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Prioritizing Value Chains for Achieving Rwanda's Agrifood System Transformation

A diagnostic of the agrifood system

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Rwanda's impressive economic growth over the past two decades has been accompanied by significant structural change in the broad economy and the agrifood system in particular. This note summarizes key results from a recent diagnostic of Rwanda's agrifood system transformation, examining the effectiveness of productivity-led growth in different agricultural value chains for promoting development outcomes related to poverty, growth, employment, diet quality, and hunger.

The findings show that value chains differ in their effectiveness in promoting these different development outcomes. The wheat and sorghum value chain, for example, has strong anti-poverty effects and is effective at reducing hunger, but is less effective at increasing jobs. Trade-offs will emerge as no single value chain is most effective at achieving every desired outcome; therefore, promoting a few value chains jointly will diversify agrifood system growth and help achieve multiple development outcomes simultaneously.

Rwanda's Agrifood System Transformation

Rwanda has made remarkable economic progress during the past two decades, and its rapid economic growth has been accompanied by a significant structural change in the country's economy as well in its agrifood system (AFS). Rwanda's economy grew rapidly at more than 7 percent annually in the two decades prior to the COVID-19 pandemic, while the AFS achieved a respectable annual growth rate of 5.4 percent. During this period, the growth rate for the off-farm component of the AFS was much higher than the growth rate on the farm—6.2 and 5.1 percent, respectively—and the off-farm share of the AFS increased from 26.3 to 28.4 percent between 2009 and 2019.

[1] This brief summarizes results from Diao, X., M. Ellis, S. Mugabo, K. Pauw, G. Rosenbach, D.J. Spielman, and J. Thurlow (2022), *Rwanda's Agrifood System: Structure and Drivers of Transformation*, Rwanda SSP Working Paper 6 (Washington, DC: IFPRI). Also see updates published in the Agrifood System Diagnostics Country Series by the same authors as Brief 15 (July 2023).

Agriculture continues to play an important role in Rwanda's economic development despite the challenges of scarcity in agricultural land, small farm sizes, limited infrastructure, constrained access to production inputs and technologies, and repeated climate shocks (Dusingizimana et al. 2022; Adolph et al. 2021; Malabo Montpellier Panel 2021; World Bank and Government of Rwanda 2020). Given this reality, it is important to better understand agriculture's contribution to the country's development beyond just primary agriculture and to the transformation of the entire agrifood system.

Using the Rwanda Computable General Equilibrium (CGE) model,[2] we assessed the effectiveness of productivity-led growth across 14 agricultural value chain groups in Rwanda in promoting the following five development outcomes:

- poverty, based on a poverty-growth elasticity that measures the percentage-point change in the poverty headcount rate per unit of agricultural GDP growth generated within the targeted value chain;
- economic growth, which relies on a growth multiplier that measures the change in GDP per unit of increase in agricultural GDP in each value chain;
- employment, based on an employment multiplier that measures the change in the number of jobs created per unit of increase in agricultural GDP in each value chain;
- diet quality, which relies on an indicator that measures the percentage change in a diet quality index per unit of agricultural GDP growth generated within the targeted value chain; and
- Hunger, which uses a hunger-growth elasticity measuring the percentage-point change in the rate of undernourishment per unit of agricultural GDP growth generated within each value chain.

The simulations entail first raising on-farm productivity (what we call an "exogenous productivity shock") separately in each value chain group,[3] and then comparing development outcomes across the value chains. While the exogenous productivity shock is imposed only in the primary agriculture component of each value chain, there are spillover effects into that value chain's off-farm components as well into other agricultural value chains or sectors outside the AFS. These spillovers are captured by the economywide model and provide an indication of the transformation effect that productivity growth in the value chain has within the AFS and the broader economy.

There are also structural differences across value chains. For example, value chains have unique links to other sectors as suppliers or users of intermediate inputs, or they have unique links to rural or urban households in different income groups because of the types of workers they employ or the consumption preferences of households for the agrifood products produced by those value chains.

As such, each value chain growth scenario is expected to have a unique impact on the development outcomes. Moreover, not all value chains will be equally effective at improving outcomes. In some cases, there may even be trade-offs because of competition for resources across value chains. With the aid of the Rwanda CGE model, these complex effects can be unpacked, thus providing information to governments or development partners that can be used to prioritize across different value chains—subject to the development outcomes they value most highly.

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[2] The Rwanda CGE model is an adaption of IFPRI's Rural Investment and Policy Analysis (RIAPA) model to the Rwandan context and applying the model to the 2019 Social Accounting Matrix (SAM) for Rwanda, which was updated from the 2017 SAM jointly developed by IFPRI, MINECOFIN, and NISR (IFPRI 2023; IFPRI, MINECOFIN, and NISR 2021).

[3] See Annex 1 for a detailed description of each value chain group.

Impact of value chain growth on development outcomes

Figure 1 shows the scores each value chain achieves across the five development outcome indicators.[4] We arbitrarily rank the value chains by their poverty score for the purposes of displaying the results.

These results indicate that value chains clearly differ significantly in terms of their effectiveness in improving different development outcomes. For example, the "other cereals" (mainly wheat and sorghum) value chain has strong poverty effects and is most effective at reducing hunger, but it is much less effective in increasing jobs.

The rice value chain, in contrast, has a growth multiplier of 3.35, the second-highest of all value chains, which means that for every US$1.00 increase in GDP in the rice value chain driven by rising productivity, an additional US$3.35 is generated in total GDP, that is, US$2.35 is generated either in the off-farm components of the rice value chain or in other value chains or sectors of the economy. The rice value chain also scores high on the hunger outcome but ranks much lower on the diet quality and job creation outcome.

Figure 2 presents composite scores using equal weights across the four development outcome indicators to simplify interpretation of results.[5] Specifically, the individual outcomes are normalized because they are initially measured and reported using different underlying units, and normalization allows them to be comparable without changing their ranking within the outcome category.[6] Each bar in Figure 2 shows the equally weighted score, while each colored section of bars shows the relative contribution of a particular outcome indicator in the final score.

It is important to note that the equal weighting of each development outcome is simply our "default" approach—we assume that each of the four outcome indicators is equally important, so an equal weight is assigned to each score. However, if policymakers consider a particular development outcome to be more or less important than the other outcomes, the weights assigned to each particular outcome score can be adjusted accordingly which, in turn, may affect the ranking.

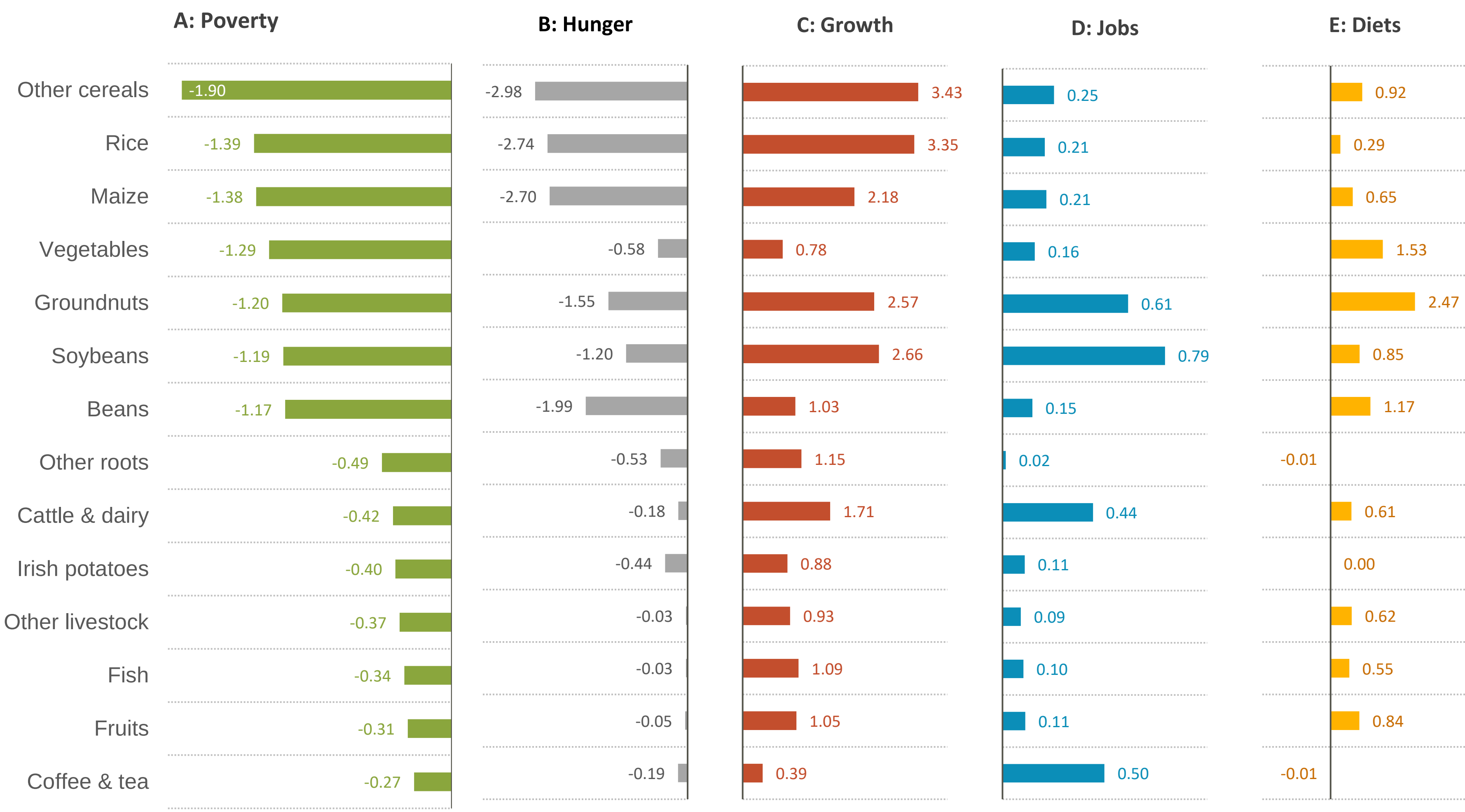
As Figure 2 indicates, the value chains for groundnuts, other cereals, soybeans, and rice are ranked highest. But while each of the four outcomes makes some contribution to the individual value chain's composite score, there is considerable variation between the value chains. For groundnuts, the highest-ranked value chain, the contribution to diet outcome is far more important than in other high-ranking value chains. By contrast, in the second-ranked "other cereals" value chain, it is the growth component that makes the most important contribution. Similarly, the rice value chain contributes only minimally to diet quality improvement and job creation, even though it may have important impacts on the other two development outcome areas.

[4] Figure 1 shows results in terms of actual scores for each value chain. Although this figure differs from the normalized scores shown in Figure 9 of in Diao et al. (2022). Figure 6 remains consistent with Table 4 in Diao et al. (2022). Also note that the poverty and hunger outcome indicators are reported in negative terms, that is, as reductions in poverty and hunger, for purposes of clarity only.

[5] The exclusion of the hunger outcome indicator in this composite indicator is due to its high correlation with poverty. This is the main difference between this version of the diagnostic (detailed in Diao et al. 2023) and the previous version reported in Diao et al. (2022). Note that this change does not affect the ranking of most value chains reported below. In fact, the five top-ranking value chains remain, with only groundnuts and other cereals switching their rankings among the top five.

[6] Normalization entails assigning a score of 1 to the value chain that is most effective within an outcome category and a score of 0 to the least effective value chain. Also note that all value chains with adverse effects on an outcome are also assigned a score of 0. This includes value chains with a growth multiplier of less than one (vegetables, Irish potatoes, other livestock, and export crops (coffee and tea)) or those with negative diet effects (other roots). The remaining value chains receive a score between 1 and 0 that is proportionate to their original score relative to the highest-ranked value chain. The individual normalized scores for the outcomes are then combined into a composite score for each value chain.

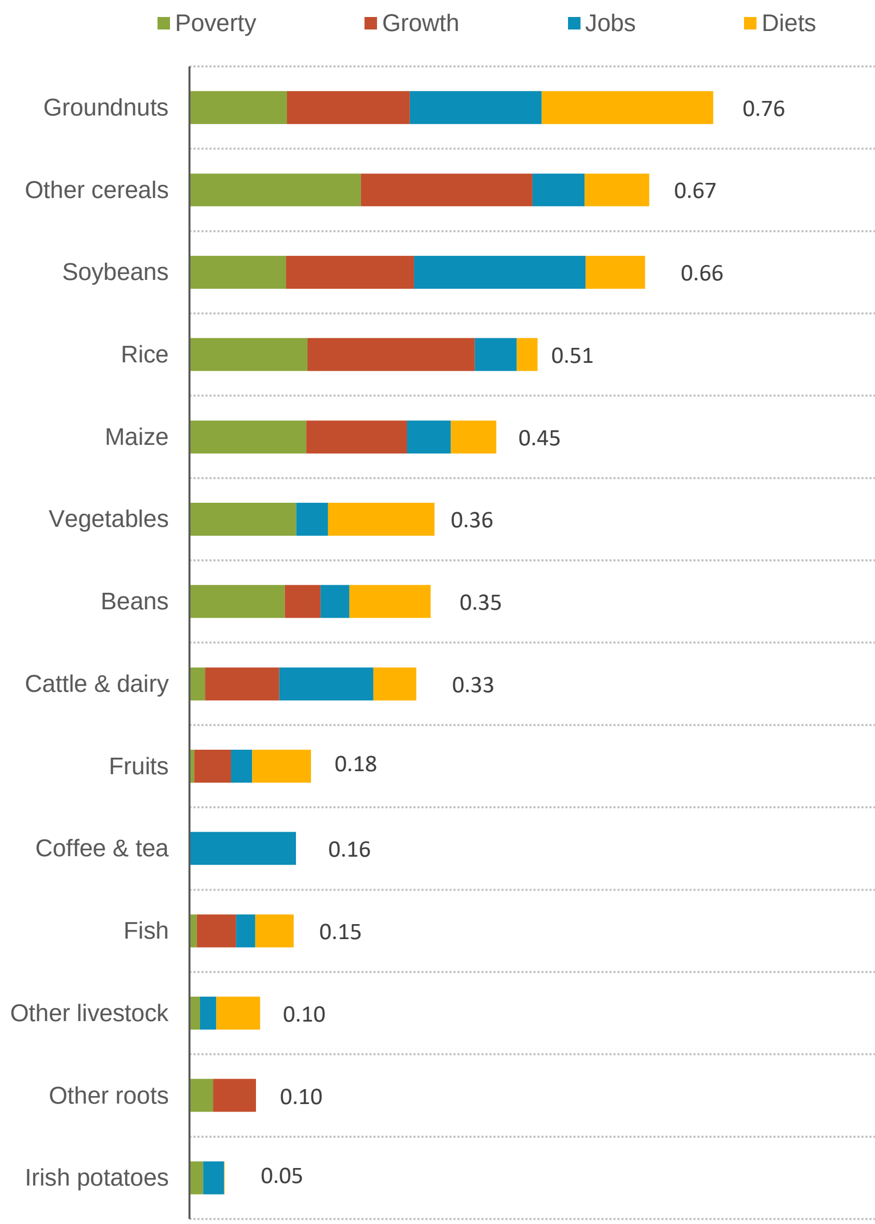
Figure 1. Impact of value chain growth on development outcomes



Source: Rwanda CGE Model Results.
Note: Panel A shows the percentage point changes in the poverty rate that are associated with a 1 percent increase in agricultural GDP. Panel B shows the percentage point changes in hunger rate that are associated with a 1 percent increase in agricultural GDP. Panel C shows the changes in total GDP (in US$ millions) that are associated with a US$1.0 million increase in agricultural GDP from the targeted value chain. Panel D is the change in total economywide employment (in thousand persons) that is associated with a US$1.0 million increase in agricultural GDP from the targeted value chain. Panel E is the percentage improvement in diet quality that is associated with a 1 percent increase in agricultural GDP. The figure is ordered by the poverty rate outcome.

In summary, while it is possible to rank the impact of agricultural productivity shocks on multiple development outcomes, trade-offs clearly exist. The results presented here highlight the possible trade-offs that might emerge when prioritizing individual value chains, indicating that no single value chain is most effective at achieving each and every development objectives. Instead, a strategy of promoting several value chains jointly may help to diversify agricultural growth in Rwanda while also aiding efforts to simultaneously achieve multiple development objectives. These considerations are potentially useful in the development of the investment portfolio and selection of priority value chains in the next Strategic Plan for the Transformation of Agriculture (PSTA 5).

Figure 2. Composite score of development outcomes: Equal weights



Source: Rwanda CGE Model Results.
Notes: The composite score is a simple average (equally weighted) of the scores for each of the four outcome categories; the figure is ordered according to the highest composite score.

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Annex

Table A1. Value chain groups and their corresponding agricultural subsectors

Value chain groups and their share of AgGDP+	Individual value chains (or agricultural subsectors) in the group and their share of the group's agricultural GDP
Maize (2.3%)	Maize 100%
Rice (2.9%)	Rice 100%
Other cereals (2.2%)	Sorghum & millet 93.5% | Wheat & barley 3.5% | Other cereals 3.1%
Groundnuts (2.7%)	Groundnuts 100%
Soybeans (0.3%)	Soybeans 100%
Beans (4.4%)	Beans 100%
Irish potatoes (4.0%)	Irish potatoes 100%
Other roots (17.6%)	Cassava 49.7% | Sweet potatoes 23.4% | Cooking bananas 14.3% | Cooking bananas 12.4%
Vegetables (3.0%)	Leafy green vegetables 27.9% | Other vegetables 72.1%
Fruits (11.9%)	Nuts 2.4% | Sweet bananas 57.8% | Other fruits 37.8%
Export crops (5.1%)	Coffee 61.1% | Tea 37.4% |Cut flowers 1.5%
Other crops (5.2%)	Sugarcane 82.0% | Tobacco 6.3% | Other crops 11.7%
Cattle & raw milk (9.5%)	Cattle meat 45.6% | Raw milk 54.4%
Other livestock (2.2%)	Poultry meat 27.8% | Eggs 18.8% | Small ruminants 35.8% | Other livestock 17.6%
Fish (1.2%)	Aquaculture 15.5% | Capture fisheries 84.5%
Forestry (20.9%)	Forestry 100%

Source: Authors' calculation based on the 2019 Social Accounting Matrix for Rwanda (IFPRI, MINECOFIN, and NISR 2021).

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