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POLICY STUDIES INSTITUTE
STRATEGY SUPPORT PROGRAM | WORKING PAPER 162
December 2024

Prioritizing agri-food system investments under climatic and world price risks

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Template Changelog

Last updated February 2020

Version 1.02

- Added “IFPRI is a CGIAR Research Center” to the boilerplate.

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INTRODUCTION

With a population exceeding 120 million, Ethiopia is home to 77 million people who directly depend on agriculture for their livelihoods (World Bank, 2024a). The country registered robust agricultural growth of about 5% on average for a decade since 2013 (NBE, 2023). The Ethiopian government has been encouraged to target its development interventions to sustain and accelerate the growth and transformation of the economy (IFAD, 2023; Aragie & Balié, 2019). However, the pattern of support and the composition of growth are critical factors influencing changes in poverty, employment, and diet quality (Christiaensen & Martin, 2018; Pham & Riedel, 2019). Assessing the linkages between economic growth and poverty, employment, and diet quality is a topic of importance to both country policymakers and their development partners. Few studies, including Fan and Zhang (2008), Aragie, et al (2022), Benfica, et al. (2019) and Pauw and Thurlow (2015), have so far assessed and ranked various on-farm and off-farm interventions in relation to their impacts on selected outcome indicators and suggested to policy makers the most cost-effective ways of allocating scarce public resources for maximum impact.

Climatic and global price shocks are two of the most significant exogenous factors affecting the performance of agri-food systems in developing countries (Nicholson, 2014; Palmer, et al., 2023; Sokhanvar & Bouri, 2023; Kang, Ratti, & Vespignani, 2020; Chuku, Simpasa, & Oduor, 2018). Climatic risks, such as droughts, have become increasingly common and are expected to intensify in frequency and severity (Godde, Mason-D'Croz, Mayberry, Thornton, & Herrero, 2021; Thornton & Herrero, 2014; Palmer, et al., 2023). Ethiopia, for example, has faced eight major droughts since 2000 (Nicholson, 2014; Palmer, et al., 2023). FAO (2024) data reveals that, on average, Ethiopia has experienced yield shocks of -9.7% for cereals and -13.0% for pulses and oilseeds since 1995. Similarly, global commodity markets have undergone significant price fluctuations, with booms and busts affecting economic performance and other macroeconomic factors (Sokhanvar & Bouri, 2023; Qian, Zhang, & Li, 2023), including exchange rates and domestic prices. According to the World Bank's commodity price data (World Bank, 2024), cereal prices have risen by an annual average of 17.2%, and pulses and oilseeds by 15.8% during the years where prices show an increase. However, the extent to which these climatic and price shocks influence the effectiveness of alternative agricultural policies and investments remains unclear and context specific.

This study provides evidence to inform policy discussions on the design and prioritization of agricultural interventions, taking into account the current state of the agri-food system and the growing risks it faces. The research identifies a range of on-farm investment options and ranks them based on their cost-effectiveness across multiple development outcomes, including growth, poverty reduction, employment, and diet diversity. Additionally, we evaluate how these rankings change when the system is subjected to historical declines in yield and fluctuations in world prices, specific to each agricultural subsector.

To address these research questions, the study employs the Rural Investment and Policy Analysis (RIAPA) economywide model, integrated with the Agricultural Investment Data Analyzer (AIDA) module. This RIAPA-AIDA framework is commonly utilized to assess the economywide impacts of various public expenditure options (Aragie, Benfica, Pauw, Randriamamonjy, & Thurlow, 2024; Aragie, et al., 2022; Benfica, Cunguara, & Thurlow, 2019). The framework includes microsimulation modules that measure changes in poverty and diet quality at the household level in response to shifts in growth performance. By using this comprehensive modeling approach, the study connects agricultural and rural development spending to key development outcome indicators.

The remainder of the paper is organized as follows. Section 2 introduces the policy context in Ethiopia, along with its historical exposure to yield fluctuations and global price shocks. Section 3 details the modeling approach used to evaluate agricultural investments and their impacts, emphasizing the RIAPA-AIDA framework and its microsimulation modules, which assess changes in household poverty and diet quality. Section 4 presents the different investment scenarios analyzed in the study, and Section 5 discusses the results from the model simulations. Finally, Section 6 concludes by outlining the policy implications derived from the findings.

POLICY AND EXTERNAL CONTEXT

A significant majority of Ethiopia's population lives in rural areas, relying heavily on subsistence agriculture. While the agricultural sector has demonstrated robust performance in recent years and remains crucial for overall economic growth and poverty reduction, the country continues to grapple with pervasive poverty and food insecurity. To address these challenges and sustainably improve rural incomes and national food security, the Ethiopian government introduced the Agricultural Sector Policy and Investment Framework (ASPIF) for 2010-2020 (MoARD, 2010). More recently, the government developed the National Agriculture Investment Plan (NAIP) for the 2021-2030 period (MoA, 2022). These development plans aim to sustainably boost agricultural productivity, promote agricultural commercialization, manage natural resources, and enhance disaster risk management and food security. However, achieving these ambitious objectives necessitates the efficient allocation of limited public resources toward carefully identified and cost-effective interventions.

Meanwhile, Ethiopia's macroeconomy, particularly its agricultural sector, has faced numerous climatic and global market changes. This section examines the historical data on domestic yield changes and global price movements, which will assist in designing the simulations and interpreting model results. For instance, we anticipate that a sector experiencing significant global price volatility will be the one that will experience movements in relative impacts when these shocks are considered compared to a scenario where they are overlooked. Understanding these dynamics is essential for accurately assessing the potential effects of agricultural interventions in the context of fluctuating productivity and market conditions.

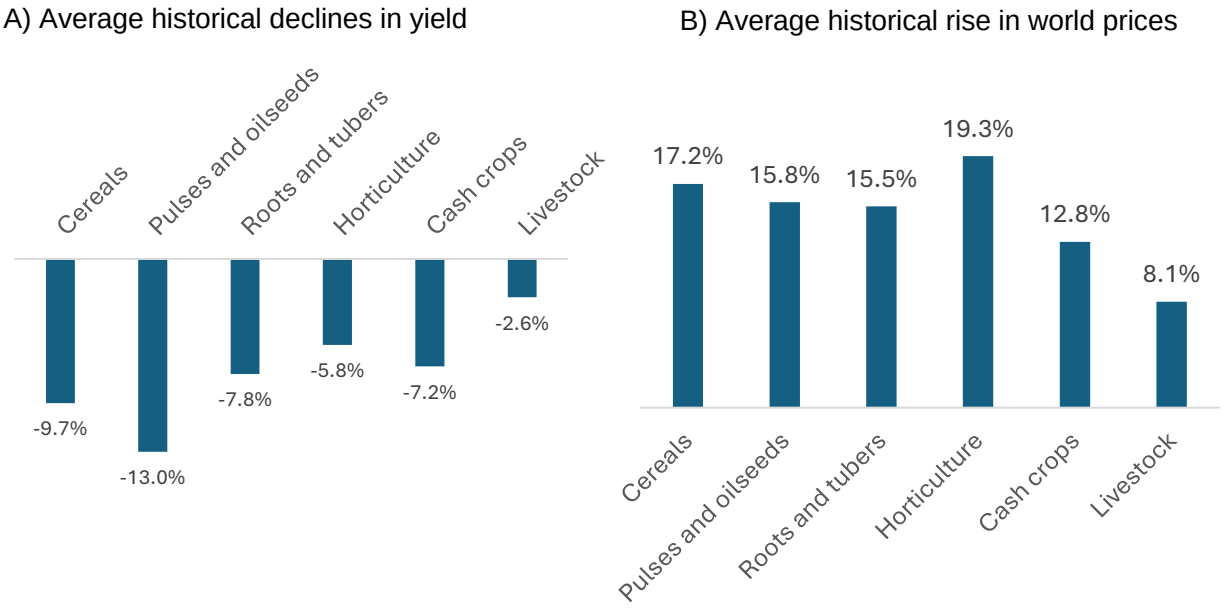
Figure 1 illustrates the average declines in yield and increases in world prices for a group of agricultural products from 1995 to 2022. The yield declines represent annual averages recorded only during years when Ethiopia experienced a drop in yield. Similarly, the increases in world prices are calculated as averages for the same period, but only for years when prices for the respective commodity group rose. While the yield changes pertain specifically to the agricultural sector within Ethiopia, the world price shocks reflect broader price movements in the global marketplace.

According to Figure 1, Panel A, cereals, pulses, and oilseeds have historically experienced significant drops in yield in Ethiopia, ranging on average from -9.7% to -13.0%. In contrast, horticultural crops, which include vegetables and fruits, experienced a more moderate decline of -5.8%, while livestock products, such as milk and meat, exhibited the least variation at -2.6%. Over the analyzed period, cereals showed an average yield decline in 10 years, whereas pulses faced the most volatility with 13 instances of yield drops, indicating a negative yield shock approximately every three years. Annex Figure A provides a detailed breakdown of average yield declines for individual sectors in the model. These

sector-specific yield shocks will be incorporated into the model to reassess the relative effectiveness of various interventions on selected outcome indicators.

Panel B reports the average increases in world prices of agricultural products, based on data from World Bank (2024). The findings reveal varying degrees of exposure to world price shocks among commodities. Notably, horticultural products, primarily bananas and other fruits, lead with an average price increase of 19.3% during years of rising prices. This is followed by cereals, which experience a 17.2% increase, and pulses and oilseeds, which show a 15.8% rise. In contrast, livestock products generally experience moderate price changes when prices increase. Overall, each commodity group has recorded over 10 instances of price hikes exceeding 10% during the period covered, indicating a price shock of more than 10% approximately every three years. Annex Figure B provides additional details on the average increases in world prices for the agricultural products identified in this analysis.

Figure 1: Average historical shocks to yield and world prices of agricultural products (1995-2022)



Source: Author's computation using FAO (2024) and World Bank (2024).

In addition to the patterns of rising world prices across commodities, the potential impact of price shocks on the relative effectiveness of sector-specific interventions—such as improved seed access for cereal producers—depends on the trade structure. An analysis of the share of imports in total domestic supply, based on the 2019 Ethiopian Social Accounting Matrix (SAM) used for this study, indicates that horticultural products, particularly fruits, and livestock products contribute marginally to domestic supply, accounting for 2.3% and 1.8%, respectively. In contrast, cereals and cash crops have an even smaller proportion of their domestic supply derived from imports, suggesting that world price shocks have limited direct effects on the effectiveness of interventions targeting these products. Notably, pulses, oilseeds, and root crops are almost entirely sourced from domestic production.

In contrast, 27% of domestic production of pulses and oilseeds is exported, followed by 19.1% of cash crops. This indicates that these agricultural products are likely to be directly and significantly influenced

by the price incentives generated by the global price increases. Conversely, cereals and root crops are entirely destined for the domestic market, making them less susceptible to external price shocks.

METHOD OF ANALYSIS

The core CGE model - RIAPA

Computable General Equilibrium (CGE) models are widely utilized for economic policy formulation and analysis (Devarajan & Robinson, 2010; Dixon & Parmenter, 1996). These models effectively capture the interlinkages between sectors, households, and rural-urban economies, making them well-suited for assessing the economywide effects of various public policies. They enable policymakers to understand the mechanisms and channels through which policy changes or external shocks impact economic flows, ultimately influencing levels of economic growth.

Evaluating the connections between economic growth, poverty, employment, and diet quality is crucial for both national policymakers and development partners. Understanding how these linkages affect multiple development outcomes is particularly important in the context of competing national development ambitions and limited public resources. Policymakers often question how to allocate public resources more efficiently to maximize impacts across various development outcomes. This is especially vital in agricultural and rural development, where public expenditures historically serve as critical drivers of agricultural growth and rural transformation (Tijani, Oluwasola, & Baruwa, 2016; Benfica, Cunguara, & Thurlow, 2019).

This study employs the RIAPA economywide model, which is calibrated to the 2019 Social Accounting Matrix (SAM) for Ethiopia. This SAM is an updated version of the 2018 SAM for the country (Aragie & Thurlow, 2021). The model represents the economy through a set of disaggregated sectors, encompassing 30 agricultural sub-sectors, which include 22 individual crops or groups of crops, six livestock production sectors, as well as forestry and fisheries. Additionally, the model incorporates 36 industrial sectors and 12 service sectors, many of which are closely related to agriculture. This includes 20 agro-processing activities within the industrial sector, along with trade and transport activities in the service sector.

The Ethiopia model also distinguishes 15 representative households, each of which is an aggregation of a group of households captured in the 2010/11 Ethiopian Household Consumption Expenditure (HCE) survey (CSA, 2012). These households are categorized by rural and urban income quintiles, with rural households further divided into farm and non-farm groups based on their reliance on agriculture as a primary source of income. 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 AIDA module

The investment analysis approach used in this study has been applied in various contexts (Aragie, et al., 2022; Pauw & Thurlow, 2015; Benfica, Cunguara, & Thurlow, 2019) and is documented in detail in (Aragie, Benfica, Pauw, Randriamamonjy, & Thurlow, 2024). By utilizing the AIDA module within the RIAPA model, productivity growth is calculated for each sector in the economy based on trends in

spending on various interventions aimed at enhancing sectoral productivity. The AIDA module integrates spending and investment data obtained from multiple sources—such as household and farm surveys, as well as monitoring and evaluation studies—and assesses the productivity gains from agricultural and rural development interventions. These resulting productivity gains are then linked to the productivity parameters in the RIAPA model across different sectors.

The direct productivity effect from an expenditure package is determined by the investment outcome, which refers to the additional coverage achieved through public investment in a specific technology, service, or infrastructure facility. An example might be an expansion of irrigated farmland that is accomplished with public funding. The investment outcome is determined by the current level of public investment spending and the unit cost per area of farmland.

Meanwhile, elasticities – which measure the impact per unit of expenditure outcome – determine the direct productivity gains from various investments. These elasticities, also known as impact coefficients, are assessed for each type of expenditure, such as the provision of fertilizer or improved seeds versus investments in irrigation or feeder roads. Taking into consideration the additional coverage rate from new investments at the sectoral level, productivity gains can now be specified to different sectors. The combined sector-level productivity gains from a specific investment package are then applied to the productivity parameters in the RIAPA model, allowing for the estimation of the overall economic impacts of these investments.

The modeling framework employed in this study facilitates the ranking of investment options based on their impact on key development outcome indicators, including agri-food systems (AFS) GDP growth, employment creation, poverty reduction, and diet quality improvement. This ranking serves as a tool for prioritizing investments in the agricultural sector, rural economy, and broader food system. The integration of the AIDA and RIAPA models enables a national investment planning perspective that combines investment and policy analysis with ex-ante economywide modeling.

The microsimulation modules

While changes in economic growth and employment are directly embedded within the core RIAPA–AIDA framework, assessing changes in poverty and diet quality necessitates detailed micro-level household data. To address this, the RIAPA–AIDA model system incorporates two household-level microsimulation modules: one for measuring changes in poverty levels and the other for evaluating changes in diet quality.

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 2010/11 Household Consumption Expenditure (HCE) survey (CSA, 2012), which includes 15 representative household groups within the CGE model. The new poverty status is computed for all sampled households. The 2010/11 HCE survey encompassed 27,834 Ethiopian households, providing comprehensive information on various socio-economic variables, including income, consumption, and poverty levels.

Changes in diet quality follow a similar approach. A diet quality microsimulation module, recently developed by (Pauw, Ecker, Thurlow, & Comstock, 2023) for in-depth analysis of diet quality outcomes, was adapted for this study. This module utilizes data from all surveyed households and links them to their

respective representative household groups in the CGE model. Dietary diversity is estimated across six major food group categories. This study applies the ReDD indicator, which serves as a multidimensional indicator of a household's diet quality, to track changes in the gap between a reference diet and the actual diet composition of households.

SCENARIOS

In terms of public expenditure trends and allocation patterns, we identified three major groups of simulations. First, the *baseline simulation* constitutes a "business-as-usual" scenario that assumes that past spending and investment trends continue until 2030 and provides a plausible reference scenario for evaluating alternative investment and spending patterns. This scenario captures Ethiopia's broad economic trends.

In the *second group of simulations*, we introduce shocks to the model through new expenditures and investments, leading it to deviate from the "business-as-usual" scenario. We estimate the returns on individual investments and expenditures across various crop and livestock sectors and assess their contributions to changes in GDP, employment, poverty reduction, and diet diversity. Specifically, we evaluate the effectiveness of different types of interventions by calculating their cost-effectiveness. For instance, for a given amount of spending, such as $1 million, we determine how much GDP can be generated, how many additional workers can be employed, how many individuals can be lifted out of poverty, and how much diet quality can be improved. This process allows us to identify the most cost-effective interventions for promoting inclusive agricultural transformation.

Table 1 presents the expenditure and investment scenarios evaluated under the second group of simulations. In designing these scenarios, we focus on interventions directly aimed at enhancing productivity in the agricultural sector (on-farm interventions). The first set of scenarios in Table 1 reflects the country's long-standing emphasis on providing a package of improved inputs, specifically fertilizers and seeds. Within this set, we create separate scenarios for different crop groups. The first scenario underscores the country's continued commitment to supplying improved inputs for cereal crops, particularly maize and rice. Additionally, four other crop group scenarios are designed: one for pulses and oilseeds, another for roots and tubers, another for horticulture, and a final category labeled "cash crops," which includes coffee, cotton, and various other cash crops. These scenarios aim to facilitate crop diversification and expand the economic base.

The second set of scenarios focuses on enhancing the provision of extension services to crop farmers, aligning with the priorities outlined in the country's ASPIF and NAIP. Separate extension scenarios are created for each crop group to reflect specific needs and contexts. The next set of scenarios acknowledges Ethiopia's endeavor in scaling up the provision of modern inputs jointly with farm extension advice. Additionally, another on-farm scenario proposes an increase in public investment in irrigation infrastructure, encompassing both rehabilitation of existing facilities and new construction.

Table 1: Investment and expenditure scenarios

Scenarios	Simulated sectors
Fertilizer and seeds	Cereals, pulses and oilseeds, roots and tubers, horticulture, cash crops
Extension	Cereals, pulses and oilseeds, roots and tubers, horticulture, cash crops
Improved inputs + extension	Cereals, pulses and oilseeds, roots and tubers, horticulture, cash crops
Irrigation	Cereals, pulses and oilseeds, roots and tubers, horticulture, cash crops
Livestock extension	Cattle and poultry
Livestock breeding, health, feed, and extension	Cattle and poultry

Note: 'Cash crops' category includes cotton, coffee, tobacco, cut flower, etc. A comparable $10 million spending, which grows by 2.4 percent per year during 2020-2030, is assumed for each scenario. Economic outcomes are then compared.

We also design separate scenarios focusing on livestock extension, which include the joint provision of livestock breeding, health services, feed, and extension support. These scenarios are aligned with the NAIP targets aimed at enhancing productivity and production in key livestock value chains, such as poultry, red meat, and dairy. In total, we evaluated 22 scenarios, each allocated a comparable budget of $10 million, to facilitate a thorough comparative analysis.

The *third simulation* investigates whether the ranking of interventions identified in the previous scenario across the four development outcomes would change if these interventions were implemented during periods of productivity and price shocks. Our historical yield and world price trend analysis in section 2 indicates that such shocks are relatively frequent, occurring in great magnitude once every three years.[1] To account for this recurring nature, we introduce two shocks of the same magnitude for each type during the simulation period from 2020 to 2030. Specifically, these shocks are applied separately at the beginning (i.e., in 2020) and midway (i.e., in 2025) through the simulation period.

To generate further insights, we assess the rankings under three separate assumptions: (i) when a domestic productivity shock occurs while the global market remains stable, (ii) when the domestic economy experiences world price shocks on exports and imports without significant climate-induced productivity shocks, and (iii) when both shocks occur simultaneously. In this set of scenarios, we maintain the same level of spending as in the previous simulation. The outcomes are again evaluated for the period extending through 2030.

DISCUSSION OF RESULTS

Effect on the growth impact ranking

In the absence of the assumed climatic and price risks, the joint provision of modern inputs (seed, fertilizer, and extension) to pulses and oilseeds, as well as livestock inputs, yields the highest gains in agri-

[1] Whereas few studies (Ceballos, Hernandez, Minot, & Robles, 2017; Frankel, Parsley, & Wei, 2012) find some degree of insulation of domestic commodity markets in developing countries from international price movements, we assume comparable import and export price shocks as defined in section 2.

food system GDP. Investments in cash crops and cereals also prove to be beneficial. However, irrigation development targeting roots and tubers, and horticultural products appears to be the least cost-effective due to the high costs associated with these investments and the limited feedback effects of these two sectors. It is important to note that the modeling framework does not account for the additional benefits of irrigation during drought conditions, potentially underestimating its overall contribution.

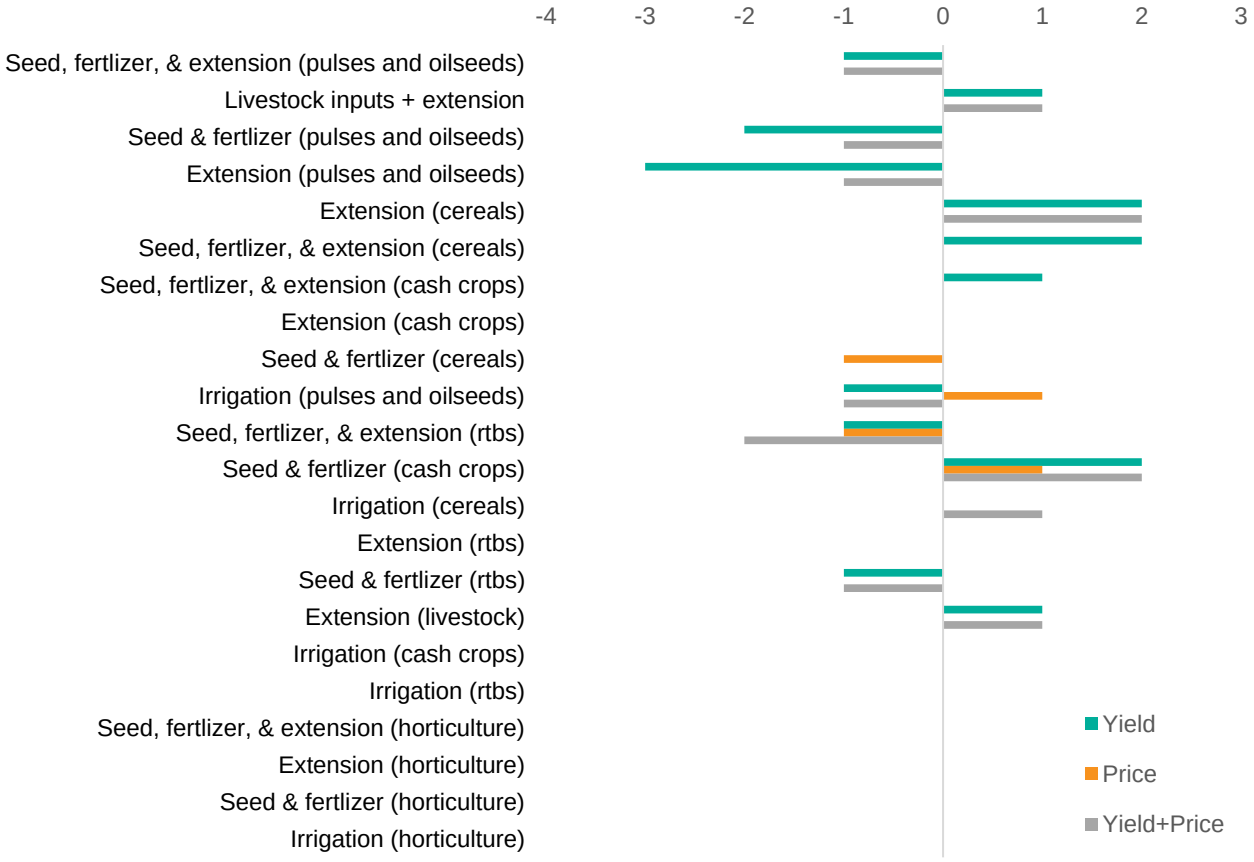
The climatic and world price shocks cause noticeable alterations in the rankings of the analyzed interventions concerning agri-food system GDP (Figure 2). However, the impact of these two sources of shock on the agricultural sector in Ethiopia differs markedly. The yield shock results in more significant shifts in rankings compared to the external price shock, affecting various sub-sectors differently.

Notably, interventions targeting pulses and oilseeds experience the most significant declines in cost-effectiveness for accelerating growth, with the extension scenario dropping three ranks and the joint provision of seed and fertilizer for this sector falling by two ranks. Figure 1 illustrates that these crops have faced the most substantial historical yield declines over the 1995-2022 period. Prior to incorporating the yield shock, pulses and oilseeds-related interventions were ranked at the top. The relative cost-effectiveness of interventions targeting pulses and oilseeds was subsequently overtaken by those focused on cereals. After recalculating the relative impacts of the interventions, the provision of livestock inputs, combined with extension services, ranks as the most cost-effective approach for promoting overall agri-food system GDP.

The price channel has a minimal impact on the growth impact ranking. This is primarily due to the opportunities created by high export prices, alongside the pressures on the local market resulting from expensive imports. Consequently, cereals, which experience one of the highest price shocks (17.2%), show only a slight decline in rank. In contrast, export-oriented products, including oilseeds and cash crops, become increasingly beneficial for promoting growth. These shifts in relative rank occur primarily in the mid-table of the rankings.

Broadly speaking, when the joint shock is considered, the yield and world price shocks reinforce each other, leading to more pronounced effects on the overall rankings of interventions.

Figure 2: Changes in the rank of interventions based on their impacts on agri-food system GDP



Effect on the employment impact ranking

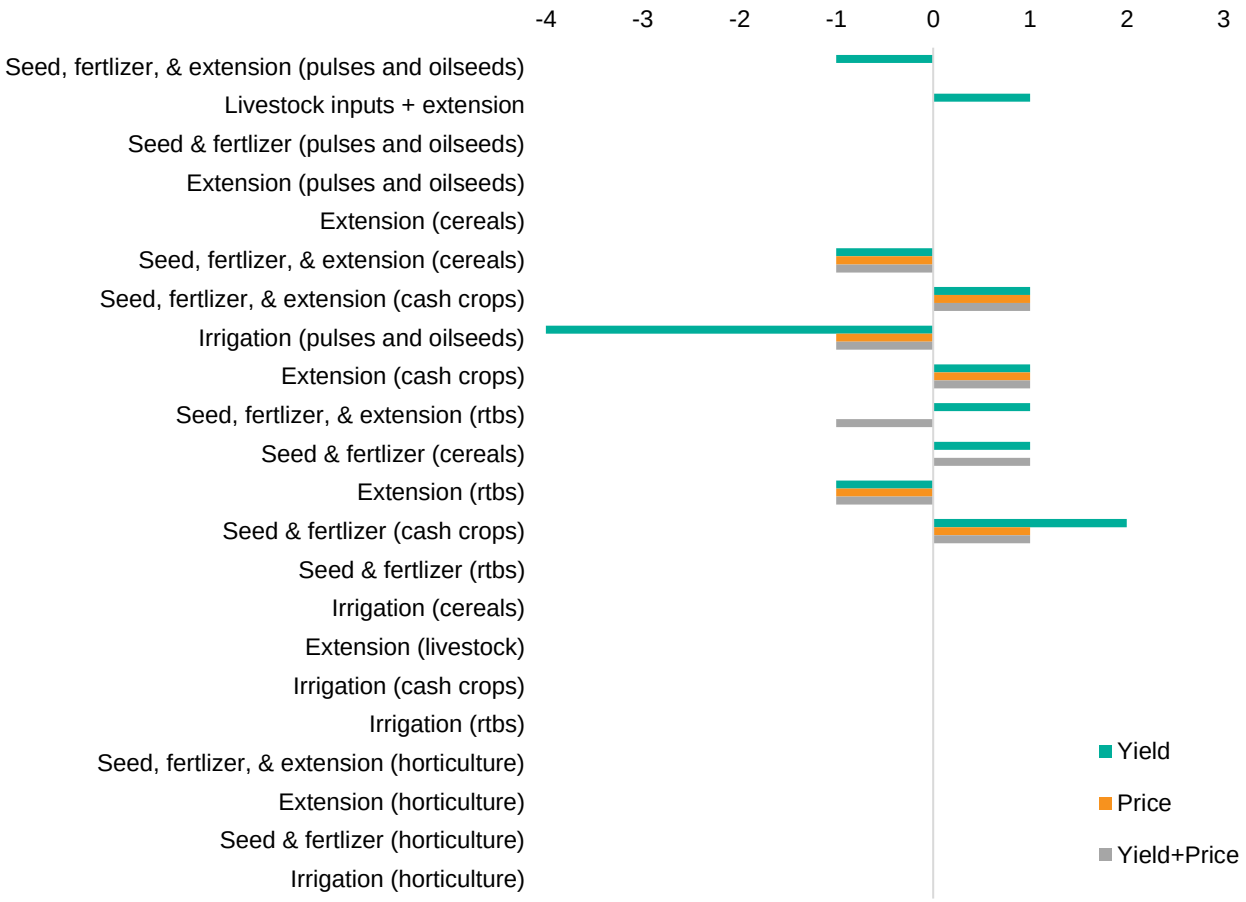
When climatic and world price shocks are not considered, interventions related to pulses, oilseeds, and livestock tend to attract more workers to agriculture due to their increased profitability. Overall, combined interventions involving fertilizers, seeds, and extension services significantly contribute to job creation. This ranking of employment impact within the agri-food system closely aligns with the GDP effects illustrated in Figure 2.

However, introducing the yield and price risks alter this ranking. Most changes in employment impact rankings are observed in the middle of the current order, primarily due to the decline in cost-effectiveness of irrigation interventions targeting pulses and oilseeds (Figure 3). This shift is particularly evident when the yield shock is taken into account. Similar to the effects on GDP, the joint provision of livestock inputs surpasses the combined inputs (seed, fertilizer, and extension) for pulses and oilseeds, emerging as the leading intervention for generating the highest employment opportunities throughout the agri-food system.

Meanwhile, world price shocks on the commodities considered in this analysis affect the same list of interventions as observed in Section 4.1, demonstrating a close association between the growth and employment effects. However, the employment ranking among the highest-ranking interventions ap-

pears robust to the joint yield and price shock scenarios. Notably, cash crop-related interventions create better employment opportunities under the joint shock scenario compared to less tradable commodities, including cereals, roots and tubers, and pulses.

Figure 3: Changes in the rank of interventions based on their impacts on agri-food system employment



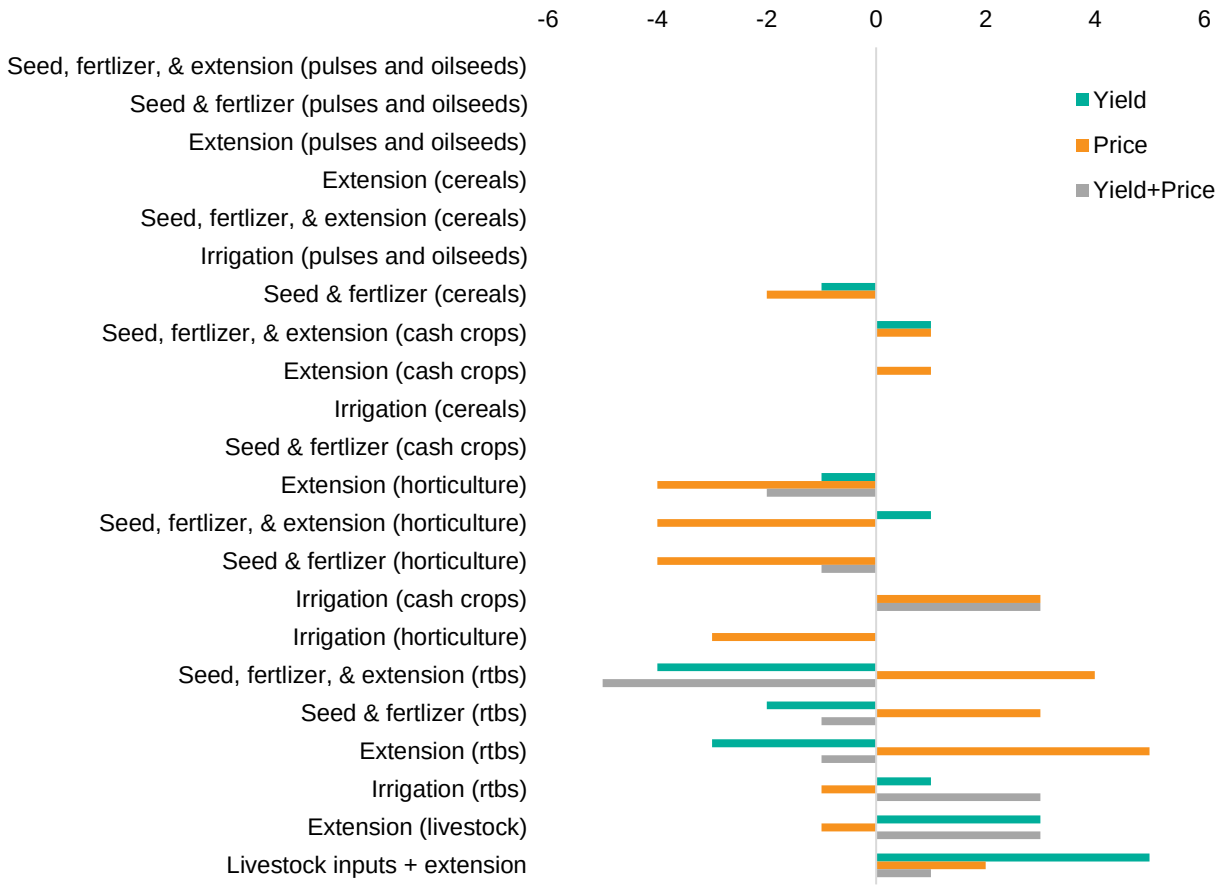
Effect on the poverty impact ranking

Public support for the agricultural sector has long been recognized as a catalyst for accelerating poverty reduction (Keynes, 1936; Tijani, Oluwasola, & Baruwa, 2016). However, yield and price shocks to the sector have also threatened to erode decades of developmental progress. In this section, we evaluate how these two shocks would alter the relative effectiveness of various on-farm interventions in alleviating poverty.

Figure 4 illustrates that the top-ranking interventions remain largely unaffected by the shocks. Most changes in relative cost-effectiveness for reducing headcount poverty occur among the lower-ranking interventions, particularly those targeting roots and tubers and livestock. These sectors have limited effectiveness in alleviating poverty: roots and tubers tend to dominate the diets of the most impoverished, while livestock serves primarily as a livelihood and consumption source for relatively better-off households.

Overall, the price shock results in more significant changes in the poverty impact rankings, particularly affecting horticulture-oriented interventions, which experience a further decline in their relative impact on the poor. This decline is likely due to their less tradable nature in the export market due to the absence of these commodities in the export composition of Ethiopia, limiting their ability to capitalize on the high world prices compared to other, more tradable sectors.

Figure 4: Changes in the rank of interventions based on their impacts on poverty headcount



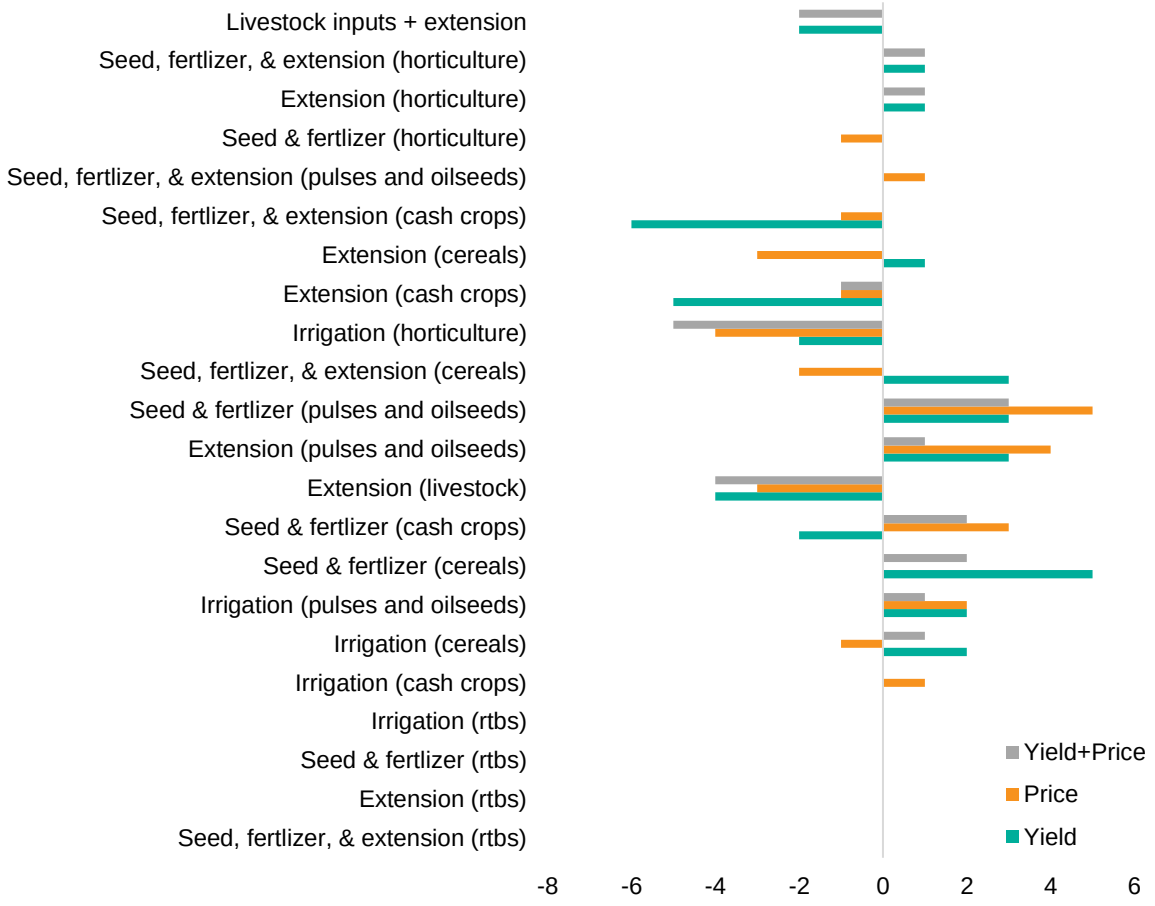
Effect on the diet diversity impact ranking

The relative cost-effectiveness of various interventions on diet diversity changes markedly when simulated yield shocks are considered. Specifically, these yield shocks make livestock interventions less efficient than they were in the absence of such shocks, despite the historical yield changes being markedly higher for horticulture, which has now surpassed livestock in effectiveness (Figure 5). This decline in the role of livestock-related interventions in diversifying diets may be linked to consumer price adjustments within the economy, as indicated by the improvements observed in GDP (Figure 2) and employment (Figure 3) effects associated with these latter interventions.

Meanwhile, the separate or joint provision of extension services, seeds, and fertilizers to cereals, pulses, and oilseeds emerges among the top half of the impact ranking, effectively replacing the significance of cash crops in aiding households to diversify their diets. This shift occurs primarily by enabling households to move away from relying solely on cereals, pulses, and oilseeds, leading to increased

consumption of products such as fruits, vegetables, and livestock products—commodities that have historically experienced lower yield shocks.

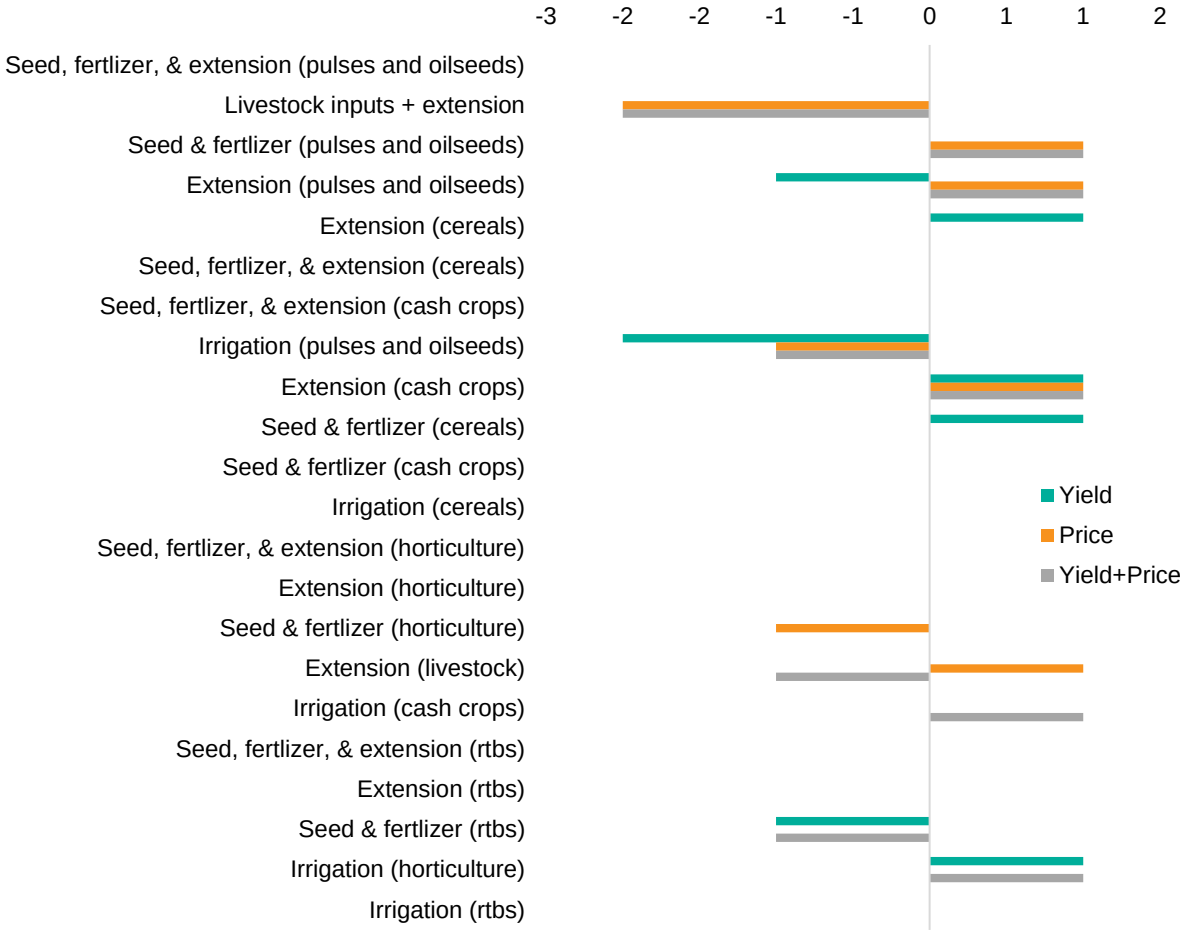
Figure 5: Changes in the rank of interventions based on their impacts on diet quality



Effect on the combined ranking

We have observed from the effects on the four development outcome indicators that no single intervention emerged as the most cost-effective across all areas. To compare the various interventions based on their overall effect on inclusive agricultural transformation, we generated a unified balanced weighted score, assigning equal weight to each outcome (25% each). This combined score indicates that the composite provision of farm inputs to pulses and oilseeds ranks at the top of this unbiased weighted assessment. Additionally, the provision of modern inputs alongside livestock extension significantly drives inclusive agricultural transformation in Ethiopia. Conversely, interventions targeting roots and tubers, as well as horticulture, remain less cost-effective overall, despite demonstrating strong impacts on growth and diet quality, respectively.

Figure 6: Changes in the combined rank of interventions



The question is whether this observed ranking is maintained when the climatic and price risks are overlayed onto these interventions. We find that combining the individual inclusive agricultural transformation indicators—growth, employment, poverty, and diet—diminishes the dynamism in ranking (Figure 6). For example, the yield shock does not alter the relative rank of the three most effective interventions. However, there is a slight decline in the relative strength of interventions focused on pulses and oilseeds, particularly those related to extension and irrigation services. This decline in the relative combined effect is primarily attributed to the deteriorating agri-food GDP growth effect, as indicated in Figure 2.

The world price shock makes the provision of seeds and fertilizers for pulses and oilseeds more effective compared to livestock-oriented interventions. This decline in the ranking of livestock interventions in the combined score is primarily driven by a reduction in their diet score, which accounts for a quarter of the composite score. Under the combined yield and world price shock scenario, the composite score closely aligns with that observed under the world price shock alone.

CONCLUSION

With poverty and food security continuing to be critical development challenges, governments in developing countries are encouraged to target their development interventions to sustain and accelerate the

growth and transformation of the economy. Previous studies have provided valuable insights into the ranking of various on-farm and off-farm interventions, highlighting cost-effective strategies for policy-makers to maximize impact with limited public resources. However, the challenges posed by climatic and global price shocks significantly complicate the agricultural landscape. With frequent droughts and fluctuations in global commodity prices impacting yields and economic performance, it is vital to understand how these external factors interact with agricultural policies and investments.

As Ethiopia continues to navigate these challenges, ongoing assessments of the linkages between economic growth, poverty alleviation, and diet quality will be essential for shaping effective agricultural strategies and ensuring sustainable development in the face of adversity. This study adopts the RIAPA-AIDA modeling framework on the case of Ethiopia and evaluates how these rankings change when the system is subjected to historical declines in yield and fluctuations in world prices, specific to each agricultural sub-sector.

Results demonstrate that climatic and world price shocks significantly alter the rankings of agricultural interventions in relation to Ethiopia's agri-food system GDP. Yield shocks cause more substantial shifts in these rankings than price shocks, affecting different sub-sectors uniquely. Specifically, interventions targeting pulses and oilseeds see the largest declines in cost-effectiveness, with those focusing on cereals and livestock inputs surpassing them. The price shock indicates that export-oriented products, such as oilseeds and cash crops, have become more advantageous for growth. When considering joint shocks, yield and price shocks reinforce each other, leading to more pronounced impacts on the overall rankings of interventions.

Most changes in employment impact rankings align with those observed for the agri-food system growth indicator. In terms of poverty impact ranking, the highest-ranking interventions remain mostly unaffected by the shocks. In contrast, lower-ranking interventions, particularly those targeting roots and tubers and livestock, experience notable deterioration in cost-effectiveness. The price shock particularly diminishes the effectiveness of horticulture-oriented interventions, likely due to their less tradable nature and inability to leverage high world prices compared to more tradable sectors.

The relative cost-effectiveness of interventions on diet diversity also changes significantly with simulated yield shocks. These shocks reduce the efficiency of livestock interventions, which were previously the most effective, while horticulture now surpasses livestock in effectiveness despite higher historical yield changes.

When the effects of growth, employment, poverty, and diet are combined, the dynamism in ranking diminishes. While the yield shock does not alter the rank of the top three interventions, there is a slight decline in the effectiveness of interventions targeting pulses and oilseeds, particularly in extension and irrigation services, primarily due to a weakening agri-food GDP growth effect. Additionally, the world price shock enhances the effectiveness of seed and fertilizer provision for pulses and oilseeds relative to livestock interventions, which experience a decline in their ranking due to a drop in their diet score. Under the combined yield and world price shock scenario, the composite score aligns closely with that of the world price shock alone.

In summary, this study indicates that stress-testing the impacts of agricultural interventions should be a crucial aspect of the planning and decision-making process. This allows policymakers to evaluate how various interventions might perform under different opportunities and adverse scenarios, such as climatic shocks or global price fluctuations.

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ACKNOWLEDGMENTS

This work was carried out under the CGIAR NEXUS Gains Initiative.

We would like to thank all who supported this research through their contributions to the CGIAR Trust Fund: https://www.cgiar.org/funders/.

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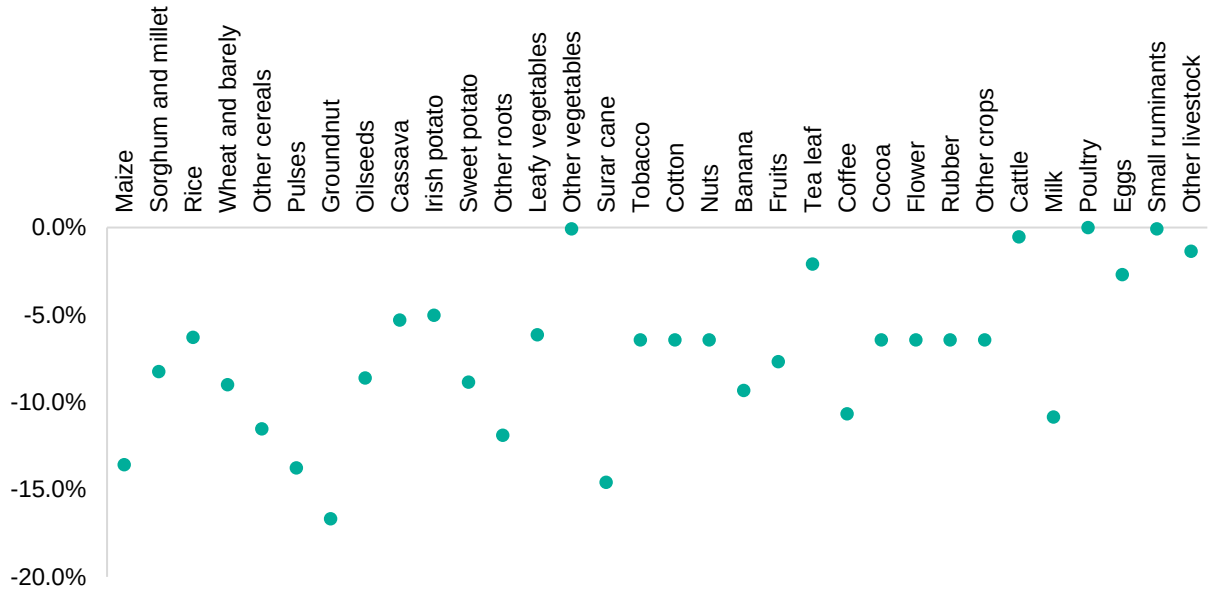
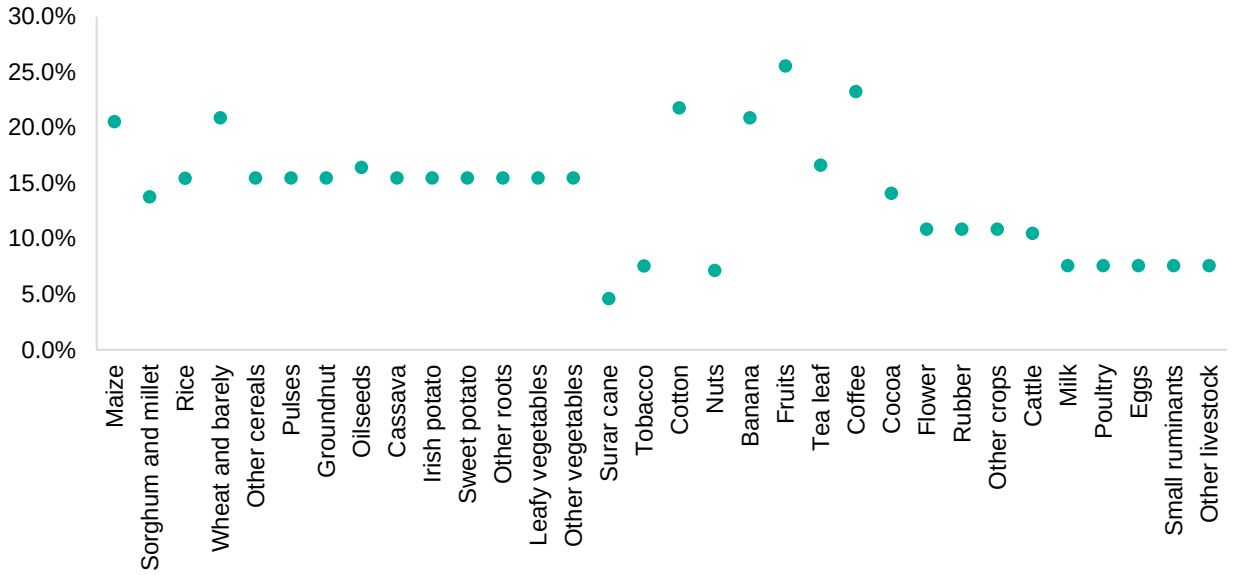
Annex Figure A: Average (1995-2022) declines in yield by sector during years of negative yield shock



Source: Author's computation from FAO (2024)

Annex Figure B: Average (1995-2022) increases in world prices of agricultural commodities during years of price rise



Source: Author's computation from World Bank (2024)

Funding for this work was provided by the various donors of the CGIAR. This publication has been prepared as an output of Nexus Gains Initiative and has not been independently peer reviewed. Any opinions expressed here belong to the author(s) and are not necessarily representative of or endorsed by IFPRI.

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The Ethiopia Strategy Support Program (ESSP) is managed by the International Food Policy Research Institute (IFPRI); is jointly implemented with the Policy Studies Institute (PSI); and is financially supported by the United States Agency for International Development (USAID), the Foreign, Commonwealth & Development Office (FCDO) of the government of the United Kingdom, and the European Union (EU). This research was conducted as part of the CGIAR Research Program on Policies, Institutions, and Markets (PIM), which is led by IFPRI.

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