for those 3 countries, there is little/no change to crop yields and irrigated areas, with the exception of the low market connectivity and high climate risk scenario for Zambia where irrigation increases by around 2000%.
- Crop yields increase by more than 50% in all South Africa scenarios (percentage increases matching half of regional historical percentage increases from 1961 to 2010), with particularly large increases in high climate risk scenarios due to irrigation expansion and additional crop diversification.
- Crop diversity increases in all scenarios in South Africa. In Zambia, crop diversity increases in all scenarios except for 'high climate risk and high market connectivity', where it decreases. In Malawi, high policy efficacy is associated with increased crop diversity. In Tanzania, crop diversity increases in low climate risk scenarios, and decreases in high climate risk scenarios.
- In South Africa, crop and livestock production more than double in every scenario, primarily due to yield increases rather than agricultural land expansions. In Tanzania, production increases significantly in the two high technology scenarios (crop production increases by over 600% and 1600%, and livestock production increases by over 200% and 300%, in low and high climate risk scenarios respectively), due to a combination of yield increases and area expansion, and increases by more than 50% in low technology scenarios due to area expansion only. In Malawi and Zambia, ineffective policy / market scenarios show little change or a slight reduction in agricultural areas and food production, and effective policy / markets lead to a more than doubling of crop and livestock production due to a combination of yield increases and area expansion.
- Intensification of agricultural production on shrinking agricultural land will accelerate soil erosion and carbon losses, which will exacerbate soil degradation in the forms of fertility decline and weakened soil structure. Increasing mechanisation and use of chemical pesticides as part of the commercialisation process could lead to a loss of livelihood for some farm workers and without alternative incomes, exacerbate social inequalities, food security and poverty.
- Gross greenhouse gas emissions (GHGs) (methane and nitrous oxide) generally increase in scenarios with yield and production increases but so too do stores of soil organic carbon (SOC), preventing net increases in GHGs. In 12 scenarios, gross GHGs (methane and nitrous oxide) from agriculture increase, ranging from 45% to 295% above baseline levels. In 8 of these, SOC also increases resulting in net GHGs declining in 7 of them. Emissions intensity decreases in 11 of these scenarios.
- Net GHGs increase, as do emissions intensities, in 4 of the 16 scenarios where declines in production and/or intensification of production result in declines of SOC that outstrip the declines in gross GHGs.
- The only scenario, RCP8.5 HT for Tanzania (characterised by high climate risks and high technological transformation of agriculture), where SOC increases and net GHGs also increase, had the largest production increases across crops, meat and dairy, from all 16 scenarios across the four countries. Emissions intensity (GHGs/unit of production) declines in this scenario, but land used for crops and livestock, and water used for irrigation all increase substantially.

Policy barriers and enablers

- In all four countries, demographic pressures in the coming decades will make food production increases more essential, with population increases between 2000 and 2050 expected to be 285% in Tanzania, 276% in Zambia, 242% in Malawi, and 68% in South Africa.
- Intensifying production methods, creating monocultures and expanding agricultural land could maximise commercial gains from increasing agricultural production in the short-term, however there are significant risks to this approach. The impacts of climate change will increase across all countries and monocultures will increase the risk of yield shocks. Intensifying production methods could reduce SOC and soil fertility, and pollute water supplies. Expanding agricultural land and increasing irrigation could result in increasing conflicts over land and water, and have negative impacts on biodiversity (through habitat clearance, for example). Aligning agricultural production with broader public health, environment and climate goals is essential for minimising negative impacts of agricultural commercialisation.

Policy pathways

- Given the significant production, demographic, and environmental challenges for each country over the coming decades, the pursuit of agricultural commercialisation as a primary goal could be problematic if conventional modalities such as monocultures, land clearance, chemical pesticides and mechanisation fail to account for the broader risks, as this could increase susceptibility to climate impacts, reduce biodiversity, reduce SOC, increase soil erosion, and increase pollution – thereby increasing the risk of yield losses.
- Crop diversification away from maize and increased irrigation are needed to increase productivity and deal with increasing climate extremes, in addition to building and maintaining healthy soils and SOC. Measures include increased crop diversity and improved crop varieties, leaving crop residues on the field after harvest, and implementing conservation agriculture.
- Across all countries, investments and policies need to focus on yield gains and productivity to minimise agricultural land expansion and for agriculture to be sustainable and climate resilient. Diversification and avoiding over-reliance on maize will be important to realise yield gains and mitigate against the losses caused by a changing climate and the associated increase in pests and diseases. This may also allow for improved nutritional outcomes and create new market opportunities, in turn leading to improved incomes and livelihood prospects. Prioritising crop production to nourish humans rather than increasing land for livestock will help to reduce agriculture's land requirements and allow for better nutrition outcomes with fewer resource inputs, and minimise the environmental burden per unit of product.
- While climate risks are common across all countries and will impact agricultural production to a varying extent, policy decisions are the most important factor in determining production outcomes. Even in scenarios that assume high policy effectiveness, additional careful policy considerations are needed to minimise the impacts of agricultural commercialisation on ecosystem degradation, water pollution, biodiversity loss, and livelihoods; and to limit potential conflict over land and water use. Hence, reducing the adverse impacts of agricultural commercialisation requires a comprehensive and coherent policy approach in which agricultural production decisions are actively informed by and aligned with other social, economic, and environmental objectives from the design stage.

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About the Agricultural and Food-system Resilience: Increasing Capacity and Advising Policy (AFRICAP) Programme
The Agricultural and Food-system Resilience: Increasing Capacity and Advising Policy (AFRICAP) programme is a four-year research programme focused on improving evidence-based policy making to develop sustainable, productive, agricultural systems, resilient to climate change. The programme is being implemented in Malawi, South Africa, Tanzania, Zambia, and the UK led by the University of Leeds, in partnership with the Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN), a pan-African multi-stakeholder policy network. The programme is funded by the UK Government from the Global Challenges Research Fund (GCRF), which aims to support research that addresses critical problems in developing countries across the world. It is administered by the UK's Biotechnology and Biological Sciences Research Council (BBSRC) - UK Research and Innovation (UKRI).

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