GCRFAFRICAP
CLIMATE SMART AGRICULTURE FOR DEVELOPMENT

COUNTRY-LEVEL SUMMARY **Nov 2021**

Malawi

KEY MESSAGES

- **iFEED focusses on changes to 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.**
- **Future scenarios for Malawi were characterised by two critical uncertainties – the magnitude of climate risks and effectiveness of agriculture policy implementation. These have been used to develop four future scenarios to explore agricultural productivity and transformation.**
- **Extreme conditions are likely to increase across all scenarios, making relatively bad years in terms of domestic food production more likely.**
- **Greenhouse gas emissions increase in scenarios with low policy effectiveness and decrease in scenarios with high policy effectiveness.**
- **The amount of food produced, agricultural land area, and area under irrigation all increase substantially in scenarios with high policy implementation effectiveness - through intensification of agricultural production; and crop diversity is largely different from the baseline (all crops have an equal cropland area, with a large diversification away from maize).**
- **If relying on trade to achieve nutrition security, this would require importing more than half of calories in scenarios with low policy effectiveness; whereas around half of calories produced could be exported without compromising nutrition security in scenarios with high policy effectiveness.**
- **The expected outcomes under each scenario are largely determined by the level of policy effectiveness, rather than climate impacts alone. Hence, in a scenario with lower climate impacts, food and nutrition security outcomes could be much less favourable compared to a higher climate impact scenario that has a greater policy response to adapt agricultural production.**
- **Even in scenarios with high implementation effectiveness, additional careful policy considerations are needed to minimise the impacts of increased food production on water pollution and biodiversity loss, and limit potential conflict over land and water use.**

Future scenarios

A participatory workshop was used to describe four contrasting and comprehensive future scenarios for the Malawi food system. These scenarios were characterised by the magnitude of climate risks (low (RCP2.6) to high (RCP8.5)) and the effectiveness of agriculture policy implementation (effective or ineffective policy implementation): **'path to heaven'** RCP2.6 - HT (characterised by low climate risks and effective policy implementation); **'degrading economy'** RCP2.6 - LT (characterised by low climate risks and ineffective policy implementation); **'demanding but coping'** RCP8.5 - HT (characterised by high climate risks and effective policy implementation) and **'road to hell'** RCP8.5 - LT (characterised by high climates risks and ineffective policy implementation).

KEY MESSAGES: climate extremes

- Extreme conditions are likely to increase across all scenarios, making relatively bad years in terms of domestic food production more likely. In the 2 scenarios with low implementation effectiveness (LT), increases in average temperatures, as well as more frequent temperature and rainfall extremes increase the chance of yield shocks and yield variability, making significant reductions in domestic food production more likely. Increasing intensity of rainfall would also accelerate soil erosion.
- A lack of agricultural diversity combined with a low implementation effectiveness are key factors that lower resilience/increase vulnerability to climate extremes in these 2 scenarios. Conversely, in the 2 scenarios with high implementation effectiveness (HT), effective design and strategic implementation of policy with high technology investments such as irrigation use and promotion of diverse cropping systems, improved farmer access to enhanced cultivars, and promotion of climate-smart technologies substantially improve yield and reduce yield shocks by 2050.

KEY MESSAGES: Impacts on and implications for agricultural systems

- In the 2 scenarios with low implementation effectiveness (LT), changes in food production range from -14% (RCP8.5) to -1% (RCP2.6) for crops; -13% (RCP8.5) to -1% (RCP2.6) for meat; and 2% (RCP2.6) to 6% (RCP8.5) for dairy. Maize continues to occupy the largest cropland area. The agricultural land area (arable and pasture) varies from relatively unchanged (RCP2.6) to a 10% reduction (RCP8.5). Land conflicts are expected to increase e.g. between livestock and crop production.
- In the 2 scenarios with high implementation effectiveness (HT), changes in food production increase substantially compared to the baseline through intensification and homogenisation of agricultural production. The increases range from 719% (RCP8.5) to 728% (RCP2.6) for crops; 151% (RCP2.6) to 152% (RCP8.5) for meat; and 237% (RCP2.6) to 243% (RCP8.5) for dairy. Intensification of agricultural production could accelerate soil erosion and carbon loss - exacerbating soil degradation in the forms of fertility decline and weakened soil structure. Crop diversity is largely different from the baseline (all crops have an equal cropland area, with a large diversification away from maize). Agricultural land area increases substantially in both scenarios. With expansion of cropland/pasture, woodlands could come under pressure – including miombo woodlands (which are not classed as forest), with potentially adverse implications for biodiversity and soil carbon if forests are replaced with agriculture. Land conflicts are expected to increase e.g. between livestock and crop production, and non-agricultural users. A decline in environmental sustainability/health and ecosystem services is expected.
- Impacts on crop yields vary across the scenarios, ranging from a mean yield decrease for most crops (RCP8.5 LT) to a more than doubling (RCP2.6 HT and RCP8.5 HT). Without adaptation to climate change, maize yields are expected to decline by 30% (RCP8.5) to 19% across many regions (RCP2.6) in the LT scenarios. Crop yield change (and production) is driven by climate change only in the LT scenarios (there are no technological improvements). Yields of non-maize crops such as soybean could potentially increase (due to increased atmospheric CO_2 levels). Compared to present day, significant yield penalties are expected to occur 2-3 times

more frequently for maize and groundnut, ~6 times more for potato, and only 0-1 times more for soybean (RCP8.5).

- In the 2 scenarios with high implementation effectiveness (HT), the area under irrigation increases substantially. In the 2 scenarios with low implementation effectiveness (LT), changes to irrigation water demand range from -10% (RCP 8.5) to 13% (RCP2.6). In all scenarios except RCP2.6 LT, there is an expected increase in competition for water with a likely rise in conflicts between agricultural users (livestock and crop producers) and downstream consumers across different sectors and geographical boundaries.
- In scenario RCP2.6 LT, there are no significant changes to crop and livestock pests and diseases (20-40% loss is expected). In RCP8.5 LT, elevated CO_2 levels alter the type of diseases prevalent, and higher daily temperatures increase disease incidence – likely resulting in higher crop damage and yield losses, and an increased need for veterinary services (to deal with potential increase in disease / heat stress) for livestock.
- In the 2 scenarios with high implementation effectiveness (HT), an increase in crop pest and disease (CPD) prevalence and damage results from homogenisation of agricultural systems, intensive cultivation, monocropping, and a reduction in biological control. Such production circumstances could also facilitate introduction and establishment of novel transboundary pests and diseases and invasive species that could have a devastating impact on production (60-100% yield losses in RCP2.6 HT). Resultantly, a high use/reliance on chemical inputs (pesticides, herbicides, and fungicides) is expected, increasing food production costs and water pollution, and possibly negatively impacting human health. Additionally, climate change will increase susceptibility of CPD-induced crop damages and yield losses by facilitating an increase in CPD distribution and prevalence (especially in the highland areas in Malawi) (RCP8.5 HT).

KEY MESSAGES: trade and nutrition trade-offs

- In the 2 scenarios with low implementation effectiveness (LT), food and nutrition security is not achieved for most nutrients under the non-optimised trade scenarios. If relying on trade to achieve food and nutrition security, given shortfalls in domestic production, 59% (RCP2.6) to 65% (RCP8.5) of calories would need to come from imports - owing partly to a 242% population rise. To ensure that all macro- and micro-nutrient requirements are met, rather than just energy requirements, these imports would need to include a particular mix of nutrient-dense foods, resulting in increased dietary diversity.
- Reliance on domestic production for nutrition security may be hampered by an increased cost of agricultural production and food, lack of crop diversity, loss of crops and livestock to pests and diseases, and cassava toxicity (a fourfold increase is expected for RCP8.5 LT). Income reductions due to yield losses could compound these issues, widening wealth-based inequalities in nutrition outcomes (further exacerbated owing to gender-differentiated care roles). Potential consequences of nutrition insecurity include an increased reliance on food aid, detrimental health impacts, and declines in labour productivity. Rural vulnerabilities, poverty and social inequalities maybe exacerbated by inequitable and insecure land tenure.
- In the 2 scenarios with high implementation effectiveness (HT), food and nutrition security is achieved for most nutrients under non-optimised trade scenarios; if using trade to achieve nutrition security, 46% (RCP2.6) to 47% (RCP8.5) of calories produced could be exported whilst still attaining population-level nutrition security. This also indicates some potential to reorientate domestic agriculture to better reflect domestic nutritional requirements.

- Diverse cropping systems may enhance yield stability, food security and climate variability buffering. However, annual droughts result in a fourfold increase in cassava toxicity in both scenarios, which could pose health risks and necessitate a reduction in cassava consumption. Due to policy intervention, no significant change is expected in maize aflatoxin contamination. Higher food availability could in turn reduce food prices and increase affordability. However, increased risk of extreme climate events and severe losses due to CPD mean that relatively bad years in terms of domestic food production could become more common under scenario RCP 8.5 HT.

KEY MESSAGES: policy responses

- The expected outcomes under each scenario are largely determined by the level of policy effectiveness, rather than climate impacts alone. Hence, in a scenario with lower climate impacts, food and nutrition security outcomes could be much less favourable compared to a higher climate impact scenario that has a greater policy response to adapt agricultural production.
- However, even in scenarios with high implementation effectiveness, additional careful policy considerations are needed to minimise the impacts of increased food production on water pollution and biodiversity loss, and limit potential conflict over land and water use.
- The availability and affordability of key resources including new agricultural technologies and suitable seed varieties, and the equitable distribution of land tenure will determine whether farmers are able to maintain their incomes from food production or transition to new livelihoods.
- Diversification of crops will be important to mitigate against the losses caused by a changing climate, and the associated increase in pest and disease burden. Minimising crop losses is crucial for nutrition security, to avoid food prices rising beyond affordable levels.
- Nutrition security could be further improved by optimising nutrition using trade and reorientating domestic agriculture to better reflect domestic nutritional requirements – which requires high policy effectiveness.

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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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