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MOZAMBIQUE

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 findings of a systematic evaluation and ranking of investment options for Mozambique'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 undernourishment, and lowering diet deprivation. Additionally, the study assesses their environmental footprint, focusing on water consumption, land use, and emissions. In Mozambique, investments in small and medium enterprise (SME) processors and traders are identified as the most cost-effective means of enhancing social outcomes, such as poverty reduction and addressing undernourishment. They are also highly ranked in accelerating agrifood GDP and employment. Moreover, extension services for livestock and agronomy, rural road infrastructure, and post-harvest losses reduction are also highly ranked. However, many of these cost-effective investments come with relatively high environmental footprints, which highlight potential tradeoffs. The study further reveals shifts in the cost-effectiveness ranking of investment options over time and marginally so in the presence of extreme production shocks.

Keywords: Investment priorities, agrifood system, economic, social, environmental, Mozambique

Introduction

The agrifood system in Mozambique serves as the main driver of economic growth, a major source of employment, and the foundation of livelihoods for millions of people. Nonetheless, low-productivity agriculture continues to dominate it, finding it difficult to provide affordable, high-quality food for a rapidly growing population. This imbalance highlights the urgent need for a sustainable transformation of the agrifood system. Providing technical and financial support to the sector is crucial to achieving this transformation. However, policy and investment choices, and the growth patterns they drive, play a decisive role in shaping the magnitude and sustainability of 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. Identifying potential tradeoffs across these outcomes can support more informed decisions about resource allocations. Increasingly, policymakers and development partners are also incorporating environmental sustainability considerations into their evaluation frameworks. This is based on an enhanced awareness that unsustainable production practices contribute to environmental degradation and climate change, the burden of which will fall disproportionately on future generations of poor people (GLOPAN, 2020).

The effectiveness of policies and investments may be undermined by unforeseen shocks, such as global commodity market disruptions, conflict and war, and climate-related events. We focus on the latter, given that climatic shocks have been the most significant exogenous factors affecting the performance of agrifood systems in Mozambique (Salvucci and Santos, 2022; Justino et al., 2025). Extreme events such as drought and flooding have become increasingly common and are expected to intensify in frequency and severity (Mavume et al., 2021). While there is little doubt these climatic shocks adversely affect the performance of the agrifood system, and, therefore, the effectiveness of agrifood system policies and investments in general, it remains unclear whether such shocks also influence how these policies and investments are prioritized.

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 Mozambique 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 Mozambique.

Results are derived from the IFPRI's Rural Investment and Policy Analysis (RIAPA) modeling system (IFPRI, 2023) which offers a uniquely integrated framework for assessing investment impacts. The system includes: (i) an investment module that translates proposed investments into changes in productivity at the subsector level; (ii) a household survey-based microsimulation module that estimates changes in poverty, undernourishment, and diet deprivation; and (iii) a newly added environment module that computes environmental footprints, related to water use, greenhouse gas emissions, 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).

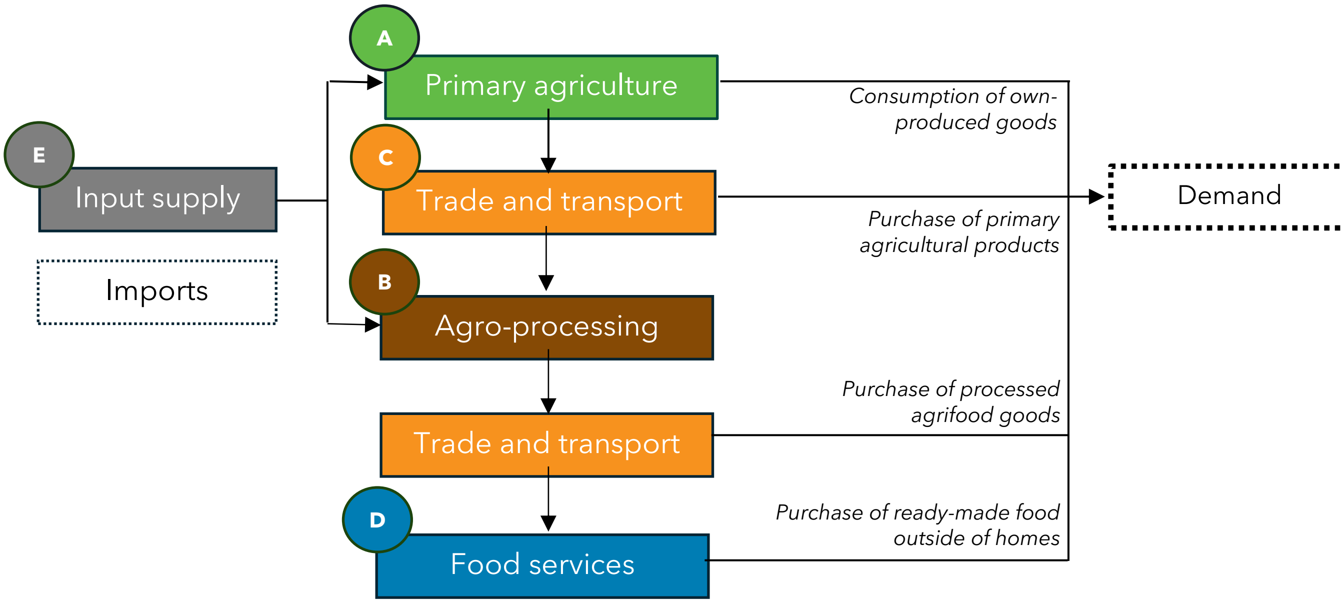
Country Context

Structure of Mozambique's agrifood system

A country's agrifood system involves a complex and dynamic 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 agrifood GDP growth and job creation under alternative investment scenarios and over time. By breaking down the agrifood system into distinct value chain groups and mapping targeted interventions aimed at addressing specific bottlenecks, this approach provides valuable insights into the main drivers of agrifood system growth and associated environmental impacts in Mozambique.

Figure 1 presents a simplified conceptual framework of the agrifood system, comprising five key components labeled **A** to **E** (see Benfica 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**) refers to the manufacturing sector and includes subsectors that process agriculture-related food and non-food products. Meanwhile, trade and transport (**C**) capture the demand for services that facilitate the movement, wholesaling, and retailing of agrifood products across farms, firms, and final points of sale. Food services, represented in (**D**), include services such as meals prepared in restaurants, food stalls, or hospitality venues. Finally, input supply (**E**) represents the portion of domestically produced intermediate inputs - such as fertilizers, seeds, and financial services - used directly in agricultural and agro-processing operations.

Figure 1: A simple conceptual framework of the agrifood system



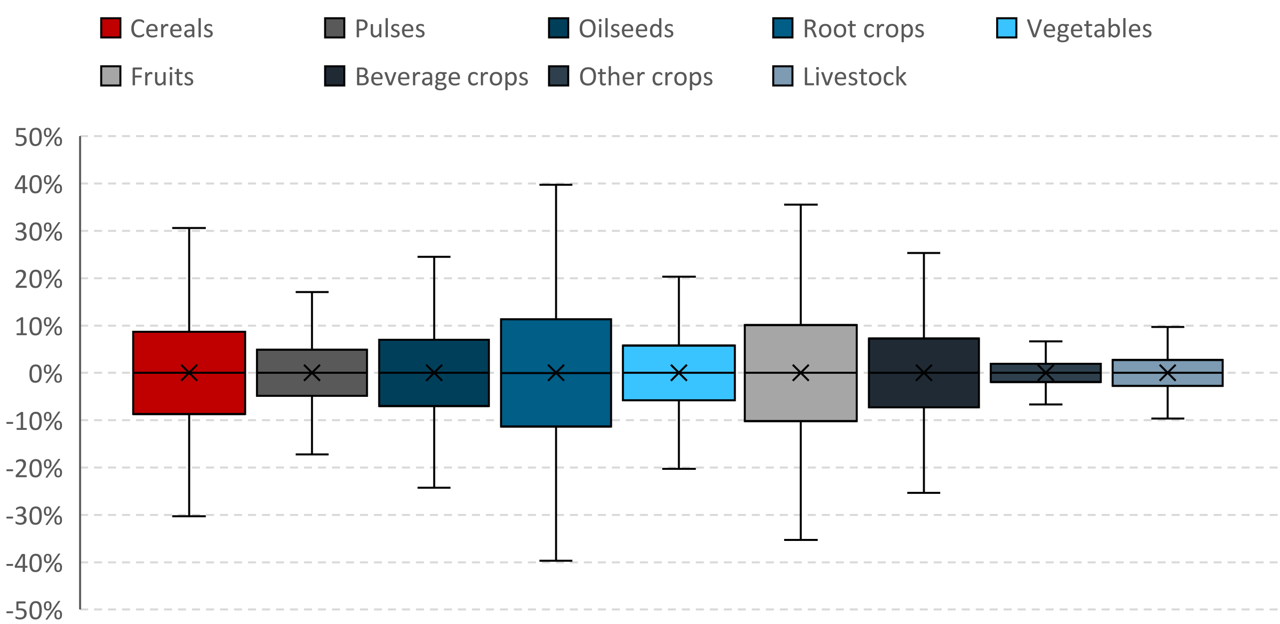
Source: Benfica et al. (2023)

The agrifood system in Mozambique plays a central role in the national economy, contributing over 39.4 percent of gross domestic product (GDP) and employing about 77.6 percent of the workforce (Benfica et al., 2023). Primary agriculture has been a consistent driver of growth, expanding at a modest average annual rate of 4.5 percent over the past two decades and currently contributing a considerable 27.2 percent of GDP (World Bank, 2025; Benfica et al., 2023). With appropriate policy reforms and targeted investments, together with a stable socio-political environment, the sector has a significant potential to continue its rapid growth and contribute to broader structural transformation in Mozambique. Accelerating growth and sustaining high employment levels have long been central development objectives for countries worldwide, and Mozambique is no exception. Yet, with a poverty headcount rate of 65 percent at the national poverty line, undernourishment rate of 25 percent in 2022 (World Bank, 2025), and notable concerns about diet deprivation, the Mozambique government recognizes the formidable challenges it faces, particularly as it strives to its ambition to pursue economic development and social progress while transitioning towards a green economy (World Bank, 2023; AfDB, 2021).

Agricultural production variability in Mozambique

Despite its limited contribution to the country's GDP, agriculture remains a critical engine of social and economic outcomes in Mozambique. The sector's heavy reliance on rainfed production systems makes it particularly vulnerable to weather-related 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 improved seeds (Shah et al., 2024; Kumar and Maiti, 2024). Historical data for Mozambique reveal that yields for root and fruit crops are significantly more volatile than livestock or pulses (see Figure 2). For instance, production losses during a 1-in-25-year drought event relative to a "normal" year could range between 6.9 and 12.2 percent for livestock and pulses and between 25.6 and 28.5 percent for fruits and root crops. This variation across sectors highlights different degrees of vulnerability of sectors to climatic shocks. Moreover, spatial variation both in the severity of drought conditions and sectoral composition contribute to the national-level variation in yield impacts. In order to assess the resilience of investment strategies, our modeling framework tests the robustness of investment rankings to climatic shocks using historical 1-in-25-year drought scenarios as indicative of how such shocks may influence sectoral yield losses and alter the impact of investments.

Figure 2: Historical production variability for crops and livestock



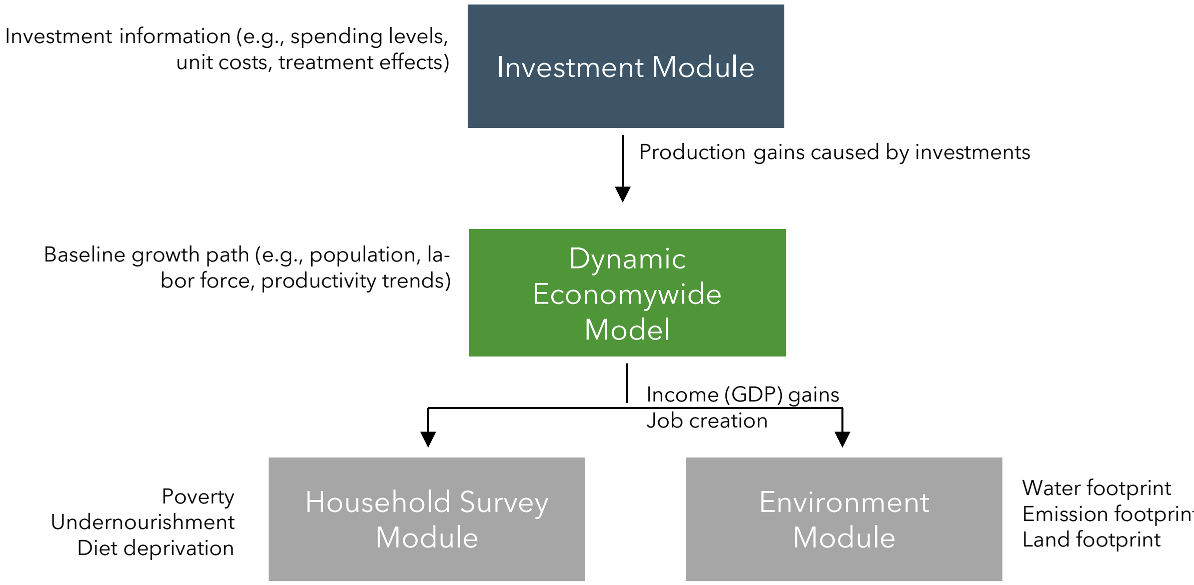
Note: The historical variability values are residual fluctuations from the determined production time series for 1990-2021. Pulses, cereals, and vegetables are the three main contributors of agricultural GDP, with shares of 22, 16, and 16 percent, respectively. Livestock and roots follow, contributing 12 and 14 percent to the sector's GDP (IFPRI, 2025).

Method of Analysis

Modeling approach

This study estimates the impacts of alternative agrifood system investments on Mozambique's economy, focusing on three categories of outcome indicators: 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 added environment module that computes environmental footprints, including impacts on water use, greenhouse gas emissions, and land utilization (Figure 3). This integrated RIAPA framework thus enables a more comprehensive assessment of investment impacts across sectors and time horizons.

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, a widely used tool for economic policy formulation and analysis (Dixon and Parmenter, 1996; Devarajan and Robinson, 2010). They capture the complex interlinkages between sectors, households, and rural-urban economies, making them well-suited for evaluating the broad economywide effects of public investments and policy reforms.

The Mozambique model is calibrated to a 2022 Social Accounting Matrix (SAM) for the country (IFPRI, 2025). The calibrated model represents the economy through a set of disaggregated sectors, encompassing 29 agricultural sub-sectors, which include 20 individual crops or groups of crops, six livestock production sectors, as well as forestry, captured fisheries, and aquaculture. The model also incorporates 38 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 Mozambique model also distinguishes 15 representative household groups, each of which is an aggregation of a group of households captured in the 2015 Mozambique Household Budget Survey (Inquérito Sobre Orçamento Familiar) (IOF) (INE, 2017). These households are categorized into rural and urban household groups, with rural households further divided into farm and non-farm categories based on their 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 trends of broader economic and sectoral growth, population and labor force growth, and levels of government spending. This "business-as-usual" scenario runs until 2045 and serves has benchmark for evaluating all investment scenarios. As will be seen later, the temporal feature of the model allows us to explore how the effects of various interventions unfold and evolve over time.

The investment module

The investment module is used to synthesize data from multiple sources to measure, at a detailed sectoral level, the expected productivity gains that can be attributed to a unit of expenditure associated with 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 by Aragie et al. (2024). The updated framework categorizes agrifood system investments in layers depending on whether they are at the knowledge generation stage (upstream: 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 distinct individual interventions, many of which targeting up to six different agricultural sector groups.

The investment module structures agrifood investments and processes data on the costs and impacts of interventions across targeted sectors. Specifically, it integrates investment parameters - such as spending levels, unit costs, 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. These productivity gains are then fed into the economywide model, which endogenously adjusts the targeted sectors' productivity levels. Through direct and indirect economywide linkages, these adjustments lead to changes in income, prices, employment levels, and other key economic indicators.

Unit cost estimates are typically drawn from existing literature and are retrieved from project planning (such as irrigation master plans) or evaluation reports. Baseline adoption rates and coverage levels are sourced from farm household surveys such as the 2023 Mozambique's Inquérito Agrário Integrado (IAI) 2023 (MADER, 2024) 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 requires specialized modules. To this end, the CGE model is linked in a top-down fashion 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, observed by the fifteen representative household groups in the RIAPA model, are mapped to the corresponding individual households in the 2015 IOF (INE, 2017). The new poverty status is computed for all sampled households. Likewise, the undernourishment module uses the same set of households and measures the change in the share of the population below a certain 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. The 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, greenhouse gas emissions, 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 cereals 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 Poore 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 Mozambique 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 Mozambique CGE model. Mozambique had over 6 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 over 35 million hectares of grazing land in Mozambique in 2022. Our modeling analysis assumes total agricultural land expands by one 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; each modeled with an annual incremental spending of $25 million between 2025 and 2030. The relative effectiveness of each intervention is assessed based on its effect in driving various development outcomes projected through 2045. To ensure comparability across time, all future benefits are discounted to present value using a 4 percent discount rate. 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, enhancement of productive agronomic practices, and advancement of 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 systems, and climate-smart agricultural practices.
- Market 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, and expand access to credit.
- Risk reduction and resilience interventions support better decision-making among agrifood system actors by developing improved climate forecasting and providing productive safety nets.
- Infrastructure investments raise overall value chain productive efficiency by expanding irrigation schemes, constructing feeder roads that connect farmers to input suppliers and product markets.

Calibrating the investment module requires a diverse set of data inputs for each of the eighteen investment areas. Key parameters 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, and the corresponding yield gains. Baseline adoption and 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. Mozambique's IAI 2023 (MADER, 2024) is specifically used to estimate adoption and coverage rates for the various technologies and practices modeled in this analysis. The survey shows high fertilizer adoption in horticulture production at about 54 percent of cropland, followed by cash crops and pulses at 28 and 21 percent, respectively. Coverage is the least among cereals. Meanwhile, improved seed adoption is the highest for cereals (16 percent) and pulses (5 percent). IFPRI's crop model (IFPRI, 2024) is used to estimate yield gains from adopting different farm practices. For Mozambique, the model reveals stronger cereal yield effects from irrigation infrastructure, followed by information of planting window and the adoption of improved seeds. These investment module parameters, alongside measures such as value-added and output prices, play a critical role in determining the returns on investments across different technologies and 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 Mozambique has historically been 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.

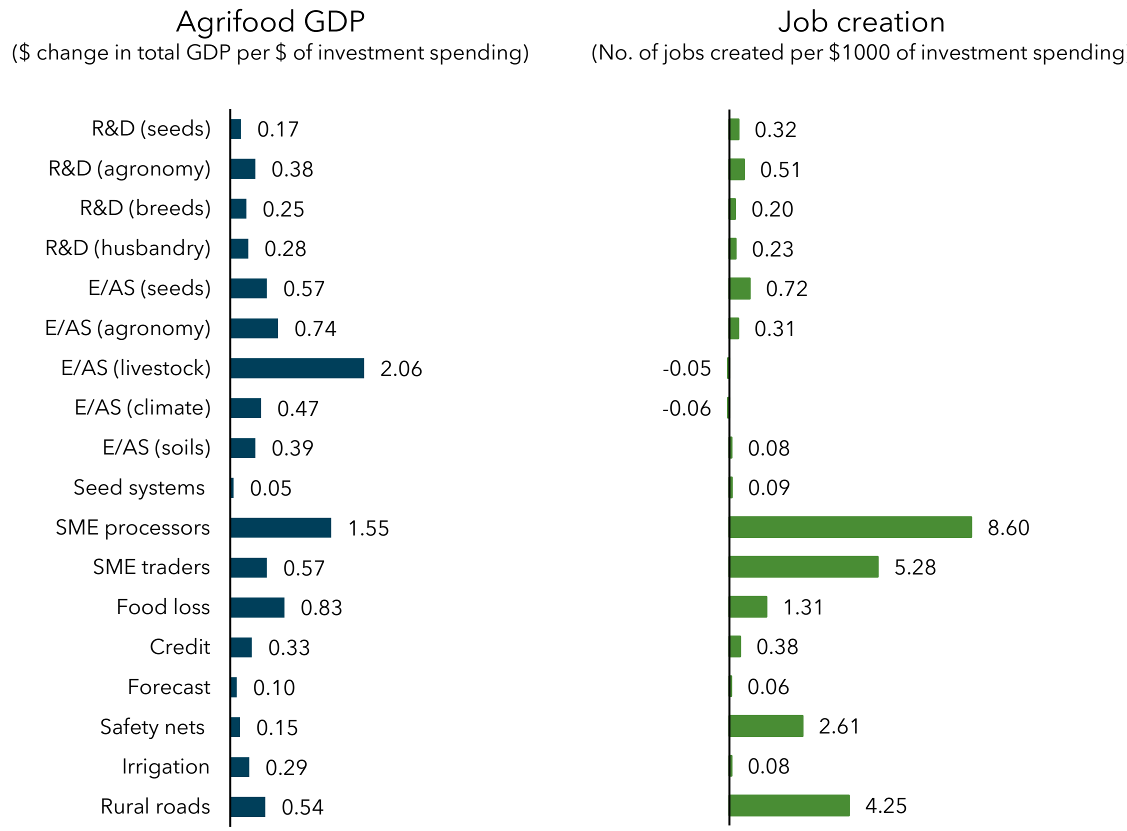
Cost-Effective Investment Options for Inclusive and Sustainable Transformation

Comparing the impacts of investments

The analysis starts by comparing investments based on their effects on two standard economic outcomes: agrifood growth and job creation. These indicators are directly derived from the economywide model (see Figure 3), with results reported in Figure 4. These reveal relatively stronger growth effects from investments in livestock advisory services, support to SME processors, and post-harvest loss reduction. Specifically, each additional dollar spent on livestock advisory services yields an additional $2.06 in agrifood system GDP, compared to around $1.55 from supporting SME processors (Figure 4). Spending on advisory services in agronomy and seeds also yields economywide benefits just under the cost, suggesting their potential in transforming the agrifood system in Mozambique if the services are provided in a most efficient way.

Job creation remains an important development challenge for most developing countries, including Mozambique, especially given the continued rapid increase in the working-age population. Notably, model results highlight SME processors and traders as the most effective, generating over 5.28 additional jobs per $1000 invested due to their backward and forward linkages across the economy. Infrastructure and market development, particularly rural roads, safety nets, and food loss reduction, also emerge as priority areas of investment for job creation. Investing in advisory services on the use of seeds, support to R&D in animal husbandry, and micro credit to farmers rank among the top on their employment effects.

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

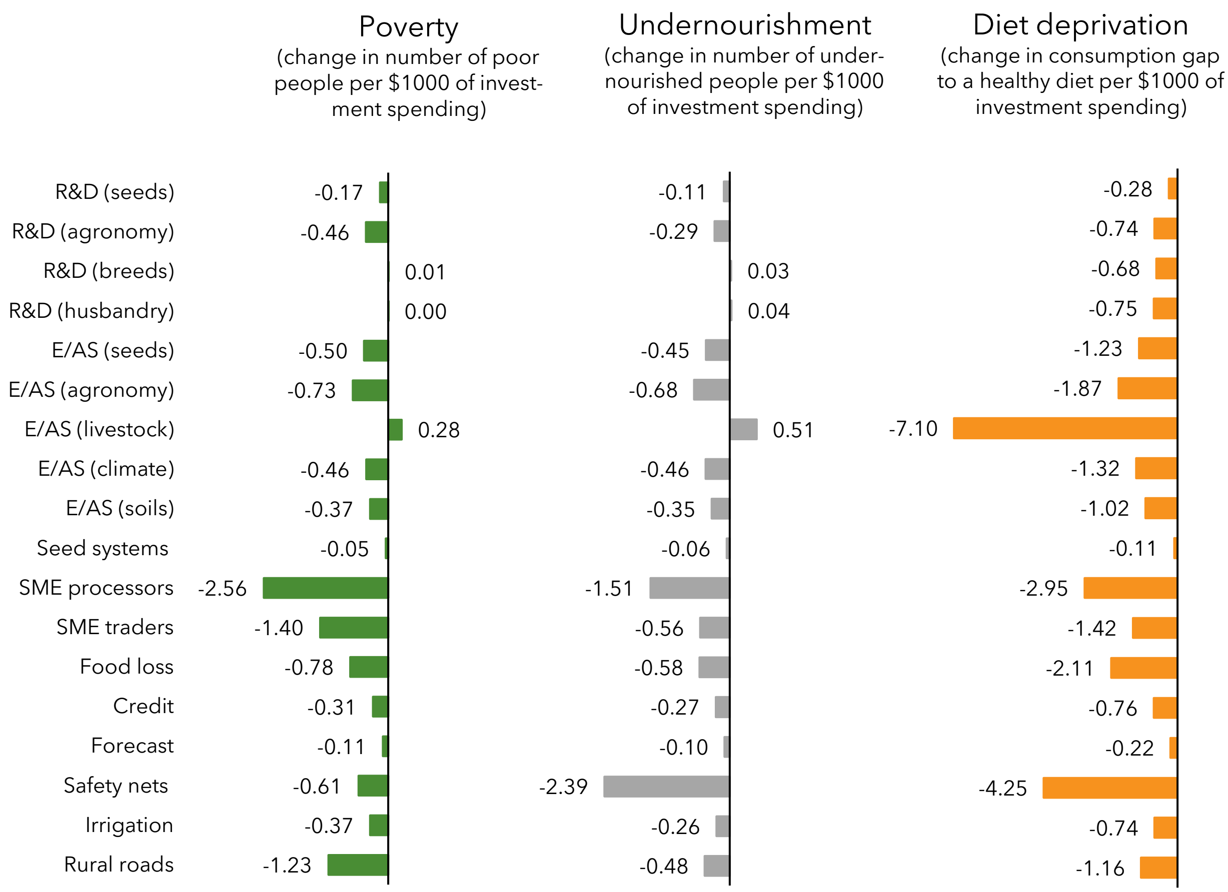


Source: RIAPA modeling system

The three social indicators considered in this study are the poverty headcount, prevalence of undernourishment, and household diet quality. These are obtained from the various household survey-based microsimulation modules 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 serves in agronomy rank highest in reducing poverty and undernourishment, partly explained by their strong GDP effects and underlining the role of sectors linked to these investments on the livelihoods of the lower income-quintile households. Additionally, support for SME traders and the expansion of rural road infrastructure are among the top-performing spending options with particularly strong impacts on poverty reduction.

Regarding the effects on the prevalence of undernourishment, productive safety nets and post-harvest food loss reduction stand out among the most cost-effective interventions, delivering substantial improvements. Other impactful investments include support to SME traders, expansion of rural roads, and advisory services on climate and seeds. While only a few agrifood interventions show strong benefit-cost ratios for poverty and undernourishment outcomes, a broader set of interventions prove highly cost-effective in improving diet diversity. Notably, expanding access to extension services for livestock farmers, extending safety nets, post-harvest food loss reduction, and investing in SME processors and traders all have strong impacts on reducing 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



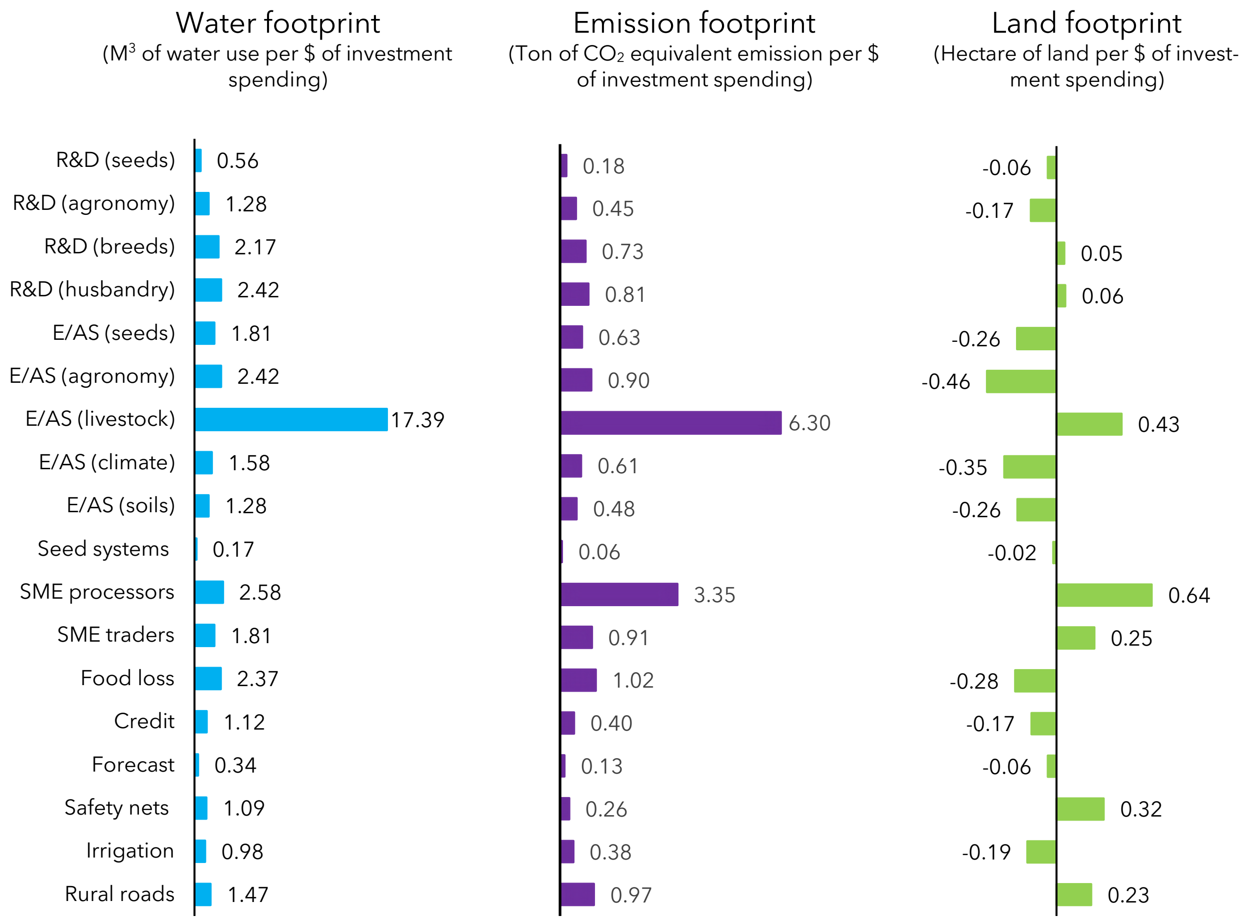
Source: RIAPA modeling system

We also evaluated the various investments based on their resource use or environmental impacts, looking specifically at economywide changes in water use, emissions, and land footprints. These changes in environmental footprints are associated with three main factors: the baseline resource intensity of the targeted sectors, the 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 is considered undesirable.

Results from the environment module indicate that investments in SME processors and traders, extension services to livestock producers, and rural roads consistently rank highest across all three environmental indicators, underscoring the resource intensity of sectors that experience significant expansion due to these interventions (Figure 6). Among them, livestock extension emerges as the most emission intensive investment per dollar spent in Mozambique, followed by support to SME processors and traders. These interventions have strong emission effects because they specifically promote production in sectors with higher emission footprints in addition to their stronger overall production effects. Figure 6 also highlights a stronger economywide water use effect from spending on extension services on livestock, animal husbandry, and agronomy, support to SME processors, and investments in food loss reduction efforts.

Land footprint can show movements in both directions depending on how investments reshape economywide demand for land. In the case of Mozambique, land footprint increases strongly (i.e., more land put under cultivation) when investments in SME processors and livestock extension are considered. These increases in land footprints are due to additional opportunities for land-intensive sectors to grow as economic opportunity changes. Similar increases in land footprint are also observed with investments in safety nets, SME traders, and rural roads. In contrast, advisory services on agronomy, seeds, climate, and soils, along with investments in food loss reduction, irrigation expansion, and micro credit access are associated with land-saving effects likely due to improved efficiency and reduced pressure on land resources.

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



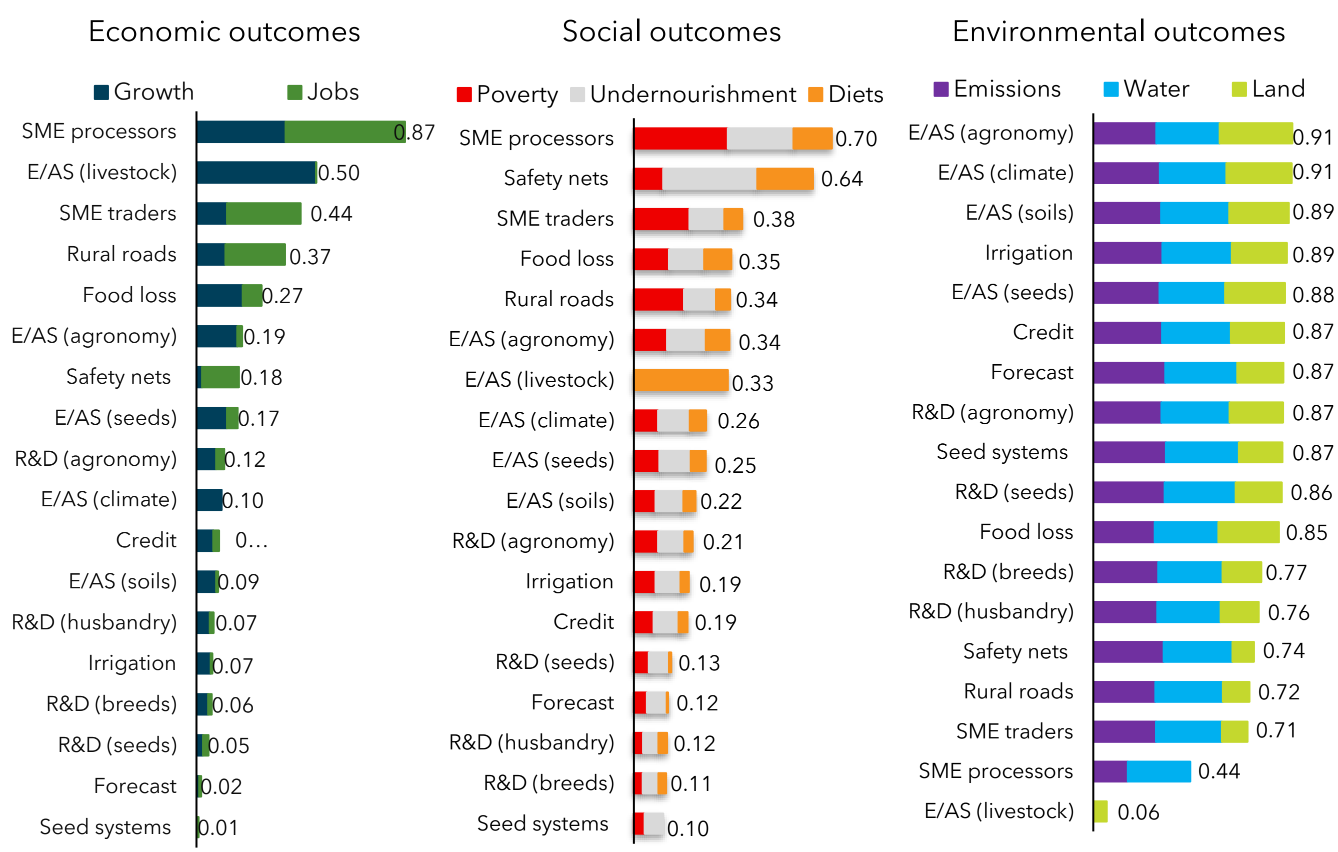
Source: RIAPA modeling system

Composite score of investments by their impact on selected outcome indicators

As outlined in the preceding section, investments were ranked by their impacts across a range of outcomes, grouped into economic, social, and environmental dimensions. The results revealed that no single intervention was ranked the highest across all outcomes, highlighting potential tradeoffs among these indicators. In this section, to better understand overall performance, we constructed composite scores for each intervention within each outcome group using a three-step process. 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 SME processors as the most cost-effective option for jointly expanding agrifood system GDP and employment, with the employment indicator contributing to most of the change in this combined indicator for economic outcomes. Supporting SME processors and livestock extension/advisory services are also cost-effective investments—market- and farmer-facing, respectively—driven by faster growth in agrifood system employment and GDP, in that order. Amongst R&D investments, agronomy appears more cost-effective regarding its impact on economic outcomes than improved seeds, breeds, and husbandry. Investing in SME traders, rural roads, food loss reduction, and safety nets are among the more cost-effective market and infrastructural investments.

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



Source: RIAPA modeling system

Figure 7 further reports composite scores for each intervention based on their overall impacts on social outcomes, specifically poverty headcount, prevalence of undernourishment, and diet deprivation. The overall impact is constructed by summing together each indicator's normalized score assuming equal weights. Notably, the top four investment options for economic outcomes also rank at the top in the social outcome scores, albeit in a different order. Specifically, investments in SME processors rank as the most cost-effective option for achieving greater progress in all social outcomes combined. Safety nets and food loss reduction rank highly, driven largely by their strong effects on reducing undernourishment. Meanwhile, investments in SME traders and rural roads are also crucial for achieving better social outcomes mainly through their effects on poverty reduction.

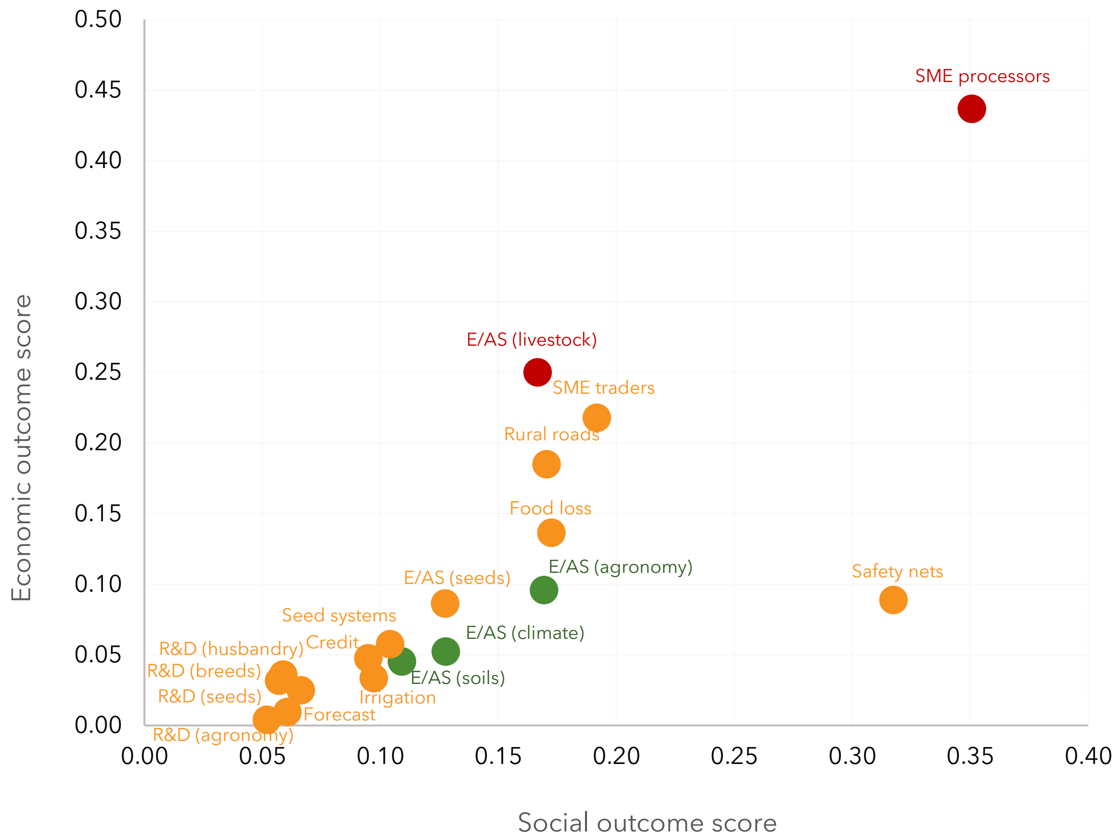
The last panel in Figure 7 reports the composite scores for each intervention based on their overall effects on the three environmental indicators: water, emission, and land footprint, each receiving an equal weight. A clear trade-off emerges, as interventions with greater GDP effects tend to have undesirable environmental outcomes. Livestock-related investments such as farmer-facing extension services appear most resource-intensive, mainly due to their higher emission and water use per output. Similarly, market and food system investments such as spending on SME processors and traders are among the most resource-demanding spending options. In contrast, most upstream R&D interventions—such as those targeting seeds and agronomy—as well as advisory services on agronomy, climate, soils, and seeds, exhibit the smallest environmental footprint, primarily due to their limited overall impact on the economy (see Figure 4 above).

Policymakers have traditionally based policy decisions primarily on economic and social dimensions. To create a composite ranking of the investments, these two dimensions are combined, assigning equal weight (50 percent) to each (Figure 8). This clearly illustrates the synergies and tradeoffs across investments as far as these two broader outcomes are concerned. The composite score puts supporting SME processers and traders, investing in extension and advisory services on livestock as well as safety nets and rural road expansion as top performing interventions. Whereas investing in SME processers and traders and advisory services on livestock are more cost-effective at generating better economic outcomes, extending safety nets is particularly good for greater social outcomes. Systemic interventions—such as reducing food loss and waste and extending credit—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 that deliver strong economic and social outcomes tend to be the most resource-consuming, revealing important tradeoffs. For instance, advisory services in livestock and agronomy and support to SME processors have the strongest impacts on the economic and social outcome indicators, while at the same time causing higher environmental footprints. In contrast, most upstream interventions such as R&D in breeds and seeds, and systemic investments such as climate forecast and seed systems rank as the least cost-effective although they generate among 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



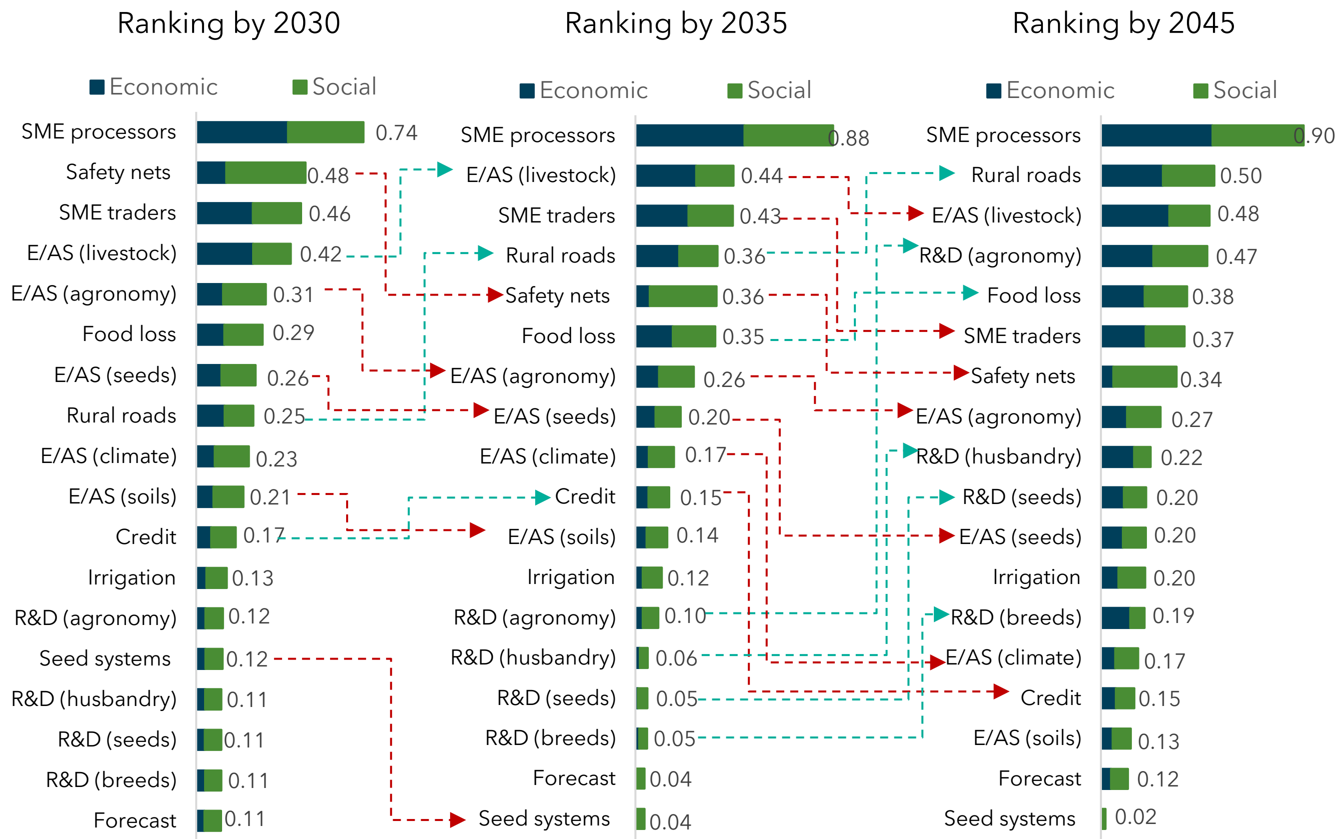
Source: RIAPA modeling system

Do the rankings change over time?

The previous section evaluated the impact of the 2025-2030 investments at the end of the simulation period, i.e., 2045. Since different types of investments exhibit varying lag times between when they are made and when economic and social outcomes materialize, 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 by 2030, 2035, and 2045 (Figure 9).

Model results indicate that R&D investments in animal husbandry, agronomy, and breeding become increasingly cost-effective over time as their delayed but long-term impacts materialize. Similarly, investments in rural road infrastructure and credit access demonstrate substantial improvements in relative cost-effectiveness as their cumulative impacts take effect. By contrast, farmer-facing and recurrent investments—such as extension and advisory services on agronomy, soils, and seeds—gradually decline in relative effectiveness as long-term, high-impact investments assume a greater role in driving economic and social outcomes.

Figure 9: Changes in rankings over time



Source: RIAPA modeling system

Stress-testing of investments

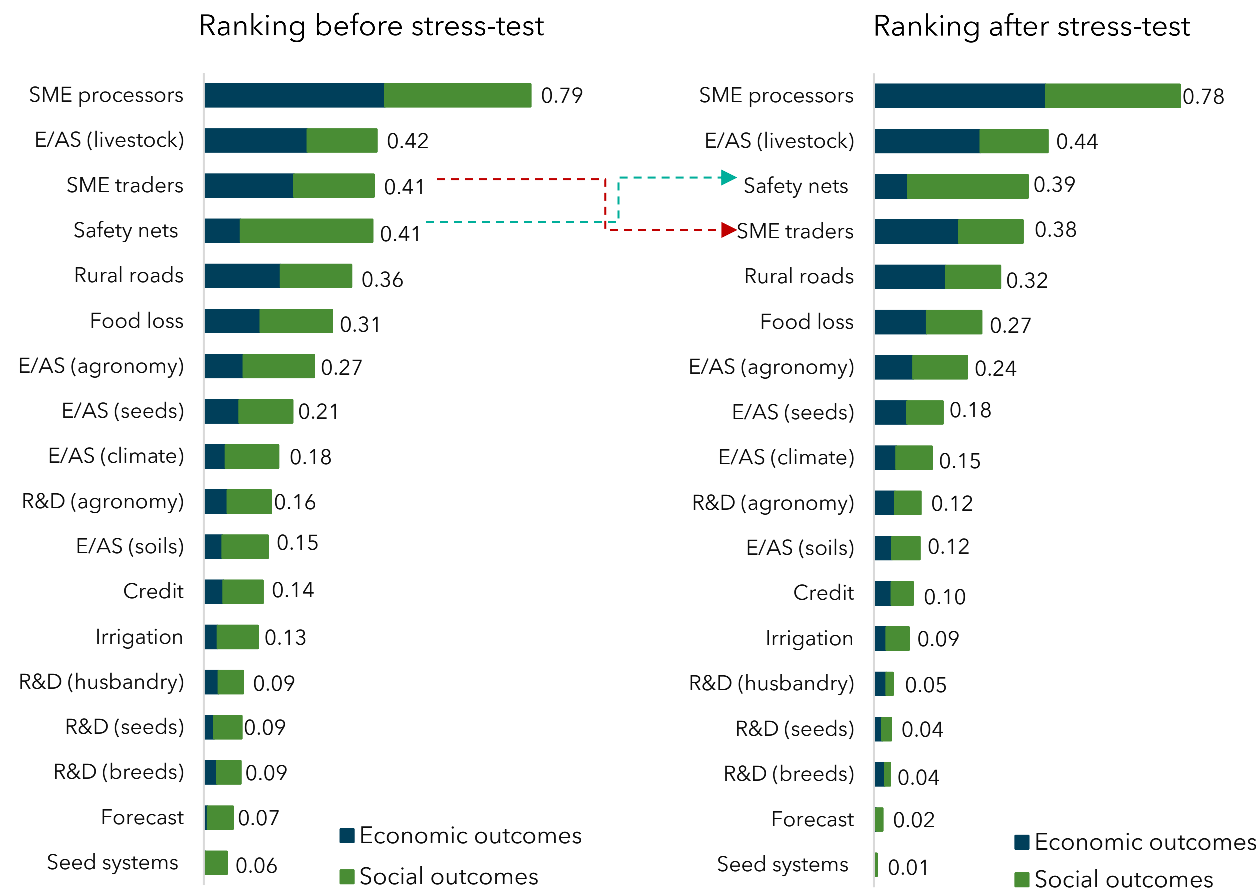
This section reports on how investment rankings might change when a 1-in-25-year drought shock slashes the yield gains throughout the simulation period (2025-2045).[1] Of course, climatic shocks are unanticipated events, and so these simulations should not necessarily influence policymakers' decisions, but they do shed light on the robustness of the ranking results. The Mozambique case demonstrates only minor changes in rankings (Figure 10). The top cost-effective investments—such as support to SME processor, advisory services for livestock, road expansion, and food loss reduction—retain their high benefit-cost rankings even after accounting for the production risks previously discussed. This is because targeted sectors like livestock have historically shown the least yield variability in response to climate change or have only been indirectly and minimally affected by on-farm production losses (see Figure 2).

Meanwhile, a slight shift is observed in the rankings of two of the top four interventions. In particular, the relative cost-effectiveness of SME traders declines marginally due to the disproportionate impact

[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.

of the simulated 1-in-25-year production shock on targeted sectors, as effects ripple through the economy. In contrast, safety nets, which directly benefit households, show a marked improvement in relative effectiveness under conditions of extreme shocks.

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 improved seeds is relatively low – at 0.01 – when the intervention's impact is evaluated across all targeted sectors. However, its impact is well above the average for cash crops, at 0.26. 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 improved seeds for cash crops shows above-average impact relative to the cross-sector score, it does not fall within the top five crop-specific intervention areas. Conversely, R&D in agronomy related to cash crops not only exceed the average impact score of such interventions in agronomy but also are among the top five investment priorities for greater agrifood system performance. Furthermore, Table 1 indicates that focusing extension and advisory services on improved seeds and agronomic practices for cash crops, along with supporting food loss and waste reduction in these crops, would significantly enhance the overall effectiveness of investments in the agrifood system. Support to SME processors, advisory services to livestock, and productive safety nets also remain the top cross-cutting (non-crop-specific) interventions in terms of their impact on social and economic outcomes.

Table 1: Composite scores by investment area and crop sector

			Cross-cut-ting	Cereals	Root crops	Pulses and oilseeds	Horti-cul-ture	Other cash crops
R&D	1	R&D (improved seeds)	0.01	0.02	0.00	0.03	0.02	0.26
	2	R&D (agronomy)	0.04	0.05	0.02	0.05	0.07	0.84
	3	R&D (animal breeds)	0.01					
	4	R&D (animal husbandry)	0.01					
Extension / advisory services	5	E/AS (improved seeds)	0.06	0.05	0.02	0.06	0.16	0.33
	6	E/AS (agronomic practices)	0.08	0.09	0.03	0.05	0.28	0.61
	7	E/AS (livestock)	**0.11**					
	8	E/AS (climate information)	0.05					
	9	E/AS (climate smart agriculture)	0.04	0.04	0.02	0.02	0.16	0.33
Markets and food systems	10	Seed systems	0.00					
	11	SME processors (finance, training)	**0.19**					
	12	SME traders (finance, training)	0.09					
	13	Food loss and waste	0.09	0.05	0.04	0.07	0.33	0.76
	14	Credit access (financial inclusion)	0.03					
Risk reduction and resilience	15	Seasonal forecast (early warning)	0.01					
	16	Productive safety nets	**0.14**					
Infrastructure	17	Irrigation infrastructure	0.03	0.04	0.02	0.01	0.13	0.29
	18	Rural roads	0.08					

Source: RIAPA modeling system

Summary

Mozambique's agrifood system is an important source of livelihood for households, an engine of economic growth, and a key sector of employment, particularly in rural areas. Despite encouraging progress, Mozambique has an urgent need to transform its agrifood system sustainably. Achieving this requires greater technical and financial support to agriculture and its allied sectors. Policymakers can benefit greatly from data- and model-driven insights on the impacts of agrifood system investments on economic, social, and environmental outcomes, including for different planning horizons and under conditions of uncertainty and risk. This country brief presents results from a systematic evaluation of a range of agrifood system investment options. We rank investment choices 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. We also considered the environmental implications of these investments, focusing on water, emissions, and land footprints.

Model results indicate that investments in SME processors and traders, rural road infrastructure, and food loss reduction are the most cost-effective means for improving social outcomes, such as reducing poverty, undernourishment, and diet quality. These investments also perform strongly in terms of expanding agrifood GDP and employment. Similarly, extension and advisory services in livestock, agronomy and seeds emerge as high-impact, farmer-facing interventions. Additionally, the study identifies investments in markets and food systems—particularly those targeting safety nets, micro credit to farmers, and micro-credit to famers—as cost-effective strategies for promoting inclusive agrifood transformation. However, many of these high-performing investments are associated with relatively high environmental footprints, highlighting the tradeoffs between development outcomes and the environment. The analysis reveals only slight changes in the ranking of agrifood system investments under climatic shocks, suggesting the robustness of the ranks.

Several general policy messages can be drawn from this analysis. Firstly, it demonstrates not only 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. Finally, the analysis highlights the importance of designing appropriate climate adaptation and mitigation strategies to help enhance the productivity and resource use efficiency of sectors identified as key drivers of socioeconomic progress.

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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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