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Cost effective options for inclusive and sustainable development

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This brief is part of IFPRI's series of country studies that utilize the RIAPA modeling system to systematically evaluate and rank agrifood system investment options based on their cost-effectiveness in achieving multiple development objectives. These country studies examine whether the rankings evolve over time and production shocks such as droughts influence their relative cost-effectiveness.

Abstract

In this policy brief, we present research findings of a systematic evaluation and ranking of investment options for Tanzania's agrifood system based on their cost-effectiveness in achieving multiple development outcomes, including agrifood gross domestic product (GDP) growth, agrifood job creation, poverty reduction, declining rates of undernourishment, and lowering diet deprivation. Additionally, the study assesses their environmental footprint, focusing on water consumption, land use, and emissions. Investments in extension and advisory services on livestock are shown to be the most cost-effective in expanding agrifood GDP and jobs. We also find that targeting SME processors generates stronger impacts on jobs, while extension services in agronomy are particularly cost-effective in fostering growth. Similarly, investing in extension services in agronomy and livestock, along with support to SME processors, yields significant gains in social outcomes, though with varying effects on poverty, hunger, and diet quality. However, many cost-effective investments have relatively high environmental footprints, highlighting potential tradeoffs. The study further reveals shifts in the cost-effectiveness ranking of investment options over time and when extreme production shocks occur.

Keywords: Investment priorities, agrifood system, economic, social, environment, Tanzania

Introduction

The agrifood system in Tanzania is the engine of growth, the main employer, and the source of livelihood for millions. However, its main constituent is low-productivity agriculture, which struggles to supply affordable high-quality food for the growing population. This juxtaposition underscores the urgent need for a sustainable transformation of the entire agrifood system. 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 Agriculture Sector Development Programs (ASDPs) for the past two decades (MoA, 2017). However, the specific policy and investment choices, along with the growth patterns they drive, play a decisive role in shaping the magnitude and sustainability of the development gains (Christiaensen and Martin, 2018; Pham and Riedel, 2019). As such, 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. Understanding whether tradeoffs exist across these outcomes can help inform policymakers' decisions about resource allocations. Increasingly, policymakers and development partners are also incorporating environmental sustainability considerations into their assessments. This is based on an enhanced awareness that unsustainable production practices contribute to environmental degradation and to climate change, the burden of which will fall disproportionately on future generations of poor people (GLOPAN 2020).

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 Tanzanians and the overall economy (Randell et al., 2022; Blocher et al., 2024). The main risks that adversely affect the population include droughts, floods, landslides, and storms. With the changing climate, it is fair to assume that these phenomena will increase both in intensity and duration. 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, it is not evident whether climatic shocks would also alter the prioritization of these policies and investments.

In this country brief, we provide data- and model-driven insights to inform policy discussions on the design and prioritization of agrifood system interventions, considering both the current state of the system in Tanzania and the emerging risks that threaten its performance, sustainability, and resilience. 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 nature capital, 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 climatic shocks with varying adverse crop yield effects across the agricultural sub-sector (the design of these sensitivity scenarios is informed by observed historical climatic shocks). This additional layer of analysis ensures policy recommendations are not only effective under normal conditions but also resilient to external risks, providing a more robust framework for guiding agricultural investments in Tanzania.

Results are generated using IFPRI's Rural Investment and Policy Analysis (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 water, emission, and land. As such, this integrated RIAPA framework provides a comprehensive assessment of investment impacts. The RIAPA modeling system has been widely applied to evaluate the economywide impacts of various public expenditure options across different contexts (Thurlow et al. 2007; Pauw and Thurlow 2015; Benfica et al., 2019; Aragie et al., 2019; Aragie et al., 2024).

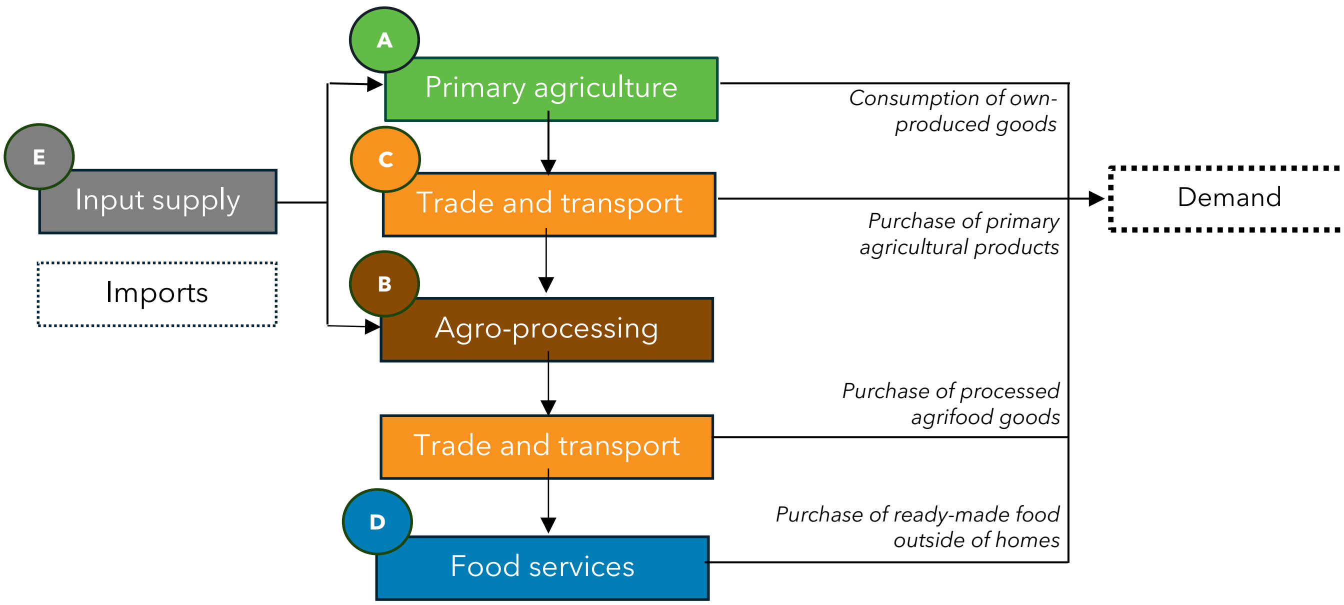
Country Context

Structure of Tanzania's agrifood system

A country's agrifood system involves a complex network of actors linked to each other through their roles in producing, distributing, processing, and consuming primary agricultural and agro-processed products. We measure the agrifood system from a supply-side perspective, leveraging national accounts and employment statistics to directly simulate changes in growth and employment by investment scenarios and over time. By disaggregating the agrifood system into distinct value chain groups and mapping interventions that target improving some of their bottlenecks, this approach provides valuable insights into the key drivers of agrifood system growth and associated environmental impacts in Tanzania.

Figure 1 presents a simplified conceptual framework of the agrifood system, consisting of five key components, labeled **A** to **E** (see Diao et al., 2023). Primary agriculture (**A**) encompasses the supply and demand for all agricultural products, including crops, livestock, fisheries, and forestry products. Agro-processing (**B**) is part of the manufacturing sector and includes subsectors that process agriculture-related food and non-food products. Meanwhile, trade and transport (**C**) involve services related to the transportation, wholesaling, and retailing of agrifood products between farms, firms, and final points of sale. Food services, represented in (**D**), include services such as meals prepared in restaurants, food stalls, or hotels. Finally, input supply (**E**) represents the portion of domestically produced intermediate inputs used directly in agricultural and agro-processing production, such as fertilizers and financial services.

Figure 1: A simple conceptual framework of the agrifood system



Source: Diao et al. (2023)

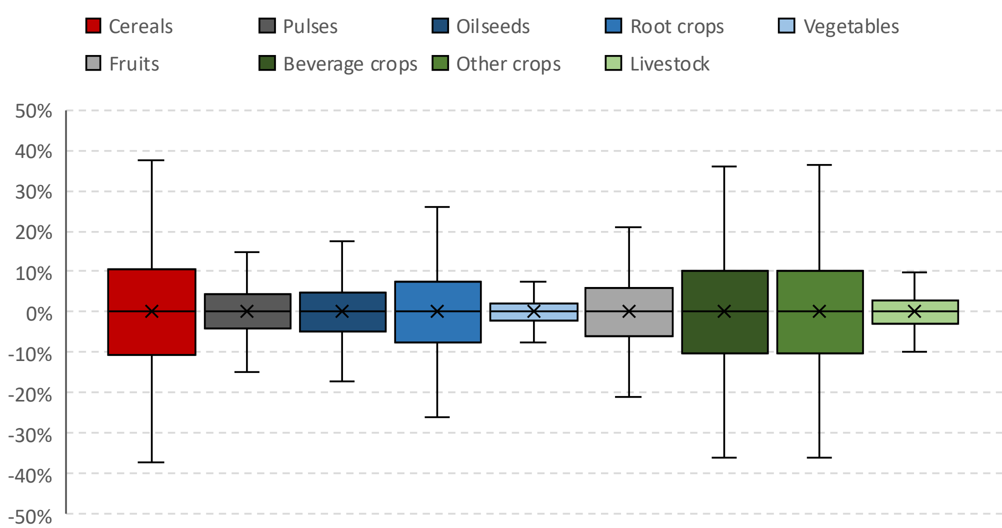
The agrifood system in Tanzania contributes to over 39 percent of gross domestic product (GDP), employing about 79 percent of the workforce (Benfica et al., 2023). Primary agriculture is the engine of growth, accelerating by about 4.2 percent annually over the past decade (World Bank, 2025), and currently contributing to 29 percent of GDP (Benfica et al., 2023). With appropriate policy reforms and targeted investments, the sector has a huge potential to further accelerate and contribute its fair share to Tanzania's economic transition.

Accelerating growth and sustaining high employment levels has long been central development objectives in Tanzania. With a poverty headcount rate of 26 percent in 2020 (NBS, 2021) and notable deficiencies in dietary diversity, the Tanzanian government recognizes the formidable challenge it faces—particularly as it strives to achieve inclusive growth through cleaner, more sustainable means (Simba et al., 2024; URT, 2021). Consequently, there is an increasing policy imperative to assess investment and development strategies not only through traditional economic and social lenses, but also in terms of their environmental and sustainability implications. In this regard, water, emission, and land footprints of activities are worth exploring.

Agricultural production variability in Tanzania

Given the predominance of rainfed production systems, Tanzania's agricultural sector has historically been exposed to weather-related production shocks. These shocks adversely affect the efficacy of technologies; for example, several studies have shown that extreme events can lower the expected yield gains from using modern inputs such as fertilizer and seeds (Kumar and Maiti, 2024; Mafie, 2022). Data show production risks in Tanzania vary across sectors where yields for cereals and beverage crops fluctuate more than yields of pulses and vegetables (see Figure 2). We find from historical data that production losses during a 1-in-25-year production shock event relative to baseline "normal" year could range between 5.4 and 7.1 percent in vegetables and livestock to 26 and 27 percent in cash crops and cereals. This variation in yield effect across sectors highlights different degrees of vulnerability of sectors to climatic shocks. Moreover, there is spatial variation both in the severity of drought conditions and sectors distribution in production, both contributing to the national-level variation in yield impacts across products. In our modeling results, we will test the robustness of our investment ranking to climatic shocks using historical 1-in-25-year drought events as indicative of how such shocks will contribute to sectoral yield losses and alter the impacts of investments.

Figure 2: Historical production variability for crops and livestock



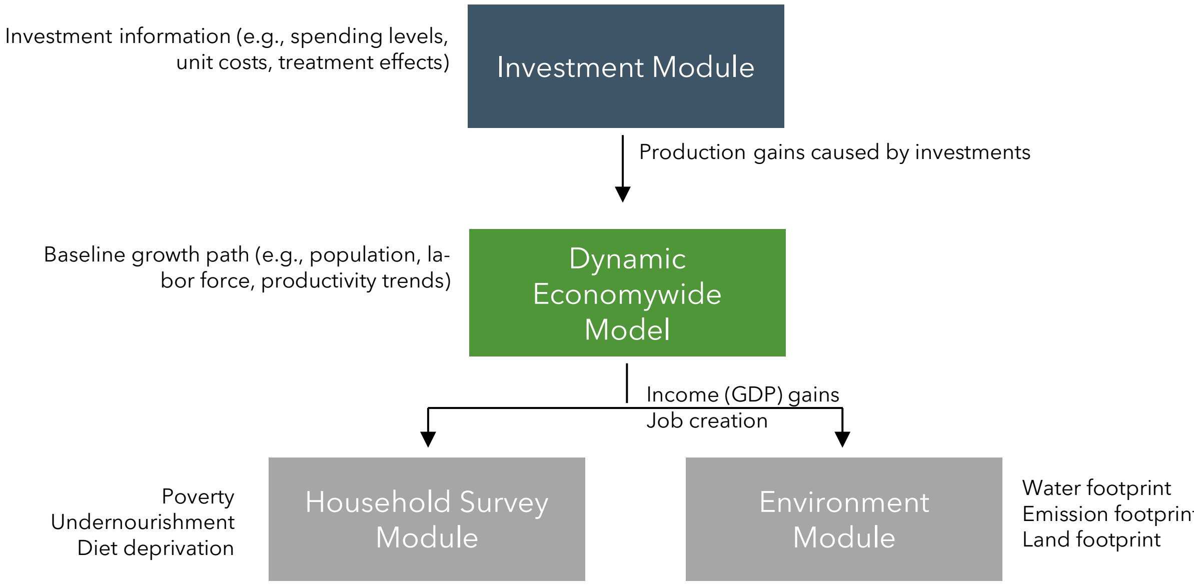
Note: The historical variability values are residual fluctuations from the determined production time series for 1990-2021. Livestock, cereals, and fruits are the three main contributors of agricultural GDP, with shares of 30, 27, and 10 percent, respectively. Pulses and roots follow, contributing about 8 percent each.

Method of Analysis

Modeling approach

This study estimates the impacts of alternative agrifood system investments on the Tanzania economy across key outcome indicators which are categorized as economic, social, and environmental/resource use. 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 3). This integrated RIAPA framework thus enables a comprehensive assessment of investment impacts.

Figure 3: An integrated model for agrifood system investment and outcomes analysis



The economywide model

At the core of the integrated RIAPA framework is IFPRI's standard, recursive-dynamic computable general equilibrium (CGE) model. These models are widely utilized for economic policy formulation and analysis (Dixon and Parmenter, 1996; Devarajan and Robinson, 2010). They capture the interlinkages between sectors, households, and rural-urban economies, making them well-suited for assessing the economywide effects of public policies.

The Tanzania model is calibrated to the 2022 Social Accounting Matrix (SAM) for the country (IFPRI, 2024). The model represents the economy through a set of disaggregated sectors, encompassing 35 agricultural sub-sectors, which include 26 individual crops or groups of crops, six livestock production sectors, as well as forestry, captured fishery, and aquaculture. The model also incorporates 36 industrial sectors—including 17 agro-processing activities—and 12 service sectors, which include food-related areas such as trade, transport, and restaurant services. This detailed representation of both the on-farm and off-farm components of the broader agrifood system permits detailed analysis of agrifood value chains, from primary producers to processors and traders to final consumers.

The Tanzania model also distinguishes 15 representative households, each of which is an aggregation of a group of households captured in the Tanzania Household Budget Survey (HBS) 2017/18 (NBS, 2019). These households are categorized into rural and urban, with rural households further divided into farm and non-farm groups based on their reliance on agriculture as a primary source of income. Finally, each household group is further disaggregated by per capita expenditure quintiles. In the model, households earn labor income and receive returns on their assets, which include land and capital, as well as domestic or foreign transfers.

The CGE 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. As will be seen later, the temporal feature of the model allows us to examine how the effects of various interventions change over time.

The investment module

The investment module is used to synthesize data from several sources to measure at a detailed sectoral level the expected productivity gains that can be attributed to a unit of expenditure on each of a range of agricultural transformation investments. The module used in this study is a newly updated version of the framework previously adopted in various contexts (Aragie et al., 2022; Pauw and Thurlow, 2015; Benfica et al., 2019). The previous version of the investment module was elaborated in Aragie et al. (2024). The updated framework separates agrifood system investments in layers depending on whether they are at the knowledge generation stage (up-stream: e.g., R&D) or innovation dissemination stage (midstream, e.g., seed system), or at the farmgate level (downstream: e.g., seed application at farmer level). In this study, the investment module tracks 18 individual interventions, with many targeting up to six distinct groups of agricultural sectors.

The investment module structures agrifood investments and processes data on the costs and impacts of interventions across targeted sectors. Specifically, it integrates investment details—such as spending levels, unit costs, changes in adoption rates, and impact coefficients (or marginal effects)—as inputs and generates corresponding productivity gains as outputs. Whereas unit costs measure costs per area of farmland or head of animal, adoption rates refer to the extent to which new technology is implemented, expressed as a percentage of the target area or number of animals. The productivity gains are then transmitted to the economywide model, which endogenously adjust the targeted sector's productivity levels. Through direct and indirect economywide linkages, these adjustments drive changes in income, prices, employment levels, and other key economic indicators.

Unit costs are usually obtained from the literature and are retrieved from project planning (such as irrigation master plans) or evaluation documents. Baseline adoption rates and coverage levels are obtained from farm household surveys such as Tanzania's National Sample Census of Agriculture (NSCA) 2019/20 (NBS, 2021a) which reports the number of farmers with access to certain technologies and practices or the cropland covered by those technologies and practices Likewise, impact coefficients—which measure the change in productivity resulting from the adoption of a specific technology or practice—can be estimated using these types of surveys or sourced from existing literature. Alternatively, crop models, which simulate how crops interact with their environment and respond to various factors, can provide usable impact estimates for many crops and interventions. Given these fundamental features of sector-investment combinations, the final productivity gains for each sector will be determined by the level of spending on each intervention. In this brief, an equal amount of hypothetical spending for each intervention area is considered for cost-benefit comparison. An actual budget allocation pattern can also be evaluated using spending data from ministries of agriculture or ministries of finance.

The household survey module

While major economic indicators – changes in economic growth and job creation – are directly calculated from the core economywide model, assessing changes in social and environmental indicators necessitates specialized modules. To this end, the CGE model is linked top-down with household survey-based microsimulation modules measuring changes in poverty, the prevalence of undernourishment, and diet deprivation. Real income changes for different household groups result in diverse effects on these social outcomes.

Changes in poverty are calculated by linking a poverty microsimulation module to the outcome variables of the CGE model—namely, household income, prices, and consumption—following the methodology of Arndt et al. (2012). The changes in real consumption across commodities, derived from the RIAPA model, are then applied to the corresponding households in the Tanzania HBS 2017/18 (NBS, 2019), which are mapped to 15 representative household groups within the CGE model. The new poverty status is computed for all sampled households. Likewise, the undernourishment model uses the same set of households and measures the change in the share of the population below a minimum dietary energy requirement per capita per day.

The process for estimating changes in diet deprivation is similar to that for poverty in that survey households are linked to their respective representative household groups in the CGE model. In this instance, however, modeled changes in real food consumption across six food groups are used to compute changes in the Reference Diet Deprivation (ReDD) index (Pauw et al., 2023), which serves as a multidimensional indicator of a household's diet quality. ReDD index, which is a deprivation gap measure, quantifies shortfalls in consumption relative to a recommended consumption threshold. A decline in the deprivation gap indicates improvement in overall diet deprivation.

The environment module

The environment module uses information on water, emission, and land intensities of sectors to calculate changes in total water, emission, and land footprints of the economy. These footprints change as the structure or size of the economy changes over time. For instance, the expansion of a water-intensive sector, such as rice, can potentially increase the total water footprint of the cereal sector. However, this shift may also result in resource reallocation—such as the increased availability of cheaper animal feed—which could, in turn, accelerate growth in more emission-intensive sectors like livestock.

The data used to calibrate the environment module come from various sources. Whereas the water footprint data for agricultural sectors come from the Water Footprint Network (Mekonnen and Hoekstra, 2010), this source only reports aggerate water footprints for industrial sectors and municipal water withdrawals. In the absence of sector-specific data, we assume water use is distributed across non-agricultural sectors in proportion to their sectoral output shares. Given our focus on agri-food system investments, this assumption, while crude, has little bearing on our results.

Sectors also differ in terms of their emissions intensities. We use total emission data (in tons of CO_2 equivalent) obtained from FAO (2025) and Climate Watch (2025). FAO (2025) reports total emissions generated in the rice sector, other cereals, and livestock sub-sectors, including milk and meat production. We complement this with global-level estimates of emission per kilogram (CO_2 equivalent) for a comprehensive list of commodities compiled by Poor and Nemecek (2018). Climate Watch (2025) reports emissions generated by major manufacturing and service sectors. The resulting emission coefficients for all sectors included in the Tanzania SAM are then scaled using the corresponding sector's output to match total emissions in agriculture, industry, and services.

The land footprint calculation uses the FAO (2025) cropland allocation estimates to calibrate the Tanzania CGE model. Tanzania had 35 million hectares of land under crop cultivation in 2022, the model base year. In addition to this, we incorporate land use for livestock grazing into the land footprint calculation. FAO (2025) reports about 24 million hectares of grazing land in Tanzania in 2022. The country usually practices minimal open-grazing livestock rearing. In our modeling analysis, we assume total agricultural land expands by over 1 percent per annum. Land use by sector may, however, adjust in line with relative changes in land productivity and output.

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. Annex Table 1 includes a detailed list of interventions considered. In short, the interventions include the following:

- R&D investments contribute to the development of improved seed varieties, productive agronomic practices, animal breeds, and animal husbandry.
- Extension and advisory services promote the adoption of improved seeds, agronomic practices, livestock inputs (e.g., feed and vaccines), climate information system, and climate-smart agricultural practices.
- Markets and food system investments are designed to strengthen seed systems, enhance the productivity of small and medium enterprise (SME) processors and traders through access to finance and training, reduce food loss and waste, or improve access to credit.
- Risk reduction and resilience interventions support better decision-making by agrifood system actors by developing improved climate forecasting and providing productive safety nets.
- Infrastructure investments raise overall value chain productivity through expanding irrigation schemes or feeder roads that connect farmers to input and product markets.

Calibration of the investment module requires a range of data inputs for each of the eighteen investment areas. These include adoption rates (or coverage rates), which specify the number of farmers that use a specific technology or service, or the area of land on which technology is applied, as well as yield gains from utilizing those technologies or services. Baseline rates of technology adoption and service coverage rates were obtained from farm household surveys. Productivity impacts of the respective interventions across the targeted sectors are derived from impact evaluation documents and crop and livestock models. Tanzania NSCA 2019/20 (NBS, 2021a) is specifically used to estimate adoption and coverage rates for the various practices and technologies modeled in this analysis. The survey shows moderate fertilizer adoption in cash crop production at about 21 percent of cropland, followed by cereals at 19 percent. Coverage is the least among pulses. Likewise, improved seed adoption is the highest for cash crops (67 percent), cereals (30 percent), and horticulture (25 percent). On the other hand, IFPRI's crop model (IFPRI, 2024) is used to estimate yield gains from adopting different farm practices. For Tanzania, the model reveals stronger cereal yield effect from irrigation infrastructure, followed by information on planting window and the adoption of improved seeds. These investment module parameters, alongside measures such as value-added and output prices, are important determinants of the returns on investments in different technologies or services.

Investment unit costs measure the financial cost of expanding input coverage (e.g., increasing irrigated land by one hectare). These are primarily sourced from impact evaluation studies, sector development plans, and existing literature. A key enhancement in this version of the investment module, compared to its most recent predecessor described in Aragie et al. (2024), is its ability to track the time lag between investment spending and its eventual impact (e.g., for rural roads or irrigation projects that take a number of years to become operational) as well as the duration of that impact (this accounts for depreciation or time-bound interventions). This distinction is crucial, as some investments yield one-time effects while others generate sustained benefits over multiple years.

The agrifood system in Tanzania is historically exposed to production shocks that can reduce the efficiency of technologies and practices. An alternative situation of a permanent decline in yield gain from a 1-in-25-year drought is also considered to test how the rankings of interventions change by 2045 when the system is faced with large climatic shocks.

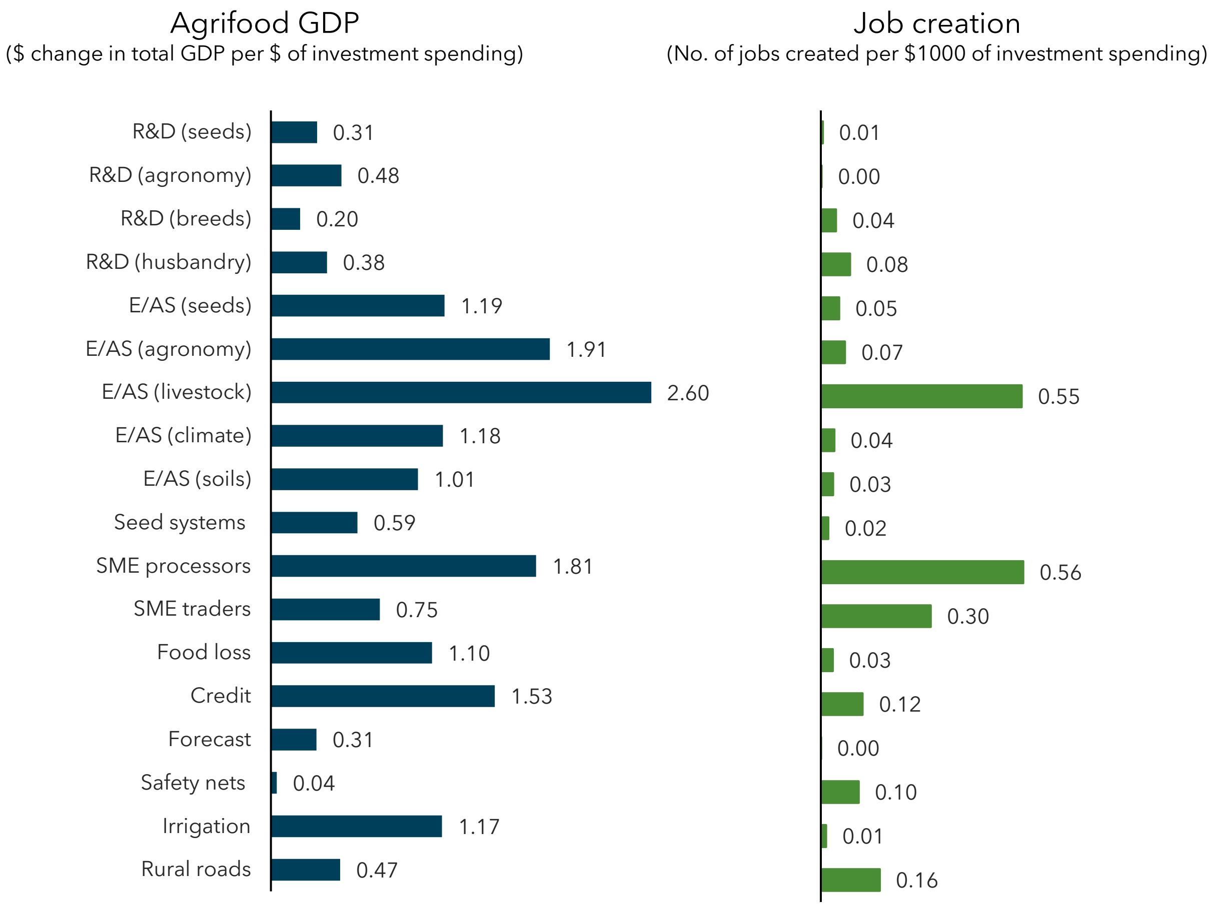
Cost-Effective Investment Options for Inclusive and Sustainable Transformation

Comparing the impacts of investments

We start our comparison of investments based on their impact on two standard economic outcomes: agrifood growth and job creation. These outcome indicators are directly obtained from the economywide model (see Figure 3). Results are reported in Figure 4. These reveal relatively stronger growth effects from investments in SME processors, livestock advisory services, irrigation infrastructure, climate information system, and access to credit to agrifood system practitioners. Specifically, 1-dollar spending on extension and advisory services on livestock could cause a $2.6 gain in agrifood system GDP, whereas such investment on agronomy may generate $1.91 in return (Figure 4). Spending on SME processors and micro credit to farmers also yields economywide benefits comparable to the cost.

Job creation remains an important development challenge for most developing countries, including Tanzania, especially given the continued rapid increase in the working-age population. Notably, model results highlight SME processors and livestock-related interventions as the most effective, generating over 0.55 additional jobs per dollar invested due to their stronger backward and forward linkages across the economy. Spending such as on SME traders, farmers credit, and R&D on animal husbandry are among the top-ranked interventions in terms of their employment impacts. By contrast, most crop-specific interventions, such as advisory services on seeds, soils, and agronomy practices, were found to have minor employment effects.

Figure 4: Comparison of investments based on their cost-effectiveness on economic outcomes

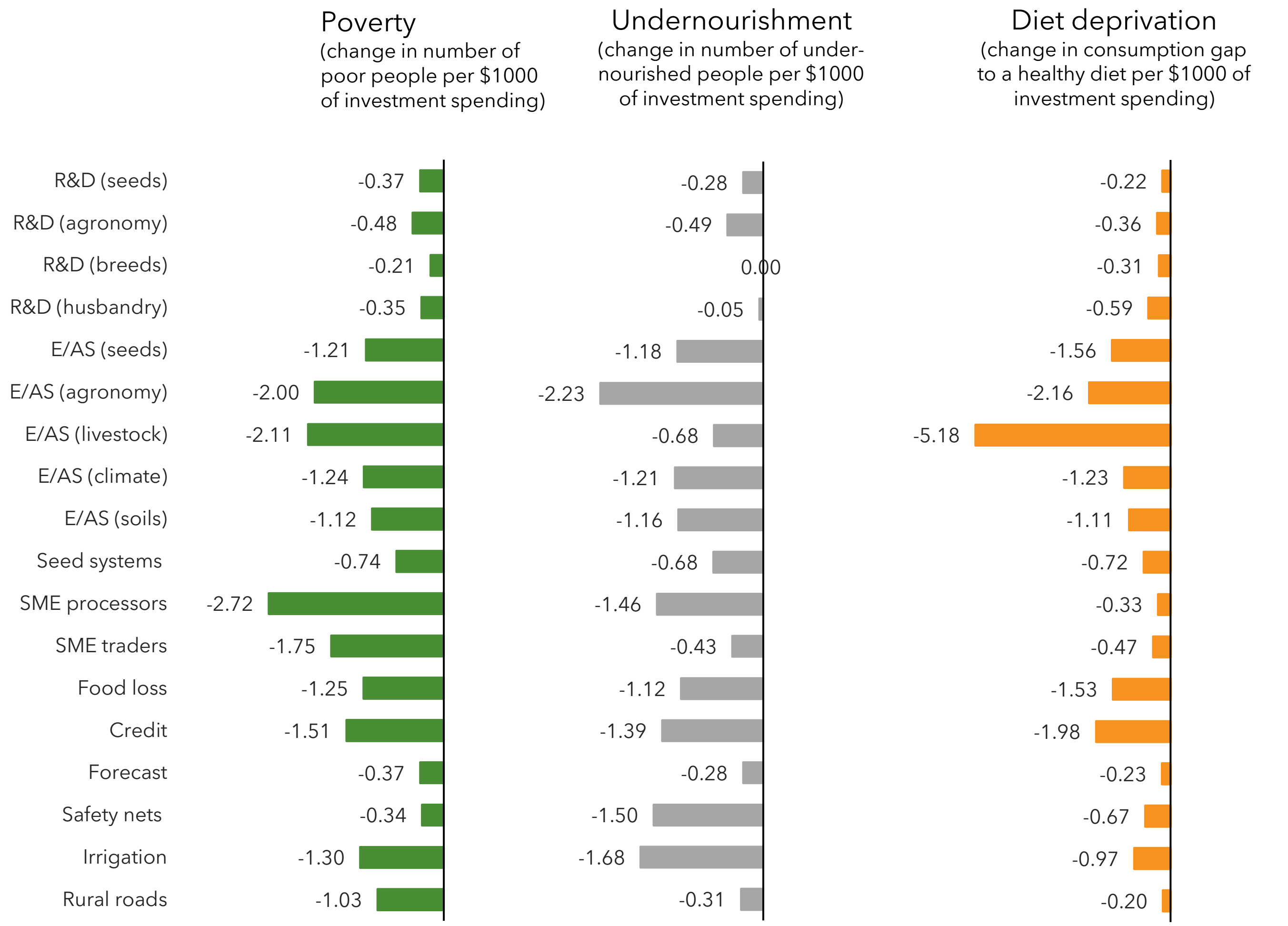


Source: RIAPA modeling system

The three social indicators considered in this study are the poverty headcount, prevalence of undernourishment, and quality of household diets. These are obtained from the various household survey-based microsimulation models incorporated into the RIAPA framework. Results show that investment areas differ in terms of their effectiveness in driving these outcomes (Figure 5). Investing in SME processors and extension and advisory services in agronomy stand at the top in their effects on poverty and undernourishment, partly explained by their strong GDP effects and underlying the role of sectors linked to these investments on the livelihoods of the lower income-quintile households. In addition, extension and advisory services to livestock producers, SME traders, and micro-credit to farmers are the other top-performing spending options for stronger poverty effect.

Regarding effects on undernourishment, irrigation infrastructure, efficient seed systems, productive safety nets, and farmers access to credit emerge among the most cost-effective interventions, driving significant reductions. In contrast, livestock-related interventions appear to have marginal effects on undernourishment, as those engaged in the livestock sector tend to be relatively better-off, limiting the benefits flowing to the most vulnerable populations. However, unlike their impact on poverty and undernourishment, livestock interventions have the strongest diet-diversifying effect. Additionally, investments in agronomy, food loss and waste reduction, and access to credit contribute to greater improvements in diet deprivation by enhancing productivity and improving access to food products, particularly fruits and vegetables, which are often lacking in household diets.

Figure 5: Comparison of investments based on their cost-effectiveness on social outcomes



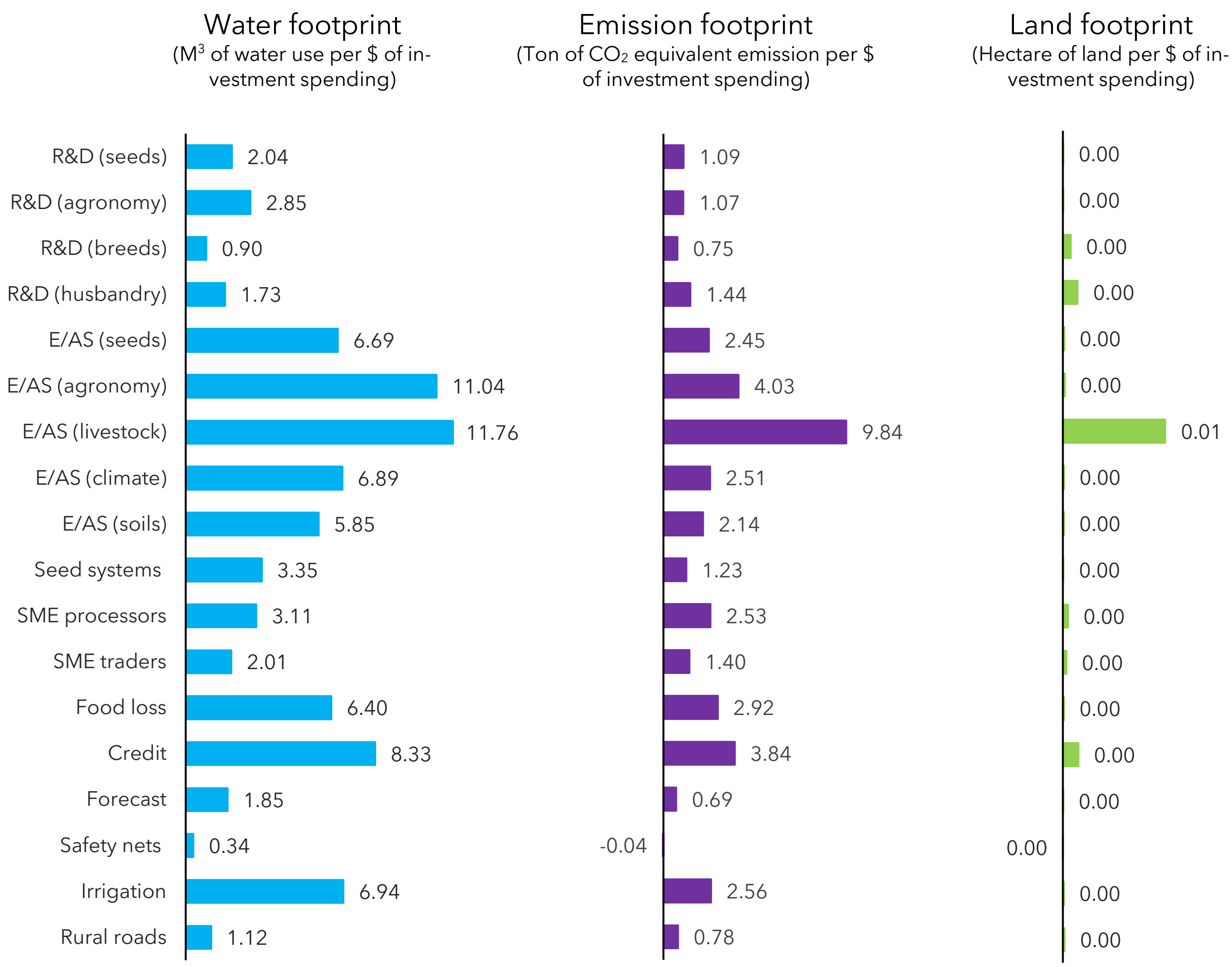
Source: RIAPA modeling system

We also evaluated the various investments based on their resource use or environmental impacts, looking specifically at changes in the economywide water, emissions, and land footprints. The changes in environmental footprints associated with investments will depend on the initial resource intensity of sectors the interventions target, changes in sectoral activity as a result of the interventions, and any indirect adjustments in the economy outside the targeted sector due to economywide linkage effects and changes in resource reallocation. The basic principle here is that increases in environmental footprint per dollar of spending are undesirable.

Results from the environment module show investments in extension services to livestock producers and SME processors consistently rank among the highest across the three environmental indicators, underscoring the resource intensity of sectors that show significant expansion due to these interventions (Figure 6). Investment in extension and advisory services on livestock is by far the leading cause of emissions per dollar spent in Tanzania, followed by similar interventions on agronomy and seeds. Infrastructural and market interventions, including irrigation, farmers' credit access, and food loss reduction have strong emission effects. Investments in food loss and waste reduction, and access to credit together with seed systems result in a stronger increase in emissions since these interventions specifically promote the production of sectors with higher emission footprints. Figure 6 also highlights a stronger economywide water use effect from spending on extension services on agronomy, livestock, and seeds. Investment in irrigation infrastructure is arguably one of the interventions with a stronger water footprint effect, specifically through increased surface and groundwater withdrawal.

The land footprint can show movements in both directions depending on the change in economywide demand for land due to these investments. In the case of Tanzania, land footprint increases strongly (i.e., more land put under cultivation) when investments in livestock advisory are considered. These increases in land footprints are likely due to additional opportunities for land-intensive sectors to grow as economic opportunity changes. Marginal increases in land footprint are observed when investments in livestock-related R&D, including breeds and husbandry, and credit access are considered.

Figure 6: Comparison of investments based on their cost-effectiveness on environmental footprint



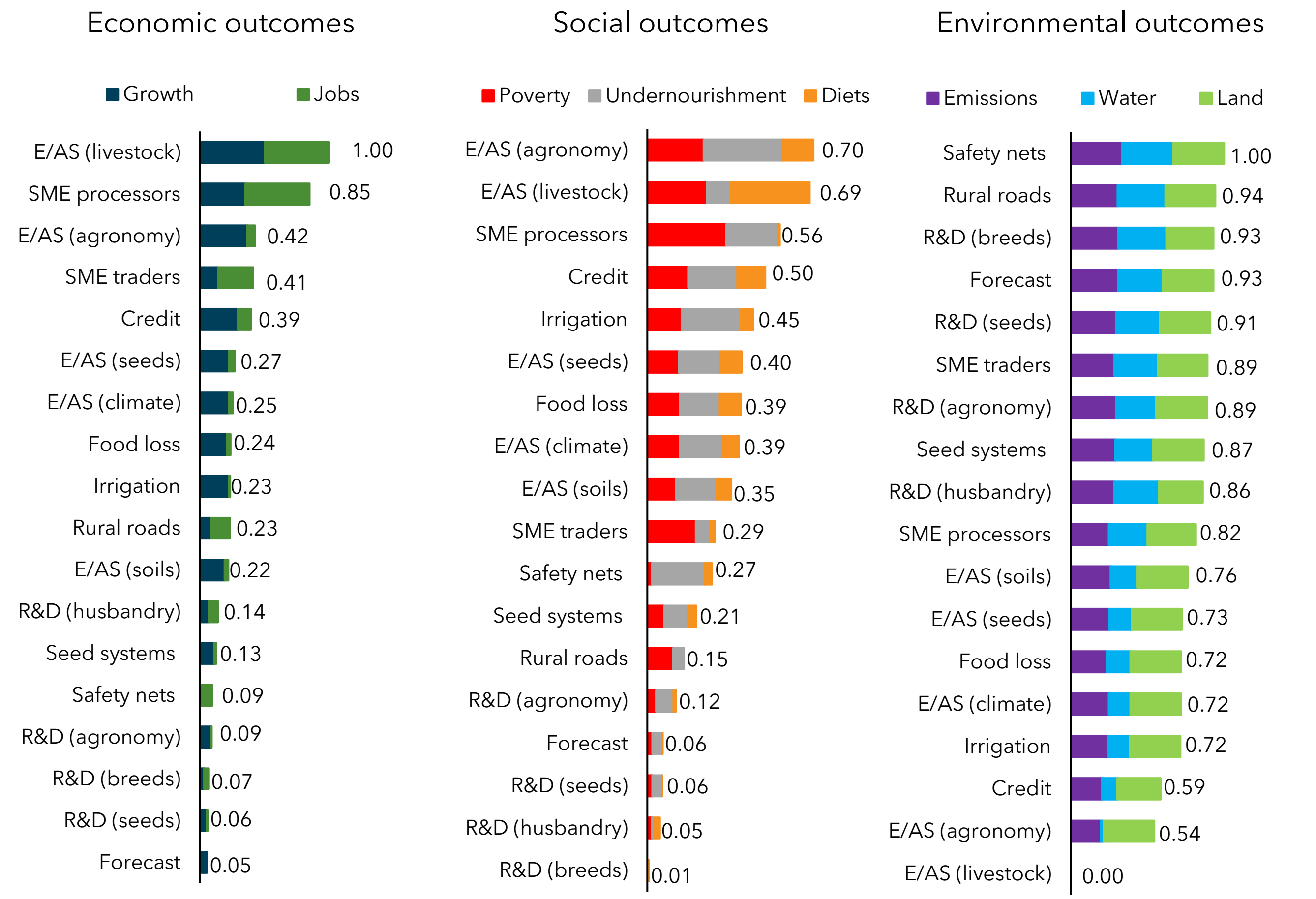
Source: RIAPA modeling system

Composite score of investments by their impact on selected outcome indicators

As presented in the preceding section, investments were ranked by their impacts on a long list of outcomes, grouped into economic, social, and environmental dimensions. We noted from the results that no single intervention was ranked top across all outcomes 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 7 ranks investing in extension and advisory services to livestock and SME processors as the most cost-effective options for expanding the agrifood system's GDP and employment. While investing in advisory services in the livestock sector is equally important for growth and jobs, investing in SME processors greatly contributes to stronger growth in agrifood jobs as these enterprises provide employment opportunities for most workers in the emerging sector. Providing credit, supporting SME traders, and reducing post-harvest food losses are among the most cost-effective market and system interventions. Among R&D investments, animal husbandry has the strongest impact but ranks poorly overall. Irrigation and road infrastructure are among the more cost-effective investments in Tanzania.

Figure 7: Composite scores on economic, social, and environmental outcomes by investment area



Source: RIRPA modeling system

Figure 7 further reports composite scores of interventions based on their overall impacts on social outcomes, summarizing their effects on poverty, undernourishment, and diets. The overall impact is constructed by summing together each indicator's normalized score assuming equal weights. The top three investment options on economic outcomes also rank at the top in their social outcome score. Specifically, investing in extension and advisory services in agronomy and livestock, and SME processors rank as the most cost-effective options for achieving greater progress in poverty reduction, improvement in the rate of undernourishment, and diversity of diets. Extension and advisory services in the seed sector and climate information are top-ranked farmer-facing interventions. Meanwhile, investing in farmers' access to credit and irrigation, and reducing food loss and waste are the market system interventions that can effectively improve social outcomes, mainly through their strong effects on poverty and undernourishment.

The last panel in Figure 7 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 most resource-intensive, mainly due to their higher water use and emission per output.

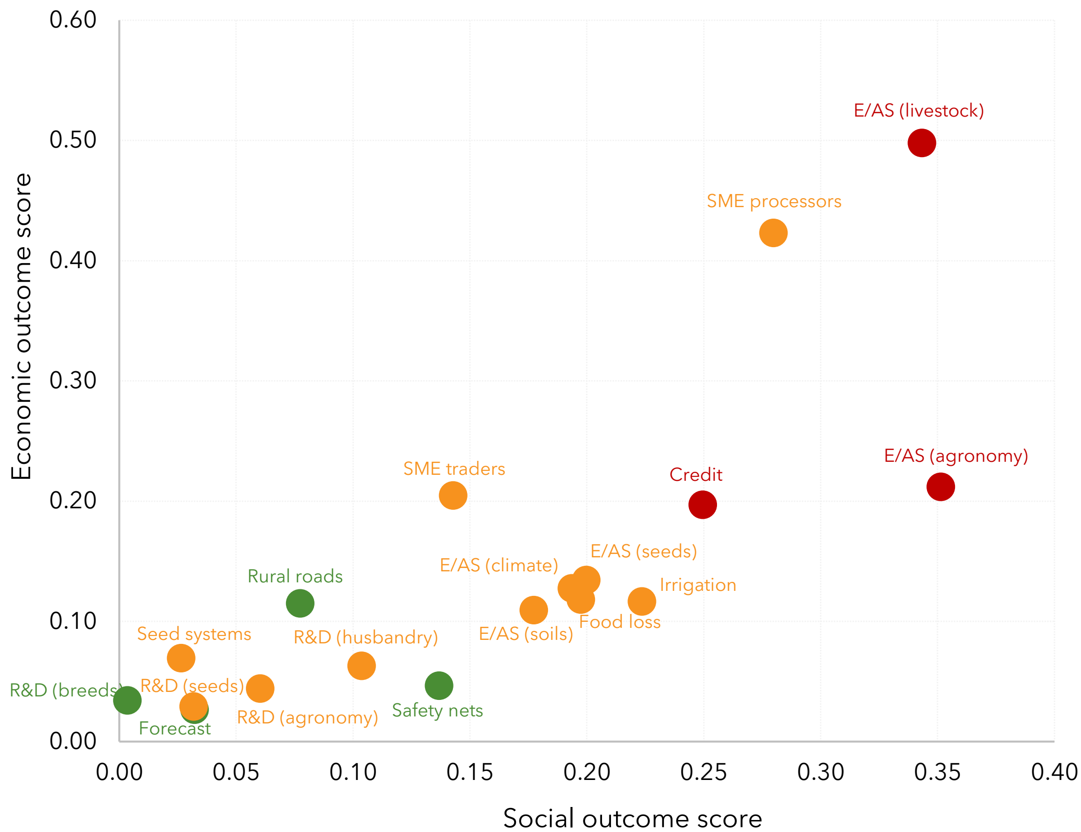
Market and food system investments such as spending on credit packages, food loss reduction, and SME processors are among the most resource-demanding spending options. Irrigation expansion also contributes highly to the environmental footprint, mainly due to increased water and land use. By contrast, most upstream R&D interventions—such as those targeting seeds, breeds, and agronomy—as well as safety nets and rural roads, exhibit the smallest environmental footprint, primarily due to their limited overall impact on the economy (see Figure 4 above).

Traditionally, policymakers base policy decisions primarily on economic and social dimensions. To create a composite ranking of the investments, these two dimensions are combined attaching 50 percent weight to each and reported in Figure 8. This clearly illustrates the synergies and tradeoffs across investments as far as these two broader outcomes are concerned. The composite score puts investing in extension and advisory services on livestock and agronomy as well as supporting SME processers at the top. Whereas investing in advisory services on livestock and promoting SME processors are particularly effective at generating better economic outcomes, investing in advisory services in agronomy is good for better social outcomes. Systemic interventions—such as improving credit access, supporting SME traders, reducing food loss, and upgrading rural roads—are also among the most cost-effective strategies for generating broad gains across the agrifood system.

These two dimensions – economic and social – remain important and may still dominate decision-making in many countries. However, a broader agrifood systems approach requires policymakers also to consider the environmental footprint of their policy or investment choices. Figure 8 also reports a comparison of investments' environmental outcomes against their economic and social outcome scores. Interventions with red markers have a high environmental footprint, those with orange markers have a medium-level environmental footprint, and those in green have a lower footprint. This grouping of interventions by their environmental impact is determined by first calculating their Z-scores and then identifying those with the highest and lowest impacts as outliers from the data using a specified standard deviation threshold.

We find that interventions with greater economic and social outcomes tend to be most resource-using, implying some tradeoffs. For instance, advisory in livestock and agronomy and support to SME processors have the strongest impacts on the economic and social outcome indicators, at the same time causing greater environmental footprints. Meanwhile, most up-stream interventions such R&D in breeding and seeds, and systemic investments such as climate forecast, safety nets, and rural roads rank as the least cost-effective although they generate the least environmental footprint principally because of overall weaker impacts on production. This tradeoff between economic and social impacts, on one hand, and environmental impact, on the other, highlights the need to improve the resource-use efficiency of interventions that yield strong economic and social benefits.

Figure 8: Composite scores on economic and social outcomes by investment area



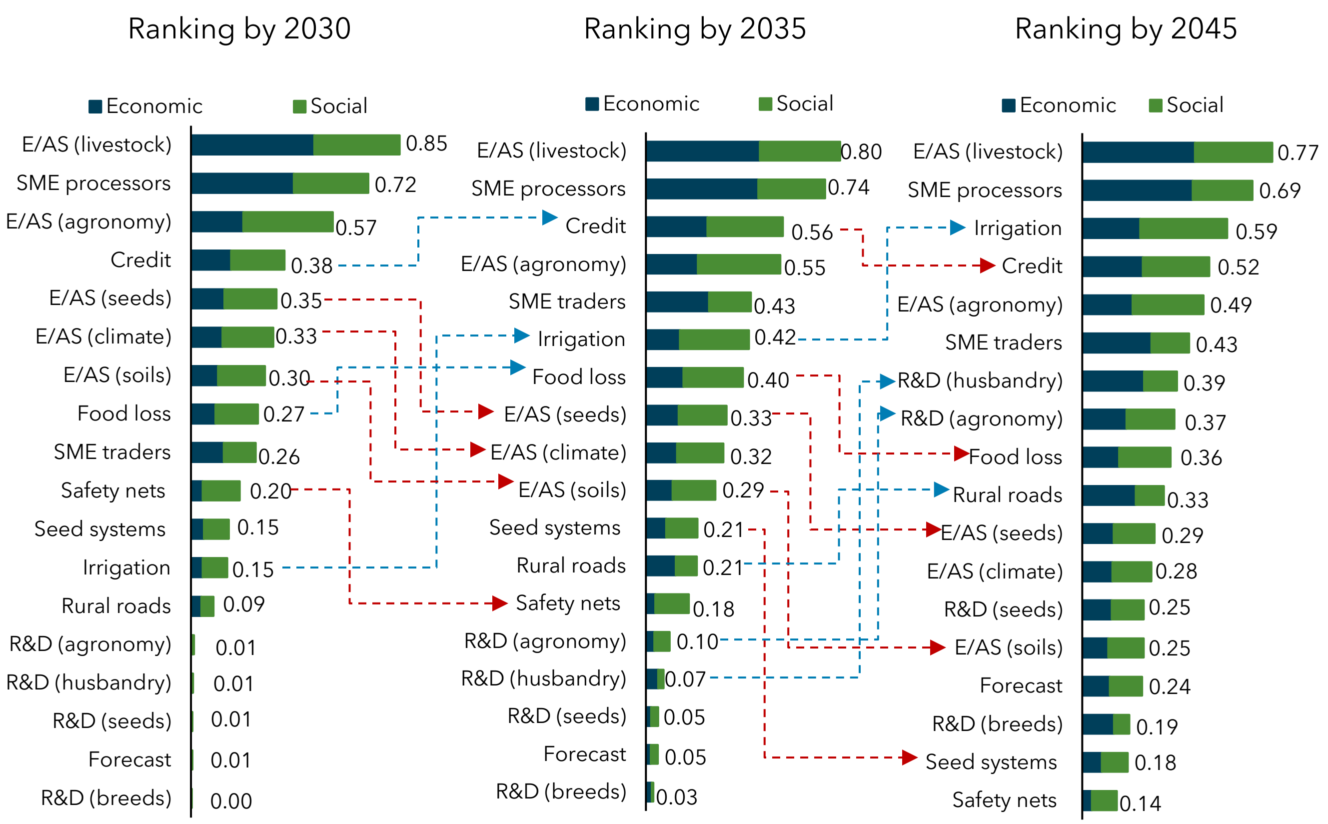
Source: RIAPA modeling system

Do the rankings change over time?

The previous section compares the impact of the 2025-2030 investments at the end of the simulation period, i.e., 2045. Given differences in the lag time between when a particular investment is made and when it starts having an impact on economic and social outcomes, it is of interest to consider whether investment priorities change depending on the time horizon of the policymaker. Notably, most politicians or line ministries in governments may have a shorter time horizon (i.e., matching the typical 4-5 years of the political cycle). In contrast, national planners may have much longer planning horizons (often several decades). The modeling framework adopted in this study accounts for these time delays between when an investment is made and when its effect materializes. This section assesses the magnitude of changes in composite scores by investment area over time. We specifically compared the rankings at 2030, 2035 and 2045 (Figure 9).

Model results indicate that R&D-related investments in agronomy and husbandry become increasingly more cost-effective over time as their lagged but long-term impacts materialize. Likewise, investments in irrigation and road infrastructures achieve significant improvements in relative cost-effectiveness over time as impacts accumulate. In contrast, markets- and food system-related investments, such as farmers credit and food loss and waste reduction, show a rise in effectiveness by 2035 compared to 2030 but a decline in impact in later periods. Meanwhile, farmer-facing and recurrent investments—such as extension and advisory services on seeds, agronomy, and soils—gradually lose relative effectiveness as long-term, high-impact investments take over their role in driving economic and social outcomes.

Figure 9: Changes in rankings over time



Source: RIAPA modeling system

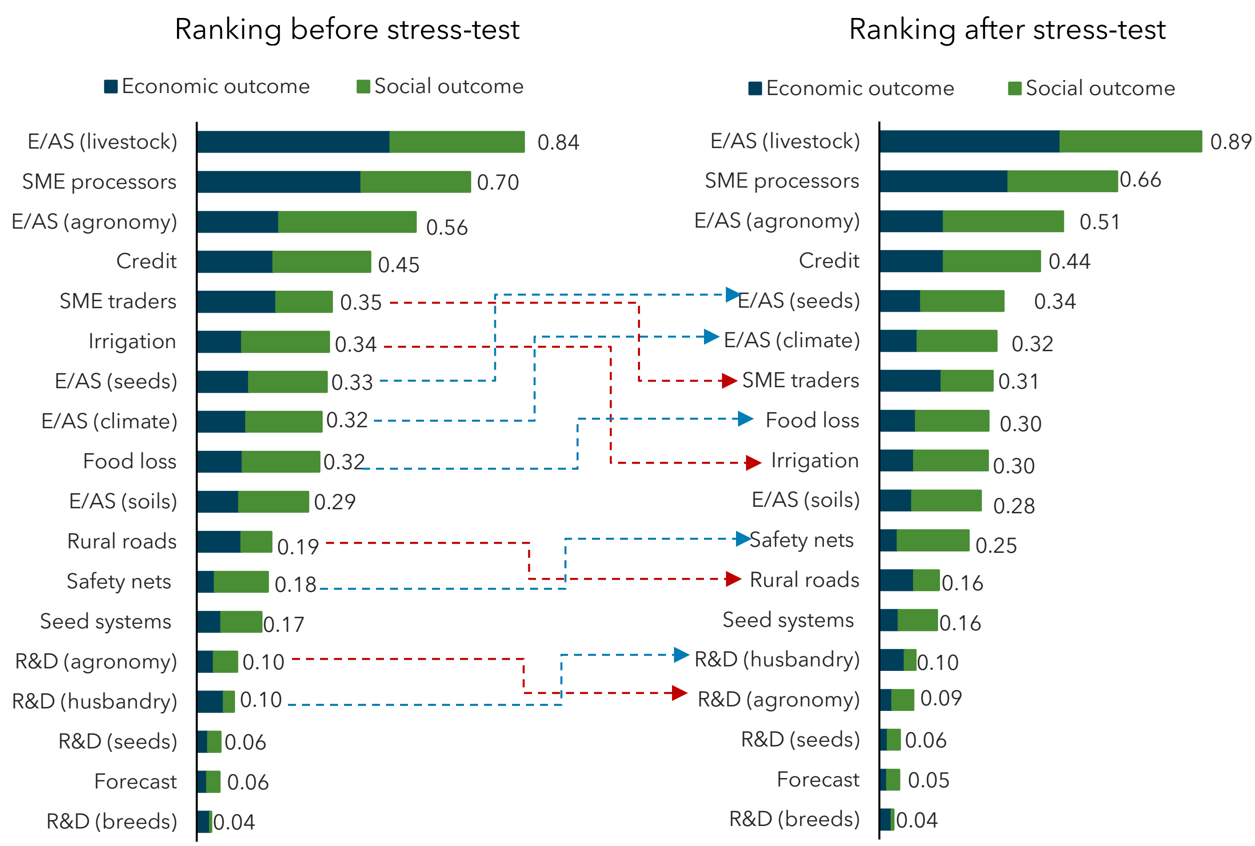
Stress-testing of investments

This section reports on how investment rankings might change when a 1-in-25-year drought shock slashes the yield gains throughout the simulation period (2025-2045).[1] 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 Tanzanian case demonstrates a few changes in rankings (Figure 10). The top four cost-effective investments maintain their benefit-cost ranks even after accounting for the production risks discussed earlier; some of these investments target market and downstream food system actors that are not directly affected by the production shock. Advisory services for livestock also remain unaffected, consistently ranking first in both cases, as the livestock sector has historically exhibited the least yield variability in response to climate change (see Figure 2).

[1] A drought shock causes a temporary but significant drop in yield, which can reduce productivity over an extended period if it becomes frequent, by affecting resource quality. However, we proxy the yield effect of the drought shock through a shift in yield gain throughout the simulation period since it is difficult to determine the year when the shock may occur. We noted that the timing of the weather shock affects the relative effectiveness of the investments. Since the permanent yield effect is considered for each investment option, the results generated from this analysis remain insightful.

However, the cost-effectiveness of R&D investments in agronomy falls slightly, especially when accounting for the environmental dimension in the assessment of ranks. The relative cost-effectiveness of SME traders, irrigation, and rural road investments also decline moderately due to a 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. Likewise, farmer-facing interventions in extension and advisory services targeting seeds and climate as well as post-harvest loss reduction show improvements in ranking since these interventions improve the performance of the wider rural economy by enhancing productivity.

Figure 10: Rankings of interventions after stress-testing



Source: RIAPA modeling system

Unpacking priorities by sub-sector

In the previous sub-sections, we present the cost-benefit rankings of interventions that also target various sub-sectors. For example, food loss reduction measures can focus on cereals, cash crops, or root crops. In this section, we consider a dual approach and provide a much deeper analysis of the ranking of interventions based on the sectors they target. The investment-sector combinations are compared using their normalized composite scores using their effects on economic and social indicators (Table 1).

The blue-shaded cells in Table 1 identify value chains or sectors where the impacts of a given intervention exceed the overall average impact score of the cross-cutting investment. For instance, the composite score for R&D in agronomy is relatively low – at 0.14 – when the intervention's impact is evaluated across all targeted sectors. However, its impact on cereals is well above this cross-cutting average for cereals, at 0.27. Meanwhile, the green-shaded cells denote sector–investment combinations ranked among the top five in terms of potential impact. These indicate priority areas where targeted investment could substantially enhance the overall performance of the cross-cutting intervention. As such, although R&D in agronomy for cereals shows above-average impact relative to the cross-sector score, it does not fall within the top five crop-specific intervention areas. Conversely, extension and advisory services in agronomic practices to cereal and pulses producers not only exceed the average impact score but also include such investments in cereals among the top five investment priorities. Furthermore, Table 1 suggests that concentrating food loss and waste reduction and irrigation efforts on root crops would significantly improve the effectiveness of agrifood system investments. Agronomy-oriented extension services targeting roots and horticulture are among the top five crop-specific interventions on their cost-effectiveness. Supporting SME processors and advisory services to livestock also remain the top cross-cutting (non-crop-specific) interventions in terms of their impacts on social and economic outcomes.

Table 1: Composite scores by investment area and crop sector

			Cross-cutting	Cereals	Root crops	Pulses and oilseeds	Horticulture	Other cash crops
R&D	1	R&D (improved seeds)	0.11	0.19	0.06	0.08	0.09	0.09
	2	R&D (agronomy)	0.14	0.27	0.09	0.11	0.11	0.07
	3	R&D (animal breeds)	0.09					
	4	R&D (animal husbandry)	0.14					
Extension / advisory services	5	E/AS (improved seeds)	0.30	0.29	0.34	0.36	0.30	0.31
	6	E/AS (agronomic practices)	0.47	0.52	0.55	0.32	0.48	0.53
	7	E/AS (livestock)	**0.66**					
	8	E/AS (climate information)	0.30					
	9	E/AS (climate smart agriculture)	0.27	0.29	0.34	0.18	0.30	0.31
Markets and food systems	10	Seed systems	0.19					
	11	SME processors (finance, training)	**0.62**					
	12	SME traders (finance, training)	0.34					
	13	Food loss and waste	0.29	0.24	0.48	0.29	0.38	0.41
	14	Credit access (financial inclusion)	0.39					
Risk reduction and resilience	15	Seasonal forecast (early warning)	0.11					
	16	Productive safety nets	0.19					
Infrastructure	17	Irrigation infrastructure	0.31	0.37	0.43	0.11	0.32	0.35
	18	Rural roads	0.22					

Source: RIAPA modeling system

Summary

The Tanzania economy relies heavily on its agrifood system as a major source of livelihood, an engine of growth, and source of employment. Despite encouraging progress thanks to the Agriculture Sector Development Programs (ASDPs), Tanzania has an urgent need to transform its agrifood system in a sustainable manner, requiring increased technical and financial support to agriculture and allied sectors. This calls for evaluating a long list of agrifood system investments against their simulated impacts across economic, social, and environmental outcomes. These impacts should also be scrutinized against history-grounded potential production shocks to affirm if investments' relative cost-effectiveness is maintained under such unprecedented shocks.

This policy brief 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, and improvements in diet diversity. These investments are also evaluated based on their impacts on key sustainability and nature capital indicators, focusing on water, emissions, and land footprints.

The results indicate that investing in extension and advisory services for livestock farmers is the most cost-effective option for expanding agrifood system GDP and employment. Supporting SME producers further accelerates economic gains, particularly due to its strong impact on job creation. Agronomy-focused extension and advisory services also rank among the most cost-effective farmer-facing investments, primarily driven by their significant contribution to agrifood system GDP growth. Similar to the economic outcome scores, investing in advisory services for livestock and agronomy, and supporting SME processors rank as the most cost-effective options for achieving greater progress in poverty reduction, improvement in the rate of undernourishment, and diversity of diets. Credit access, irrigation development, and post-harvest loss reduction are additional interventions that promote greater social outcomes. However, most up-stream interventions such as R&D on breeds, seeds, and animal husbandry 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.

The model results also reveal moderate shifts in the relative cost-effectiveness of interventions over time. As the lagged but long-term impacts of investments such as R&D and irrigation begin to materialize over time, the effectiveness of recurrent investments—such as advisory services—gradually diminishes. 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 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.

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References

Aragie, E., Benfica, R., Pauw, K., Randriamamonjy, J. and Thurlow, J. 2024. Assessing Investment Priorities for Driving Inclusive Agricultural Transformation: An Application to Tanzania. *Development Policy Review*, 42(6): e12812.

Aragie, E., Artavia, M., and Pauw, K. 2019. Strategic public spending: Scenarios and lessons for Ghana. IFPRI Discussion Paper 1852. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.133332

Aragie, E., Diao, X., Spielman, D.J., Thurlow, J., Mugabo, S., Rosenbach, G. and Benimana, G. 2022. Public investment prioritization for Rwanda's inclusive agricultural transformation: Evidence from rural investment and policy analysis modeling. Rwanda Strategy Support Program. Working Paper 03.

Arndt, C., M. Hussain, E. Jones, V. Nhate, F. Tarp, and J. Thurlow. 2012. Explaining the evolution of poverty: The case of Mozambique. *American Journal of Agricultural Economics*, 9 (94): 854-872.

Benfica, R., Cunguara, B. and Thurlow, J. 2019. Linking agricultural investments to growth and poverty: An economywide approach applied to Mozambique. *Agricultural Systems*, 172, 91–100.

Benfica, R., Diao, X., Pauw, K., Randriamamonjy, J., Thurlow, J. and Ellis, M. 2023. Tanzania's agrifood system structure and drivers of transformation. Agrifood System Diagnostics Country Series 19. https://doi.org/10.2499/p15738coll2.136787

Blocher, J.M., Hoffmann, R. & Weisz, H. 2024. The effects of environmental and non-environmental shocks on livelihoods and migration in Tanzania. *Population and Environment*, 46(7). https://doi.org/10.1007/s11111-024-00449-4

Christiaensen, L., and W. Martin. 2018. Agriculture, structural transformation and poverty reduction: Eight new insights. *World Development*, 109: 413-416.

Climate Watch. 2025. Historical GHG Emissions. https://www.climatewatchdata.org/ghg-emissions?end_year=2021&start_year=1990

Devarajan, S. and Robinson, S. Contribution of Computable General Equilibrium Modeling to Policy Formulation in Developing Countries. In Handbook of Computable General Equilibrium Modeling, Peter B. Dixon, Dale W. Jorgenson (ed), 1: 277-301.

Dixon, P. and Parmenter, B.R. 1996. Computable general equilibrium modelling for policy analysis and forecasting. Chapter 01 in Handbook of Computational Economics, 1: 3-85.

FAO. 2025. FAOSTAT. Food and Agricultural Organization of the United Nations. https://www.fao.org/faostat/en/#data

GLOPAN (Global Panel on Agriculture and Food Systems for Nutrition) 2020. Future food systems: for people, our planet, and prosperity. London, UK. https://www.glopan.org/wp-content/uploads/2020/09/Foresight-2.0_Future-Food-Systems_For-people-our-planet-and-prosperity.pdf.

IFPRI (International Food Policy Research Institute). 2023. RIAPA Data and Modeling System. Washington, DC. https://www.ifpri.org/project/riapa-model

IFPRI (International Food Policy Research Institute). 2024. Global Spatially-Disaggregated Crop Production Statistics Data for 2020 Version 1.0.0. https://doi.org/10.7910/DVN/SWPENT. Harvard Dataverse. Version 3.

IFPRI (International Food Policy Research Institute). 2024. 2022 Social Accounting Matrix for Tanzania: A Nexus Project SAM. Data Paper. Washington, DC: International Food Policy Research Institute (IFPRI). Handle: 10568/155120. https://hdl.handle.net/10568/155120

Mafie, G. K. 2021. The Impact of Climate Change on Agricultural Productivity in Tanzania. *International Economic Journal*, 36(1), 129–145. https://doi.org/10.1080/10168737.2021.2010229

Kumar, N. and Maiti, D. 2024. Long-run macroeconomic impact of climate change on total factor productivity — Evidence from emerging economies. Structural *Change and Economic Dynamics*, 68: 204-223.

MoA (Ministry of Agriculture). 2027. Agricultural Sector Development Program Phase II (ASDP II). https://asdp.kilimo.go.tz/uploads/2018%205%20ASDP%20II%20OCTOBER%202017.pdf

Mekonnen, M.M. and Hoekstra, A.Y. (2010) The green, blue and grey water footprint of farm animals and animal products. Value of Water Research Report Series No. 48, UNESCO-IHE, Delft, the Netherlands. http://www.waterfootprint.org/Reports/Report47-WaterFootprintCrops-Vol1.pdf

NBS (National Bureau of Statistics). 2021. 2020 Tanzania in Figures. The United Republic of Tanzania. https://www.nbs.go.tz/nbs/takwimu/references/2020_Tanzania_in_Figure_English.pdf

NBS (National Bureau of Statistics). 2021a. The United Republic of Tanzania. National Sample Census of Agriculture 2019/20. National Report. August 2021. https://www.nbs.go.tz/uploads/statistics/documents/sw-1705482872-2019-20_Agri_Census_%20Main_Report.pdf

NBS (National Bureau of Statistics). 2019. Household Budget Survey 2017-18. Tanzania Mainland. Key Indicators Report. https://www.nbs.go.tz/nbs/takwimu/hbs/2017_18_HBS_Key_Indicators_Report_Engl.pdf

Pauw, K., O. Ecker, J. Thurlow, and A.R. Comstock. 2023. Measuring changes in diet deprivation: New indicators and methods. *Food Policy*, 117, Article #102471.

Pauw, K., J. Thurlow. 2015. Prioritizing Rural Investments in Africa: A Hybrid Evaluation Approach Applied to Uganda. *European Journal of Development Research*. 27(3): 407–424. Special Issue on Public Investments in and for Agriculture. https://doi.org/10.1057/ejdr.2015.24.

Pham, T. H., and J. Riedel. 2019. Impacts of the sectoral composition of growth on poverty reduction in Vietnam. *Journal of Economics and Development*, 21 (2): 213-222.

Poore, J. and Nemecek, T. 2018. Reducing food's environmental impacts through producers and consumers. *Science*, 360:987-992.

Randell, H., Gray, C. and Shayo, E.H. 2022. Climatic conditions and household food security: Evidence from Tanzania. *Food Policy,* 112: 102362.

Shimba, H.B., Pauline, N.M. and Luhende. B. 2024. Towards developing a national climate change framework in Tanzania: Evidence from taxing energy sources to enhance use of renewable energies as a mitigation policy. *Energy and Climate Change*, 5:100148.

Thurlow, J., J. Kiringai, M. Gautam. 2007. Rural Investments to Accelerate Growth and Poverty Reduction in Kenya. IFPRI Discussion Paper 00723 (October 2007). Washington DC: International Food Policy Research Institute. https://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/40627/filename/40628.pdf.

URT (United Republic of Tanzania). 2021. Tanzania's Nationally Determined Contribution. https://unfccc.int/sites/default/files/NDC/2022-06/TANZANIA_NDC_SUBMISSION_30%20JULY%202021.pdf

World Bank. 2025. World Development Indicators Database. https://databank.worldbank.org/source/world-development-indicators/Series/NV.AGR.TOTL.KD.ZG#

Annex Table 1: List of investment scenarios considered

Broad category	Number	Scenario	Description
Research and development (R&D)	1	R&D (improved seeds)	R&D into improved seed development
	2	R&D (agronomic practices)	R&D into improved agronomic practices
	3	R&D (animal breeds)	R&D into improving breeds
	4	R&D (animal husbandry)	R&D into improved husbandry practices
Extension / advisory services	5	E/AS (improved seeds)	Advising improved seed use
	6	E/AS (agronomic practices)	Advising improved agronomic practices
	7	E/AS (livestock)	Advising improved livestock handling
	8	E/AS (climate information)	Providing climate information system
	9	E/AS (climate smart agriculture)	Advising on climate smart practices
Markets and food systems	10	Seed systems	Extended seed system
	11	SME processors (finance + training)	Finance and training for SME processors
	12	SME traders (finance + training)	Finance and farming for SME traders
	13	Food loss and waste	Food storage and transport
	14	Credit access (financial inclusion)	Micro-credit access for farmers
Risk reduction and resilience	15	Seasonal forecast (early warning)	Seasonal weather forecast
	16	Safety nets	Productive safety nets for the poor
Infrastructure	17	Irrigation infrastructure	Small and medium scale irrigation
	18	Rural roads	Unpaved feeder roads

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