STRATEGY SUPPORT PROGRAM | POLICY NOTE 25 MAY 2025

Synopsis: Cost effective options for inclusive and sustainable development in Rwanda

Emerta Aragie, Josue Niyonsingiza, James Thurlow, James Warner, Valencia Wenqian Xu

Summary

- The study systematically ranks investment options in the agrifood system based on their cost-effectiveness across multiple development outcomes.
- Investments in SME processors and traders and livestock extension are the most cost-effective for promoting agrifood GDP growth and employment.
- SMEs and livestock services together with seed systems and credit access contribute positively to social outcomes (poverty, undernourishment, and diet).
- The analysis finds a trade-off between economic gains and environmental outcomes—higher GDP effects often come with greater environmental costs.
- The Rwandan case demonstrates a slight shift in the relative cost-effectiveness of investments when accounting for historical climatic risks.
- The study emphasizes the need for data-driven investment planning, climate-aware policies, and balancing short-term gains with long-term sustainability objectives.

Introduction

The agrifood system in Rwanda is the engine of growth, the main employer, and the source of livelihood for the majority of the population. However, its main constituent is low-productivity agriculture, which struggles to supply affordable high-quality food for the growing population. Providing technical and financial support to agriculture and allied sectors is crucial to achieving this transformation. As such, the country has been implementing a series of Strategic Plan for Agricultural Transformation (PSTA) programs. In order to maximize efficiency, policies and investments should be evaluated in terms of their impact on key economic outcomes, such as economic growth or job creation, as well as social outcomes, such as poverty, undernourishment, or diet deprivation and increasingly, policymakers and development partners are incorporating environmental sustainability considerations into their assessments.

Furthermore, the effectiveness of policies or investments may be affected by unanticipated shocks facing the economy. Changes in temperature and precipitation and their distributions are the key drivers of climate and weather-related disasters that negatively affect Rwandans and the overall economy.[1] While there is little doubt these climatic shocks adversely affect the performance of the agri-food system and, therefore, the effectiveness of agrifood system policies and investments in general, it is not evident whether climatic shocks would also alter the prioritization of these policies and investments.

This policy note briefly reports data- and model-driven insights on the design and prioritization of agrifood system interventions in Rwanda, considering both the current state of the system in the country and the emerging risks that threaten its performance, sustainability, and resilience.[2]. In this study, we systematically evaluate a range of investment options and rank them based on their cost-effectiveness in delivering multiple development outcomes, including agrifood GDP growth, agrifood job creation, poverty reduction, undernourishment reduction, and improvements in diet deprivation. To assess the impacts of these investments on the environment, we calculate the associated environmental footprints, focusing on water, emission, and land. We also analyze how these investment rankings shift when the system is exposed to a 1-in-25-year production shock event with varying adverse crop yield effects across the agricultural sub-sector (the design of these sensitivity scenarios is informed by observed historical climatic shocks).

Modeling approach

This study estimates the impacts of alternative agrifood system investments on the Rwandan economy across key outcome indicators which are categorized as economic, social, and environmental. We apply IFPRI's RIAPA modeling system (IFPRI, 2023) which uniquely integrates an investment module that translates identified investments into changes in productivity at the subsector level; a household survey-based microsimulation module that estimates changes in poverty, undernourishment, and diet deprivation; and a newly incorporated environment module that computes environmental footprints, including impact on water utilization, emission, and land use (Figure 1). This integrated RIAPA framework thus enables a comprehensive assessment of investment impacts. The Rwanda model is calibrated to the 2022 Social Accounting Matrix (SAM) for the country that includes disaggregated agricultural and non-agricultural sectors. These models capture the interlinkages between sectors, households, and rural-urban economies, making them well-suited for assessing the economywide effects of public policies.
The model is used to produce a baseline that follows historical levels of economic and sectoral growth, population and labor force growth, and levels of government spending. This "business-as-usual" scenario runs until 2045. All investment scenarios are compared against this baseline.

Scenario design

This study assesses the impact of eighteen different investment areas. We assume a marginal increase of $25 million in spending per year from 2025-2030 for each investment area. The relative effectiveness of each intervention is assessed based on its effect in driving different development outcomes by 2045. To bring future returns to their current equivalent for comparability reasons, we discount the future impacts using a discount rate of 4%. Investments are grouped into five broad types of interventions: (i) research and development (or R&D), (ii) extension and advisory services, (iii) markets and food systems, (iv) risk reduction and resilience, and (v) infrastructure.

[1] MoE (Ministry of Environment). 2020. Updated Nationally Determined Contribution. Ministry of Environment (MoE), Kigali.

[2] Detailed discussion of the method of analysis and results are available in Aragie et al. 2025. Rwanda: Cost effective options for inclusive and sustainable development. Agrifood Investment Prioritization Country Series Brief 2. Washington, DC: International Food Policy Research Institute. https://hdl.handle.net/10568/174468

We grouped each outcome indicators as follows: Agrifood system GDP and job creation are grouped to create composite economic outcome score; poverty, undernourishment and diet deprivation impacts are grouped to create composite social outcome score, and water, emission and land footprint impacts are groped to show overall environmental outcome score for each intervention.

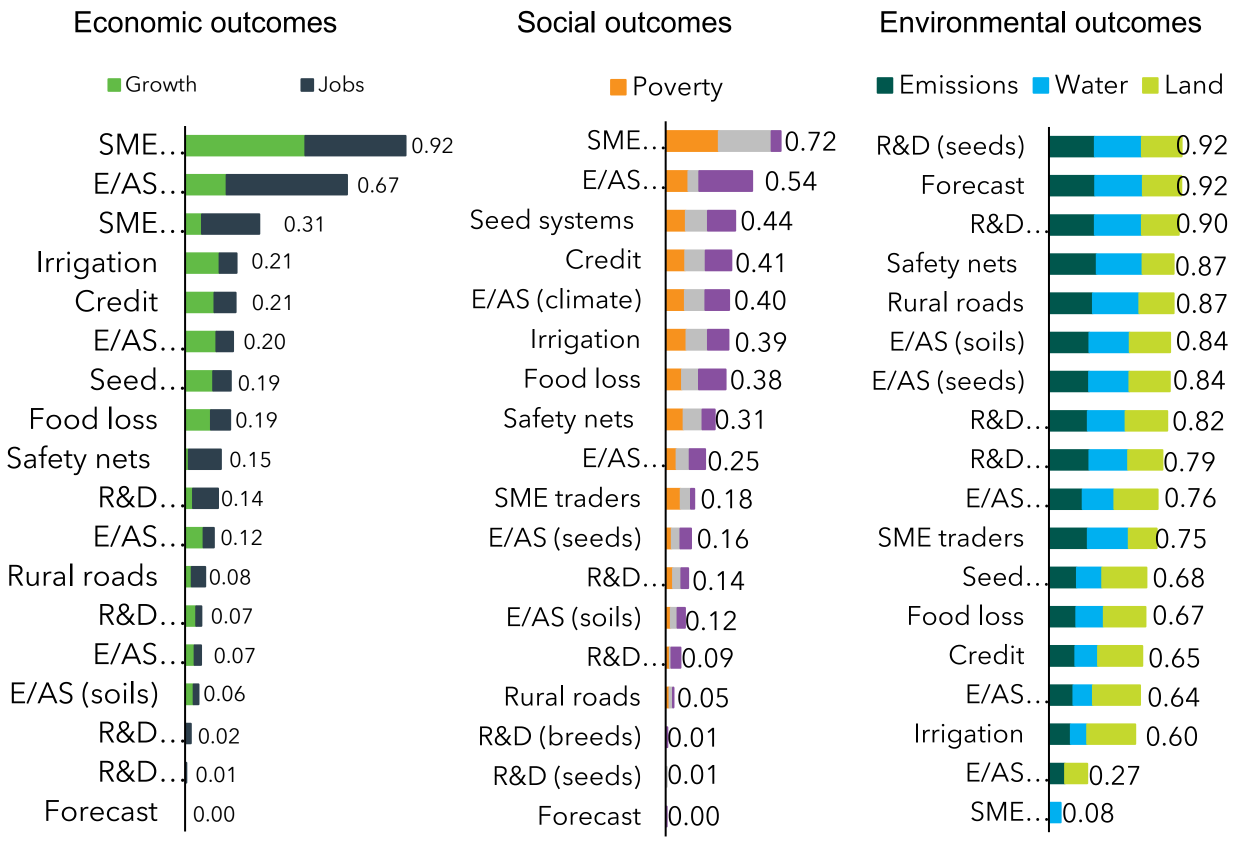
Composite score of investments by their impact on selected outcome indicators

We noted from the results that no single intervention was ranked top across all individual outcomes assessed and that we witnessed potential tradeoffs across these indicators. In this section, we construct composite scores of the interventions by their impact on each group of outcomes. This is done in steps. First, we normalize the intervention scores for each outcome, attaching a value of 1 to the most cost-effective and 0 to the least cost-effective. Second, we then attach equal weights to each outcome in a group. Third, we sum up the weighted scores of the outcomes for each intervention to use it for ranking the interventions based on their overall impact. For example, when creating the composite score for the interventions based on their overall economic outcome, an equal weight – 50 percent each – is attached to growth and job creation, assuming equal preference by policymakers for these outcomes. Finally, for each intervention, we sum the weighted scores for growth and job creation to produce an overall score, which is then used to rank all interventions.

Figure 1 ranks investing in SME processors as the most cost-effective option for expanding the agrifood system's GDP and employment. This effect of investment in SME processors was greatly contributed to by stronger growth in agrifood GDP. Livestock extension/advisory services and irrigation infrastructure are among the most cost-effective investments, mainly driven by faster growth in agrifood system employment. Improving access to credit and climate information, facilitating the seed system, and reducing food loss and waste are among the more cost-effective resilience investments. Figure 1 further reports composite scores of interventions based on their overall impacts on social outcomes, summarizing their effects on poverty, undernourishment, and diet. The overall impact is constructed by summing together each indicator's normalized score assuming equal weights. Similar to the economic outcome scores, investing in SME processors ranks as the most cost-effective option for achieving greater progress in poverty reduction, improvement in the rate of undernourishment, and diversity of diets. Providing extension services to the livestock sector and climate information can cost-effectively promote greater social outcomes. Investing in irrigation, reducing food loss and waste, extending farmers' credit and functioning safety nets are among the cross-cutting interventions with stronger effects, mainly on undernourishment and diet deprivation.

The last panel in Figure 1 reports the composite score of the interventions based on their overall effects on the three environmental indicators, namely water, emission, and land footprint, each receiving equal weight. Interventions with greater GDP effects tend to have undesirable environmental outcomes, demonstrating tradeoffs. Livestock-related investments such as farmer-facing extension services appear the most resource-intensive, mainly due to their high water use and emission per output. Market and food system investments such as spending on SME traders and processors, seed systems, and credit packages are among the most resource-demanding spending options. Irrigation expansion also contributes highly to the environmental footprint, mainly due to increased water use. By contrast, most farmer-facing interventions such as extension and advisory services on seed, agronomy, and soil management have the least environmental footprint effect due to their limited effect on the economy.

Figure 1: Composite scores on economic, social, and environmental outcomes by investment area efficiency

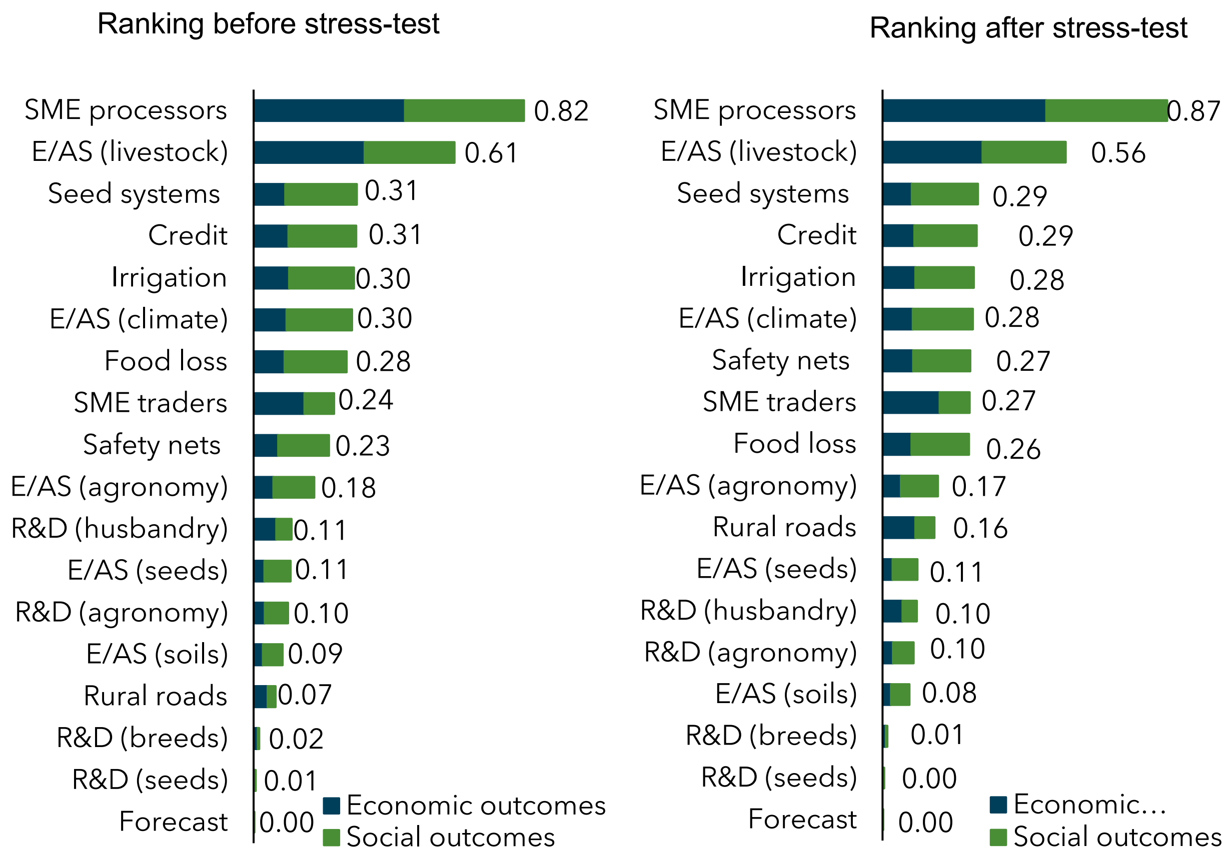


Source: RIAPA modeling system.

This section reports on how investment rankings might change when a 1-in-25-year drought shock permanently slashes the yield gains throughout the simulation period (2025-2045). Of course, climatic shocks are unanticipated events, and so these simulations should not necessarily influence policymakers' decisions, but they do shed light on the robustness of the ranking results. The Rwandan case demonstrates a few changes in rankings (Figure 2). The top half cost-effective investments maintain their benefit-cost ranks even after accounting for the production risks discussed earlier, mainly because these investments target market and downstream food system actors that are not directly affected by the production shock.

However, the cost-effectiveness of R&D investments in agronomy and animal husbandry interventions fall slightly, especially when accounting for the environmental dimension in the assessment of ranks. The relative cost-effectiveness of food loss and waste reduction investments also decline moderately due to the direct and disproportional effect of the simulated 1-in-25-year production shock on targeted sectors. By contrast, safety nets directly impact households, demonstrating a strong improvement in relative impact when extreme shocks are likely. Investments on rural roads also show an improvement in ranking since this intervention improves the performance of the wider rural economy by enhancing productivity and intersectoral linkages.

Figure 2: Rankings of interventions after stress-testing.



Detailed analysis of the ranking of interventions based on the sub-sectors they target also show priority areas where targeted investment could substantially enhance the overall performance of the cross-cutting intervention. The study suggests that investments in cash crops, concentrating food loss and waste reduction efforts on horticulture and cash crops—as well as expanding irrigation access for horticultural and cash crop producers—would significantly improve the effectiveness of agrifood system investments. Supporting SME processors also remains one of the top cross-cutting interventions in terms of its impact on social and economic outcomes.

Summary

This policy note reported a research output that systematically evaluates a range of investment options, ranking them based on their cost-effectiveness in delivering multiple development outcomes, including economic growth, job creation, poverty reduction, undernourishment reduction, improvements in diet diversity, and environmental impact indicators (water, emissions, and land footprints).

We observe from the results that investing in SME processors and traders as the most cost-effective option for expanding the agrifood GDP and employment. Livestock extension/advisory services are the most cost-effective farmer-facing investments, mainly driven by faster growth in agrifood system employment. Similar to the economic outcome scores, investing in SME processors and advisory services to livestock producers rank as the most cost-effective option for achieving greater progress in poverty reduction, improvement in the rate of undernourishment, and diversity of diets. Improved seed systems and credit access are among the interventions that promote greater social outcomes. However, most farmer-facing interventions such as extension and advisory services on crops rank as the least cost-effective in relation to their effects on economic and social outcomes although they generate the least environmental footprint principally because of overall weaker impacts on production. Overall, interventions with greater GDP effects tend to have undesirable environmental outcomes, demonstrating tradeoffs. This analysis also reveals modest changes in the relative cost-effectiveness of interventions when the system is exposed to extreme production shocks.

Several general policy messages can be drawn from this analysis. Firstly, not only have we demonstrated that integrating data- and model-driven insights into policy and investment prioritization decisions is feasible, but it is also important to do so given synergies and tradeoffs across of these investments on development outcomes. Secondly, considering the environmental implications of policy and investment decisions is critical to ensure that the adverse effects of climate change or environmental degradation do not fall disproportionately on future generations of poor people. Our analysis highlights the importance of designing appropriate climate adaptation and mitigation policies to help increase productivity and resource use efficiency of sectors identified as drivers of socioeconomic progress.

ABOUT THE AUTHORS

Emerta Aragie is a Research Fellow in IFPRI's Foresight and Policy Modeling Unit, based in Washington, DC

Josue Niyonsingiza is a Senior Research Analyst with Development Strategies and Governance (DSG) unit of IFPRI based in Kigali, Rwanda.

James Thurlow is the Director of IFPRI's Foresight and Policy modeling Unit based in Washington DC.

James Warner is a Research Fellow with Development Strategies and Governance (DSG) unit of IFPRI and Program Leader of Rwanda's SSP, based in Kigali, Rwanda.

Valencia Wenqian Xu is a Research Analyst in IFPRI's Foresight and Policy modeling Unit based in Washington DC.

ACKNOWLEDGMENTS

This work was undertaken as part of the "Future Food Systems" project funded by the International Affairs Office at the Presidential Court of the United Arab Emirates and the Gates Foundation. The modeling and data systems and analytical techniques were developed with financial support from the CGIAR Science Program on Policy Innovations. We would like to thank all funders who supported this research through their contributions to the CGIAR Trust Fund (www.cgiar.org/funders).

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

1201 Eye St, NW | Washington, DC 20005 USA
T. +1-202-862-5600 | F. +1-202-862-5606
ifpri@cgiar.org
www.ifpri.org | www.ifpri.info

IFPRI-RWANDA

KG 563 Street #7, Kacyiru
P.O. Box 1269 | Kigali, Rwanda
IFPRI-Rwanda@cgiar.org
www.rwanda.ifpri.info