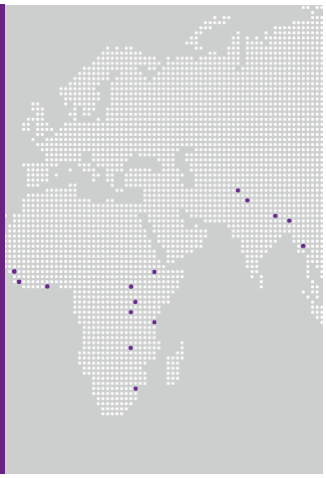
Policy Brief

38414 | January 2019

Abdullah Al-Mamun, Derek Apell, David Laborde, and Will Martin

Prioritising agricultural research and development for economic growth in Rwanda



In brief:

- The Rwandan government recognizes agriculture's importance towards achieving its medium-term development objectives. Successive strategic plans since PSTA-1 (2007) have included substantial increases in total allocations to agriculture.
- Officials face difficult decisions allocating limited resources across sectors and activities. In a high-performance context, activities with long-term benefits such as agricultural R&D can face static or declining allocations in favor of short-term support measures.
- To help guide budget allocation, we used Computable General Equilibrium (CGE) modelling, using data for Rwanda to analyze the impact of increased research and development' (R&D) investment on economic indicators of high priority to decision makers.
- The findings show that raising investment in Agricultural R&D from 0.44 percent of GDP currently to 1 percent could increase agricultural productivity by around 50 percent. This could result in a decline in poverty—measured at the $1.90 level— by 12 percentage points. Allocating R&D resources according to value of output would give almost as large a gain as the poverty reduction benefit, which is harder to evaluate.

This project was funded by IGC Rwanda.

Overview of the research

Rwanda aspires to achieve rapid and inclusive economic growth leading up to middle income status by 2035, and high income status by 2050 (National Strategy for Transformation, 2017). There is significant potential for agriculture to be an engine for growth—the sector accounts for 70% of employment but only 33% of GDP. To unlock this potential, investments should be private sector-led, driven by market imperatives (Delgado, 2018). Public policy can enable this process by providing well targeted complimentary investments which boost private sector profitability.

A key challenge in developing countries is how to allocate limited resources for maximum impact. Across countries, investment in agricultural public goods has resulted in larger economic benefits than other expenditures like general subsidies (FAO, 2012). In addition, investment in R &D has been found to be the most effective form of public expenditure towards raising productivity in agriculture (Fan and Saurkar, 2006). Because agricultural R&D drives technical change and productivity growth, it raises farm incomes. This in turn creates benefits for other sectors, as the additional income is used to purchase goods and services. Ensuring enhanced expenditures in agricultural R&D is therefore a key priority for Rwanda.

As such, this research addressed two main questions:

1. What is the impact of investing in agricultural R&D on national income, exports and poverty reduction?
2. How can agricultural research resources be allocated for maximum impact?

To address these questions, we used a Computable General Equilibrium model to assess the impact of agricultural R&D on the general economy and then a household model to assess the impacts on household welfare. The CGE model that we use is the MIRAGRODEP model (Laborde, Robichaud and Tokgoz 2013; Bouët, Laborde and Traore 2017). The household model is constructed using survey micro-data from the Fourth Integrated Household Living conditions measurement survey (EICV-4). A more detailed exposition of the methodology can be found in Al-Mamun et al. (2018) accompanied with this policy brief.

Analysis and results

Based on experience in other countries, it seems likely that raising investment in agriculture from around 0.44 percent of agricultural GDP to the African Union target of 1 percent of agricultural GDP might increase agricultural productivity by around 50 percent. For a commodity and producer affected by this policy, profitability would increase, thereby attracting additional resources into the activity. For a sector as important as agriculture, one likely consequence will be an increase in real wages. Higher real wages are likely to be important for the welfare of the majority semi-skilled labor in Rwanda's agricultural sector.

Another potentially important channel of effect is through declines in prices of agricultural goods. If increases in output result in price decline--households might face two counteracting effects on welfare. Producers face declining incomes resulting from lower producer prices. Consumers would benefit from lower cost of living in addition to increased food production. The net impact on poverty is most likely positive in the case of Rwanda, as households near the poverty line consume a large share of their output and are net buyers of food.

Similar to the theoretical predictions discussed above, our analysis shows that investment in agricultural R&D consistent with increased allocations to 1 percent of agricultural GDP will result in:

1. An increase in rural wage by 13.2%
2. A reduction in Consumer Price Index (CPI) by 11%
3. A reduction in producer price by 22.6%
4. An increase in the agriculture trade balance by 382 million US dollars.

The reduction in CPI arises due to increased output, which tends to reduce consumer prices. Likewise, lower prices would result in more competitive local produce which improves the agricultural trade balance. The poverty impacts resulting from the macro-economic shifts above are Table 1.

The results show poverty falls by 11 percentage points overall, but slightly higher benefits accrue to rural and farmer-headed households, both of whom obtain direct income gains from the productivity change. These benefits are not completely offset by the declines in producer prices which only have adverse impacts on the real incomes of net sellers, many of whom are not poor. Most of the differences between the rows are due to differences in coverage. Crops has the broadest coverage and the largest benefit. Maize has the smallest coverage and the lowest poverty impact. Vegetables and Fruits has a surprisingly large impact, reflecting the importance of this group of products and the poverty of many of the farmers producing them.

Table 1: Poverty reduction impacts, % points

	All	Farmer	Rural
Agriculture	-11.1	-12.0	-12.6
Crops	-10.1	-10.9	-11.4
Maize	-1.3	-1.5	-1.5
Vegetables & fruit	-7.1	-8.1	-8.1

In table 2 below, we estimate the impacts on poverty for 19 individual crops. The first column focuses on the *small-open-economy* case where exports rise proportionally to the supply shock, leaving prices unaffected. The second column is based on a situation where exports increase less than proportionately to the supply shock, which reduces prices. Under both scenarios, the commodities with the largest poverty-reducing impacts are core staples, such as Pulses, Bananas, Irish Potatoes, Cassava and Sweet Potatoes. In the first column, where prices are unaffected, the large poverty impacts are explained by the large share of working poor, and labor intensity in agriculture which benefits from higher wages. In the second column where prices fall, poverty reduction is explained by the fall in consumer prices benefits poor consumers who spend a large share of their incomes on food. Surprisingly cash crops such as coffee, tea and pyrethrum have small poverty impacts. This may be due to the fact that producers of these commodities are non-poor, and the smaller are coverage suggests that impacts through the labor markets are likely to be smaller than for staples.

Table 2: Poverty reduction impacts by sub-sectors, % points

	Prices unaffected (1)	Prices decline (2)
All crops	-13.38	-10.02
Banana/plantains	-1.66	-1.05
Cassava	-1.70	-1.25
Coffee	-0.19	-0.12
Fruit	-0.48	-0.28
Irish potato	-1.94	-1.34
Maize	-1.24	-0.84
Milk	-0.34	-0.28
Oilseeds	-0.08	-0.23
Pulses	-2.86	-2.01
Pyrethrum	-0.01	-0.01
Rice	-0.30	-0.39
Root crops	-0.01	-0.01
Sorghum	-0.53	-0.31
Sugar	-0.06	-0.11
Sweet potato	-1.99	-1.38
Tea	-0.04	-0.04
Tobacco	-0.01	-0.01
Vegetables	-1.12	-0.85
Wheat	-0.03	-0.03

The approach presented above provides a useful guide for budget allocations in agriculture, towards the objective of poverty reduction. Table 3 below compares this approach with alternative allocation approaches such as equally and based on value of output. The table shows that with enough resources to generate a 50% increase in productivity, a planner allocating resources based on the value of output would generate almost as large a gain as targeting their much-harder-to-evaluate poverty-reduction benefit.

Table 3: Poverty reduction impacts under different research allocations

Approach	Poverty impact
Equal shares	-4.9
Output shares	-9.6
Productivity impact	**-10.4**

There are concerns that it may be much more difficult to raise productivity in highly traditional crops like beans, cassava and sweet potatoes. However, the literature on this question suggests that introducing new varieties can create substantial increases in productivity. A key challenge looking forward is the reason for low adoption of these innovations, despite the presence of improved varieties and input support measures provided under the Crop Intensification Program.

Policy recommendations

- **Strengthen the link between agricultural innovations and technology adoption.**

Through discussion with stakeholders and official statistics, this study observed that Rwanda's adoption rates for modern agricultural technologies remains low, despite substantial public investment to improve their availability. A stronger agricultural research system and enhanced collaboration between the different actors can accelerate the pace of knowledge development and dissemination. Investments should be made to strengthen the link between Rwanda Agriculture Board, tertiary learning institutions, and farmer groups. The high coverage of mobile phone access presents an opportunity to lower the cost broadening the reach of agricultural extension services.

- **Investment in agricultural R&D are shown to be large and should be prioritized in budget allocations**

Rwanda's expenditure on agricultural R&D as a share of GDP in the last decade has remained less than 0.5% while the total agricultural budget has increased. The results The results from The large economic benefits of investing agricultural R&D presented in this study provides an objective benchmark for comparison with alternative productivity-enhancing investments—such as infrastructure and input subsidies—when setting expenditure priorities.

- **Improve market linkages as an incentive for adoption of modern technologies.**

As previously noted, the adoption rate for modern technologies is low in Rwanda compared to its regional peers. Improvement in market access costs such as transport, storage and aggregation can encourage farmers' participation in commercial agriculture, which itself is an incentive to invest in productivity-enhancing technologies. On the downstream side, results from this study also indicate the high cost of non-agricultural inputs and factors relative to the value of agricultural raw materials. This suggests an important role for the National Industrial Research and Development Agency (NIRDA) to improve efficiency in agro-processing, which can increase the price paid to consumers and/ or reduce the cost to consumers of processed agricultural products.

Notwithstanding the benefits, it has been noted that agricultural R&D is a slow process with a long time horizon before returns are realized. However, alternative initiatives to raise productivity such as lowering the price of intermediate inputs might be fiscally and biophysically unsustainable in the long-run. To enhance agriculture's contribution to Rwanda's economic aspirations, it seems imperative to prioritize investment in agricultural R&D. To ensure optimal return to public investment in agricultural R&D, it is important to identify and address the key constraints to adoption of modern inputs including institutional organization, inadequate budget allocations and access to produce markets.

Bibliography

Al-Mamun, A., Apell, D., & David Laborde and Will Martin. (2018). Prioritizing Agriculture-Related Research and Innovation for Growth and Poverty Reduction in Rwanda. *Forthcoming*.

Bouët, A., Laborde, D., & Traore, F. (2017). The European Union–West Africa Economic Partnership Agreement: Small Impact and New Questions. *IFPRI Discussion Paper 01612*.

Delgado, C. (2018). Chapter 5: Transitioning Agriculture and Food to be an Engine of Growth. In W. B. Group, *Future drivers of growth in Rwanda: Innovation, Integration, Agglomeration and Competition* (pp. 221-251).

Fan, S., & Saurkar, A. (2006). Public spending in developing countries:. http://siteresources.worldbank.org/EXTRESPUBEXPANAAGR/Resources/opm1.pdf.

MINECOFIN. (2017). *National Strategy for transformation.* http://www.minecofin.gov.rw/fileadmin/user_upload/NST1_7YGP_Final.pdf: Rwanda Ministry of Finance and Economic Planning.