

Rwanda Agricultural Sector Risk Assessment

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As the Government of Rwanda (GoR) pursues strategies to increase commercialization and private investment in agribusiness, stakeholders will need to manage risks in order to maximize the potential for growth and development. This Note assesses existing risks to Rwanda's agricultural sector, prioritizes them according to their frequency and impact on the sector, and identifies potential solutions to strengthen agricultural risk management in Rwanda. In contrast to neighboring countries, there are few systemic risks to agricultural production at the national level in Rwanda. However, local- and commodity-specific risks cause significant losses to the sector. Unmanaged, these risks will prevent Rwanda from reaching its full potential for agricultural productivity and growth, which are key drivers of national economic growth and poverty reduction.

BACKGROUND

Agriculture is the dominant sector of Rwanda's economy, contributing one-third of the country's GDP and about half of export earnings. Approximately 80 percent of the population lives in rural areas and is engaged in agriculture to some extent. The Government of Rwanda has therefore made agricultural development a priority and allocated significant resources to improve productivity, expand the livestock sector, promote sustainable land management, and develop supply chains and value-added activities. Between 2002 and 2012, the sector grew an average of 5 percent per year, which is significant, but still below both the government's own objective of 8–9 percent annual growth and the Comprehensive Africa Agriculture Development Programme (CAADP) commitment of 6 percent growth in the agriculture sector.

Today, Rwanda's agricultural sector faces a series of risks and challenges. Agricultural land plots are very small—80 percent of land holdings are less than 1 hectare—and over 70 percent of agricultural land is either on hills or on the side of hills. Production is dominated by small-scale, subsistence farmers relying on traditional agricultural practices and rain-fed agriculture. As a result, average crop yields are low compared with potential yields, and crops are exposed to risks such as weather-related shocks and pest and disease outbreaks. Current agricultural policies are geared to increasing productivity in the sector by achieving scale in agricultural production.

Risks can have significant impacts on agricultural stakeholders, investments, and the development of supply chains in Rwanda. Adverse movements in agricultural commodity and input prices, together with production-related shocks (for example, from weather,

pests, and diseases), not only affect farmers and firms active in Rwandan supply chains, but also put severe strains on government resources. Rapid or significant declines in production and trade may reduce government tax revenues, affect balance of payments, necessitate compensatory (or recovery) expenditures, and adversely affect the government's fiscal position. The prevalence of "shock-recovery-shock" cycles creates a poverty trap for smallholder farmers and vastly reduces the Government's ability to address long-term development issues. The purpose of this report is to assess existing risks to Rwanda's agriculture sector, prioritize them according to their frequency and impacts on the sector, and identify areas of risk management solutions that need in-depth, specialized attention.

MAJOR RISKS

Many Sub-Saharan African countries experience recurring negative agricultural growth because of various shocks, however, Rwanda has had only one year of negative growth in the 20 years since the civil war in 1994 (figure 1). In 2003, agricultural value added growth was negative because of a drought that hit the country. On an annual basis, production losses for food and export crops averaged US\$65 million between 1995 and 2012, or about 2.2 percent of Rwanda's total annual agricultural production value. Although risk events have not caused large deviations from general yield trends on a national scale in Rwanda, some risks, especially pests and diseases, are pervasive and their impacts on production likely explain part of Rwanda's yield gaps. Agricultural risks can thus have a significant impact on productivity, growth

objectives and on the government's efforts to transform the sector.

Pests and diseases pose a significant risk to agricultural production. Due to poor access to preventative inputs, food crop producers are more vulnerable to pests and disease outbreaks compared to export crop producers. Coffee producers also suffer from pest and disease outbreaks that have impacts on yields and on market access, however, they are more likely to have access to preventative extension services and pesticides because they are part of more organized supply chains. The main weather-related risk impacts on food crop production are from moisture stress caused by erratic rainfall. Export crops are also exposed to weather-related risks, but market risks—particularly international price volatility—have a relatively greater impact, especially on coffee supply chain stakeholders. Market risks are limited for food crops, with prices responding predictably to seasonal supply and demand, and domestic prices are not affected by global prices.

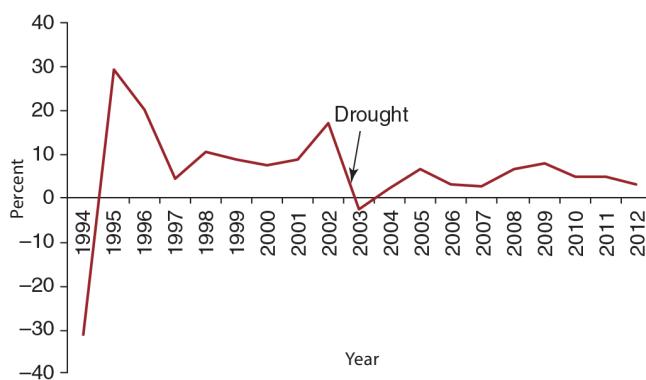
In addition to crops, livestock is an important component of household income and food security in Rwanda. Milk is a source of nutrition for the family, surplus milk is sold, and the manure produced is applied in the fields. Half of all households own one or more of the following: goats, cows, and chickens, and 68 percent of all livestock units are cattle. The production of milk and beef has increased dramatically in Rwanda over the past two decades, in part because of government-financed livestock production programs, and in part because increased incomes have driven consumer demand for livestock products.

The key risks for the milk value chain occur first at the production level, then at the marketing level (that is, bulking/collecting and transporting), and finally at the retailing stage. The risks for meat producers are mainly related to production. Since the mid-1990s, milk production has been affected by droughts and livestock disease outbreaks, such as anthrax, lumpy skin disease, and foot and mouth disease.

ADVERSE IMPACTS

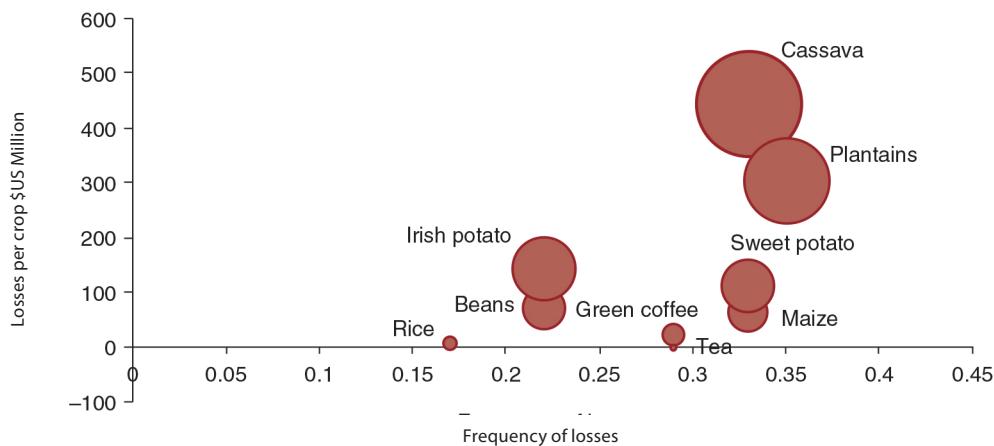
Currently, the crops most exposed to production risks are cassava and plantain, followed by fairly evenly distributed losses between Irish potatoes and sweet potatoes (figure 2). Maize has relatively frequent losses but the losses are not as large as for the first four crops. The scope of the losses are

FIGURE 1: Agricultural value added (annual % growth), 1995–2012



Source: World Development Indicators 2013.

FIGURE 2: Frequency and scope of losses per crop, 1995–2012



Source: FAOSTAT; Authors' calculations.

clearly in line with the importance of the crop in the total sector, because cassava, plantain, potatoes, and maize dominate agricultural production in terms of value.

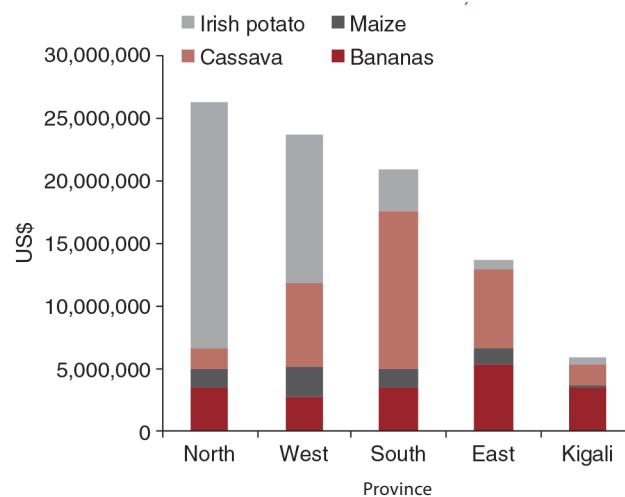
Because pests and diseases are endemic in nature and outbreaks are not visible in the national-level yield data, the biggest losses tend to be correlated with weather events, that is, drought or excessive rainfall (figure 1). In years with these events, Rwanda experienced losses of up to 9.5 percent of total agricultural production value. Nevertheless, omnipresent pests and diseases, including bean flies, the antestia bug, cassava mosaic virus, coffee leaf rust, and more recently, banana bacterial wilt, are widespread in Rwanda, causing yield losses ranging from a third up to 100 percent in infected plants. Thus, more systematically mitigating risks of pests and diseases would likely affect the general yield trend and narrow the yield gap for crops that currently have yields much lower than potential yields.

This analysis looks at indicative crop production losses in Rwanda's five provinces: Northern, Western, Eastern, Southern, and the City of Kigali. Losses were estimated for maize, bananas, cassava, and Irish potatoes for 2000–12 using MINAGRI's disaggregated data. Results indicate that losses are the greatest in absolute terms in the Northern Province and smallest in the City of Kigali (which also produces much less than the other provinces). Figure 3 provides an overview of the value of annual losses per province for Irish potatoes, cassava, maize, and bananas. Although the Northern Province has the highest aggregate losses in absolute amounts, it is clear that the

geographic target area for any risk-management intervention will depend on the crop.

In the livestock sector, disease outbreaks in 2008 caused a 13 percent loss in milk production in comparison with the previous year's production and cost an estimated US\$10 million in lost income for farmers and US\$163,000 in the value of destroyed, slaughtered, or dead cattle. Meat production is also affected by drought, albeit with a lagging effect, because production declines are visible only a year after the drought's occurrence. Nevertheless, the impacts are limited and cannot be compared with those on milk production.

FIGURE 3: Provincial crop losses in Rwanda (annual US\$, sum of season A and season B)



Source: Authors' calculations, based on NISR's 2014 Seasonal Agricultural Survey.



Photo credit: World Bank

Monthly milk prices are excessively volatile in Rwanda. In general, this kind of price volatility can occur when daily milk consumption is fairly constant (that is, demand is relatively stable), because even small shifts away from equilibrium supply levels will lead to high price volatility. Similarly, high demand price elasticity for milk may magnify volatility at smaller changes in supply, because consumers quickly respond to price changes. Price fluctuations are less frequent for meat and occur between years (inter-annual). Finally, especially for milk but also for fodder, the supply chains are susceptible to contamination. The milk cold chain is subject to electricity cuts that put food safety standards at risk, and the fodder chain has sporadic problems with aflatoxin contamination.

EVOLVING RISK LANDSCAPE

As Rwanda's agriculture sector transforms, the risk landscape will evolve, changing the incidence of risk events and impacts. Two emerging trends in the agricultural sector, land consolidation and monocropping, facilitate the spread of pests and diseases. Similarly, Rwandan farmers' current practice of mixing local varieties for crops, which mitigates certain risks, is likely to be replaced with

single-variety cultivation as output markets become more sophisticated. Storage-related risks are currently limited because few farmers store their crops for extended periods of time. However, if storage of commodities increases as a result of commercialization, exposure to these risks will increase.

The livestock sector is predicted to grow along with consumption, which will elevate the significance of sanitary and food safety risks. In land-constrained Rwanda, an increased number of animals in close proximity could lead to greater impacts associated with disease outbreaks. With limited land in Rwanda, more animals are also likely to increase demand for fodder, which would imply greater impact from aflatoxins in fodder. Further, greater demand for livestock products as a result of income increases makes potential impacts from food safety risks greater as supply chains grow and products reach more consumers.

RISK MANAGEMENT

The Government of Rwanda can strengthen risk management in the sector by formulating policies that incentivize investments in risk mitigation and trigger

effective risk-coping mechanisms. The private sector also has an important role in managing risks, since many risk management decisions are made at the farm-level and depend on the relative costs and benefits of interventions in new technologies and practices. When designing a risk management framework, policy makers should take into account aspects such as private versus public goods, investment gaps, and market failures. Since the incidence and impacts of risks are likely to shift as the sector develops and markets grow, it is important that appropriate institutions and actors are in place to respond effectively to transitions in the sector.

Based on the prioritized risks, feedback from stakeholders, and ongoing activities, the following recommendations are tailored to address Rwanda's unique risk landscape, address existing gaps, and scale-up effective strategies. Many of the suggested risk management interventions also enhance crop and livestock productivity. The GoR is already undertaking activities in these areas. However, given the risks identified in this analysis and the strategies the Government is pursuing to promote commercialization and investments in agribusiness, strengthening agricultural risk management is critical to economic growth, poverty reduction, and food security.

POTENTIAL SOLUTIONS

Recommendations are organized in three solutions areas: 1) managing water for agriculture, 2) improving plant health, and 3) managing drought-related risks in the livestock sector. The proposed solutions for improving risk management in these three areas are based on field visits, discussions with government officials and practitioners in Rwanda, and best practices from other countries.

Managing Water for Agriculture

Localized drought and erratic rainfall are major risks for Rwandan producers. Although threats to production originate as anomalies in the intensity, occurrence, and frequency of rainfall, they encompass all aspects of managing water for agriculture, including: soil moisture storage, groundwater recharge and storage, and runoff and streamflow, and involve the broader integrated concepts of land and watershed management. Despite ongoing investments in irrigation and integrated water-

shed planning, the effective and efficient management of water for agriculture is a key risk management challenge.

The GoR's investments in water management are consistent with international best practice and appropriate for the country's mountainous terrain. However, the investment program is very expensive—ranging from US\$8,000–20,000 per hectare. At these investment cost levels, an adequate internal rate of return is difficult to achieve, and GoR financing will be very difficult to sustain. Further, until now, the GoR has not closely monitored the impact of these investments on productivity, production, and farmers' incomes. Without monitoring and measuring outcomes, there are no means of either understanding constraints to further improved potential outcomes or assessing the sustainability of its investments.

While The GoR's current strategic framework and investment programs encompass many of the potential risk management solutions identified in the risk assessment, important challenges remain to improve the effectiveness and impact. Stakeholders identified five high-priority actions to improve water management:

1. Develop and implement joint integrated watershed management plans (WMP) that address flood risk issues and the allocation of water among users.

A WMP is a mechanism to integrate the interests of all stakeholders (in the land and water resources of the watershed), resolve conflicts, and establish the rules and priorities for action that ensure achievement of the economic, social, and environmental goals of stakeholders (including district authorities) for the watershed.

2. Produce knowledge, data, and information. To maximize water's economic and social benefits, its stock, use, and productivity must be measurable by decision makers. This is true for staff in the respective ministries and agencies, and staff in district and sector development offices, as well as for farmers, water-use organizations, co-operatives, and other community groups. Recommended actions are to:

- Measure water managed in existing projects (e.g., what is flowing into or out of the reservoir, what is flowing into canals at key locations), and develop a database to monitor key parameters;
- Modernize and upgrade the hydro-met monitoring network;

- Expand access to and acquisition of remotely sensed and public domain data by strengthening GIS cells in the concerned ministries;
- Ensure public access to data and information; and
- Develop an information and data management action plan for each district.

3. Link farmers with financial institutions. Although a limited amount of small-scale irrigation (SSI) using pumps already exists in Rwanda, financial institutions are unfamiliar with financing this type of equipment and with smallholder farmers who want credit to purchase the equipment. This will require promoting and facilitating increased awareness of the benefits of SSI among farmers, financial institutions, and potential private importers and dealers. It is recommended that the GoR:

- Assess the potential for innovative financial instruments such as matching grants, rent-to-buy, and lease arrangements;
- Help farmers document production costs and net financial returns and use these data to promote favorable treatment by financial institutions; and
- Open membership in cooperatives to farmers using SSI technologies to give them access to inputs at favorable prices.

4. Promote rapid expansion of SSI equipment in the market at affordable prices. While the GoR has considerable interest in the manufacture of pump equipment in Rwanda, in the short- to medium-term (at least), the SSI technology program will have to rely on imported pump equipment. Recommended solutions for the GoR are to:

- Encourage dealers and importers in neighboring countries to link up with Rwandan entrepreneurs and existing businesses, particularly those with a rural presence in districts where demand will be high; and
- Ensure that there are no barriers (e.g., the GoR should refrain from trying to pick winners) or disincentives (e.g., burdensome taxes, import duties, complex or costly licensing requirements, restrictions on access to credit, etc.) to the private initiatives that will be needed.

5. Increase efforts to strengthen water users' organizations (WUOs) to take responsibility for maintenance.

The current system for irrigation and land husbandry

includes as core infrastructure a system and components that are not "hardened" and are susceptible to damage. With regular vigilance and surveillance and well-organized and well-funded maintenance plans, these infrastructures can have long, useful economic lives. WUOs will have to shoulder this responsibility, for which they will need organizational capacity building.

Improving Plant Health

Crop pest and disease losses are a major concern for Rwandan farmers. Damaging crop pests and diseases limit the yield potential of crops in Rwanda, and the risk of pests and diseases creates uncertainty amongst the most vulnerable families, a majority of whom overwhelmingly depend on crops for food and livelihoods. Pests and diseases limit export earnings and commercial development, while lost production weakens food and feed security. Pest and disease outbreaks are both highly probable (likely to occur one year in three) and of high impact. For example, annual crop losses for Irish potatoes in the northern region were estimated at around US\$20 million, and at US\$12 million for cassava in the southern region. Effective crop protection is essential if primary targets for increasing crop production are to be met and the ultimate goals of improving social and economic indicators achieved.

In Rwanda, major gaps in risk management vis-à-vis pests and diseases stem from a lack of integration across Rwanda's emerging plant health system (PHS), with insufficient synchronization of contributions, most notably in the timely and adequate supply of seeds and planting material. Responses to pest and disease outbreaks are reactive and emphasize costly and less effective control measures, rather than being predictive, more cost-effective, and based on preventative measures that limit disease build-up and spread. Coordination between the public and private sectors is weak; for example, the supply and access to agricultural inputs is not streamlined. Finally, evidence is lacking about what works and what doesn't, particularly with regard to the success of efforts to manage major diseases; little is known about the impact of previous campaigns or the effectiveness of extended efforts by projects and government programs.

The proposed solutions address systemic weaknesses in knowledge, capacities, and resources. The intended impact of the proposed interventions is to limit losses due to crop pests and diseases and strengthen farmers'

capacity to manage outbreaks. The main gain is to achieve improved efficiencies and speedier responses. Integration and coordination are key to making best use of existing resources and ensuring that future investments yield the maximum returns. The financial gains from mitigating and avoiding losses are a compound figure based on the value of "saved" crops (i.e., those crops not attacked by a pest or disease) minus the cost of control measures.

To limit losses and maximize future investments, a systematic approach to risk management that accounts for interlinkages between pest and disease threats and other components of plant health is needed. Ultimately, producers will be responsible for managing the risk of pest and disease outbreaks, however, action at the institutional level can facilitate better risk management at the farm level. Proposed solutions for plant health risk management ranged from improving agronomic practices and information about pests and diseases to strengthening crop research and access to inputs.

The five key interventions suggested to improve risk management in plant health are to:

- Expand and strengthen the Twigire-Muhinzi extension system to improve knowledge and surveillance skills of farm promoters. Promoters are ideally situated to report new outbreaks, provide support in control programs, and assist in supplying inputs.
- Monitor pest and disease status to facilitate planning and response.
- Conduct a comprehensive review of past efforts in pest and disease management to identify what works and where improvements are needed.
- Ensure the continuing supply of healthy plant material to prevent outbreaks. Prevention is usually cheaper and more effective than treatment.
- Continue to expand and increase research capacity to build scientific knowledge on pests and diseases in Rwandan agriculture.

The target beneficiaries of these five interventions include farmers and their families and commercial enterprises buying and exporting plant products. The National Forum for Plant Health (NFPN) provides an existing platform for developing the plans, schedules, and resources needed to make a national PHS a reality. Overall, the lack of an



Photo credit: Asa Gieritz

integrated plant health policy limits coordinated actions and needs to be followed up through the NFPN.

Managing Drought-Related Risk in the Livestock Sector

As Rwandans' incomes improve, its production and demand for livestock products are also growing. The number of livestock grew tremendously between 1999 and 2013, having increased by 51 percent for cattle, 284 percent for goats, 188 percent for sheep, 370 percent for pigs, 135 percent for poultry, and 382 percent for rabbits. Milk production increased 10 times over the same period while meat production increased by over 250 percent.

In the livestock sector, drought is the most important risk for both the dairy and beef value chains. Drought caused by rainfall variability affects the sector through reduced water and feed availability and access, particularly in the east and parts of the south, and increased vulnerability to diseases. Production losses to the dairy value chain reached 11 percent in 2002/03 and 13 percent in 2007/08, both major drought years. The impact on milk yield was even higher: 18.3 percent and 20.8 percent drops in milk yield in these same years, respectively. The impact on meat products was not as significant or felt as immediately, probably due to the time needed to restock herds. Foot-and-mouth disease, anthrax, and Lumpy Skin Disease epidemics in 2008 and 2012 had a devastating impact

on livestock production because of the current livestock disease response system. It is estimated that in 2008 alone, farmers incurred a US\$10 million loss in milk income.

The following recommendations are intended not only to assist stakeholders in the dairy and meat value chains to mitigate the impacts of drought but also to augment their productivity in normal and good rain years. The prioritized recommendations are to:

- Continue supporting communal feedlots.
- Build a commercial seed and fodder market in cooperation with regional feed producers.
- Distribute small, motorized, three-wheeled vehicles on credit to MCCs, linked to milk sales by farmers and small-scale milk traders to pay back credit.
- Facilitate private sector market research on new and profitable export markets for meat products within East Africa, and further in Africa (e.g., Francophone West Africa).
- Support the development of East African dairy goats production as an alternative to cattle production for small-scale farmers. This could include financing mechanisms, extension services for goat husbandry, and support services for goat milk marketing.

NEXT STEPS

Since there is no silver bullet to manage agricultural risk, effective risk management requires a combination of measures designed to address the interconnected risks

and constraints stakeholders face. Measures will have to be implemented at both the policy level and at the implementing institution level among processors, traders, and farmers. Agricultural risk management is most effective when risk mitigation, transfer, and coping mechanisms are integrated in national development strategies and policies. Developing a strategy that specifies clear roles, responsibilities, and timelines for designing and implementing risk management interventions would complement the GoR's efforts to transform the agricultural sector and provide a roadmap for policy makers and investors in the sector.

In an environment of scarce resources, budget and cost will often determine which measures are most appropriate to implement at the sector level, as well as at the individual farm/business level. Additional factors to evaluate include: feasibility, or ease of implementation; scalability, the ability to scale up the intervention beyond a small pilot group; poverty alleviation potential; and project sustainability. Policy makers should take all of these factors into consideration when designing an agricultural risk management strategy, weighing factors based on their priorities and goals, which may vary by region and subsector. The cost-effectiveness of the intervention will likely influence these additional factors, particularly scalability and sustainability. Consequently, evaluating the cost-effectiveness of different types of interventions by identifying their relative costs and benefits is an important step in developing an agricultural risk management strategy.

This Note was based on the World Bank publication: Åsa Giertz, Mohinder Mudahar, George Gray, Rhoda Rubaiza, Diana Galperin, and Kilara Suit. 2015. *Agricultural sector risk assessment in Rwanda*. Washington D.C. : The World Bank.

This work was funded by the World Bank, the United States Agency for International Development, and a Multi-Donor Trust Fund on Agricultural Risk Management financed by the Ministry of Foreign Affairs of the Government of the Netherlands and the State Secretariat for Economic Affairs (SECO) of the Government of Switzerland, and was conducted by the World Bank's Agricultural Risk Management Team.



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