AGRA
Growing Africa's Agriculture

KIT Royal Tropical Institute

PIATA 2019 Outcome Monitoring Report
AGRA Rwanda

Consolidated report
KIT Royal Tropical Institute, Amsterdam
30 April 2020

Colophon

Correct citation:
KIT, 2020. *Rwanda Outcome Monitoring Report 2019, AGRA-PIATA Programme*. Alliance for a Green Revolution in Africa, Nairobi; KIT Royal Tropical Institute, Amsterdam.

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This report has been commissioned by AGRA to monitor its PIATA programme progress in Rwanda.

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Acronyms

AGRA	Alliance for Green Revolution in Africa
AGRIFOP	Agribusiness Focused Partnership Organisation
API	Agro-Processing Industries
APTC	Agro-Processing Trust Corporation
AU	African Union
BTC	Belgian Technical Cooperation (currently known as ENABEL)
CAADP	Comprehensive Africa Agriculture Development Programme
CIALCA	Consortium for Improving Agriculture-based Livelihoods
CIAT	International Institute for Tropical Agriculture
CIP	Crop Intensification Programme
CICA	Centre for Information and Communication in Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CNFA	Cultivating New Frontiers in Agriculture
COMESA	Common Market for East and Southern Africa
DfID	United Kingdom Department for International Development
EGS	Early Generation Seeds
FAAS-R	Forum for Agricultural Advisory Services
FFS	Farmer Field School
FP	Farmer Promoter
GIZ	German Development Cooperation
GoR	Government of Rwanda
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
ICT	Information and Communication Technologies
IFDC	International Fertilizer Development Center
ISAR	Rwandan Institute for Agronomic Sciences
ISTA	International Seed Testing Association
MINAGRI	Ministry of Agriculture and Animal Resources
MINALOC	Ministry of Local Government
NAP	National Agricultural Policy
NISR	National Institute of Statistics Rwanda
NSAR	National Seed Association of Rwanda
OAF	One Acre Fund
PIATA	Partnership for Inclusive Agricultural Transformation in Africa
PPP	Public-Private Partnership
PSF	Private Sector Federation
PSTA	Strategic Plan for Agricultural Transformation
QDS	Quality Declared Seed
RAB	Rwanda Agriculture Board
RICA	Rwanda Inspectorate Competition and Consumer Protection Authority
RDO	Rwanda Development Organisation
SDG	Sustainable Development Goals
SEDO	Social and Economic Development Officer
SHF	Smallholder Farmers
SME	Small and Medium-sized Enterprise
SNS	Smart Nkunganire System

TASAI	The African Seed Access Index
USAID	United States Agency for International Development
VRC	Variety Registration Committee

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1 Summary of results

1.1 Introduction

The Alliance for Alliance for Green Revolution in Africa (AGRA) is catalysing and sustaining an inclusive agricultural transformation in Africa by increasing incomes and improving food security for 30 million farming households in 11 focus countries. Since 2006, AGRA and its partners have worked across Africa to deliver proven solutions to smallholder farmers and thousands of African agricultural enterprises. The alliance has built the systems and tools for Africa's agriculture: high quality seeds, better soil health, and access to markets and credit, coupled with stronger farmer organisations and agriculture policies.

AGRA's theory of change is that sustainable agricultural transformation can be facilitated through a combination of:

- Policy and state capability – investments to work with and support governments to strengthen execution and coordination capacities, enhance transparency, accountability and enabling policy environment;
- Systems development – investments to build downstream delivery systems while providing support to local private sector to scale technologies and services for better productivity and incomes; and
- Partnerships – to facilitate alignment between government and private sector, improving integration and coordination for investments in agriculture.

In Rwanda, AGRA focuses on:

- Country support and policy engagement, which aims to provide specific support to enhanced sector evidence-based planning and analytics in order to enhance MINAGRIs value chain analysis capabilities, and support the development of an enabling environment for private sector engagement;
- System and farmer-level development that seek to:
- Strengthen local seed systems
- Strengthen private agro-dealer networks to enhance adoption of technologies
- Expand market access through value addition, structured trade, quality enhancement and aggregation
- Enhance access to finance

By executing this strategy, AGRA expects to improve food security and increase incomes for at least 410,000 smallholder households directly and a further ~2.2 million indirectly and targeting four key crops: beans, maize, potato and rice. Deployment of this strategy in Rwanda began in 2018 and, to date, AGRA has invested ~US$8.7 million against the strategy. With these funds, AGRA has invested in the different areas of work as below:

- Increase the production and utilisation of improved seeds, aiming to release new varieties of hybrid maize, soybean, beans and Irish potato, increase the production of certified seed of selected crops by supporting local private seed companies, increasing farmer adoption of quality seed, and expanding and strengthening women-owned seed enterprises
- Enhance the operational capacity of the domestic seed market system by strengthening the agro-dealer network, strengthening national aflatoxin control to

improve access to markets for high quality maize, and supporting youth-led/owned/focused enterprises related to seed production
- Support and operationalise policies that regulate the seed system, by increasing knowledge and adoption of the new seed law and policies, strengthening institutional capacity in seed inspection and certification – staffing, tools, certification of labs/ upgrading, and supporting the setup and operationalisation of the national seed platform.

The strategy is aligned with the government's priorities and contributes to the need for a strong sector with effective coordination and implementation capabilities. For the 2019 outcome monitoring, AGRA Rwanda elected to focus on two crops – maize and beans. For the qualitative systems analysis, AGRA selected seed systems and market systems.

1.2 System analysis

Seed system

Amongst the most important constraints in seed sector performance is the Rwanda Agriculture Board (RAB)-controlled system for early generation seed (EGS), which forms a disincentive for the private sector to further develop its EGS production. RAB is also heavily implicated in variety development, seed inspection and certification (constrained by limited capacity), and is the buyer and distributor of seed.

Similarly, seed marketing to farmers is still lacking in competing private seed companies. Seed distribution and marketing is dominated, through the subsidy system, by centralised decision-making. Cautious steps are being taken towards a more dynamic system based on competition between companies and the supply and demand mechanisms of the real market.

Seed policies and regulatory reform have resulted in a good policy framework for seed sector development. What is currently required is the implementation of the proposed organisational reform, in which the Rwanda Inspectorate Competition and Consumer Protection Authority (RICA) is taking over responsibilities from RAB.

AGRA has made clear strategic investment decisions in the seed system, which are closely aligned with the ambition and objectives of government priorities. The investments are well distributed across the seed system components of the formal seed system, with all components receiving attention. Overall, this study finds that AGRA-PIATA (Partnership for Inclusive Agricultural Transformation in Africa programme) is responsive to seed sector needs in terms of addressing bottlenecks and priorities for change. AGRA investments are likely to be embedded and institutionalised, which bodes well for the sustainability of investments. Further, it is clear that AGRA grants provide good additionality and are well-integrated with those of other actors in the seed system domain.

Key observations and recommendations:

- AGRA is fast-tracking new variety releases. To effect systems change, it will be important to ensure these releases also become available for multiplication and sale.
- As the seed sector grows, the transparency and speed of the release process needs to be strengthened.

- By engaging the private sector in the production of foundation seed, RAB should be able to dedicate more time to on-time delivery of breeder seed to private multipliers.
- Pragmatic aspects of the long-term 'business case' for the private EGS sector is still uncertain, given the current public-private partnership (PPP) seed procurement and distribution model and with investment motivations dampened by late (or refusal) of payments for seed in recent years by RAB. This requires resolution.
- Aligning with the PPP seed sourcing and subsidised distribution model implies trade-offs for private seed supply engagement. There is currently little incentive for distinctive branding, direct seed sales, or leveraging producer comparative advantages.
- Seed pricing increases, due to subsidy reductions or otherwise, could introduce unforeseen upstream shocks to the seed system. It will be important to anticipate and plan for possible consequences.
- It would make sense to support a quality-declared seed (QDS) model for beans.
- AGRA is supporting initiatives towards the accreditation and functioning of independent and licensed private seed inspectors and village-level quality control systems, a model proven in other countries in East Africa.
- Some AGRA-supported companies report difficulties in accessing complementary institutional finance at viable interest rates.
- AGRA has recently issued a portfolio of investments that aim to operationalise a seed consortium and institutions to coordinate seed production and mainstream seed laws and regulations. These investments respond directly to key criticisms and weakness identified by sector stakeholders, and have significant potential to improve policy and quality aspects of the seed system.
- Along with this report, The African Seed Access Index (TASAI) has identified longer-term challenges to the seed subsidy scheme and PPP sourcing and distribution model. AGRA should conduct an independent review of the effectiveness, efficiency and sustainability of the seed subsidy programme.

Extension system

Rwanda's agricultural advisory and extension system is in a period of policy-driven change which AGRA seeks to leverage with its system investments. A number of key gaps in the extension system are evident. The lack of effective sector coordination between Ministry of Agriculture and Animal Resources (MINAGRI)/RAB (technical support and evaluation) and Ministry of Local Government (MINALOC)/decentralised entities (district, sector, cell, villages) is a significant concern, and will limit or slow system change unless addressed. A streamlining of extension policy and frameworks is required. Who exactly are the extension providers, especially as services become increasingly pluralistic? How does the information flow? The sector coordination body – the Forum for Agricultural Advisory Services (FAAS-R) appears to be non-functional, and there is concern there may not be enough consultation with civil society. There is no official monitoring and evaluation (M&E) system for the *Twigire Muhinzi* extension system and, although the model appears to work well, there is inadequate follow-up with farmers.

Since 2017, AGRA has invested in three extension-related activities. The first is support to the 'Farmer to Market Alliance' project with the Rwanda Development Organisation (RDO), which aims to build farmers' capacity to increase incomes and production by improving post-harvest management, access to the market through forward contracts and other formal mechanisms, as well as improved access to yield improving technologies and finance. The

second is the *Hinga Weze* Feed the Future initiative, which has the core objective to design a system to incentivise farmer promoters (FPs) to train farmers who receive subsidies through the digital Smart Nkunganire System (SNS) system. It will also provide capacity-building support to sector agronomists to train FPs and support the development of training curricula. The third AGRA support for extension is allocated to the SNS system to increase efficiency, productivity, transparency and bridge communication gaps in the agro-input subsidy programme. SNS aims to increase financial inclusion, cashless transactions and the green economy in the agriculture sector. At the time of this study, AGRA-PIATA grant contributions to early system change were not able to be assessed, but AGRA is building on previous activities and grants. This creates continuity and helps to institutionalise practices. AGRA investments that underscore government policy priorities and support SNS piloting and implementation – itself a 'system disrupter'- bode well for positive system level outcomes in the future.

Key observations and recommendations:

- AGRA should invest in strengthening policy coordination, governance and accountability which are identified as system weaknesses; addressing them would improve the relevance and impact of the extension system. These are areas which PIATA currently does not support.
- AGRA supports the professionalisation of FPs; a key requirement for improving the functioning and efficacy of the system. Volunteer FP's may be a bottleneck to ensuring the last 40% (maize farmers) and 46% (bean farmers) are reached.
- The Farmer Promoter Incentive Fund is an important step towards a sustainable business model for FPs.
- *Twigire Muhinzi* has been highly successful, but faces important challenges to remain relevant and sustainable. The Farmer Field School (FFS) component is costly and weakened due to a lack of donor support. The proposed way forward is professionalisation of FPs and agro-dealers, supported by better information and value-added services through SNS. AGRA's support of SNS is a key step in digitalising the sector and making the advisory system more effective, efficient, and sustainable.
- AGRA could play a meaningful role by supporting the (re)operationalisation of FAAS-R, housed within MINAGRI
- Individually-tailored extension is valuable insofar as 'demand driven' means 'needs driven'. Farmers must have access to the right information to make informed production decisions, but follow-up of farmers at this level is presently weak.
- The Rwanda extension policy orientation is progressive, but the National Agricultural Extension Strategy (2009) needs updating. This could be done in tandem with the reinvigoration of FAAS-R.

1.3 Household survey

A household survey was carried out amongst a group of maize farmers (N=819) and a separate group of bean farmers (N=701); both groups of farmers were sampled from the population of farmers benefitting directly from AGRA interventions. The household survey collected data for the 2018 cropping season. Table 1 summarises AGRA outcome indicators for maize and beans farmers based on the 2018 crop season. These indicators are used to measure progress at farmer level towards the AGRA goal of increasing income and food security and were quantified in the household survey.

Table 1: AGRA outcome indicators (2018 cropping season)

Outcome indicator	Maize farmers	Bean farmers
Goal indicator 2: Average number of months of adequate household food provision	9.2	9.3
Goal indicator 6: Wealth assets index score	-0.083	-0.110
1. Average yield (kg/ha) (Indicator 1)	1,396	718
3. Rate of application of target improved technologies or management practices (Indicator 14)	76%	16%
4.4 Average distance (minutes) from farmers to agro-dealers (Indicator 15)	40.3	45.4
4. Percent of farmers accessing agricultural advisory extension support services (Indicator 16)	60%	54%
Percent of hectares under improved technologies or management practices (Indicator 20)	73%	11%
Average fertiliser use (Total N + P + K, kg/ha) (Indicator 21)	26	3
6. Percent of post-harvest losses (at farm level) (Indicator 22)	0%	0%
33. Percent of total household produce sold through structured market facilities/arrangements (Indicator 30)	20%	11%
10. Value of incremental sales as a result of AGRA (crop revenue in US$) (Indicator 36)	US$34	US$29.8
13. Percent farmers using financial services of formal institutions (Indicator 43)	56%	55%
Numbering according to the terms of reference. In parenthesis numbering of AGRA's Theory of Change		

AGRA-supported farmers have, on average, enough food to meet their family's needs for more than nine months of the year. The wealth assets index shows that AGRA farmer beneficiaries are slightly better off, on average, compared to the rest of the rural population in Rwanda.

For maize, the estimated average yield is a moderate 1,396 kg/ha, despite a reasonably high proportion of land (76%) being reportedly under improved management practices. The average yield for beans is 718 kg/ha; a much lower percentage of bean farmers apply recommended inputs and use improved practices than maize farmers, but the contribution of cowpea to household incomes is also lower.

Average post-harvest losses are relatively low, but also difficult to estimate as they are not measured. The majority of both cowpea and maize farmers reported no post-harvest losses.

1.4 SME performance

An important pathway of change of the PIATA programme is supporting the development of small and medium-sized enterprises (SMEs) operating in agricultural value chains and providing support services to agricultural value chains. Key findings from a rapid SME survey indicate that:

- AGRA-supported commercial seed multipliers (189 staff on average, 43% women) have relatively strong financial stability and good access to formal credit, but make limited investments in R&D, equipment and infrastructure.
- Seed companies (122 staff on average per company, 19% women) have moderate business resilience, financial stability and strength of human capital. As for seed multipliers, technology investment is weak.
- The case of agro-dealers (5 staff on average per agro-dealer, 55% women) paints a mixed picture. Most are young enterprises, which weakens their resilience score. They have good access to formal credit and are particularly strong in human capital, including the availability of skilled and female labour. No SME made investments in equipment or infrastructure, such as a building or storage.
- Input supply companies (45 staff on average per company, 23% women) are largely young (average of one year since establishment) and score poorly in business resilience. Financial stability is high, with high turnover and levels of investments. Levels of human capital are moderate and technology investment poor.

Overall, SMEs are young and have yet to demonstrate their resilience to changing market and business contexts. Access to credit is good overall and when SMEs elect to invest in their growth and development, it is most often in the building of staff capacity. Nearly all seed producers, agro-dealers and input supply companies reported having trained staff, although neither seed company in the sample did so.

2 Objectives and scope of the report

KIT Royal Tropical Institute was contracted by AGRA to implement annual outcome monitoring of its activities under the 2017-2021 Partnership for Inclusive Agricultural Transformation in Africa (PIATA).

The annual outcome surveys have three different, interrelated objectives:

1. Understand AGRA's progress towards desired outcomes, both for internal and external reporting.
    a. Elicit data and insight into the effect of AGRA interventions on its beneficiaries
    b. Provide insight into sustainable improvement of the performance of agricultural sector support systems
2. Learn about the performance of AGRA interventions to allow for intelligent evidence-based adaptation of implementation.
3. Document lessons learned for improved design of future AGRA, but also external, interventions.

These objectives are realised through a combination of quantitative and qualitative methods, implemented by a team of qualitative and quantitative experts.

The Ghana team consisted of:

- Two international experts in quantitative data collection in agriculture
- An international expert in qualitative data collection in agriculture
- A national coordinator of quantitative and qualitative field data collection in agriculture
- A team of local enumerators trained on the specific components of the survey and data management

AGRA Rwanda selected maize and beans as priority crops for reporting for 2018. AGRA also selected the seed system and policy and extension system as the priority domains for system analysis.

Primary data was collected by the qualitative team in Kigali, Rwanda, over a period of two weeks in July 2019. For each system, information was collected via key informant interviews and expert workshops. Key informants were identified by AGRA, and a small number were referrals from key informants that were interviewed. The consultants also attended the TASAI workshop in Kigali on 17th July, 2019.

Household survey data was collected based on AGRA beneficiary lists. The sample was determined using multi-stage random sampling, by first randomly selecting geographically spread locations and, within each location, randomly selecting beneficiaries. Households were randomly selected from this population, using two-stage clustered sampling. A total of 819 households were interviewed for maize and 701 for beans, both in Eastern Province, Rwanda.

SME surveys were administered to 24 randomly selected companies and businesses linked to AGRA interventions.

AGRA Rwanda made available country programme roadmaps and information related to issued and planned grants. Secondary data and online reports completed the data sources.

This report should be read keeping in mind the limitations of the study. To manage costs, sample sizes of the household data collection effort had to be capped. Also the SME performance survey was designed for rapid and cost effective data collection. The system analysis was limited to two systems, and field data collection was limited to one week per system.

The report results should be interpreted with caution. The household data refers to the 2018 main cropping season, and should be considered a baseline for monitoring future change, as AGRA-PIATA interventions had not been implemented at a scale such that significant results could be expected in the 2018 season. Similarly, the SME performance measurement will serve as a baseline for measuring change over time. The system change studies have made an effort to place the entirety of AGRA investments in a country, impacting on the system, in context. The field work, however, could, because of the limited field time, only cover a portion of AGRA's intervention portfolio.

Part I: Qualitative system analysis

3 Introduction system analysis

3.1 Agricultural policy context

Agriculture is central to the Rwanda economy, and contributes significantly to economic growth, national poverty reduction, income generation, and food security. Vision 2020 – the overarching national development policy document – seeks to realise the transformation of Rwandan agriculture through infrastructural development, the promotion of the private sector that is considered to be the major engine of growth, and regional and international economic integration. This agricultural transformation should contribute to a more diversified and competitive economy[1]. A particularity of the Rwanda agriculture is the high population density (525 inhabitants per km^2) and hence high pressure on natural resources including arable land. Subsequently, agriculture is mainly an activity by smallholder farmers with an average holding of 0.3 ha per household.

Rwanda's Strategic Plan for Agriculture Transformation phase 4 (PSTA 4) outlines priority investments in agriculture and estimates required resources for the agriculture sector for the period 2018-2024. It should be noted that Rwanda formulated the first phase of PSTA (2004-2008) in 2004 and, thus, was one of the first African countries in developing a transformative vision for agriculture.

PSTA 4 is the implementation plan of the National Agricultural Policy (NAP) and represents the agriculture sector's strategic document under Rwanda's National Strategy for Transformation. In turn, PSTA is aligned with the Comprehensive Africa Agriculture Development Programme (CAADP) framework. PSTA 4 has four key priority areas:

- **Innovation and extension**. The focus is on improving agronomic knowledge and technology in terms of basic research and innovation, especially aimed at developing improved varieties and breeds. Innovative projects will be promoted through PPPs and developing innovative networks and beneficial partnerships with research institutions and the private sector.
- **Productivity and resilience**. Investment focus on irrigation, erosion control, fertiliser uptake, and 75% of farmers utilising improved seed.
- **Inclusive markets and value addition**. Stimulation of input markets for fertiliser, financial services, and value addition and aggregation, and market infrastructure.
- **Enabling environment and responsive institutions**. This provides the regulatory framework by defining and coordinating public sector involvement. The aim is to improve evidence-based policymaking through better collection and handling of information and enhanced capacity for analysis and policy development.

Rwanda's agriculture sector strategy responds well to international and regional compacts such as the Sustainable Development Goals (SDGs). The 2017 CAADP biennial review measuring the overall progress for implementing the Malabo Declaration for agriculture transformation scored Rwanda at 6.1 out of 10. This was the highest score amongst AU member countries.

[1] Currently the Government of Rwanda is preparing the Vision 2050, which builds on the lessons learned from implementing Vision 2020.

Table 2: Rwanda's progress towards implementing the Malabo Declaration on agricultural transformation in Africa. (AU, 2017)

Five key areas of strong performance		**Five key areas of weak performance**	
CAADP process completion	100%	Public agriculture expenditure as % of total expenditure	7.5%
Inclusive institutionalised mechanisms for accountability	100%	Prevalence of stunting amongst children under 5 years old	38%
Percentage of farmers having access to agricultural advisory services	52%	Percentage of the population that is undernourished	32%
Percentage of rural women that have access to productive assets in agriculture	91%	Yield increase of Rwanda's priority agricultural commodities	3.9%
Number of agricultural commodity value chains for which a PPP is established	2	Increase of the value of intra-Africa trade of agricultural commodities and services	-5.6%
Country progress score (out of 10): 6.1			

3.2 AGRA objectives and activities

Through PIATA, AGRA aims to catalyse and sustain an inclusive agricultural transformation in Africa by increasing incomes and improving food security for 30 million farming households in 11 focus countries. Since 2006, AGRA and its partners have worked across Africa to deliver solutions to smallholder farmers and local African agriculture enterprises. The alliance has invested in the systems and tools for Africa's agriculture: high quality seeds, better soil health, access to markets and credit, coupled with stronger farmer organisations and agriculture policies.

AGRA is an African-led alliance focused on reorienting subsistence-based farming into businesses that thrive. It was established to catalyse the transformation of smallholder agriculture into a highly productive, efficient, sustainable and competitive system, while also protecting the natural resource base on which agriculture depends. As the sector that employs the majority of Africa's people, nearly all of them small-scale farmers, AGRA recognises that developing smallholder agriculture into a productive, efficient, and sustainable system is essential to ensuring food security, lifting millions out of poverty, and driving equitable growth across the continent.

AGRA Rwanda focus and activities, 2006-2016

AGRA commenced activities in Rwanda in 2007. In the decade that followed, AGRA invested circa US$9 million to strengthen the capacity of public institutions towards yield improvement, while supporting the private sector and other institutions to deliver services to farmers. AGRA dedicated funding to some farmer cooperatives and seed companies, but these were not able to become self-sustaining. In total, 10 maize hybrids were developed, but only four were commercialised.

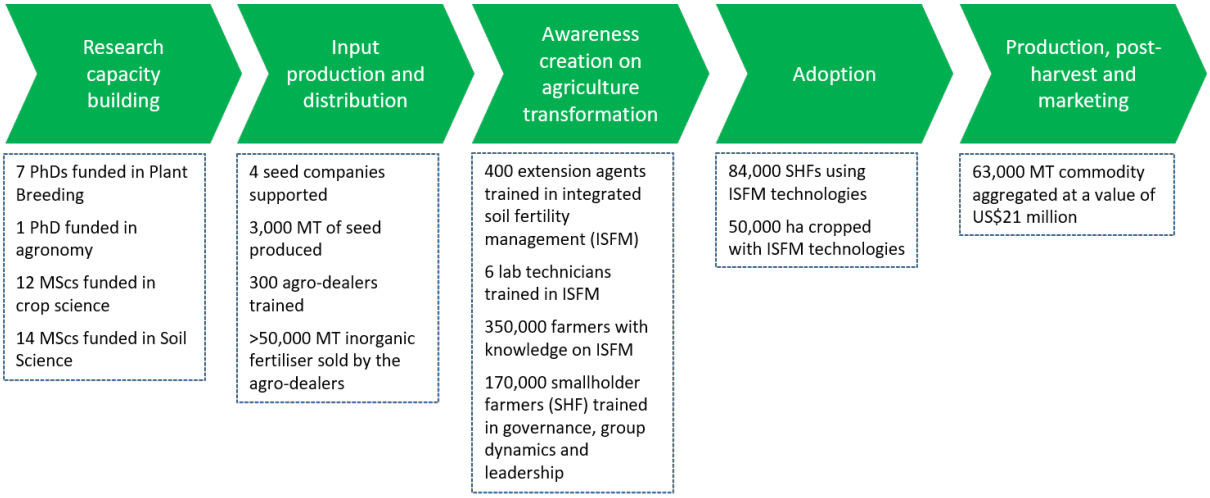

Figure 1: AGRA investments and results in Rwanda, 2007-2016

AGRA country strategy 2017-2021

AGRA's overall goal in Rwanda is an inclusive agricultural transformation to increase incomes and improve food security of 409,000 smallholder farming households. Agricultural transformation is a process by which farmers shift from highly diversified, subsistence-oriented production towards more specialised production oriented towards the market, involving a greater reliance on input and output delivery systems.

AGRA recognises Rwanda's strength in evidence-based planning and analytics, sector coordination, implementation and accountability. AGRA's country support model in Rwanda is therefore considered 'light touch', in full alignment with government priorities and programmes, and responding to specific government requests. AGRA believes that, in Rwanda, there is room to drive scale through working at national level to support the development of an enabling policy environment, and working with the private sector to build systems that improve access to inputs, markets and finance, and drive sustainability.

The AGRA Rwanda country strategy for 2017–2021 foresees US$25 million of investments, which it aims to attribute selectively in order to catalyse complementary funds from the Rwanda Government and international donors. The strategy is harmonised with PSTA 4.

AGRA in Rwanda – PIATA partnership

AGRA is the primary coordinating institution for PIATA, which aims at an innovative and transformative partnership and financing vehicle to drive inclusive agriculture transformation across the African continent. The partner (donor) organisations are the Bill & Melinda Gates Foundation, the Rockefeller Foundation, the United States Agency for International Development (USAID), German Development Cooperation (GIZ) and the UK Department for International Development (DfID).

As of mid-2019, PIATA is operationalised through one grant from USAID, called *Tera Imbuto Nziza* ('plant good seeds'). The programme commenced in October 2019, with US$5 million in funding from USAID plus US$5.9 million leveraged funds for a total of US$10.9 million. The total amount of the sub-awards (grants) is approximately US$8.7 million.

The goal of *Tera Imbuto Nziza* is to sustainably increase the productivity and incomes of female and male farmers through the development of private sector-led seed industry,

enabling farmers to have timely access to affordable quality seeds in adequate quantities. Three strategic objectives are being pursued:

Strategic objective 1: Increase the production and utilisation of improved seeds.

- Release new varieties of hybrid maize, soybean, beans and Irish potato.
- Increase the production of EGS and certified seed of selected crops by supporting local private seed companies and other seed multipliers to produce foundation seed.
- Increase farmer adoption of quality seed.
- Expanded and strengthened women-led/women-owned seed enterprises.

Strategic objective 2: Enhance the operational capacity of the domestic seed market system.

- Strengthen the agro-dealer network.
- Strengthen national aflatoxin control to improve access to markets for high quality maize.
- Strengthen youth-led/owned/focused enterprises related to seed production.

Strategic objective 3: Support and operationalise policies that regulate the seed system.

- Increase knowledge and adoption of the new seed law and policies, by stakeholders.
- Strengthen institutional capacity in seed inspection and certification – staffing, tools, and certification of labs/ upgrading.
- Setup and operationalise the national seed platform.

Table 3: Expected results of the Tera Imbuto Nziza *programme.*

• At least 40% increase in the production and utilisation of hybrid maize seed • At least 25% increase in utilisation of certified Irish potato seed • Release of at least two (2) high yielding and market-demanded varieties of soybean • Established and operationalised strong consortium/association of all actors (PPP) in the seed value chain • Capacity of seed multipliers and other private stakeholders built in business development services	• 40% of capacitated enterprises will be owned by the youth • 80% of women owned seed enterprises will be capacitated • Empowered seed producer associations and companies to engage in monitoring the implementation of seed law and policies and holding public authorities accountable • Increased capacity of seed producer associations and companies to engage in seed policies analysis, advocacy and use of collective approaches to influence decisions conducive to the development of a private–led seed industry.

4 Seed system

4.1 System performance

Table 4: Timeline of key seed system changes and events, 2008 to present.

	2008-9	20010-11	2012-13	2014-15	2016-17	2018-19
Variety development	• RAB and Rwandan Institute for Agronomic Sciences (ISAR) focus on variety release	• RAB/ISAR focus on variety release	• First research trials on hybrid maize cultivars	• Multiple evaluation trials, variety releases for many crops		
EGS production			• Private sector partners first engaged for foundation seed production		• A significant increase in EGS production	
Seed multiplication	• Private sector engaged in seed multiplication (since 2006)				• Private sector seed multipliers started multiplying hybrid varieties	
Seed marketing and distribution	• With introduction of subsidy programme in 2007, seed marketing intensified			• Seed potato fund (SPF-Ikigega) created	• Increased demand for potato seed	• Agro-Processing Trust Corporation (APTC) plays key role in seed marketing and distribution, but not for potato as this will be handled by cooperatives
Seed use	• Crop Intensification Programme (CIP) promotion of high quality			• Farmers increased purchases of subsidised seed	• Seed systems became more formalised for priority	

	seed of maize, beans, potatoes and cassava		crops	
Seed quality assurance		• Belgium Technical Cooperation (BTC) supports four new seed quality inspectors		
Seed policies and laws			• Updated seed law and policy	• Seed Ministerial Orders issued
Seed system governance and partnerships	• Merger of RADA and ISAR to create RAB			

Source: KIT-convened expert meeting, Kigali, 18 July 2019

PSTA 3 (2013-17) identified the following seed system constraints:

- Inadequate quantities of seeds produced nationally for some crops, which forces the government to import seeds, particularly for maize and wheat.
- Poor quality of internally produced seed; quality deterioration has occurred during seed production and storage.
- Poor sanitary status of seed and the prevalence of crop pests and diseases.
- Poor germination of seeds distributed under the Crop Intensification Programme (CIP) to date.
- Limited effective distribution.

PSTA 4 (2018-24) attempts to address these constraints by:

- Increased focus on developing domestic improved varieties.
- Promoting small-scale irrigation and marshland irrigation engaging with farmers and investors.
- Better sector coordination of all actors.
- Development of decentralised capacity for delivery in agriculture.
- Improve evidence-based policy planning, monitoring and evaluation functions.
- Promote PPPs and dialogue to increase private engagement and investment.

PSTA 4 builds on its predecessor by emphasising greatly reduced reliance on seed imports and stimulating the development and multiplication of quality seed locally.

The main government focus from 2008 till around 2016 has been on the production and use of higher volumes of quality seed. In the seed sector, variety development, EGS production, part of the certified seed production, but also seed marketing and distribution and quality assurance, were all performed by RAB. The aim was to assure availability of quantities of seed to meet CIP demands. From around 2016, organisational reform in the seed sector got

on the government agenda to improve the dynamics of the seed sector, reduce conflicts of interest within RAB, and facilitate the development of a private sector-driven seed sector.

Table 5: Gaps and opportunities in the seed system.

	Actors	Strengths	Weaknesses	Root cause of weakness	Opportunities for improvement	Priority for improvement 1= high, 5 = low)
Variety development	RAB, International Center for Tropical Agriculture; Centro International de La Papa; International Crop Research Institute for the Semi-Arid Tropics; private seed companies	Well established at RAB	Inadequate funding for RAB; limited capacity	Limited government financial allocation	Capacity (human resources) available in country	Not indicated
EGS production	RAB; private companies	Diversification of supply	Inadequate technical and managerial capacity; Inadequate infrastructures; Inadequate funding; Reliance on RAB for seed marketing	Young/nascent sector; Reliance on RAB for seed marketing	Allow by-passing RAB, direct sales	2
Seed multiplication	RAB; private companies; West Seed/API/OAF	Reducing reliance on imports	Post-harvest losses; infrastructure; skills; isolation	Lack of experience; access to finance and capital	More training; better extension; leverage more donor funding	Not indicated
Seed marketing and distribution	APTC; Agro-dealers; SPF (for Potato)		Shortage of working capital post-harvest/storage infrastructure Dominant position of RAB in seed distribution and marketing;		Liberalise the distribution; create competition; progressively reduce subsidy; targeted subsidy	1
Seed use	Famers Multipliers	Hybrid maize in high demand also	Beans: farmers rely on own seed.	Subsidy based market maize seed; No	Develop market chains;	Not indicated

	Agro-industries	certified potato seed		market bean seed	ensure sufficient quality seed for national food security	
Seed quality assurance	Seed producers; RAB/RICA		Not enough inspectors; uncertainly about organisation going on in RICA	Lab not internationally a credited	Private inspectors; established lab	Not indicated
Seed policies and laws	MINAGRI; RAB; RICA	Good policy framework and instruments	Incomplete implementation of new policies and regulations	Multiple RICA reforms slowing down the process; funding	More funding; capacity weakness	Not indicated

Source: expert meeting

One of the most important constraints in system performance was identified as the RAB-controlled market system for EGS, which forms a disincentive for the private sector to further develop its EGS production and marketing. Seed distribution is centrally organised and not market led, which results in inefficiencies.

Similarly, seed marketing to farmers is still lacking in competing private seed companies. Seed distribution and marketing is dominated, through the subsidy system, by centralised government decision-making. Cautious steps are being taken towards a more dynamic system based on competition between companies and the supply and demand mechanisms of the real market.

Seed policies and regulatory reform have resulted in a good policy framework for seed sector development. The implementation of the proposed organisational reform, in which the RICA is taking over responsibilities from RAB, is now needed.

Alongside the expert workshop, the authors attended the inaugural Rwanda TASAI (The African Seed Access Index) meeting convened in Kigali. Standardised (formal) seed system performance metrics for Rwanda were presented, as well as stakeholder perspectives on gaps and opportunities. The following gaps and opportunities were identified via the TASAI process and key informant interviews.

Variety development and release

- Very few recent releases of beans and maize. There have been no new bean releases since 2014, and a steady decrease to zero in new maize varietals during 2015-17. In 2017, 13 maize varieties and only three bean varieties were available for purchase. Beans pass directly from RAB to farmers, bypassing seed multipliers.
- The time of the variety release process is currently unknown. Under the new RICA and the National Plant Variety Evaluation and Registration Committee, there have been no variety releases.
- In 2019, a large number of improved crop varieties were technically released and marketed, but were not gazetted and were not available for sale. Of 146

applications in 2018 (9 private sector applicants and 2 public institutions), the variety release commission 81 varieties were 'recommended for release and registration'.

- Four active plant breeders – this number is low even when compared to other African countries.
- The current hybrid maize varieties registered in Rwanda are not very competitive in terms of yield.

Table 6: Number of varieties released and sold (TASAI, 2019)

	Number of varieties		**Varieties sold as % of varieties released**
	Sold in 2017	Released between 2000-2017	
Maize	18	33	55%
Beans	3	43	7%

EGS production

- Nearly all breeder/foundation seed originates from RAB. There is limited availability of EGS for seed companies and seed multipliers.
- Seed multipliers complain of late foundation seed deliveries from RAB.
- Very few private companies are involved in EGS production; those that do have insufficient technical and managerial capacity and lack needed infrastructure and equipment.
- The 'business case' for the private EGS sector is still inadequate, players lack ability to identify and leverage market opportunities.

Seed multiplication

- Local seed production does not yet cover national needs by a significant margin.
- There is good engagement of local, private seed companies going through a process of professionalisation.
- Limited irrigated, isolated land available, along with a lack of mechanisation for land preparation, harvesting and processing. This results in very high (casual) labour costs and sometimes labour shortages.
- With RAB having a dominant stake in nearly all stages of the seed value chain, seed multipliers are hesitant to complain if quality of supplied EGS is poor.
- AGRA-supported seed multipliers have relatively strong financial stability and good access to formal credit, but make limited investments in research and development (R&D), equipment and infrastructure.

Seed marketing and distribution

- In practice, 100% of maize seed is subsidised. In a PPP model, all seed is sold to APTC and distributed via agro-dealers. This approach is highly rated by sector stakeholders in its transparency and administration, but significantly less for its predictability (advance notice to seed suppliers on quantities, varieties) and efficiency (promptness of seed supply contracts payments by the government). The National Seed Association of Rwanda (NSAR) feels this discourages investors.
- Only imported maize seed is available in small packages; all locally produced seed is sold in large volumes.

- The public seed marketing and distribution channel is not as effective as it could be. Seed companies cannot market their own brand and comparative advantage within the subsidy scheme.
- Currently all seed passes via Kigali before entering the agro-dealer distribution network, which is expensive and inefficient.
- Seed companies have a moderate level of business resilience, financial stability and strength of human capital. Seed multipliers investment in technology is weak.

Seed use

- Low utilisation of improved seed and planting materials, between 5.8% and 13.3% of smallholder farmers (SHFs) (NISR, 2018), with only 1.5 t/ha average maize yields. The maize yield gap is 61%, the bean yield gap is 72% (RAB, 2019). The household survey in this report reports much better figures for AGRA beneficiaries for the adoption of improved maize varieties (48%), although the average maize yield is similar at 1.4 tons/ha. For beans, the survey indicates improved varieties are used by 19% of households.
- Limited financial capacity of SHFs to purchase certified seed, which means they continue to use farmer-saved seed.
- Limited effective seed demand is confused with actual (subsidised) demand. There is also low demand due to low farmer awareness of the value of quality seed.
- QDS is (officially) only intended to supplement certified seed for wheat, potatoes and cassava.

Seed quality control

- Rwanda has eight seed quality inspectors (all RAB, public), which is low, although satisfaction of clients is moderately high. Inspectors require better equipping.
- Seed producers require more frequent monitoring and follow-up.
- The national seed laboratory is not accredited to the International Seed Testing Association (ISTA) standard.
- There is insufficient post-harvest equipment for seed producers, particularly seed driers and appropriate storage facilities.

Table 7: Seed testing and certification by RAB, showing growth, abatement, and growth again until 2018; 2019 figures for hectares of seed crops and seed multipliers are down from the previous year.

Activities	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Total hectares of seed crops registered per year	5,212	5,772	6,592	3,701	2,149	3,192	4,978	4,419
Number of seed inspectors	5	9	13	13	9	9	8	8
Number of seed multipliers	-	-	68	40	27	72	93	60

Seed policy and regulation

- Good legal and regulatory framework for seed. The legislative instruments governing plant varieties (2016 seed law, 2016 seed policy, 2017 seed regulations), as well as the relevant subsidiary Ministerial Orders are in place. These are harmonised with Common Market for East and Southern Africa (COMESA) Seed Regulations.
- Implementation of the seed law and instruments, including RICA and the Variety Registration Committee is needed. RAB is still providing services in the place of RICA.
- NSAR is rated as 'fair' with respect to its ability to provide value to members, advocate effectively, and act on important issues in the seed sector.
- NSAR has limited financial capacity to implement planned activities.
- RAB is responsible for variety development, EGS supply, seed inspection and is the certifier, and the buyer and distributor of seed. According to Nyiringabo (2019), restricting the sector in this way is a serious hindrance for private sector investment in the seed business.
- Limited awareness of the seed policy and associated regulations among many sector stakeholders. The documents are not available in the Kinyarwanda language.
- The across-the-board seed subsidy distorts the market and is a disincentive to direct seed marketing and sales.

4.2 AGRA change ambition

Table 8: AGRA-PIATA grants mapped according to seed system component.

Envisioned Change	AGRA activity	Timeline	Scope and scale	Intervention budget (US$)	Implementing partners
Variety development	Fast track release and commercialisation: Verification of newly released varieties of maize, soybean, beans and potato and assessment of economic and market of each	2019-	Beans: 5 Maize: 20 Soybean: 5 Potato : 8	300,000	RAB
	Build capacity of scientists and technicians – for example with respect to skills necessary for the processes of testing, selection and maintenance of varieties; control of EGS purity; seed multiplication; and in-vitro technologies	June 2019	Supporting travel expenses and training of 20 people: 10 scientists and 10 technicians	300,000	RAB
EGS production	Build capacity of scientists and technicians – for example with respect to skills necessary for the processes of testing, selection and	June 2019	Supporting travel expenses and training of 20 people: 10 scientists and 10 technicians	300,000	RAB

	maintenance of varieties; control of EGS purity; seed multiplication; and in-vitro technologies				
	Build capacity of scientists and technicians – for example with respect to skills necessary for the processes of testing, selection and maintenance of varieties; control of EGS purity; seed multiplication; and in-vitro technologies	June 2019	Supporting travel expenses and training of 20 people: 10 scientists and 10 technicians	300,000	RAB
Seed multiplication	Build capacity of youth enterprises in seed production	2019-		220,000	Horeko youth group
	Build capacity of women-led enterprises in seed production	2019-	At least 40% of seed companies, processors, agro-dealers, contract women farmers	200,000	UN Women
	Training of seed out-growers for quality seed production and post-harvest handling and storage	2019-	400 contract farmers	250,000	University of Nairobi, Kenya, University of Rwanda and University of Technology and Arts, Byumba.
	Match grant funding to support commercial capacity for the production of certified seed for maize, soybean, and beans	2019-		1.2 million	One Acre Fund, Western Seed Company, API, Sozo and Seeds of Trust
	Training of trainers on maize disease management practices	2019-	20 seed company staff	80,000	RAB, consultants
Seed marketing and distribution	Provision of cold rooms and seed processing equipment	2019-	4 cold rooms, 20 seed drying and processing installations	900,000	Split across various proposals/users
	Training of seed company personnel in seed enterprise management at the University of Nairobi	2019-	50 staff of seed companies	350,000	University of Nairobi, Kenya, University of Rwanda and University of Technology and Arts, Byumba.
	Enhancing business and management capacity of local seed companies	2019-	9 seed companies trained	300,000	Consultancy
	Training of agro-dealers, content depends on needs (to be identified). Business	2019-	2000 agro-dealers, business linkages strengthened for 200.	300,000	CNFA

	linkages strengthened and formalised				
Seed use	Changing attitudes and practices to use of quality seeds	2019-	100.000 small seed packs distributed to farmers	300,000	CNFA
Seed quality control	None specific, although quality-related interventions planned with MINAGRI and Private Sector Federation under 'Seed policy and regulation'				
Seed policy and regulation	1. Promote common understanding of the Seed Law, Ministerial Orders and regulations for all seed value chain actors 2. Empower members to adhere to laws and regulations, monitor implementation and accountability	2019-	10 seed companies, 20 farmer groups, 10 grain traders, 2,000 farmers, 1 seed platform/consortium,20 seed inspectors, 1 National Seed Traders Association Strengthened RICA Secretariat	500,000	MINAGRI/Private Sector Federation Project 'Seed Coordination Platform and Enabling Business in Agriculture'
	Establish consortium of actors to coordinate seed production and planning	2019-	1 Seed Association	120,000	
	Reduce counterfeit seed through training and technology	2019-	20 seed certification officers trained, seed labelling technologies piloted with 5,000 farmers, 20 agro-dealers and government officers.	230,000	
	Increase capacity of seed actors in policy advocacy, and support accreditation of private seed inspectors and village level quality control.	2019-	Information not available	Information not available	
	Support the operationalisation of RICA, the Secretariat of the National Variety Release Committee, and removal of constraints delaying release of improved varieties	2019-		260,000	
	Support the Seed Consortium, develop a communications strategy, and implement merit awards for exceptional performance of value chain actors	2019-		230,000	

In planning and awarding these grants, AGRA has made clear strategic investment decisions in the seed system, which are closely aligned with the ambition and objectives of *Tera Imbuto Nziza* and thus government priorities. The investments are well distributed across the seed system components of the formal seed system, with all components receiving attention.

4.3 AGRA system change results

AGRA-PIATA contributions to early system change are not able to be assessed. At the time of this study, PIATA had been running for approximately eight months, with the first grants commencing early in 2019. Many grants will build on previous AGRA funding (before PIATA).

4.4 Analysis of AGRA results

AGRA's position in the intervention landscape

- AGRA is a key supporter of the transition to locally-produced seed by investing in the capacity of private seed multipliers.
- Further, it is clear that AGRA grants provides good additionality and are well-integrated with those of other actors in the seed system domain.
- The USAID *Hinga Weze* programme is addressing weak financial capacity of SHFs to purchase certified seed by supporting input loans issued through agro-dealers. This is a strong complementarity to the AGRA programme.
- AGRA provides 'matched funding' grants for small private seed producers to enhance seed quality post-harvest. However, companies report difficulties in accessing complementary institutional finance for mechanised seed dryers, and at viable interest rates. AGRA could possibly seek complementarity from the USAID-funded *Nguriza Nshore* ('Lend so that I may Invest') programme designed to facilitate seed companies to access loans and other financial products.

Relevance

Rwanda's seed system is at an important juncture in its development as it transitions from costly import substitution of seed to the local production of quality, certified seed for selected commodity crops. This ambition is accompanied by a multitude of necessary seed system policies and reforms intended to drive private sector investment in the seed value chain to support the transformation of agriculture. The AGRA country support model in Rwanda is explicitly 'light touch', in alignment with national policies and programmes, and intended to respond to specific government requests for support.

The AGRA portfolio of actions does respond well to the needs of the Rwanda seed sector, and aligns well with government ambitions for the sector. In this case, a good match between a government willing and acting to address the constraints in the system identified by stakeholders, and AGRA fully supporting this change agenda by injecting temporary resources in system change.

- Supporting private sector engagement for the production of foundation seed for maize reduces reliance on RAB for EGS. RAB should be able to dedicate more time to on-time delivery of breeder seed to private multipliers.
- AGRA has recently issued a portfolio of investments that aim to operationalise RICA and the Secretariat of the National Variety Release Committee, increase the capacity of seed actors for policy advocacy through the Private Sector Federation,

support the establishment of a seed consortium to better coordinate seed production and planning, and sensitise actors on the seed law and associated regulations. These investments respond directly to key criticisms and weaknesses identified by sector stakeholders, and thus have significant potential to improve policy and quality aspects of the seed system. The seed policy advocacy and seed law/regulations awareness activities are implemented in conjunction with the 'Enhancing participatory governance and accountability' project implemented by RDO.

- Overall, from a systems perspective, this study finds the AGRA-PIATA programme orientation is responsive to the seed system needs in terms of addressing bottlenecks and priorities for change. The programme is strongly aligned with Rwanda's national agricultural development frameworks and priorities.

Expected impact

- With support to RAB, AGRA is fast-tracking new variety releases. It will be important to ensure these releases also become available for multiplication and sale. This intervention alone has limited scope for enabling systems change.
- As the seed sector grows, the transparency and speed of the release process needs to be strengthened (TASAI, 2019)
- By promoting small packages for maize, AGRA may create incentives for farmers to test and become acquainted with quality seed, stimulating demand-pull.

Sustainability

- Professional development training of seed breeders and technicians will help strengthen breeding capacity. AGRA does not support new staffing positions, so long-term capacity to develop and release improved varieties may remain constrained.
- Pragmatic aspects of the long-term 'business case' for the private EGS sector is still uncertain given the current PPP seed procurement and distribution model and with investment motivations dampened by late (or refusal) of RAB payments for seed in recent years.
- The scalability of certified seed (and foundation seed) produced locally is likely to be constrained by the availability of irrigated, physically-isolated land available, along with a lack of investment in mechanisation for land preparation, harvesting and processing. This increases risk (drought/flooding) and costs of production (high labour requirements during peak-labour season).
- Aligning with the PPP seed sourcing and subsidised distribution model implies trade-offs for private seed supply engagement. There is little incentive for distinctive branding, direct seed sales, or leveraging producer comparative advantages. On the other hand, local seed production is a nascent industry, which demands external interventions in capacity strengthening.
- Based on previous experiences in Rwanda, the end-user, price-elasticity of seed in Rwanda is questionable. This may change, but any seed pricing increases due to subsidy reductions, or otherwise, could introduce unforeseen upstream shocks to the seed system. It will be important to anticipate and plan for possible consequences.
- QDS is (officially) only intended to supplement certified seed for wheat, potatoes and cassava. It would also make sense to support a QDS system for beans, which has a more limited commercial market and value addition potential.

- PIATA is offering support towards the operationalisation of RICA. Rather than add to the number of public seed inspectors, AGRA is supporting initiatives towards the accreditation and functioning of independent and licensed private seed inspectors and village level quality control systems, a model proven in other countries in East Africa.
- Along with this review, TASAI has identified longer-term challenges to the seed subsidy scheme and PPP sourcing and distribution model. AGRA should conduct an independent review of the effectiveness, efficiency and sustainability of the seed subsidy programme. An alternative subsidy model could shift the subsidy to the farmer, so they can choose who they buy from, including from private seed providers. This would create market transparency and entrepreneurial space, and create a level playing field for seed suppliers, which could be administered and monitored through the SNS system.
- Rwanda has a well-planned and relatively consistent agricultural policy, so AGRA investments are more likely to be embedded and institutionalised, which bodes well for the sustainability of investments.

5 Extension system

5.1 System performance

We have assessed the performance of the agricultural extension system in Rwanda and identified successes, gaps and opportunities with respect to AGRA support and interventions in the system. Guided by PSTA, the Government of Rwanda aims to improve the performance of the national agricultural extension system.

PSTA 4 (2018-24) identifies the following extension system priority issues, mapped under Priority Area 1: Innovation and Extension.

Proximity to extension and advisory services
Objective: To capacitate producers to make informed decisions and adopt agricultural innovations which increase, diversify, specialise, and intensify agricultural production. While smart farmers generally make smart choices, different farmers have different support needs and require context-specific approaches. PSTA 4 promotes a more pluralistic extension and service delivery system that is flexible enough to consider different production systems, farms size, capacities, and social status, among others. Private sector engagement in agriculture service delivery is promoted

Figure 2: Objective of extension services according to PSTA 4: Informed decision-making

PSTA 4 also aims to strengthen the following aspects:

- Institutional capacity development. Extension will become increasingly decentralised and delivered ever closer to the field level allowing for better targeting and impact. To ensure coordination, regular interactions are foreseen at sector, district, and national level. 'Research-into-use platforms' will be established to improve dialogue and links between research and extension.
- Quality proximity extension services to farmers. Focus on building capacity of FPs as well as FFS facilitators and their linked cooperatives. A performance evaluation and incentive system is proposed, with more emphasis on technical backstopping and supervision and provisions for transport and communication. Financial incentives to FFS facilitators and FPs will be provided. Extension messages will be revised to take into account evolving realities and priorities, and support pluralistic extension models using mobile phones and ICT. An extension communication system will be built to allow direct feedback from extension workers to farmers for questions and queries. Most of the implementation will be at the local government level (districts), so considerable emphasis will be on coordination between MINAGRI, agencies, local government, and other stakeholders.
- Tailored and demand-driven services by the private sector. Specialised private sector extension and service delivery systems for high quality, consistent and market-oriented extension, and advisory services to farmers are promoted. Public sector investment at the district level will be required to display the value of private extension services to commercial farmers. The capacity of private service providers will be strengthened to meet farmers' demands, while demand will be stimulated, including through a farmer voucher system.

Table 9: Key events and changes in the agricultural advisory and extension systems in Rwanda, 2008 to present.

	2008-9	20010-11	2012-13	2014-15	2016-17	2018-19
Extension providers & funding	• National Agricultural Extension Strategy published • Local NGOs contracted to provide extension services • IFDC supported provision of extension materials	• Local NGOs and farmer organisations (FOs) contracted to provide extension services	• Local NGOs and FOs contracted to provide extension services development	• New service providers: Agribusiness-Focused Partnership Organsiation (AGRIFOP) agro-dealers, BK Tech Smart Nkunganire System (SNS), One Acre Fund, CNFA		• Policy opens up opportunities for private sector participation in extension
Extension effectiveness	• BTC supported delivery of FFS extension model • PSTA 2 aims for permanent training service for extension agents			• APTC selected as sole distributor of fertiliser (PPP model)	• SNS by BK Tech introduces digital value chain, stock management and order processing	• USAID Food for the Future programme organises input supply in 10 districts in all Provinces
Collaboration and coordination	• Centre for Information and Communication in Agriculture (CICA) created • MINAGRI starts devolving extension responsibility to local districts		• Increasing responsibility for extension at district level		• Integration of *Twigire Muhinzi* and SNS. • Shifting focus from Social and Economic Development Officer (SEDO) to direct extension via FPs.	
Accountability						• FPs tracked for performance using mobile technology
Extension policy and governance	• Voucher system for fertilisers	• Agro-dealer system development		• *Twigire Muhinzi* extension model		• PSTA 4 aims to increase extension

	• Privatisation of fertiliser imports	developed and disseminated	pluralism, private sector role in extension

Sources: expert meeting, key informant interviews, PSTA 3 (2013) and PSTA 4 (2018)

Public agricultural extension and advisory services are organised through the *Twigire Muhinzi* model, introduced in 2014. This is a decentralised extension model which gives a key role to farmer extension agents: FFS facilitators and FPs; FPs engage small groups of farmers around demonstration plots, and some farmers from each group join FFS groups. Rwanda has trained a total of 14,200 FPs and 2,350 FFS facilitators (who, in turn, were trained by 'FFS master trainers') (MINAGRI & BTC, 2016). In the *Twigire Muhinzi* model, MINAGRI, via RAB, provides technical support by training FFS facilitators and FPs, linking research with extension and providing quality extension material. Districts, under MINALOC supervision ensures that extension activities are in line with district development plans and coordinates the day-to-day implementation of extension activities. FPs are voluntary positions, but they sometimes receive in-kind incentives paid by donors, such as bicycles for commuting between farms.

Table 10: Key aspects of extension system performance.

	Strengths	Weaknesses	Root cause of weakness	Opportunities for improvement
Extension providers & funding	• Increasing pluralism in extension, multiple service providers	• Belgian Technical Cooperation (BTC) stopped funding FFS programme, agreed to support PSTA implementation instead • Incentives for FP and agro-dealers limited	• Government still set prices for agro-dealer margins, FPs voluntary position	• Lobby for increased margins, also for FPs
Extension effectiveness	• Each cell (the lowest level administrative unit) has trained FFS facilitator. • Transition to digital extension and using multiple channels and platforms • Effective coverage (69% of farmers in 2015[1]60% of maize farmers in 2019[2])	• FFS is no longer implemented • FFS is expensive, difficult to scale, and difficult to make sustainable	• BTC stopped funding for FFS programme in 2016	• With funding, FFS facilitators could work with FPs, reducing pressure on social and economic development officers (SEDOs) and district agronomists for follow up/monitoring of FPs
Collaboration and coordination	• *Twigire Muhinzi* has proven effective model	• Extension body of agriculture sector working group, coordinated by MINAGRI, is not functional • Lack of standardised extension messaging, confusing farmers	• Reasons unsure	• AGRA could support reactivation of platform, ensuring coordination of strategy and practice

		• Needs to be a better linkage between agricultural research and development		
Accountability		• One-third of FPs are inactive	• There is no performance management system for FPs, or indeed for *Twigire Muhinzi* as a whole	• Better sensitisation of FPs of roles, responsibilities • Establish monitoring system for SEDOs and FPs
Extension policy and governance	• Pluralism and public service provision recognised and promoted	• Challenges in system operationalisation and coordinator between national levels (MINAGRI, RAB) and local levels (MINALOC, district, sector, cell)	• Reasons unsure	

[1] MacNairn and Davis, 2018

[2] Outcome survey data, 2019

Sources: workshop, interviews, desk review.

Table 11: Advantages and challenges of the Twigire Muhinzi *model (MacNairn and Davis, 2018)*

Advantages	Challenges

• Very effective national coverage
• Empowers farmers
  • FFS structures allow for informed, collective response e.g. in disease outbreaks.
  • Structure permits both vertical (from Ministry down to village) and horizontal (within groups) information flow
  • Strong integration with MINALOC, which facilitates model implementation at local level.
• Access to subsidised inputs incentivises formation of Twigire groups
• Farmers' trust is enhanced through facilitation by farmer facilitators rather than GoR or NGO staff
• Group savings schemes are a side benefit of being in a TM group
• Twigire groups reported functioning effectively for dissemination of information and technologies within groups and to neighbouring groups, enhanced by geographic proximity
• While initial focus was on annual crops, model is flexible enough to include other types of enterprises (livestock, agroforestry)
• 53 percent of all FFS group members are female.
	• Government still sets prices for agro-dealer margins, FPs voluntary position.
	• FFS approach is expensive, intensive and difficult to scale up
	• FFS facilitator training takes a long time (six months), difficult for married women to participate
	• FPs need more technical training than current system provides; they are limited in what they can do
	• Some farmers resist forming groups
	• There is little private sector involvement with FFS groups
	• Outside of the FFS programme, sustained extension contact with farmers is minimal
	• Despite evidence of good initial performance, there is no guarantee for sustainability or future success
	• Distinctive functions and differences between FFS facilitators and FPs may get blurred and then be less valuable/effective as TM becomes more established
	• GoR district and sector agriculture staff are not always attuned to TM and its implementation; they may take some time and adjustment to fully understand and accept the farmer-centred TM model
	• Though well integrated with local government, there is still potential for some differences to arise

between RAB and local government in implementation
- In some cases, farmers are told what to grow and where, especially for variations among valleys/terraces/home plots
- Quick decisions are often needed for effective implementation
- Selection process of FPs at village level is sometimes disputed
- Occasional late delivery of inputs and current voucher subsidy may reduce overall input usage

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Extension providers and funding

The *Twigire Muhinzi* agricultural extension model combines farmer Field School (FFS) approach and the Farmer Promotor approach, adding to the pluralistic nature of the national agricultural extension system in Rwanda. In 2012, only 5% of all extension services were provided by Farmer Promoters. In 2016, FPs were providing 21% while FFS Facilitators were responsible for 13% of all services. However, Belgium dropped financial support for FFS and *Twagire Muhinzi* in December 2016, and numbers of FFS events have reduced. This has had the follow-on effect of increasing administrative loads on District Agronomists and the sector-level SEDOs for extension follow up and coordination. 60% of maize-farming households reported having had contact with a Government extension agent, but 85% had received information from non-Government advisory service (AGRA outcome survey data, 2019). 5% of farmers received services from private companies. See also Household Survey tables Table 41 and Table 42 for maize and Table 80 and Table 81 for beans.

Extension effectiveness

Overall, *Twigire Muhinzi* provides good coverage of farmers and reaches 96% of all villages (MacNairn and Davis, 2018). However, ensuring that the remaining one-quarter to one-third of farm households are reached will be challenging. A key challenge is ensuring FPs are motivated to deliver advisory services despite. Communication channels – other than face-to-face contact – include two-way SMS, training videos and printed materials, and through a toll-free number (4675) that serves as a call-in help desk for farmers.

Collaboration and coordination

Technical content for *Twigire Muhinzi* is developed by RAB and other collaborators (universities, NGOs, and research for development consortia such as the Consortium for Improving Agriculture-based Livelihoods (CIALCA), although some links with partner institutions could be stronger. The links between agricultural research and development (extension) needs further strengthening. Researchers need to better understand farmers experience with new technologies, while extension staff need to be aware of the available technologies (MacNairn and Davis, 2018). *Twigire Muhinzi* is operationalised under the MINALOC organisational structure (planning, implementation and monitoring), but stakeholders describe inadequate working mechanisms between MINAGRI/RAB (technical support and evaluation) and MINALOC/decentralised entities (District, Sector, Cell, villages).

Accountability

At present, there is no official monitoring and evaluation system for *Twigire Muhinzi* (MINAGRI/RAB plans to establish an effective system to measure extension progress – MINAGRI, 2016a). Concerns were expressed that the model works well but there is inadequate follow-up to ensure farmers practice what they have learnt from the demo

plots/FFS. There may be reluctance by farmers to adopt because although they may understand the technologies showcased, they feel it is risky if they do not know the underlying costs of production.

Extension policy and governance

MINAGRI has the ambition to achieve financial sustainability by allowing FFS to become professional service providers, an approach that that commenced in 2017 but will take some time to become institutionalised (MacNairn and Davis, 2018). Sector stakeholders felt that the Streamlining of extension policy and frameworks is required, neither are very clear. Who exactly are the extension providers, especially as services become increasingly pluralistic? How does the information flow? The sector coordination body – the Forum for Agricultural Advisory Services appears to be non-functional, and there is concern there may not be enough consultation with civil society.

5.2 AGRA system change ambitions

Compared to the change ambitions for the seed system, AGRA's aims for the extension system in Rwanda are relatively modest in terms of financial investment. The key ambition is to strengthen *Twigire Muhinzi*, in particular by assisting to formalise the position of FPs (CNFA, pers. comm) and by supporting the Smart Nkunganire System (SNS) digital supply chain management system. Alignment with overarching policy objectives is the underlying principle of AGRA's investments.

*Table 12: AGRA-PIATA grants mapped according to extension system component**

Envisioned Change	AGRA activity	Timeline	Scope and scale	Intervention budget (US$)	Implementing Partners
Extension providers & funding	Incentivising FPs to improve production and productivity of maize in eastern province	July 2019 -August 2020	200,000 farmers, in Rwamagana, Nyagatare, Kirehe	250,000	CNFA (*Hinga Weze* programme)
	Farmer to Market Alliance Project	July 2017 – August 2018	30,000 farmers in 11 districts of Rwanda	250,000	RDO
Extension effectiveness	Incentivising FPs to improve production and productivity of maize in eastern province	July 2019 -August 2020	200,000 farmers, in Rwamagana, Nyagatare, Kirehe	250,000	CNFA (*Hinga Weze* programme)
	Leveraging digital solutions to improve effectiveness of the inputs distribution system and farmer promoter system	July 2019 – August 2020	200,000 farmers	250,000	Bank of Kigali
Collaboration and coordination	None				
Accountability	None				

Extension policy and governance	None

Source: AGRA, pers. comm. * There are limited extension interventions embedded in other projects from which it is difficult to disaggregate extension components. They have not been added to the table.

Since 2017, AGRA has invested in three extension-related activities. The first is support to the 'Farmer to Market Alliance' (FtMA) project with RDO, which has origins pre-PIATA and has since closed. FtMA was a partnership between AGRA, the World Food Programme and other private companies. FtMA aimed to build the capacity of farmers to increase incomes and production by improving post-harvest management and improve access to the market through forward contracts and other formal mechanisms, as well as improved access to yield improving technologies and finance. The project built on the AGRA-funded 'Market Access' project from 2011 to 2014 with similar activities although implemented in different districts.

The second intervention – mapped against PIATA- is a grant to CNFA, which implements the *Hinga Weze* Feed the Future programme in Rwanda. The project, which started in July 2019, has the core objective to design a system to incentivise FPs to train farmers who receive subsidies through the digital SNS system. It will also provide capacity building support to sector agronomists to train FPs and support the development of training curricula. CNFA and partners BK TecHouse will pilot this system in four districts in Eastern Province in 2019, and AGRA funds will allow the project to be rolled out to the three remaining districts. A system is proposed to ensure those farmers that will receive the SNS from agro-dealers are trained by FPs, which will include the provision of incentives to FPs to reward them for training these farmers. Since the 2019A season, CNFA has already negotiated, on behalf of FPs, a margin of RF2 per kilogramme of fertiliser and seed sold through the SNS. This margin is currently being allocated to a FP Incentive Fund. This Fund needs to be formalised and legalised and a system further developed so that individual FPs earn their commission directly from agro-dealers on the basis of actual sales to farmers that they have trained.

The third AGRA support is allocated to the Bank of Kigali, which runs BK TecHouse – a spinoff technology company founded in 2016. Together with RAB, BK TecHouse developed the SNS system to increase efficiency, productivity, transparency and bridge communication gaps in the agro-input subsidy programme. SNS aims to increase financial inclusion, cashless transactions and the green economy in the agriculture sector. AGRA will support better access to finance using the SNS system.

5.3 AGRA system change results

Rwanda's agricultural advisory and extension system is in a period of policy-driven change which AGRA seeks to leverage with its system investments. In the past, there has been a latent tension in the formulation and implementation of Rwanda's agricultural extension strategy between top-down supply driven (e.g. the CIP) and bottom-up, demand-driven. PSTA 4 seems to be more open for a more pluralistic and demand-driven system, which is an opportunity for AGRA.

Although the focus of this study is the PIATA programme, it is recognised that AGRA has a much longer history in Rwanda and continues to build on previous activities and grants. This creates continuity and helps to institutionalise practices, leading to system changes in the longer term.

AGRA-PIATA grant contributions to early system change are not able to be assessed at this point in time. These were issued just prior to this study. However, investments which both underscore government policy priorities and support SNS piloting and implementation – itself a 'system disrupter'- bode well for positive system level outcomes in the future.

5.4 Analysis of AGRA results

AGRA's position in the intervention landscape

As can be seen in Table 11, AGRA has elected to invest in the components extension providers and funding, and extension effectiveness. It is not intervening in extension collaboration and coordination, accountability, and extension policy and governance.

Table 13: Other projects and programmes intervening in the agricultural extension domain.

Project or Programme	Timeline	Envisioned change: 1. Extension providers and funding 2. Extension effectiveness 3. Collaboration and coordination 4. Accountability 5. Extension policy and governance	Scope and scale	Intervention budget (US$)	Implementing partners	Link to AGRA activities
***Hinga Weze* (USAID Feed the Future programme)**	2017 – 2022	1,2	10 districts nationwide	250,000	CNFA (*Hinga Weze* programme), MINALOC	Complementary grant for changes 1, 2
One Acre Fund (*Tubura*) country programme	2013-onward	1,2,3	30 districts, 110,000 farmers	Estimated. 1,000,000 per year	One Acre Fund, RAB	Not indicated
AGRIFOP agro-dealer development	2013-onward	1,2,3	National	Unsure	AGRIFOP	Not

Source: expert meeting

Relevance

- Sector stakeholders and AGRA partners indicated that the lack of sector coordination was of significant concern. AGRA could play a meaningful role by supporting the (re)operationalisation of FAAS-R housed within MINAGRI.

- Considering the changes on which these initiatives focus, I would conclude that there is an opportunity/gap for AGRA to support the policy, governance and accountability of the public extension system. This could be a recommendation for AGRA Rwanda.

Expected impact

- Given that AGRA has elected to focus only on extension effectiveness and extension providers/funding, AGRA may be missing opportunities for addressing other bottlenecks and the priorities for change. In particular, a weakness in extension sector coordination and communication – a concern noted by several sources – will limit or slow system change unless addressed. Otherwise, AGRA's support of the SNS system, and structured remuneration systems for FPs, are areas where there is good potential for structural and sustainable improvement.
- There are plans to make extension more demand-driven and even individually customised and targeted. This is valuable insofar as 'demand driven' means 'needs driven', where farmers have access to the right information to make informed production decisions. Follow-up of farmers at this level is presently weak.

Sustainability

- Through the CNFA grant, AGRA is seeking to support the professionalisation of FPs. Under the *Twigire* model, this is a key requirement for improving the functioning and efficacy of the system. The (largely) voluntary FPs are a bottleneck to ensuring that the last one-third of Rwandan farmers are reached, and boosting the number and quality of interactions between extensionists and farmers. The CNFA model – a decentralised FP Incentive Fund providing commissions on inputs for FPs with related administrative and oversight structures – is an important step towards a sustainable business model for FPs.
- *Twigire Muhinzi* has been highly successful, but faces important challenges with regard to remaining relevant. The FFS component is costly and weakened due to a lack of donor support. The advocated path forward is professionalisation of FPs and agro-dealers, supported by better information and value-added services through SNS. AGRA's support of SNS through CNFA and Bank of Kigali is a key step in digitalising the sector and making the advisory system more effective, efficient, and sustainable.

Part II: Household survey

6 Methodology of the household survey

6.1 Introduction

AGRA has activities at multiple levels. This report presents the results of the household survey, which is designed to measure changes at farm level. This is part of the internal monitoring of change within the beneficiary population of AGRA's interventions against an agreed upon (restricted) set of indicators, which allows the continuous tracking of progress towards its desired outcomes. The methodology targeted data collection by external local and international consultants under the guidance of and coordination by KIT.

The household's survey monitored the following indicators:

- Average number of months of adequate household food provision (Goal indicator 2)
- Wealth assets index score (Goal indicator 6)
- Average yield (kg/ha) of focus crops
- Rate of application of target improved productivity technologies or management practices at farmer level
- Percent of farmers accessing agricultural advisory extension support services
- Average fertiliser use
- Percent of post-harvest losses
- Value of smallholder incremental sales (value of additional volumes sold)
- Percent of farmers accessing financial services of formal institutions
- Average age of varieties of focus value chains on farmer fields
- Additional indicator 1: Average distance to agro-dealer
- Additional indicator 2: Hectares under improved productivity technologies or management practices
- Additional indicator 3: Farmers' clients
- Additional indicator 4: Small seed pack' exposure and utilisation

6.2 Sampling strategy

As the purpose of this assignment is monitoring performance against specific indicators, AGRA and KIT have jointly decided to opt for a statistically sound, yet targeted sample strategy. Because the purpose is monitoring, AGRA and KIT also have agreed not to make use of counterfactuals. The target population for this study are all AGRA beneficiaries in the Eastern province in Rwanda. The sampling was done based on AGRA beneficiary lists. As the lists were considered representative of the AGRA beneficiary population, they were used for the sample selection.

The sample is determined using multi-stage random sampling by first randomly selecting geographically spread locations and, within the location, randomly selecting beneficiaries. A sample of 1,000 households was randomly selected from this population, using two-stage clustered sampling. These households were interviewed for both maize and beans.

Firstly, districts were randomly selected covering enough beneficiaries so that 60% in each district could be interviewed. The number of interviews to be conducted per district was then determined proportionally to the beneficiary population in each district. Thereafter, cells were randomly selected in the districts. The number of interviews per cell was again

determined based on the relative population size. Within each cell, the number of male and female farmers to be interviewed was determined proportionally to the number of male and female beneficiaries in the community. Respondents were selected randomly. A buffer (about 20% of the interviews to be conducted) was added in each community in case the selected sample could not be found.

The total number of surveys was agreed between KIT and AGRA based on budget availability, and power considerations. The sample size per crop was set at 1,000 for each crop. With a sample size of 1,000 observations, it is expected that a change in yields of 10% among the survey population with a confidence level of 95% will be detected (see Figure 3). Based on agreements between AGRA and KIT, a total sample of 1,000 farm households was selected to be interviewed on both maize and beans.

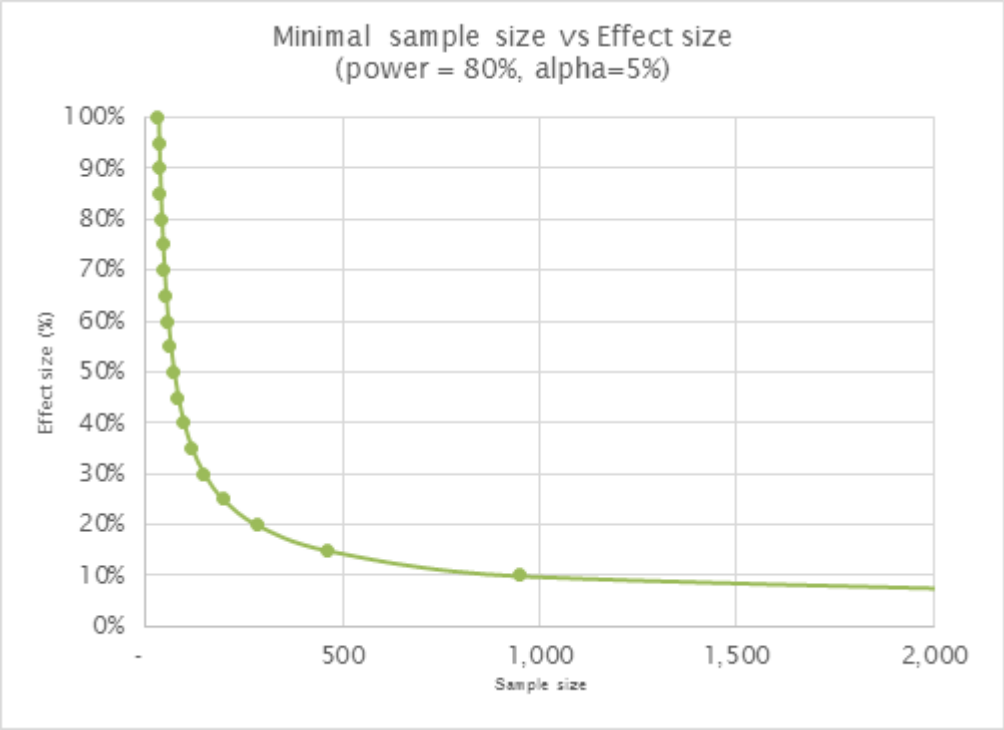


Figure 3: Power calculation

6.3 Survey structure

The main unit of analysis is the household. Therefore, it is possible that multiple household members are involved in answering questions. The survey always started with AGRA's main beneficiary, but during the survey the respondent could switch. Questions on agricultural production are answered by the person in the household who knows best about production. Questions on household food security are answered by the household member in charge of food and cooking in the household, which was usually a woman.

The survey starts with a general part, followed by a crop-specific part, and then followed by, again, a set of generic questions. At the start of the survey, the enumerator selects the crop cultivated by the respondent, which ensures that only questions concerning that crop appear in the interactive form. The same applies for the respective seasons the farmer cultivated the respective crop.

The survey instrument was designed to collect detailed information on the following topics:

- General:
    - Demographics and wealth indicators
- Crop-specific:
    - Agricultural land
    - Production of the focus crop
    - Allocation of the focus crop
    - Revenues
    - Crop varieties and seed use
    - Use of productivity-enhancing technologies
    - Post-harvest practices
    - Farmers' clients
- General:
    - Agricultural extension
    - Financial services
    - Food security

Survey deployment and quality control

The data was collected using tablets and Open Data Kit (ODK), in combination with the secured survey site Kobo Toolbox. ODK is the leading open-source platform for collecting, storing and processing quantitative survey data. The use of this application ensures quick and reliable data collection. The questionnaire programmed in ODK makes calculations during the survey, which allows for referencing to responses given previously. It also allows for data checks since it reduces the chance of errors by warning enumerators when unexpected values are entered. The form also includes skip-logics that were programmed into the questionnaire, so that enumerators only ask relevant questions based on previous responses, which ensures efficiency in data collection.

6.4 Limitations of household survey

When interpreting this data, there are a few aspects that should be kept in mind. Firstly, the purpose of the assignment is 'internal' monitoring of change. As such, the assignment does not require impact measurement of AGRA's and partners' interventions and therefore does not require measuring change against counterfactuals and attribution of results.

Secondly, since the sampling was done based on AGRA beneficiary lists, the sample is only representative of AGRA's beneficiary population and its representativeness cannot be extended to the wider region or nation.

7 Household-level results: maize

7.1 Sample description

Survey area

Within the Eastern Province, interviews were conducted in six districts: Gatsibo (23%), Kayonza (21%), Kirehe (20%), Ngoma (5%), Nyagatare (16%), and Rwamagana (14%). Within these districts, 819 households were interviewed on maize production practices. Figure 4 shows the geographical spread of surveyed households.

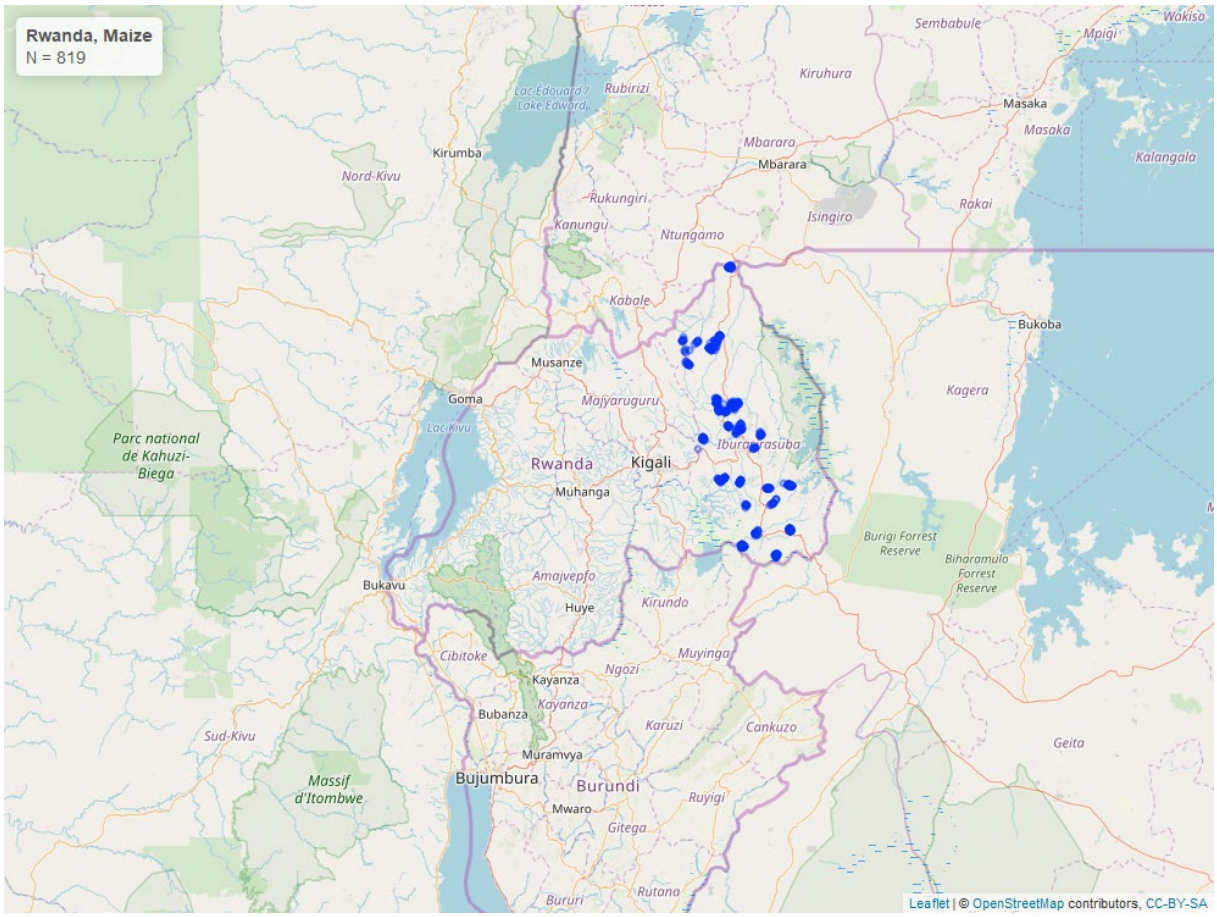


Figure 4: Location of farm household interviews, maize sample

Farm household characteristics (maize farm households)

Respondents are all AGRA beneficiaries; 60% of respondents are male, 40% are female. In 84% of cases, the participant in AGRA activities is also the head of the household. Respondents are, on average, 47 years old (see Figure 5).

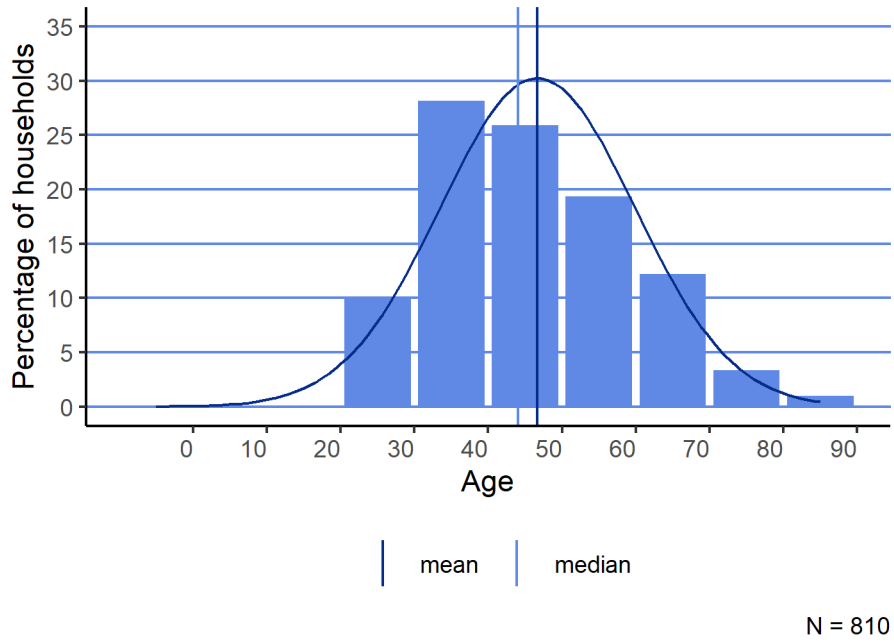


Figure 5: Distribution of respondent age

About 71% of the farm households are male-headed. Households, on average, consist of 5.4 members (2.7 adults and 2.7 children), with female-headed households being significantly smaller (see Table 14).

Table 14: Household composition

Adult/Children	All	Male-headed	Female-headed	sig
Number of children in the household	2.7	2.8	2.3	***
Number of adults in the household	2.7	2.7	2.6	
n	819	584	234	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Almost all households (99%) declared that they own their agricultural land. The average amount of land owned is 0.4 ha. About the same amount of land is also being cultivated. On average, 95% of this land is used to cultivate maize in the A season (see Figure 6); 11% of households intercrop maize with other crops. Most commonly, maize is intercropped with cowpea (60%) and sorghum (52%).

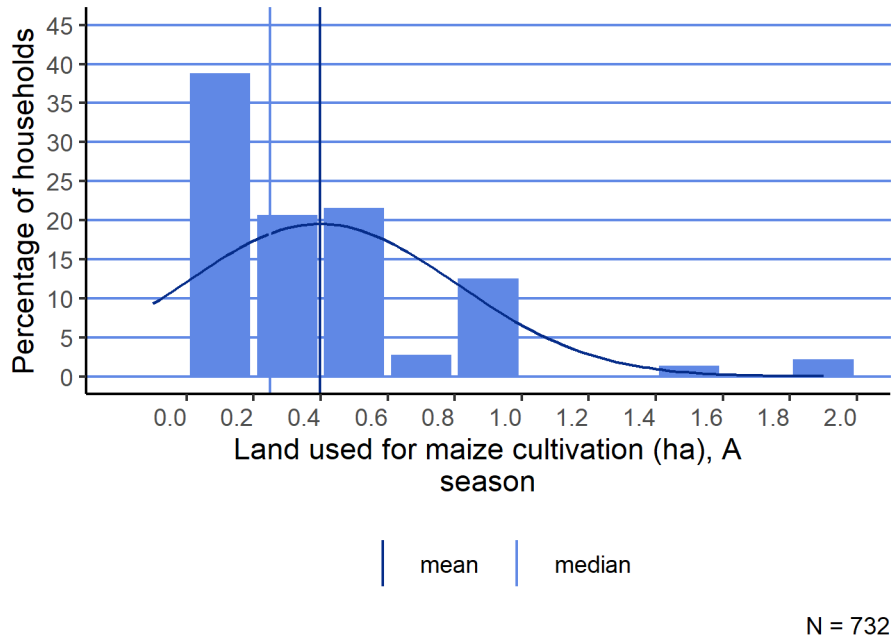


Figure 6: Distribution of land allocated to maize (ha), A season

In Rwanda, there are two farming seasons for maize: A season (September to February) and B season (March to June). Table 15 shows that 92% of interviewed households cultivated maize in the A season and that 15% cultivated maize in the B season.

Table 15: Percentage of households producing maize, per season

	All	Male-headed	Female-headed	sig
A season	92%	93%	91%	
B season	15%	14%	18%	
n	819	584	234	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
Note: Multiple choices possible, therefore total does not need to add to 100%

7.2 Main indicators

Table 16 gives an overview of the primary indicators collected. The enumeration of the indicators corresponds to the one used in the Term of Reference. See Annex A: data dictionary main indicators for definitions for each indicator. The indicators and the underlying behavioural patterns are discussed in further detail in the following sections.

Table 16: Overview of main indicators for maize-farming households

	All	Male-headed	Female-headed
G2: Average number of months of adequate household food provision	**9.2**	**9.2**	**9.2**
G6: Wealth assets index score	**-0.083**	**-0.076**	**-0.098**
G6.1 Share of households in first wealth quintile (%)	6%	6%	6%

G6.2 Share of households in second wealth quintile (%)	13%	12%	15%
G6.3 Share of households in third wealth quintile (%)	30%	30%	31%
G6.4 Share of households in fourth wealth quintile (%)	40%	41%	39%
G6.5 Share of households in fifth wealth quintile (%)	11%	11%	10%
IWI International Wealth Index	27.5	27.8	26.9
1. Average yield (kg/ha)	**1396**	**1439**	**1295**
3. Rate of application of target improved technologies or management practices	76%	78%	69%
3.1 Adoption of improved varieties (%)	48%	51%	42%
3.2 Adoption of endorsed varieties (%)	22%	23%	21%
3.3 Number of seasons variety is recycled	4.1	4.0	4.2*
3.4 Adoption of endorsed planting practice (%)	50%	51%	50%
3.5 Adoption of inorganic fertiliser (%)	68%	70%	62%
3.6 Adoption of endorsed fertiliser (%)	68%	70%	62%
3.7 Adoption of organic fertiliser (%)	72%	73%	68%
3.9 Adoption of pest-management practices (%)	54%	57%	47%
3.10 Adoption of endorsed post-harvest practices (%)	53%	52%	54%
3.11 Adoption of improved storage (%)	15%	15%	16%
3.12 Use of designated storage facilities (%)	2%	2%	2%
3.13 Adoption of tablets to preserve quality of recycled seed (%)	40%*	40%*	42%*
Ha under improved technologies or management practices (%)	73%	73%	73%
3.14 Area under improved varieties (%)	53%	53%	53%
3.15 Area under inorganic fertiliser (%)	73%	73%	73%
3.16 Area under pesticides (%)	56%	56%	56%
4. Access to agricultural advisory extension support services	**60%**	**63%**	**54%**
4.1 Avg. no. of visits per year by agri. advisory extension support services	5.3	5.5	4.5
4.2 Received small seed pack (%) (additional indicator 4)	42%	43%	38%
4.3 Used small seed pack (%) (additional indicator 4)	99%	99%	99%
4.4 Distance to nearest agro-dealer (minutes)	40.3	40.5	39.9
5. Nitrogen application (kg/ha)	**19.0**	**19.8**	**16.9**
5.1 Phosphorus application (kg/ha)	8.3	8.8	6.9
5.2 Potassium application (kg/ha)	0.7	1.0	0.2
Average fertiliser use (Total N + P + K, kg/ha)	25.8	27.5	21.7

6. Percent of post-harvest losses (%)	**0%**	**0%**	**0%**
10. Value of incremental sales as a result of AGRA (crop revenue) (US$)	**38.4**	**42.6**	**27.9**
13. Access to formal financial services (%)	**56%**	**61%**	**44%**
13.1 Bank account (%)	56%	61%	45%
13.2 Agricultural loan (%)	7%	8%	7%
13.3 Agricultural insurance (%)	0%	0%	0%
17. Average age of varieties used (years)	**12.3**	**12.6**	**11.3**
33. Sale through structured trading facilities/arrangements (%)	**20%**	**20%**	**18%**
33.1 Selling to traders/middlemen (%)	21%	18%	28%
33.2 Selling to consumers (%)	3%	2%	5%
33.3 Selling to friends/neighbours (%)	1%	1%	0%
33.4 Selling to aggregation centre (%)	1%	1%	1%
33.5 Selling to farmer organisation (%)	31%	35%	23%
33.6 Selling to wholesalers (%)	25%	24%	26%
33.7 Selling to processors (%)	0%	0%	0%
33.8 Selling to retailers (%)	19%	18%	21%
33.9 Selling to company (undefined) (%)	7%	8%	7%
33.10 Selling to institutional buyers (%)	1%	1%	1%
37. Access to market information through formal channel (%)	**21%**	**23%**	**18%**

The composition of variables can be found in the data dictionary in Annex 1; N might vary across indicators
** indicates that the average has been calculated with less than 50 observations*

7.3 Number of Months of Adequate Household Food Provision (indicator G2)

Table 17 reports the average number of months of adequate household food provision (MAHFP), which shows that farm households have, on average, enough food to meet needs during 9.2 months of the year. There is no difference in food security between male and female-headed households.

Table 17: Average number of months of adequate household food provision (G2)

	All	Male-headed	Female-headed
G2: Average number of months of adequate household food provision	9.2	9.2	9.2

Figure 7 shows the MAHFP distribution, which shows that only 28% of farm households report having had enough food to meet their family's needs during the entire year. About 12% of farm households did not have enough food during 6 months or more. About 2%

reported being chronically food insecure (reporting to have adequate food provision in none of the months).

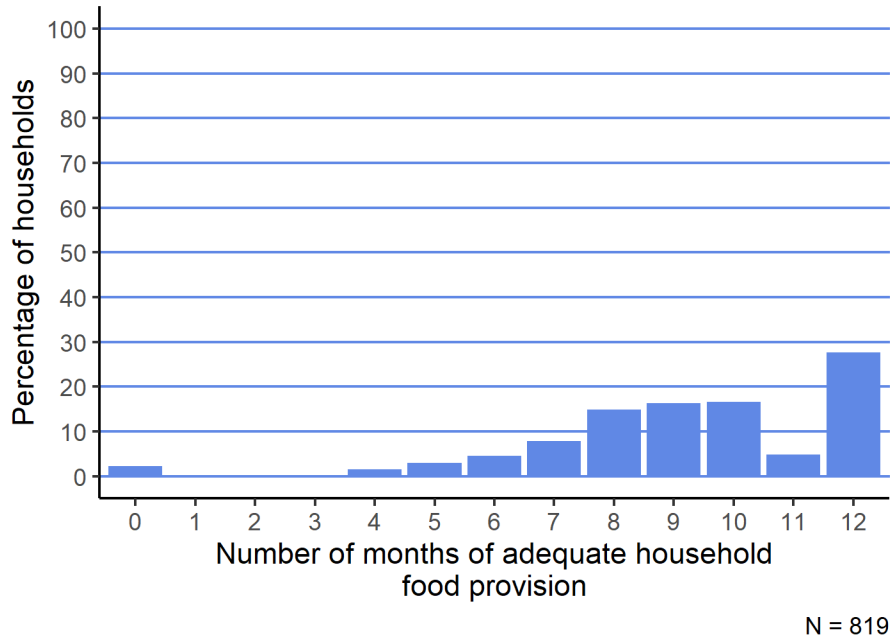


Figure 7: Distribution of number of months of adequate household food provision (G2)

Figure 8 shows the distribution of months with adequate household food provision over the year. The figure shows that AGRA beneficiaries have experienced two lean periods: between September and December 2018 and between April and May 2019, which precedes the harvesting periods of A season and B season, respectively.

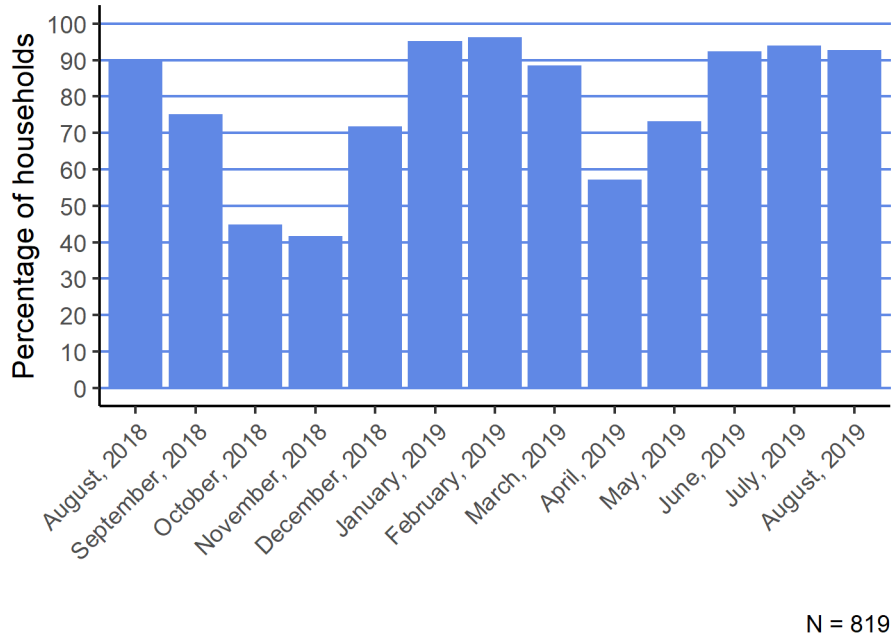


Figure 8: Distribution of months with adequate household food provision

7.4 Wealth asses index score (indicator G6)

Table 18 shows the quintile distribution of the Demographic and Health Surveys (DHS) wealth index. The DHS household wealth index is a composite measure of a household's cumulative living standard. It is composed of data on asset ownership, materials used for housing construction, and types of water access and sanitation facilities.[2] Wealth index scores were compared with the national Rwandan DHS distribution for rural areas to determine the household's relative wealth compared to the country average. As can be seen from Table 18, most households are in the 3rd and 4rd quintiles, whilst 19% is in the 1st (poorest) and 2nd poorest quintile of the country. In other words, according to this indicator, AGRA beneficiaries are slightly better off, on average, compared to the rest of the rural population in Rwanda. Female and male-headed households are about equally wealthy.

Table 18: DHS wealth index

	All	Male-headed	Female-headed
G6: Wealth assets index score	-0.083	-0.076	-0.098
G6.1 Share of households in first wealth quintile (%)	6%	6%	6%
G6.2 Share of households in second wealth quintile (%)	13%	12%	15%
G6.3 Share of households in third wealth quintile (%)	30%	30%	31%
G6.4 Share of households in fourth wealth quintile (%)	40%	41%	39%
G6.5 Share of households in fifth wealth quintile (%)	11%	11%	10%
IWI International Wealth Index	27.5	27.8	26.9

7.5 Yield (indicator 1)

Yield figures are calculated by dividing the total maize production by the amount of land under maize cultivation. To enhance data accuracy, respondents could report land size and production in units of their preference. These were then converted to kilogrammes and hectares. Respondents reported an average maize production of 385 kg. Figure 9 shows the distribution of the quantity of maize harvested. Production is significantly higher among male-headed households than among female-headed households (see Table 19). There are observations on production for 84% of the sample.

[2] Source: https://dhsprogram.com/topics/wealth-index/Wealth-Index-Construction.cfm

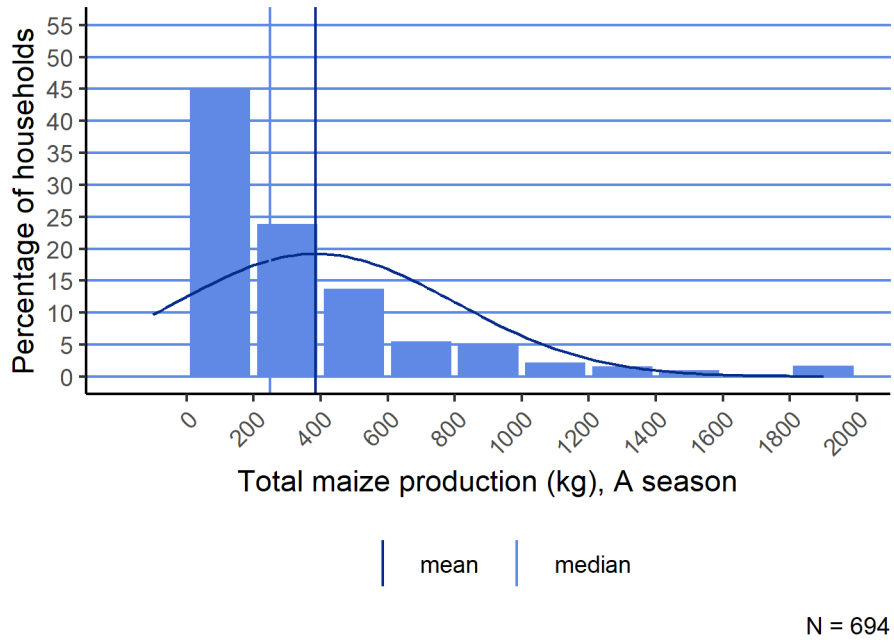


Figure 9: Total production of maize (kg), A season

Table 19: Total production of maize (kg), A season

Total maize production (kg), A season	All	Male-headed	Female-headed	sig
mean	384.8	414.8	311.8	***
median	250.0	300.0	200.0	
n	694	493	200	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
Total production includes dry maize and green maize. A 20% difference in mass was assumed in the conversion from green to dry maize.

Maize yields are, on average, 1,396 kg/ha (see Table 20 and Figure 10). Although male-headed households, on average, report slightly higher yields than female-headed households, this difference is not statistically significant.

Table 20: Average maize yield (kg/ha)

	All	Male-headed	Female-headed
1 Average yield (kg/ha)	1,396	1,439	1,295

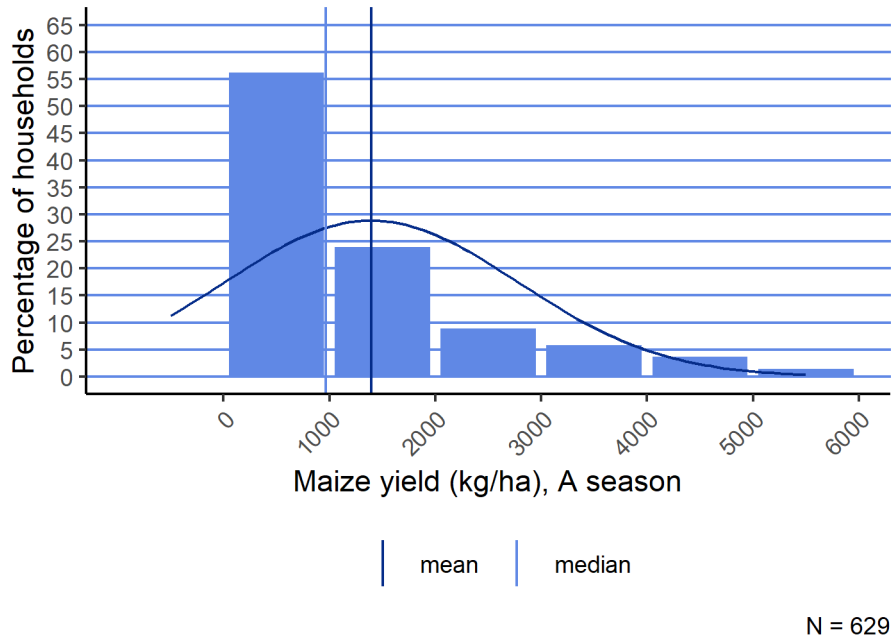


Figure 10: Distribution of average maize yield (kg/ha), A season

Most farm households (53%) perceive the harvest of the 2018 A season to be worse than usual (see Table 21); about 29% consider it to be a normal season. The remaining 34% considers the season to be worse than usual.

Table 21: Ranking of this season's maize harvest compared to other seasons (percentage of households per answer), A season

This season's harvest relative to other seasons	All	Male-headed	Female-headed	sig
Normal	29%	31%	25%	
Worse than usual	53%	51%	58%	
Better than usual	17%	18%	17%	
n	746	536	209	

*Note: significance from a Chi-squared statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

7.6 Rate of application of target improved productivity technologies or management practices (indicator 3, 5, 17)

Improved varieties, recycling and planting practices

Table 22 shows that 48% of farm households make use of improved maize varieties. These improved varieties are either hybrids or improved open-pollinated varieties (OPVs). In Rwanda, the varieties promoted by AGRA are PAN53, PAN4M-21, WH403, SC513, and SC403. In 2018, 22% of the farmers used these endorsed varieties.

Table 22: Main indicators for the use of improved varieties, recycling, and planting practices

	All	Male-headed	Female-headed
3.1 Adoption of improved varieties (%)	48%	51%	42%

3.2 Adoption of endorsed varieties (%)	22%	23%	21%
3.3 Number of seasons variety is recycled	4.1	4.0	4.2*
3.4 Adoption of endorsed planting practice (%)	50%	51%	50%
17 Average age of varieties used (years)	12.3	12.6	11.3
Ha under improved technologies or management practices (%)	73%	73%	73%

Table 23 lists the maize varieties that are being cultivated by AGRA beneficiaries. The endorsed PAN53 variety is most widely used among the farm households (22%); another 5% uses the endorsed variety PAN4M-21. Less than 1% uses the endorsed WH403, SC513, or SC403. Many farmers, however, either do not know which variety they grow (20%) or use an unspecified local variety (17%).

Table 23: Maize varieties used (percentage of households per variety), A season

Varieties	All	Male-headed	Female-headed	sig
PAN53 (promoted)	22%	22%	21%	
Don't know	20%	19%	21%	
Local variety, unspecified	17%	17%	18%	
Hybrid, unspecified	9%	10%	8%	
PAN4M-21 (promoted)	5%	5%	6%	
Yellow maize	4%	3%	8%	***
Pannar unspecified	4%	4%	2%	*
Other	4%	4%	3%	
Katumani	3%	3%	2%	
OPV, unspecified	2%	2%	1%	
ZM607	2%	2%	0%	*
White maize	1%	1%	1%	
SC or Seed Co, unspecified	1%	0%	1%	
WH505	1%	1%	0%	
Nyirakagoli flint	1%	1%	2%	
RAB Hybrid, unspecified	1%	2%	0%	
Red maize	1%	0%	2%	***
SC 53	1%	1%	0%	
Gakende	1%	1%	0%	
Katumane	1%	1%	0%	
Mbegu seed company, unspecified	1%	1%	1%	
n	756	543	212	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
Note: Multiple choices possible, therefore total does not need to add to 100%
Note: Categories smaller than 0.5% are combined in 'Other'

Table 24 groups the varieties that are cultivated in the hybrid, local variety, or OPV categories, which shows that 44% of farm households have, in fact, cultivated a hybrid variety and that 4% is using OPVs. The rest was either unclassified (30%) or local variety (22%).

Table 24: Type of main maize variety (percentage of households per variety type), A season

Type of main variety, A season	All	Male-headed	Female-headed	sig
Hybrid	44%	46%	39%	
Not able to classify	30%	27%	36%	*
Local variety	22%	22%	23%	
OPV	4%	5%	2%	
N	756	543	212	

*Note: significance from a Chi-squared statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

The aspect that farm households appreciate the most about the variety they are using is the yield (82%). The share of farmers who appreciate the yield among those that use hybrid varieties is significantly higher (88%) than among farmers who use local varieties (72%). Other reasons why farmers appreciate the variety they are using, include short maturing time (32%), taste (23%), and buyer appreciation (21%) (see Table 25).

Table 25: Appreciated traits of the main maize variety used (percentage of households per trait) by type of variety, A season

Maize variety traits	All	Local variety	OPV	Hybrid	sig
Yields	82%	72%	77%	88%	***
Tolerance to floods	3%	4%	3%	3%	
Tolerance to droughts	13%	11%	6%	16%	
Tolerance to pests	3%	3%	6%	3%	
Tolerance to diseases	8%	3%	3%	9%	**
Taste	23%	28%	13%	20%	*
Maturing time	32%	35%	29%	33%	
Conservation (storage time)	5%	13%	0%	5%	***
Processing	3%	4%	0%	4%	
Appreciated by buyers (market)	21%	14%	10%	23%	**
Price and/or premium from buyers	6%	2%	10%	6%	
Only variety available	7%	7%	6%	6%	
It's the only variety that I know	3%	7%	3%	2%	***
It was subsidised	8%	1%	6%	8%	***
Other	3%	2%	0%	2%	
n	756	167	31	333	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
Note: Multiple choices possible, therefore total does not need to add to 100%
Note: Categories smaller than 1% are combined in 'Other'

The average number of years since the release of the hybrid and OPV varieties used by farm households is 12.3 years (see Table 26).

Table 26: Age of main maize variety (years), A season

Age of main variety (years), A season	All	Male-headed	Female-headed	sig
mean	12.3	12.6	11.3	
median	5.0	5.0	5.0	

Age of main variety (years), A season	All	Male-headed	Female-headed	sig
n	262	194	68	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
n = number of Hybrid/OPV varieties of which the age could be classified. Age could not be classified for 84% of Hybrid and OPV varieties.

Table 27 shows the source of seeds used by farm households. About 12% of farm households report using seed that was recycled. On average, seed is recycled for 4.1 seasons. Most farmer households acquire seeds from either the farmer organisation (27%), a seed producer (20%), or from an agro-dealer (18%).

Table 27: Source of seed of main maize variety (percentage of households per source), by type of variety, A season

Source of the seed, A season	All	Local variety	OPV	Hybrid	sig
Recycled from the field of friend/family/neighbour… etc.	12%	22%	23%	0%	
Seed producer	20%	28%	6%	22%	
Seed company	4%	6%	3%	4%	
Agro-dealer	18%	13%	10%	21%	
Market stall (not specifically for inputs)	7%	20%	3%	2%	
Farmer Organisation	27%	8%	45%	30%	
NGO distribution	6%	0%	6%	7%	
Government Extension Services	6%	3%	3%	5%	
Other	0%	0%	1%	9%	
N	682	125	31	328	

*Note: significance from a Chi-squared statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
Note: Categories smaller than 1% are combined in 'Other'

Table 28 shows the difference in average yields by the type of variety used. It shows that farm households who cultivated a hybrid variety report significantly higher yields (1,641 kg/ha) than farm households that use a local variety (1,100 kg/ha) or an OPV (1,065 kg/ha).

Table 28: Average maize yield (kg/ha), by type of variety, A season

Maize yield (kg/ha), A season	All	Local variety	OPV	Hybrid	sig
Mean	1,395.5	1,099.6	1,064.8	1,641.1	***
Median	966.4	600.0	833.3	1200.0	
N	629	132	27	268	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

In Rwanda, farm households are advised by AGRA to plant seeds with fixed spacing of either 25 cm by 75 cm, 30 cm by 70 cm, or 40 cm by 70 cm. Table 29 shows that about 69% of farm households actually use fixed spacing when planting maize. The rest either broadcasts (12%) or scatters the seed (19%).

Table 29: Planting method of maize (percentage of housing per method), A season

Planting method, A season	All	Male-headed	Female-headed	sig
Broadcasting	12%	12%	10%	
Scattering	19%	17%	24%	*
Planting with fixed spacing	69%	71%	66%	

Planting method, A season	All	Male-headed	Female-headed	sig
N	697	503	193	

*Note: significance from a Chi-squared statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Table 30 shows the spacing used by the farm households that planted maize with fixed spacing: 89% used the exact spacing recommended by AGRA. Only 11% use a different spacing.

Table 30: Spacing between maize seeds (percentage of households per method), A season

Planting method, spacing, A season	All	Male-headed	Female-headed	sig
25-75 cm	3%	3%	3%	
30-70 cm	44%	41%	52%	**
70-40 cm	42%	46%	32%	
Other	11%	10%	13%	
N	541	395	145	

*Note: significance from a Chi-squared statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
Note: Categories smaller than 1% are combined in 'Other'

Fertiliser use

Table 31 presents the main indicators on fertiliser use. In Rwanda, AGRA promotes NPK, DAP and urea. About 68% of farm households uses at least one of these inorganic fertilisers. It is estimated that the share of land under inorganic fertiliser among AGRA beneficiaries is 73%. The average application rate of nitrogen is 19.0 kg per ha. The average application rates of phosphorus and potassium are 8.3 kg/ha and 0.7 kg/ha, respectively. There is no (statistically significant) difference in the use of fertiliser between male and female-headed households.

Table 31: Main indicators for the adoption and use of fertiliser

	All	Male-headed	Female-headed
3.5 Adoption of inorganic fertiliser (%)	68%	70%	62%
3.6 Adoption of endorsed fertiliser (%)	68%	70%	62%
3.7 Adoption of organic fertiliser (%)	72%	73%	68%
3.15 Area under inorganic fertiliser (%)	73%	73%	73%
5. Nitrogen application (kg/ha)	19.0	19.8	16.9
5.1 Phosphorus application (kg/ha)	8.3	8.8	6.9
5.2 Potassium application (kg/ha)	0.7	1.0	0.2
Average fertiliser use (Total N + P + K, kg/ha)	25.8	27.5	21.7

Table 32 reports how farm households were informed about the fertiliser to apply in 2018. Most of farm households report that they were informed about this fertiliser by either the farmer 0rganisation (33%) or by a village-based advisor (22%). Government extension (8%) and NGO extension (5%) were mentioned as sources of information as well. About 10% of

farm households applied this fertiliser since the current season (2018). Most have been doing so since 2017 (18%), 2016 (30%), or longer (38%).

Table 32: Source of information on fertiliser types for maize, A season

How the household learned which fertiliser to use, A season	All	Male-headed	Female-headed	sig
Myself	8%	7%	8%	
Observation in community / farmer to farmer	17%	15%	22%	
Village-based advisor (VBA)	23%	25%	20%	
Farmer organisation	33%	35%	28%	**
NGO extension	5%	4%	8%	
Public extension/ Government	8%	9%	6%	
Private extension	1%	1%	1%	
Other	5%	4%	7%	
n	614	443	170	

*Note: significance from a Chi-squared statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
Note: Categories smaller than 0.1% are combined in 'Other'
n = households that apply fertiliser

A large share of farm households (72%) use organic fertiliser, such as compost (65%), manure (37%), crop residues (9%), or granular organic fertiliser (4%) (see Table 33). Information on organic fertilisers mainly comes from observation in the community (33%) or from knowledge passed on in the household (31%). Most of farmer households (66%) have been using organic fertiliser since before 2016.

Table 33: Types of organic fertiliser used for maize (percentage of households per type)

Types of organic fertiliser	All	Male-headed	Female-headed	sig
Granular	4%	3%	6%	
Compost	65%	66%	63%	
Manure	37%	36%	40%	
Crop residues	9%	9%	7%	
n	543	398	144	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
Note: Multiple choices possible, therefore total does not need to add to 100%
n = households that apply fertiliser

There are large differences in yields between farm households that applied fertiliser and those that did not. In fact, farm households that applied fertiliser report average yields of 1,550 kg/ha, which is about twice as high as yields reported by farm households that did not apply fertiliser (Table 34).

Table 34: Average maize yield (kg/ha), by fertiliser use (yes/no), A season

Maize yield (kg/ha), A season	All	No	Yes	sig
mean	1,395.5	778.0	1,550.2	***
median	966.4	453.4	1,000.0	
n	629	126	503	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Pest management practices

Table 35 shows that the percentage of farm households that have adopted pesticides is 54%.

Table 35: Adoption of pest-management practices

	All	Male-headed	Female-headed
3.9 Adoption of pest-management practices (%)[3]	54%	57%	47%

Pesticide (insecticide) is applied by 49% of farm households (see Table 36). Qualitative reports suggest that pesticides are predominantly used to control the impact of army worms. Most farm households (93%) use the recommended 'Rocket' pesticide. Only a small share of farm households also applied herbicides (5%) or fungicides (1%).

Table 36: Percentage of households applying agro-chemical inputs, A season

	All	Male-headed	Female-headed	sig
Pesticide application, A season	49%	53%	42%	***
Herbicide application, A season	5%	4%	6%	
Fungicide application, A season	1%	1%	1%	
n	756	543	212	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Pesticides were applied on 43% of the total land area cultivated by AGRA beneficiaries (see Table 37). The share of land under herbicides and fungicides is much lower: 4% and 1%, respectively. Weeding, however, remains important: 90% of farm households have been weeding their maize plots, covering about 79% of the total land under maize cultivation.

Table 37: Percentage of total land area used for maize cultivation under pest-management practices, A season

	All	Male-headed	Female-headed	sig
Percentage of total land area under weeding, A season	79%	80%	77%	
Percentage of total land area under pesticides, A season	43%	46%	36%	***
Percentage of total land area under herbicides, A season	4%	3%	6%	
Percentage of total land area under fungicides, A season	1%	1%	1%	
n	819	584	234	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

[3] Here, pesticides refers to products for pest-management: herbicides, pesticides and fungicides.

Post-harvest practices

Table 38 shows the main indicators on the post-harvest practices endorsed by AGRA.

Table 38: Main Indicators for the adoption of improved post-harvest practices

	All	Male-headed	Female-headed
3.10 Adoption of endorsed post-harvest practices (%)	53%	52%	54%
3.11 Adoption of improved storage (%)	15%	15%	16%
3.12 Use of designated storage facilities (%)	2%	2%	2%
3.13 Adoption of tablets to preserve quality of recycled seed (%)	40%*	40%*	42%*

The adoption of endorsed post-harvest practices (indicator 3.10) is defined as the use of a sheet or tarpaulin during maize processing (drying and/or threshing). This is important to avoid contamination and keeping the grains clean. About 53% of the farmers use a sheet or tarpaulin for drying and/or threshing.

The adoption of improved storage (indicator 3.11) is defined as the use of improved storage equipment, such as Purdue Improved Crop Storage (PICS) bags or silos. Approximately 15% of farmers use such improved storage: 13% of them use PICS bags and 3% use silos. The farm households were either informed about the use of PICS bags by the farmer organisation (53%), village-based advisor (18%), NGO extension (12%), public extension (5%), or by persons in the community (12%). More than half of farm households that use PICS bags have been using them since 2016 or before (see Table 39). The rest started in 2017 (32%) or 2018 (16%).

Table 39: Year in which the household started using PICS bags, A season

Period the household has been using PICS bags, A season	All	Male-headed	Female-headed	sig
Started the season this season	16%	14%	22%	
Started in 2017	32%	33%	26%	
Started in 2016	36%	35%	39%	
Started before 2016	17%	18%	13%	
Don't know	0%	0%	0%	
n	95	72	23	

*Note: significance from a Chi-squared statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Only 2% of the households use a designated storage facility, such as storage at the farmer's organisation, a warehouse receipt system, or private storage. About 40% of farm households recycling seed use preservative tablets to preserve the quality of the seed stock (indicator 3.13).

About 9% of farmers test whether the maize has been contaminated with aflatoxins (see Table 40).

Table 40: Testing for aflatoxins in maize, A season

Test for aflatoxin, A season	All	Male-headed	Female-headed	sig
mean	9%	9%	9%	
n	754	543	210	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Farm households are recommended to sort their maize harvest according to size and to remove damaged grains to improve its marketability. About 68% of the farm households are removing damaged grains before selling and about 41% are sorting grains according to size.

7.7 Access to agricultural advisory support services (indicator 4)

Access to agricultural advisory extension support services is defined as the percentage of households that interacted with an agricultural extension officer during the last 12 months. Table 41 reports the information on this and other indicators related to extension. About 60% of AGRA beneficiaries were visited by an agricultural extension officer in the 12 months before the interview. In this period, the farm households were, on average, visited 5.3 times.

Table 41: Main indicators for access to agricultural advisory support services

	All	Male-headed	Female-headed
4 Access to agricultural advisory extension support services	60%	63%	54%
4.1 Avg. no. of visits per year by agri. advisory extension support services	5.3	5.5	4.5
4.2 Received small seed pack (%) (additional indicator 4)	42%	43%	38%
4.3 Used small seed pack (%) (additional indicator 4)	99%	99%	99%
4.4 Distance to nearest agro-dealer (minutes)	40.3	40.5	39.9

Table 42 shows that extension officers were most often affiliated with the government (60%) or with the cooperative (47%). About 31% of farm households were visited by a village-based advisor. It is striking that female-headed households are visited significantly less by government extension officers, but significantly more by village-based advisors.

Table 42: Affiliation of extension service provider (percentage of households per provider)

Type	All	Male-headed	Female-headed	sig
Government	60%	63%	52%	**
Company	5%	5%	2%	
NGO	2%	2%	3%	
Farmer Promoter/VBA	31%	28%	38%	**
Cooperative	47%	49%	43%	
Other	0%	0%	1%	
n	494	368	126	

Type	All	Male-headed	Female-headed	sig

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
Note: Multiple choices possible, therefore total does not need to add to 100%
Note: Categories smaller than 1% are combined in 'Other'

Table 41 above shows that 42% of farm households received a small seed pack. Virtually everyone that received a seed pack has tested the seeds. About 78% of farm households that tested the seeds appreciated them positively. Table 43 shows the main variety traits that were appreciated were yields (96%), taste (48%), maturing time (44%), and appreciation by buyers (41%).

Table 43: Variety traits that are positively appreciated of the promotional maize seed pack (percentage of households per trait)

Maize variety traits	All	Male-headed	Female-headed	sig
Yields	96%	96%	94%	
Tolerance to floods	3%	4%	3%	
Tolerance to droughts	8%	9%	3%	*
Tolerance to pests	4%	4%	3%	
Tolerance to diseases	20%	16%	30%	**
Taste	48%	46%	54%	
Maturing time	44%	48%	33%	**
Conservation (storage time)	14%	15%	10%	
Processing	5%	5%	3%	
Appreciated by buyers (market)	41%	43%	36%	
Colour	1%	1%	3%	
Price and/or premium from buyers	12%	11%	13%	
It was subsidised	22%	17%	35%	***
Other	2%	1%	4%	**
n	266	197	69	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
Note: Multiple choices possible, therefore total does not need to add to 100%
Note: Categories smaller than 1% are combined in 'Other'
n = households that appreciated the seeds from the promotional seed pack

The distance to the nearest agro-dealer is another aspect of the farm household's access to agricultural extension services. Average travel time to the nearest agro-dealer is 40 minutes (Table 44). Farm households most commonly go by foot (77%) or by bicycle (17%).

Table 44: Average travel time to agro-dealer (minutes)

Distance to agro-dealer in minutes	All	Male-headed	Female-headed	sig
mean	40.3	40.5	39.9	
median	30.0	30.0	30.0	
n	666	472	193	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
n = number of people who answered in time-unit

7.8 Access to formal financial services (indicator 13)

Table 45 shows that 56% of AGRA beneficiaries have access to formal financial services, which is defined as having either a bank account, a formal agricultural loan, or agricultural insurance. This indicator thus only includes access to formal financial services, provided by formal financial institutions, and excludes access to informal financial services, such as from village money lenders, relatives, or saving groups.

Table 45: Main indicators for access to formal financial services

	All	Male-headed	Female-headed
13 Access to formal financial services (%)	56%	61%	44%
13.1 Bank account (%)	56%	61%	45%

13.2 Agricultural loan (%)	7%	8%	7%
13.3 Agricultural insurance (%)	0%	0%	0%

While a bank account is quite common – 56% of the farm households have one – a much smaller share of farm households (7%) took a formal agricultural loan. Virtually no farm households have agricultural insurance.

The percentage of farm households that took a loan from either a formal or informal lender is 10%. Table 46 gives an overview of the different loan providers. It shows that loans through a savings and credit cooperative are most common: 51% of farm households took an agricultural loan from a SACCO. Other important loan providers are formal banks (23%) or informal village money lenders (14%).

Table 46: Types of loan providers (percentage of households per provider)

Loan providers	All	Male-headed	Female-headed	sig
Family or friends	1%	2%	0%	
Village money lender	14%	8%	27%	**
VSLA/ISLC/VICOBA (Informal savings and loans group)	7%	8%	5%	
Savings and Credit Cooperative (SACCO) / Credit Union	51%	51%	55%	
Microfinance institution (MFI)	2%	3%	0%	
Bank	23%	25%	18%	
Cooperative	1%	2%	0%	
Don't know	1%	2%	0%	
Other	4%	5%	0%	
n	84	61	22	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
Note: Multiple choices possible, therefore total does not need to add to 100%
Note: Categories smaller than 1% are combined in 'Other'
Excluding households that did not take loans

7.9 Post-harvest losses (indicator 6)

Post-harvest losses are measured by the maize that was lost after harvesting as a share of total production. Table 47 shows that no maize was lost post-harvest. The majority of the sample (70%) did not report any post-harvest losses. Those who did, reported losses that were relatively low: 15% reported losses of less than 1%. The remaining 15% reported losses between 1% and 10%. Losses of the remainder of the sample were low. It should be kept in mind, however, that post-harvest losses are typically difficult to estimate for farmers, as losses are typically not measured.

Table 47: Main indicator for post-harvest losses

	All	Male-headed	Female-headed
6. Percent of post-harvest losses (%)	0%	0%	0%

7.10 Access to market information (indicator 37)

The percentage of maize farmers that has access to formal channels of market information (SMS, radio, television, internet and the farmer's organisation) is 21% (see Table 48). In all these cases, farm households receive price information from the farmer organisation.

Table 48: Main indicator for access to market information

	All	Male-headed	Female-headed
37. Access to market information through formal channel (%)	21%	23%	18%

Farmers, however, also use informal channels to acquire market information, such as buyers (34%), other farmers (24%), or the market (29%) (see Table 49).

Table 49: Sources of market information used by farmers (percentage of households per source)

Source of market information	All	Male-headed	Female-headed	sig
Buyer	34%	36%	30%	
Farmer to farmer	24%	24%	24%	
Market	29%	28%	30%	
Farmer organisation	33%	35%	28%	
Other	1%	1%	1%	
n	519	373	146	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
Note: Multiple choices possible, therefore total does not need to add to 100%
Note: Categories smaller than 1% are combined in 'Other'
n = households that sold maize

7.11 Sales channels (indicator 33)

Two-thirds of the farm household sold at least part of their harvest. Table 50 shows the main indicators for farmers' sales channels, which includes information on sale through structured trading facilities/arrangements, as well as information on farmers' clients.

Table 50: Main indicators on farmers' sales channels

	All	Male-headed	Female-headed
33 Sale through structured trading facilities/arrangements (%)	20%	20%	18%
33.1 Selling to traders/middlemen (%)	21%	18%	28%
33.2 Selling to consumers (%)	3%	2%	5%
33.3 Selling to friends/neighbours (%)	1%	1%	0%
33.4 Selling to aggregation centre (%)	1%	1%	1%
33.5 Selling to farmer organisation (%)	31%	35%	23%
33.6 Selling to wholesalers (%)	25%	24%	26%
33.7 Selling to processors (%)	0%	0%	0%

33.8 Selling to retailers (%)	19%	18%	21%
33.9 Selling to company (undefined) (%)	7%	8%	7%
33.10 Selling to institutional buyers (%)	1%	1%	1%

Farm households are considered selling through a structured trading facility when they sell at least part of their harvest through a formal contract: 20% of farm households do this. Table 51 suggests that farm households that have a formal contract with a buyer earn, on average, a higher price (RF206 per kg compared to RF169 per kg). This difference is statistically significant.

Table 51: Price received for maize with/without contract

Common price received for maize (RF/kg), A season	All	No contract	Contract	sig
mean	175.4	168.7	205.9	***
median	185.0	180.0	215.0	
n	457	377	75	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
n = households that sold maize

Table 50 shows that farm households' clients are mainly farmer organisations (33%), wholesalers (25%), traders or middlemen (21%), and retailers (19%).

7.12 Value of incremental sales as a result of AGRA (indicator 10)

The value of incremental sales as a result of AGRA cannot be determined yet as only one round of data collection has been completed. Therefore, total revenues from maize sales are reported as a baseline value. Revenues were calculated by multiplying the quantity sold (in kg) by the common price received per kg.

Table 52: Value of incremental sales as a result of AGRA

	All	Male-headed	Female-headed
10 Value of incremental sales as a result of AGRA (crop revenue) (US$)	38.4	42.6	27.9

On average, the revenue from selling maize is US$38.4. Total revenue from maize sales is significantly higher for male-headed households than for female-headed households. This difference is not due to a difference in price for which the maize is sold, which is on average US$0.20 per kg. Neither this difference is explained by the share of harvest being sold. Table 53 shows that both male and female-headed households sell around 47% of their harvest. Instead male households, on average, produce larger quantities of maize; male-headed households produced 415 kg in the A season, while female-headed households produced about 312 kg.

[4] This value is converted from RWF to US$ by using the 2018 average exchange rate of US$1 = RWF 901

Table 53: Allocation of maize harvest to different household uses (percentage of total harvest)

	All	Male-headed	Female-headed	sig
Maize used for consumption (% of harvest), A season	47%	46%	50%	
Maize kept for seed (% of harvest), A season	1%	1%	1%	
Maize given away (% of harvest), A season	3%	3%	2%	
Maize used as payment for inputs (% of harvest), A season	1%	1%	1%	
Maize bartered or exchanged for goods (% of harvest), A season	0%	0%	0%	
Maize sold (% of harvest), A season	46%	46%	45%	
Post-harvest losses of maize (% of total harvest), A season	0%	0%	0%	
n	691	491	199	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

In addition to the value of the quantity that was sold, KIT also calculated the value of the *total* production, which was done by multiplying the total production by the common price received by the household. The average value of total production (the share that was sold and the share that was not sold) was US$99 in 2018 (or RF90,562) (see Table 54 and Table 55).

Table 54: Crop value (RF) of maize produced, A season

	All	Male-headed	Female-headed
Average value of production in Francs (n = households that sold maize)	90,562	97,617	71,560
Note: n = households that sold maize			

Table 55: Crop value (US$) of maize produced

	All	Male-headed	Female-headed
Average value of production in US$ (n = households that sold maize)	99	107	78
Note: n = households that sold maize			

8 Household-level results: beans

8.1 Sample description

Survey area

Within the Eastern Province, interviews were conducted in six districts: Gatsibo (22%), Kayonza (21%), Kirehe (22%), Ngoma (6%), Nyagatare (16%), and Rwamagana (14%). Within these districts, 701 households were interviewed on beans production practices. Figure 11 shows the geographical spread of surveyed households.

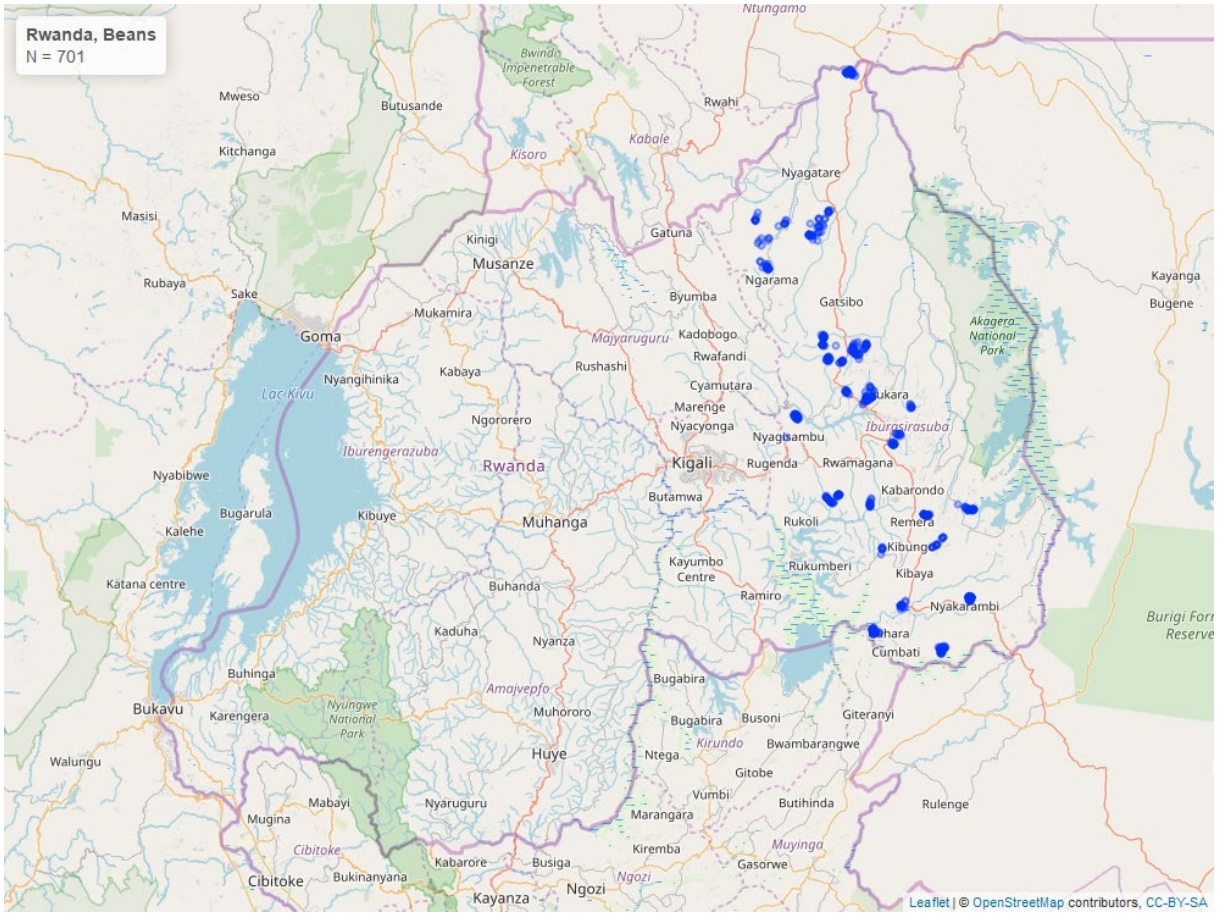


Figure 11: Location of farm household interviews, bean sample

Farm household characteristics

Respondents are all AGRA beneficiaries; 58% of respondents are male, 41% are female. In 84% of cases, the participant in AGRA activities is also the head of the household. Respondents are, on average, 47 years old (see Figure 12).

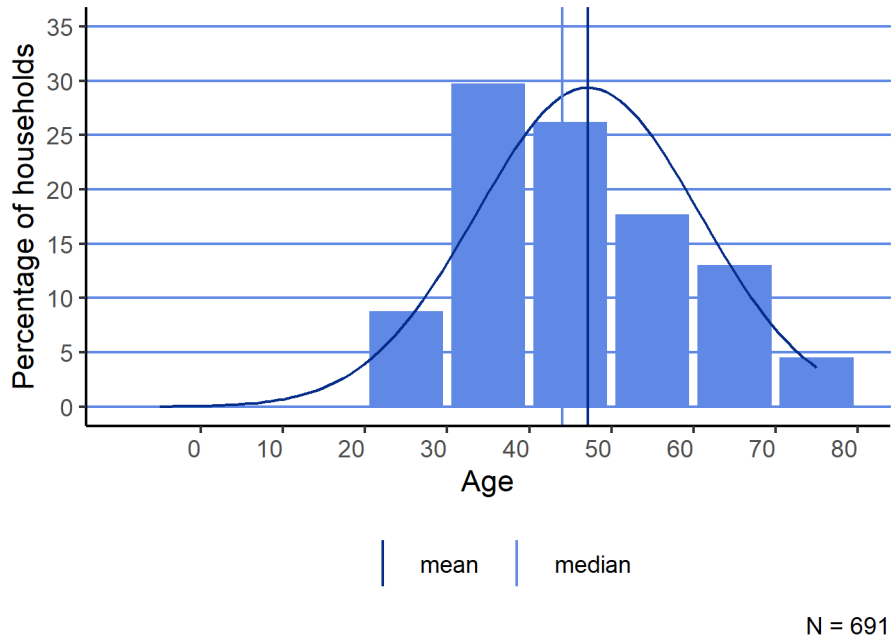


Figure 12: Distribution of respondent age

About 70% of farm households are male-headed. Households, on average, consist of 5.3 members (2.7 adults and 2.6 children), with female-headed households being significantly smaller (see Table 56).

Table 56: Household composition

Household members	All	Male-headed	Female-headed	sig
Number of children in the household	2.6	2.8	2.2	**
Number of adults in the household	2.7	2.7	2.5	**
n	701	494	207	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

In Rwanda, there are two farming seasons for beans: A season (September to February) and B season (March to June). Table 57 shows that beans, unlike maize, are mostly grown in the B season. In fact, 83% of farmers grew beans in the B season, while 25% grew beans in the A season. In the remainder of this chapter only the indicators for the main season (B) are reported, unless indicators for the A season are considered to be relevant as well.

Table 57: Percentage of households producing beans, per season

	All	Male-headed	Female-headed	sig
A season	25%	24%	29%	
B season	83%	84%	80%	
n	701	494	207	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*
Note: Multiple choices possible, therefore total does not need to add to 100%

Almost all farm households (99%) own agricultural land. The average amount of land owned is 0.4 ha. Female-headed households, on average, own less land (0.34 ha) than male-headed households (0.41 ha).

About the same amount of land is also being cultivated. On average, 83% of this land (0.32 ha) is used to cultivate beans in the B season (see Figure 13). About 34% of households intercrop beans with other crops. Most commonly, beans are intercropped with maize (69%) and cassava (26%).

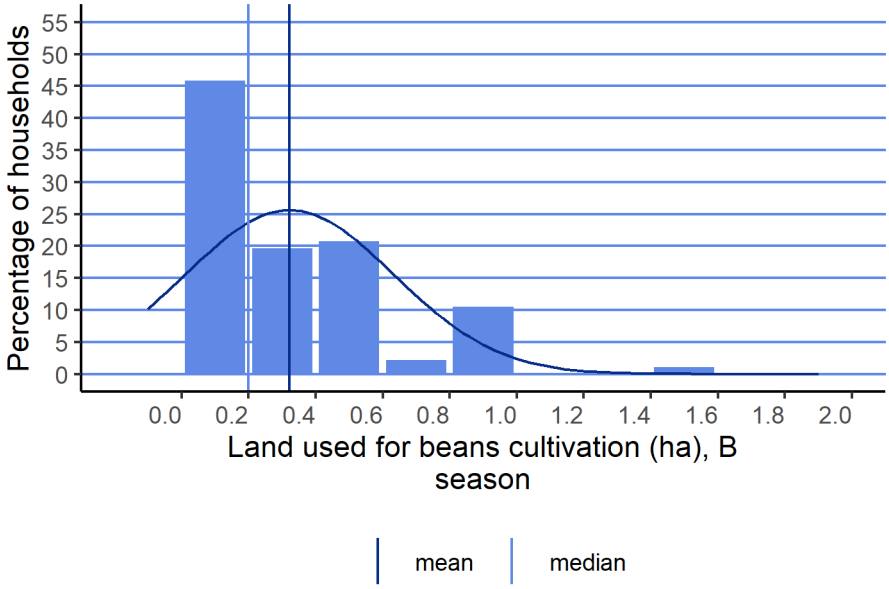


Figure 13: Land allocated to beans (ha), B season

8.2 Main indicators

Table 58 gives an overview of the primary indicators collected. The enumeration of the indicators corresponds to the one used in the Terms of Reference. See Annex A: data dictionary main indicators for definitions for each indicator. The indicators and the underlying behavioural patterns are discussed in further details in the following sections.

Table 58: Overview of main indicators for bean-farming households, B season

	All	Male-headed	Female-headed
G2: Average number of months of adequate household food provision	**9.3**	**9.3**	**9.3**
G6: Wealth assets index score	**-0.110**	**-0.103**	**-0.126**
G6.1 Share of households in first wealth quintile (%)	9%	8%	11%
G6.2 Share of households in second wealth quintile (%)	16%	15%	17%
G6.3 Share of households in third wealth quintile (%)	27%	27%	26%
G6.4 Share of households in fourth wealth quintile (%)	37%	38%	36%
G6.5 Share of households in fifth wealth quintile (%)	12%	12%	11%
IWI International Wealth Index	27.5	27.8	26.5
1. Average yield (kg/ha)	**717.5**	**744.0**	**650.8**

3. Rate of application of target improved technologies or management practices	**16%**	**16%**	**16%**
3.1 Adoption of improved varieties (%)	9%	9%	8%
3.2 Adoption of endorsed varieties (%)	19%	16%	26%
3.3 Number of seasons variety is recycled	4.1	4.2	3.8
3.4 Adoption of endorsed planting practice (%)	13%	11%	16%
3.5 Adoption of inorganic fertiliser (%)	8%	8%	8%
3.6 Adoption of endorsed fertiliser (%)	6%	6%	5%
3.7 Adoption of organic fertiliser (%)	23%	22%	24%
3.8 Adoption of inoculants (%)	0%	0%	1%
3.9 Adoption of pest-management practices (%)	2%	2%	2%
3.10 Adoption of endorsed post-harvest practices (%)	81%	86%	69%
3.11 Adoption of improved storage (%)	11%	11%	12%
3.12 Use of designated storage facilities (%)	1%	1%	1%
3.13 Adoption of tablets to preserve quality of recycled seed (%)	42%	46%	26%*
Ha under improved technologies or management practices (%)	**11%**	**11%**	**11%**
3.14 Area under improved varieties (%)	11%	11%	11%
3.15 Area under inorganic fertiliser (%)	8%	8%	8%
3.16 Area under pesticides (%)	1%	1%	1%
4. Access to agricultural advisory extension support services	**54%**	**59%**	**43%**
4.1 Avg. no. of visits per year by agri. advisory extension support services	5.0	4.3	7.6
4.2 Received small seed pack (%) (additional indicator 4)	NA	NA	NA
4.3 Used small seed pack (%) (additional indicator 4)	NA	NA	NA
4.4 Distance to nearest agro-dealer (minutes)	45.4	47.0	41.6
5. Nitrogen application (kg/ha)	**2.3**	**2.2**	**2.4**
5.1 Phosphorus application (kg/ha)	1.1	1.1	1.1
5.2 Potassium application (kg/ha)	0.2	0.0	0.8
Average fertiliser use (Total N + P + K, kg/ha)	**3.0**	**2.8**	**3.4**
6. Percent of post-harvest losses (%)	**0%**	**0%**	**0%**
10. Value of incremental sales as a result of AGRA (crop revenue) (US$)	**29.8**	**31.4**	**25.8**
13. Access to formal financial services (%)	**55%**	**60%**	**44%**
13.1 Bank account (%)	55%	59%	44%
13.2 Agricultural loan (%)	7%	7%	5%

13.3 Agricultural insurance (%)	0%	0%	0%
17. Average age of varieties used (years)	**21.8***	**22.6***	**16.0***
33. Sale through structured trading facilities/arrangements (%)	**11%**	**12%**	**5%**
33.1 Selling to traders/middlemen (%)	21%	19%	28%
33.2 Selling to consumers (%)	5%	4%	7%
33.3 Selling to friends/neighbours (%)	3%	2%	4%
33.4 Selling to aggregation centre (%)	1%	1%	0%
33.5 Selling to farmer organisation (%)	20%	23%	10%
33.6 Selling to wholesalers (%)	22%	24%	18%
33.7 Selling to processors (%)	0%	0%	0%
33.8 Selling to retailers (%)	33%	31%	39%
33.9 Selling to company (undefined) (%)	3%	3%	3%
33.10 Selling to institutional buyers (%)	1%	0%	1%
37. Access to market information through formal channel (%)	**10%**	**11%**	**8%**

The composition of variables can be found in the data dictionary in Annex 1; N might vary across indicators
** indicates that the average has been calculated with less than 50 observations*

8.3 Number of Months of Adequate Household Food Provision (indicator G2)

Table 59 reports the average number of months of adequate household food provision (MAHFP), which shows that farm households have, on average, enough food to meet their needs during 9.3 months of the year. There is no difference in food security between male and female-headed households.

Table 59: Average number of months of adequate household food provision (G2)

	All	Male-headed	Female-headed
G2: Average number of months of adequate household food provision	9.3	9.3	9.3

Figure 14 shows the MAHFP distribution. It shows that only 27% of farm households report having had enough food to meet their family's needs during the past year. About 10% of farm households did not have enough food during 6 months or more; about 2% reported being chronically food insecure (reported having adequate food provision in none of the months).

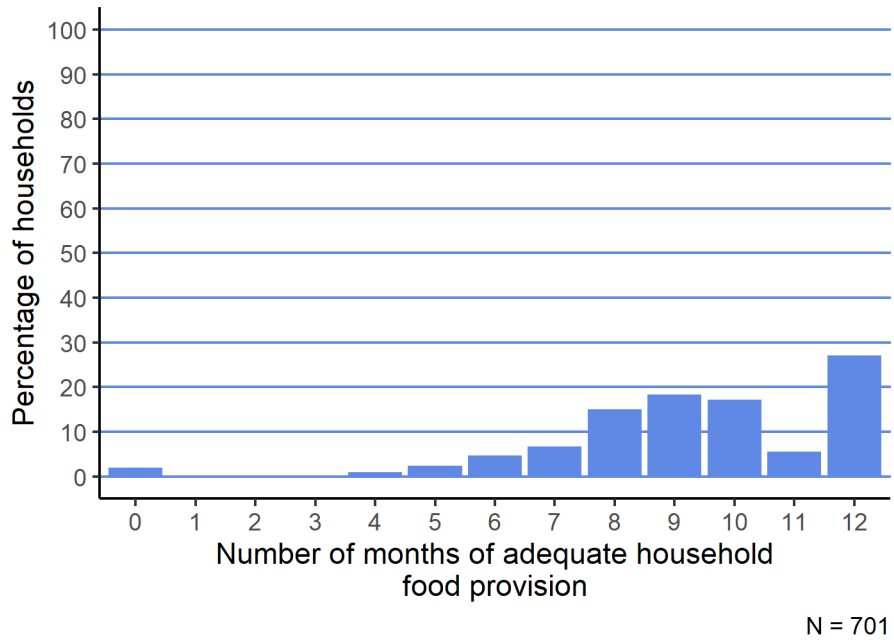


Figure 14: Distribution of number of months of adequate household food provision (G2)

Figure 15 shows the distribution of months with adequate household food provision over the year. The figure shows that AGRA beneficiaries have experienced two lean periods: between September and December 2018 and between April and May 2019, which precedes the harvesting period of A season and B season, respectively.

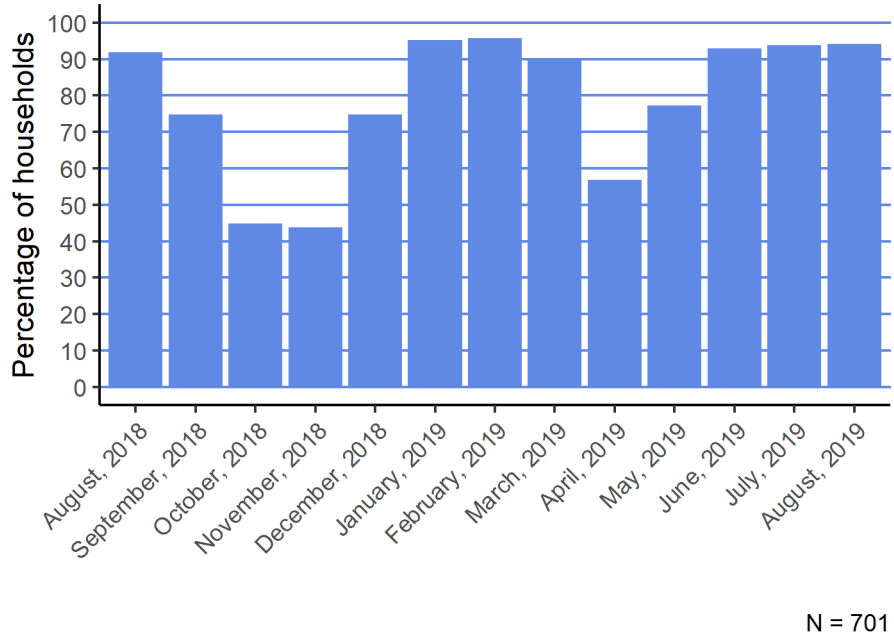


Figure 15: Distribution of months with adequate household food provision

8.4 Wealth asset index score (indicator G6)

Table 60 shows the quintile distribution of the Demographic and Health Surveys (DHS) wealth index. The DHS household wealth index is a composite measure of a household's cumulative living standard, which is composed of data on asset ownership, materials used

for housing construction, and types of water access and sanitation facilities.[5] Wealth index scores were compared with the national Rwandan DHS distribution for rural areas to determine the household's relative wealth compared to the country average. As can be seen from Table 60, most households are in the 3rd and 4rd quintiles (27% and 37%, respectively), while 25% is in either the 1st (poorest) or 2nd poorest quintile of the country. In other words, according to this indicator, AGRA beneficiaries are slightly better off, on average, compared to the rest of the rural population in Rwanda. Female and male-headed households are about equally wealthy.

Table 60: DHS wealth index

	All	Male-headed	Female-headed
G6: Wealth assets index score	-0.110	-0.103	-0.126
G6.1 Share of households in first wealth quintile (%)	9%	8%	11%
G6.2 Share of households in second wealth quintile (%)	16%	15%	17%
G6.3 Share of households in third wealth quintile (%)	27%	27%	26%
G6.4 Share of households in fourth wealth quintile (%)	37%	38%	36%
G6.5 Share of households in fifth wealth quintile (%)	12%	12%	11%
IWI International Wealth Index	27.5	27.8	26.5

8.5 Yield (indicator 1)

Yield figures are calculated by dividing the total beans production by the amount of land under bean cultivation. To enhance data accuracy, respondents could report land size and production in units of their preference. These were then converted to kilogrammes and hectares. Respondents reported average beans production of 169 kg (B season). Figure 16 shows the distribution of the quantity of beans harvested.

[5] Source: https://dhsprogram.com/topics/wealth-index/Wealth-Index-Construction.cfm

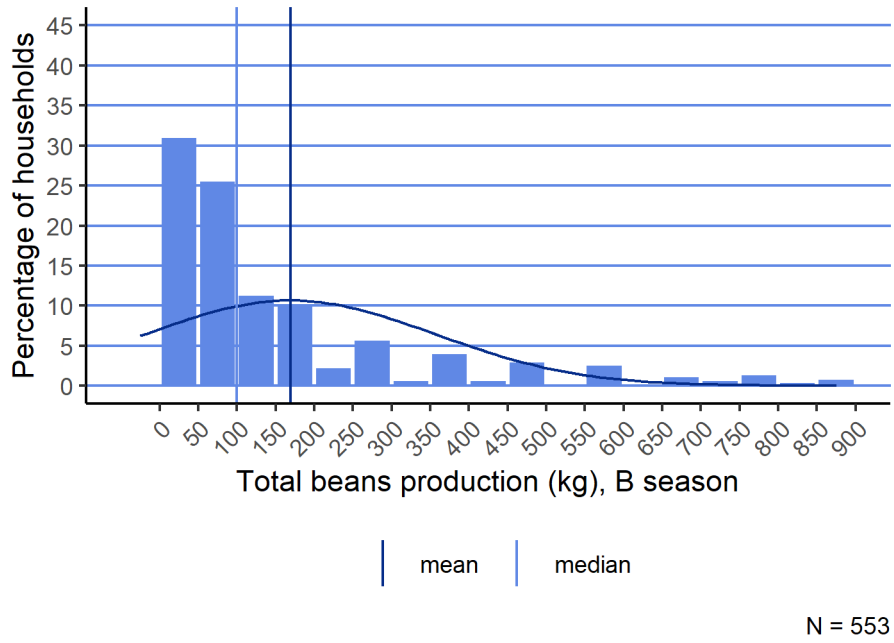


Figure 16: Total production of beans (kg), B season

Production is significantly higher among male-headed households than among female-headed households (see Table 61). Male-headed households, on average, produced 181 kg, while female-headed households, on average, produced 139 kg.

Table 61: Total production of beans (kg), B season

Total beans production (kg), B season	All	Male-headed	Female-headed	sig
mean	169.1	181.1	138.6	**
median	100.0	100.0	90.0	
n	553	396	157	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Yields are, on average, 718 kg/ha (see Table 62 and Figure 17). Although male-headed households, on average, report slightly higher yields than female-headed households, this difference is not statistically significant.

Table 62: Average beans yield (kg/ha)

	All	Male-headed	Female-headed
1 Average yield (kg/ha)	**717.5**	**744.0**	**650.8**

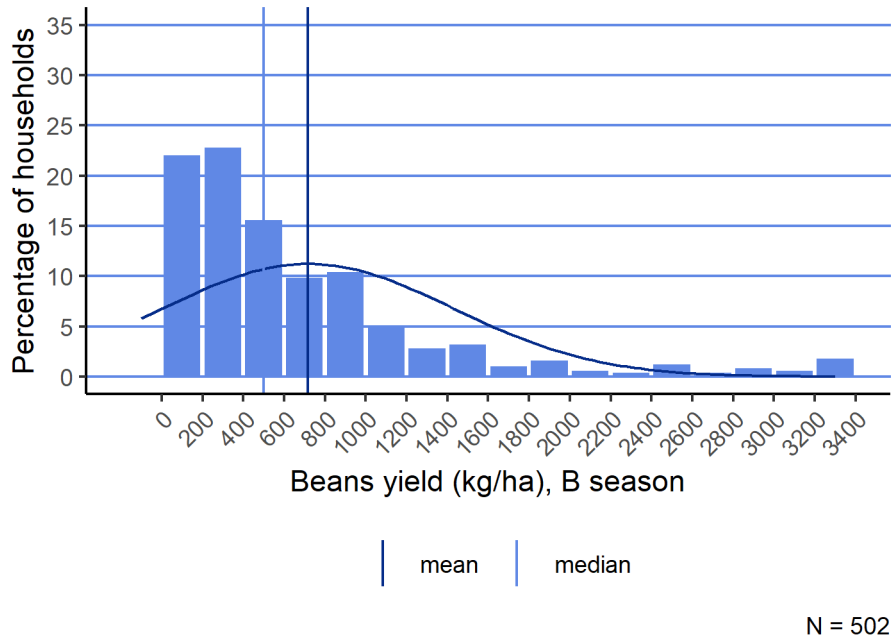


Figure 17: Distribution of average yield of beans (kg/ha), B season

Most farm households (61%) perceive the harvest of the 2018 B season to be worse than usual; about 25% consider it to be a normal season. The remaining 14% considers the season to be worse than usual.

8.6 Rate of application of target improved productivity technologies or management practices (indicator 3, 5, 17)

Improved varieties, recycling and planting practices

Table 63 shows that 19% of farm households make use of improved beans varieties (OPVs). In Rwanda, the varieties promoted by AGRA are RUV 2245 (improved variety) and Shyushya (local variety). In the 2018 B season, 18% of farmers used Shyushya. Almost no farm households used RUV 2245.

Table 63: Main indicators for the use of improved varieties, recycling, and planting practices.

	All	Male-headed	Female-headed
3.1 Adoption of improved varieties (%)	9%	9%	8%
3.2 Adoption of endorsed varieties (%)	19%	16%	26%
3.3 Number of seasons variety is recycled	4.1	4.2	3.8
3.4 Adoption of endorsed planting practice (%)	13%	11%	16%
17 Average age of varieties used (years)	21.8*	22.6*	16.0*
Ha under improved technologies or management practices (%)	11%	11%	11%

Table 64 lists the bean varieties that are being cultivated by AGRA beneficiaries. A variety called 'Akararakagenda', a local variety, is most widely used among farm households (31%). The endorsed Shyusha variety is the second most used variety (18%). The share of female-headed households that have adopted the endorsed variety (25%) is significantly larger than the share among male-headed households (15%). The remaining farm households use a wide diversity of (unspecified) local varieties and, to a lesser extent, OPVs.

Table 64: Varieties used (percentage of households per variety), B season

Varieties	All	Male-headed	Female-headed	sig
Local variety, unspecified	16%	16%	16%	
Colta	3%	3%	1%	
Mutiki	1%	1%	1%	
RWR 2245	1%	1%	1%	
Shyushya (promoted)	18%	15%	25%	***
Urunyumba	2%	2%	2%	
Akararakagenda	31%	33%	25%	*
Rwandarushya	1%	1%	1%	
Mushigiriro	5%	6%	3%	
Umugeri	1%	1%	2%	
Barukinze	1%	0%	1%	
Nyiramacumu	1%	1%	1%	
Inyumba	1%	2%	0%	*
Sambumbi	1%	1%	1%	
Singayisambu	1%	1%	1%	
Gurigare	1%	1%	1%	
Don't know	5%	4%	7%	
Other	12%	13%	11%	
n	582	417	165	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Note: Multiple choices possible, therefore total does not need to add to 100%

Note: Categories smaller than 0.5% are combined in 'Other'

The aspect that farm households appreciate the most about the variety they are using is the yield (81%). The share of farmers who appreciate the yield among those that use improved OPVs is higher (88%), though this difference is not significant. Other reasons why farmers appreciate the variety they are using, include short maturing time (52%), taste (35%), and buyer appreciation (22%) (see Table 65). Maturing time was appreciated significantly by a larger share of farm households for local varieties, while buyer appreciation was appreciated significantly by a large share for OPVs.

Table 65: Appreciated traits of the main bean variety used (percentage of households per trait) by type of variety, B season

Bean variety traits	All	Local variety	OPV	sig
Yields	81%	74%	88%	
Maturing time	52%	67%	12%	***
Taste	35%	14%	0%	

Bean variety traits	All	Local variety	OPV	sig
Appreciated by buyers (market)	22%	5%	38%	***
Tolerance to droughts	15%	12%	12%	
Tolerance to diseases	13%	5%	12%	
Conservation (storage time)	8%	0%	0%	NA
Tolerance to pests	7%	5%	0%	
Price and/or premium from buyers	5%	5%	12%	
Tolerance to floods	3%	2%	0%	
It was subsidised	3%	0%	12%	**
Processing	2%	0%	0%	NA
Colour	2%	2%	0%	
Only variety available	2%	0%	0%	NA
It was free	2%	0%	0%	NA
Other	1%	2%	0%	
n	582	43	8	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Note: Multiple choices possible, therefore total does not need to add to 100%

Note: Categories smaller than 1% are combined in 'Other'

The average number of years since the release of the varieties used by farm households is 21.8 years (see Table 66). Seeds are, on average, recycled for four years before they are renewed.

Table 66: Age of main bean variety (years), B season

Age of main variety (years), B season	All	Male-headed	Female-headed	sig
mean	21.8	22.6	16.0	
median	17.0	17.0	16.0	
n	8	7	1	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

n = number of OPV varieties of which the age could be classified. Age could not be classified for % of OPV varieties.

Table 67 shows the source of seeds used by the farm households. About 19% of farm households report using seed that was recycled. When not recycling seeds, most farm households acquire seeds from either market stalls (28%), seed producers (25%), or the farmer organisation (13%).

Table 67: Source of seed of main beans variety (percentage of households per source), by type of variety, B season

Original source of the seed, B season	All	Local variety	OPV	sig
Recycled from the field of friend/family/neighbour… etc.	19%	19%	0%	
Seed producer	25%	0%	20%	
Seed company	4%	0%	0%	
Agro-dealer	6%	6%	20%	
Market stall (not specifically for inputs)	28%	62%	20%	
Farmer organisation	13%	0%	0%	
NGO distribution	2%	0%	20%	
Government extension services	3%	6%	20%	
Other	0%	7%	0%	
n	326	16	5	

Original source of the seed, B season	All	Local variety	OPV	sig

*Note: significance from a Chi-squared statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Note: Categories smaller than 1% are combined in 'Other'

Table 68 shows the difference in average yields by the type of variety used. It shows that farm households who cultivated an OPV report significantly higher yields (1,073 kg/ha) than farm households that use a local variety (714 kg/ha). Households that use the endorsed variety report an average yield that is near to the average yield of local varieties in general: 729 kg/ha.

Table 68: Average yield of beans (kg/ha), by type of variety, B season

Beans yield (kg/ha), B season	All	Local variety	OPV	sig
Mean	717.5	714.1	1072.8	***
Median	500.0	480.0	714.3	
N	502	305	41	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

In Rwanda, farm households are advised by AGRA to plant seeds with fixed spacing of either 15 cm by 30 cm, 50 cm by 25 cm, or 40 cm by 10 cm. Table 69 shows that only 16% of farm households actually uses fixed spacing when planting beans. Most of the households either scatter the seeds without measuring distances (54%) or broadcasts the seeds (30%).

Table 69: Planting method for beans, B season

Planting method, B season	All	Male-headed	Female-headed	sig
Broadcasting	30%	32%	26%	
Scattering	54%	52%	57%	
Planting with fixed spacing	16%	16%	16%	
n	577	413	164	

*Note: significance from a Chi-squared statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Table 70 shows the spacing used by farm households that planted beans with fixed spacing. The large majority of farm households indicated having used a spacing of 40cm -10cm; a practice promoted by AGRA and its partners.

Table 70: Spacing between bean seeds, B season

Planting method, spacing, B season	All	Male headed	Female headed	sig
40-10 cm	98%	97%	100%	
15-30 cm	2%	3%	0%	
n	92	65	27	

*Note: significance from a Chi-squared statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Fertiliser and inoculants use

Table 31 presents the main indicators on fertiliser and inoculant use. In Rwanda, AGRA promotes DAP for beans cultivation. About 6% of farm households use DAP. About 8% use inorganic fertiliser in general. Almost none of the households use inoculants for the

cultivation of beans. The share of land under inorganic fertiliser is 8%. The average application rate of nitrogen, phosphorus, and potassium is quite low at 2.3, 1.1, and 0.2 kg per ha, respectively.

Table 71: Main indicators for the adoption and use of fertiliser

	All	Male-headed	Female-headed
3.5 Adoption of inorganic fertiliser (%)	8%	8%	8%
3.6 Adoption of endorsed fertiliser (%)	6%	6%	5%
3.7 Adoption of organic fertiliser (%)	23%	22%	24%
3.8 Adoption of inoculants (%)	0%	0%	1%
3.15 Area under inorganic fertiliser (%)	8%	8%	8%
5. Nitrogen application (kg/ha)	2.3	2.2	2.4
5.1 Phosphorus application (kg/ha)	1.1	1.1	1.1
5.2 Potassium application (kg/ha)	0.2	0.0	0.8
Average fertiliser use (Total N + P + K, kg/ha)	3.0	2.8	3.4

Table 72 reports how the farm households were informed about fertiliser in 2018. Many farm households (38%) indicated that they did not receive the information from anybody and have taught themselves. The remainder was informed by a village-based advisor (15%) or farmer organisation (8%). About 23% indicated being informed by other (unspecified) sources. About 10% of farm households applied this fertiliser since the current season (2018) most have been doing so since 2017 (18%), 2016 (30%), or longer (38%).

Table 72: Source of information on fertiliser types for beans (percentage of households per source), B season

Where the household learnt which fertiliser to apply, B season	All	Male-headed	Female-headed	sig
Myself	38%	40%	33%	
Observation in community / farmer to farmer	8%	10%	0%	
Village-based advisor (VBA)	15%	20%	0%	
Farmer organisation	8%	10%	0%	
NGO extension	8%	10%	0%	
Public extension/ Government	0%	0%	0%	
Private extension	0%	0%	0%	
State ministry of agriculture	0%	0%	0%	
Federal ministry of agriculture	0%	0%	0%	
Other	23%	10%	67%	
n	13	10	3	

*Note: significance from a Chi-squared statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

n = households that applied fertiliser in season 1

About 23% of farm households use organic fertiliser for bean cultivation. Organic fertilisers include compost (65%), manure (36%), crop residues (5%), or granular organic fertiliser (2%) (see Table 73). Information on organic fertilisers mainly comes from observation in the

community (40%) or from knowledge passed on in the household (28%). Most of the farm households (79%) have been using organic fertiliser since before 2016.

Table 73: Types of organic fertiliser used for beans (percentage of households per type), B season

Types of organic fertiliser	All	Male-headed	Female-headed	sig
Granular	2%	1%	2%	
Compost	65%	66%	62%	
Manure	36%	35%	38%	
Crop residues	5%	7%	2%	
n	132	92	40	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Note: Multiple choices possible, therefore total does not need to add to 100%

n = households that applied fertiliser in season 1

There are no statistically significant differences in yields between farm households that applied fertiliser and those that did not (Table 72).

Table 74: Average yield of beans (kg/ha), by fertiliser use (yes/no), B season

Beans yield (kg/ha), B season	All	No	Yes	sig
mean	717.5	721.0	710.9	
median	500.0	500.0	500.0	
n	502	376	125	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Pest management practices

Table 73 shows that the percentage of farm households that have adopted pest-management practices for bean cultivation is low: 2%.

Table 75: Adoption of pest-management practices

	All	Male-headed	Female-headed
3.9 Adoption of pest-management practices (%)[6]	2%	2%	2%

Pesticide (insecticide) is applied by 2% of the farm households and herbicides by 1% (see Table 76). None of the farm households use fungicides.

Table 76: Percentage of households applying agro-chemical inputs for beans, B season

	All	Male-headed	Female-headed	sig
Pesticide application, B season	2%	1%	2%	
Herbicide application, B season	1%	0%	1%	
Fungicide application, B season	0%	0%	0%	NA
n	581	416	165	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

[6] [6] Here, pesticides refers to products for pest-management: herbicides, pesticides and fungicides.

Pesticides were applied on only 1% of the total land area cultivated by AGRA beneficiaries (see Table 77). The share of land under herbicides and fungicides is 0%.

Table 77: Percentage of total land area used for bean cultivation under agro-chemical inputs, B season

	All	Male-headed	Female-headed	sig
Percentage of total land area under pesticides, B season	1%	1%	1%	
Percentage of total land area under herbicides, B season	0%	0%	0%	
Percentage of total land area under fungicides, B season	0%	0%	0%	
n	701	494	207	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Post-harvest practices

Table 78 shows the main indicators on the post-harvest practices endorsed by AGRA.

Table 78: Main indicators for the adoption of improved post-harvest practices

	All	Male-headed	Female-headed
3.10 Adoption of endorsed post-harvest practices (%)	81%	86%	69%
3.11 Adoption of improved storage (%)	11%	11%	12%
3.12 Use of designated storage facilities (%)	1%	1%	1%
3.13 Adoption of tablets to preserve quality of recycled seed (%)	42%	46%	26%*

The adoption of endorsed post-harvest practices (indicator 3.10) is defined as the use of a sheet or tarpaulin during processing or drying, which is important to avoid contamination and keeping the beans clean. About 81% of farmers use a sheet or tarpaulin for drying and/or threshing.

The adoption of improved storage (indicator 3.11) is defined as the use of improved storage equipment, such as PICS bags or silos. Approximately 11% of farmers use such improved storage: 10% of them use PICS bags and 2% use silos. The farm households were either informed about the use PICS bags by the farmer organisation (52%), village-based advisor (16%), NGO extension (5%), or by people in the community (12%). More than half of farm households that use PICS bags have been using them since 2016 or before (see Table 79); the rest started in 2017 (26%) or 2018 (5%).

Table 79: Year in which the household started using PICS bags to store beans, A season

Period the household has been using PICS bags, A season	All	Male-headed	Female-headed	sig
Started the season this season	5%	8%	0%	
Started in 2017	26%	23%	33%	
Started in 2016	21%	15%	33%	
Started before 2016	47%	54%	33%	
Don't know	0%	0%	0%	
n	19	13	6	

*Note: significance from a Chi-squared statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Only 1% of households use a designated storage facility, such as storage at the farmer's organisation, or private storage. About 42% of farm households recycling seeds use preservative tablets to preserve the quality of the seed stock (indicator 3.13).

8.7 Access to agricultural advisory support services (indicator 4)

Access to agricultural advisory extension support services is defined as the percentage of households that interacted with an agricultural extension officer during the last 12 months. Table 80 reports the information on this and other indicators related to extension. About 54% of AGRA beneficiaries were visited by an agricultural extension officer in the 12 months before the interview. In this period, the farm households were, on average, visited 5 times.

Table 80: Main indicators for access to agricultural advisory support services

	All	Male-headed	Female-headed
4 Access to agricultural advisory extension support services	54%	59%	43%
4.1 Avg. no. of visits per year by agri. advisory extension support services	5.0	4.3	7.6
4.4 Distance to nearest agro-dealer (minutes)	45.4	47.0	41.6

Table 81 shows that extension officers were most often affiliated with the government (66%) or with a cooperative (43%). About 22% of farm households were visited by a village-based advisor. It is striking that female-headed households are visited significantly less by cooperative extension officers, but significantly more by village-based advisors.

Table 81: Affiliation of extension service provider (percentage of households per provider)

Type	All	Male-headed	Female-headed	sig
Government	66%	68%	60%	
Company	2%	3%	0%	
NGO	2%	2%	3%	
Farmer Promoter/VBA	22%	19%	30%	**
Cooperative	43%	46%	33%	**
Other	1%	1%	0%	
n	380	290	90	

Type	All	Male-headed	Female-headed	sig

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Note: Multiple choices possible, therefore total does not need to add to 100%

Note: Categories smaller than 1% are combined in 'Other'

The distance to the nearest agro-dealer is another aspect of the farm household's access to agricultural extension services. Average travel time to the nearest agro-dealer is 40 minutes (Table 82). Farm households most commonly go by foot (85%); some travel by bicycle (10%), car (2%), or motorbike (1%).

Table 82: Average travel time to agro-dealer (minutes)

Distance to agro-dealer in minutes	All	Male-headed	Female-headed	sig
mean	45.4	47.0	41.6	
median	30.0	40.0	30.0	
n	573	399	174	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

8.8 Access to formal financial services (indicator 13)

Table 83 shows that 55% of AGRA beneficiaries have access to formal financial services, which is defined as having either a bank account, a formal agricultural loan, or agricultural insurance. This indicator thus only includes access to formal financial services, provided by formal financial institutions, and excludes access to informal financial services, such as from village money lenders, relatives, or saving groups.

Table 83: Main indicators for access to formal financial services

	All	Male-headed	Female-headed
13. Access to formal financial services (%)	55%	60%	44%
13.1 Bank account (%)	55%	59%	44%
13.2 Agricultural loan (%)	7%	7%	5%
13.3 Agricultural insurance (%)	0%	0%	0%

While a bank account is quite common – 55% of the farm households have one - a much smaller share of farm households (7%) took a formal agricultural loan. Almost no farm households have agricultural insurance.

Table 84 gives an overview of the different loan providers in use. It shows that loans through a savings and credit cooperative (SACCO) are most common: 45% of farm households took an agricultural loan from a SACCO. Other important loan providers are formal banks (24%) and informal village money lenders (14%).

Table 84: Types of loan providers (percentage of households per provider)

Loan providers	All	Male-headed	Female-headed	sig
Family or friends	5%	4%	5%	

Loan providers	All	Male-headed	Female-headed	sig
Village money lender	14%	6%	32%	***
VSLA/ISLC/VICOBA (Informal savings and loans group)	6%	9%	0%	
Savings and Credit Cooperative (SACCO) / Credit Union	45%	51%	32%	
Microfinance institution (MFI)	3%	4%	0%	
Bank	24%	23%	26%	
Cooperative	2%	2%	0%	
Other	5%	4%	5%	
n	66	47	19	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Note: Multiple choices possible, therefore total does not need to add to 100%

Note: Categories smaller than 1% are combined in 'Other'

Excluding households that did not take loans

8.9 Post-harvest losses (indicator 6)

Post-harvest losses are measured by the beans that were lost after harvesting as a share of total production. Table 85 shows that almost no beans were lost post-harvest. Only 0.4% of farm households reported any post-harvest losses. It should be kept in mind, however, that post-harvest losses are typically difficult to estimate for farmers as losses are typically not measured.

Table 85: Main indicator for post-harvest losses

	All	Male-headed	Female-headed
6. Percent of post-harvest losses (%)	0%	0%	0%

8.10 Access to market information (indicator 37)

The percentage of beans farmers that has access to formal channels of market information (SMS, radio, television, internet and the farmer's organisation) is 10% (see Table 86). In all these cases, farm households receive price information from the farmer organisation.

Table 86: Main indicator for access to market information

	All	Male-headed	Female-headed
37. Access to market information through formal channel (%)	10%	11%	8%

Farmers, however, also use informal channels to acquire market information, such as buyers (54%), the market (43%), other farmers (16%), or the farmer organisation (3%) (see Table 87).

Table 87: Sources of market information used by farmers (percentage of households per source)

Source of market information	All	Male-headed	Female-headed	sig
Buyer	54%	55%	52%	
Farmer to farmer	16%	22%	5%	*
Market	43%	40%	48%	
Farmer organisation	3%	2%	5%	
Other	0%	0%	0%	NA
n	61	40	21	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

Note: Multiple choices possible, therefore total does not need to add to 100%

Note: Categories smaller than 1% are combined in 'Other'

8.11 Sales channels (indicator 33)

About 50% of farm households sold (at least) part of their beans harvest from the B season. Table 88 shows the main indicators for farmers' sales channels. It includes information on sale through structured trading facilities/arrangements, as well as information on farmers' clients.

Table 88: Main indicators on farmers' sales channels

	All	Male-headed	Female-headed
33. Sale through structured trading facilities/arrangements (%)	11%	12%	5%
33.1 Selling to traders/middlemen (%)	21%	19%	28%
33.2 Selling to consumers (%)	5%	4%	7%
33.3 Selling to friends/neighbours (%)	3%	2%	4%
33.4 Selling to aggregation centre (%)	1%	1%	0%
33.5 Selling to farmer organisation (%)	20%	23%	10%
33.6 Selling to wholesalers (%)	22%	24%	18%
33.7 Selling to processors (%)	0%	0%	0%
33.8 Selling to retailers (%)	33%	31%	39%
33.9 Selling to company (undefined) (%)	3%	3%	3%
33.10 Selling to institutional buyers (%)	1%	0%	1%

Farm households are considered selling through a structured trading facility when they sell at least part of their harvest through a formal contract: 11% of the farm households do this. Table 89 suggests that farm households that have a formal contract with a buyer receive more or less the same price as farm households without a contract.

Table 89: Price received for beans with/without contract

Common price received for beans (RF/kg), B season	All	No contract	Contract	sig
mean	311.6	310.5	319.8	
median	300.0	300.0	320.0	
n	277	251	25	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

n = households that sold beans in season 2

Table 88 shows that farm households' clients are mainly retailers (33%), farmer organisations (20%), wholesalers (22%), and traders or middlemen (21%).

Most of the harvest (60%) is, however, used for own consumption (Table 90). On average 30% of the total harvest is sold.

Table 90: Allocation of beans harvest to different household uses (percentage of total harvest), B season

	All	Male-headed	Female-headed	sig
Beans used for consumption (% of harvest), B season	60%	57%	65%	**
Beans kept for seed (% of harvest), B season	5%	6%	3%	***
Beans given away (% of harvest), B season	2%	2%	1%	**
Beans used as payment for inputs (% of harvest), B season	1%	1%	1%	
Beans bartered or exchanged for goods (% of harvest), B season	0%	0%	0%	
Beans sold (% of harvest), B season	31%	33%	29%	
Post-harvest losses of beans (% of total harvest), A season	0%	0%	0%	NA
n	553	396	157	

*Note: significance from a one-way ANOVA statistical test. ***, **, * indicate significance levels of 1%, 5% and 10% respectively*

8.12 Value of incremental sales as a result of AGRA (indicator 10)

The value of incremental sales as a result of AGRA cannot be determined yet as only one round of data collection has been completed. Therefore, total revenues from beans sales are reported as a baseline value. Revenues were calculated by multiplying the quantity sold (in kg) by the common price received per kg.

Table 91: Value of incremental sales as a result of AGRA

	All	Male-headed	Female-headed
10. Value of incremental sales as a result of AGRA (crop revenue) (US$)	29.8	31.4	25.8

On average, the revenue from selling beans is US$30.7 Total revenue from beans sales seems higher for male-headed households than female-headed households, but this difference is not statistically significant. The price received for beans (per kg) was also similar for male-headed and female-headed households.

[7] This value is converted from RWF to US$ by using the 2018 average exchange rate of 1 USD = RWF 901.

In addition to the value of quantity sold, KIT also calculated the value of the total production, which was done by multiplying the total production by the common price received by the household. The average value of total production (the share that was sold and the share that was not sold) was US$89 in 2018 (or RF81,512) (see Table 92 and Table 93).

Table 92: Crop value (RF) of beans produced, B season

	All	Male-headed	Female-headed
Average value of production in Francs	81,512	86,786	67,888
Note: n = households that sold beans			

Table 93: Crop value (US$) of beans produced, B season

	All	Male-headed	Female-headed
Average value of production in US$	89	95.2	74.5
Note: n = households that sold beans			

Part III: Small & medium enterprise survey

9 SME performance survey

9.1 Introduction

An important pathway of change in the PIATA programme is supporting the development of SMEs operating in agricultural value chains and providing support services to agricultural value chains. To assess the changes in performance of SMEs benefitting from the AGRA-PIATA programme, a rapid survey to measure SMEs performances has been done among those SMEs. The SMEs performances have been scored using the SME performance scorecard. This scorecard is composed of four dimensions:

- Business resilience measures the ability to reduce both risk of exposure to shocks and stressors and capacity to absorb the impact of shocks affecting the market. It includes variables such as the number of years in business, diversity of services provided, and number of buyers.
- Financial stability includes all variables referring to the financial resources the SMEs use to achieve their economic objectives. It includes access to credit, annual turnover (US$) and number of investments in the last three years.
- Human capital refers to employees and their skills, knowledge, and ability to work in a non-discriminatory environment. It includes variables such as percentage of female and skilled employees (with professional certificate or post-secondary education degree), and percentage of permanent employees.
- Technology/assets can include infrastructure, services and productive assets that enable SMEs to maintain safety and enhance their productivity. In particular, it considers investments in equipment, buildings/storage and research and development.

In order to build the four performance dimensions, scores were assigned to variables in each dimension. The average of the scores gives the total score for each dimension. Performance scorecards are presented in Annex 2.1. An overview of all SME indicators and associated descriptive statistics is presented in Annex 2.2.

9.2 Methodology

AGRA officers and local consultants validated a list of 27 SMEs provided by AGRA. When possible, local consultants were asked to randomly sample 50 SMEs: 10 commercial seed producers; 5 seed companies; 10 aggregator/trader and 10 processors; 10 input supply agro-dealers and 5 input supply companies. Seed producers and agro-dealers were included, who, under the AGRA definition, would not be considered SMEs, but did want to monitor the change in performance of these more micro-enterprises, as part of monitoring system change.

In Rwanda, SMEs that agreed to participate in the interview were 24 out of the 27 sampled. The sample was composed of: 10 seed producers; 2 seed companies; 7 input supply agro-dealers; and 5 input supply companies. The performances relative to value chain actors (aggregators, processors, transporters) is not reported since they refused to participate in the survey. More information about SMEs participating in the survey can be found in Annex 2.3.

9.3 Performance dashboard

This section summarises the performances associated with the different types of SMEs for each of the four dimensions: business resilience, financial stability, human capital and technology. A red bar indicates poor performance (score 1-2); orange indicates that there is room for improvement (score 2-3); and green indicates good performance (score 3-4).

Commercial seed producers

We have 10 commercial seed producers in our sample.

Business resilience

The average score of business resilience is 2.1, which signals that there is room for improvement. The scores assigned to the four indicators (years in business, number of services provided, number of buyers) are 1, 1.4 and 4, respectively (see Figure 18). The low value is due to the fact that these SMEs are new enterprises, they have been in business almost two years on average (see Table 95 in Annex 3). They offer one services on average, mainly production of improved or certified seeds (see Table 101 in Annex 4).

The SMEs show a good level of market risk diversification since they deal with four buyers on average (see Table 100 in Annex 4).

Financial stability

The average score for financial stability is 3.1, which signals a positive pathway toward good performance. The scores assigned to the three indicators (use of formal credit, annual turnover and number of investments) are 3.4, 3.3 and 2.8, respectively (see Figure 18).These SMEs have an average annual turnover of around US$56.838 (see Table 94 in Annex 3). They have good access to formal credit: around 70% get the majority of their credit from formal credit institutions (see Table 103 in Annex 4). They declared two investments, on average, in the last three years, mainly in training and expansion of land area (see Table 102 in Annex 4).

Human capital

The average score for human capital is 2.6, which indicates that there room for improvement. The scores assigned to the three indicators (percent of permanent employees; percent female and percent skilled employees) are 2.6, 2.8 and 2.6, respectively (see Figure 18). In particular, a need to enrol more permanent and skilled work force is registered.

Technology

The average score for technology is 1.7. The scores assigned to the three indicators (investment in R&D, investment in building/storage; investment in equipment) are 1.3, 1.9 and 1.9, respectively. This signals poor investments in technology in the last three years (see Figure 18).

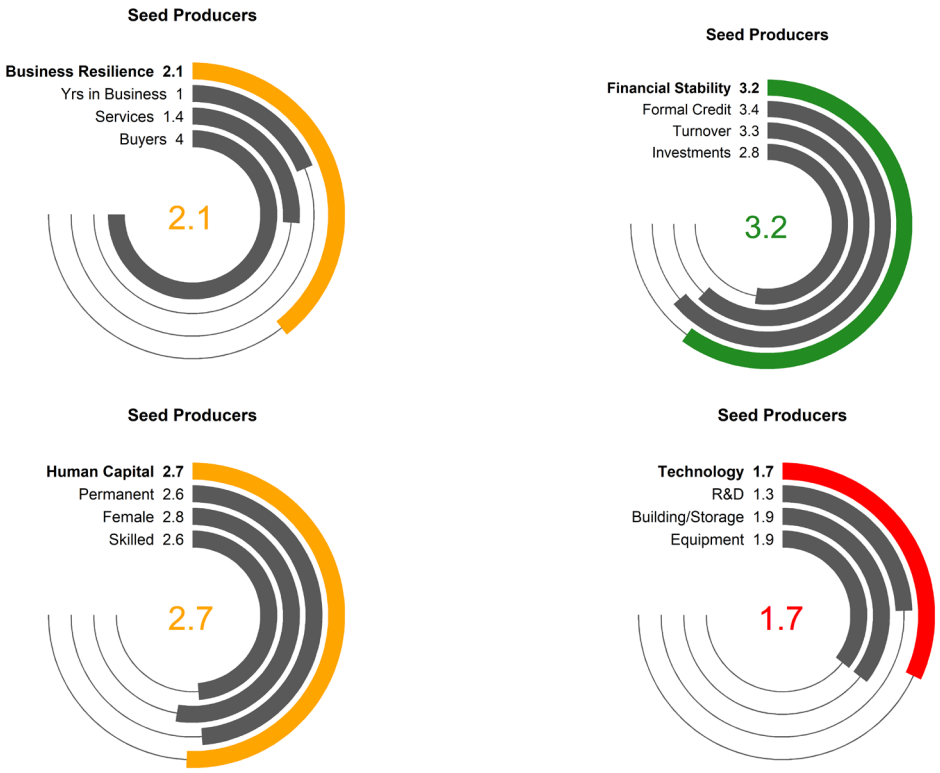


Figure 18: Seed producers' performance scorecard

Seed companies

We have two seed companies in our sample.

Business resilience

The average score of business resilience is 2.3, signalling a positive pathway toward good performance. The scores assigned to the three indicators (years in business, number services provided, number of buyers) are 1, 2 and 4, respectively (see Figure 19). The low value of business resilience is due to the fact that these SMEs are new enterprises; they have been in business for 2.5 years on average (see Table 95 in Annex 3). The SMEs offer two services, on average, mainly production or sale of improved or certified seeds, and variety development (see Table 101 in Annex 4). They deal with different buyers, three on average (see Table 100 in Annex 4).

Financial stability

The average score for financial stability is 2.7 showing moderate performance. Two indicators were used (use of formal credit, and number of investments) since the turnover information was missing; the scores are 3.5 and 2, respectively (see Figure 19). These SMEs have good access to formal credit: 50% of SMEs get the majority of their credit from formal credit institutions, and another 50% gets around 25-50% from these formal sources (see Table 103 in Annex 4).

They declared only one investment in the last three years in staff training (see Table 102 in Annex 4).

Human capital

The average score for human capital is 2.3, indicating that there is room for improvement. The scores assigned to the three indicators (percent of permanent employees; percent female and percent skilled employees) are 3, 2 and 2, respectively (see Figure 19). In particular, a need to enrol more workforce with particular attention to skilled and female employees is registered.

Technology

The average score for technology is 1. The scores assigned to the three indicators (investment in R&D, investment in building or storage facilities; investment in equipment) are 1, 1, and 1, respectively, which signals that no investments were made in technology in the last three years (see Figure 19).

Figure 19: Seed companies' performance scorecard

Input supply or agro-dealers

We have seven input supply or agro-dealers in our sample.

Business resilience

The average score of business resilience is 1.7, signalling opportunity for improvement. The scores assigned to the three indicators (years in business, number services provided, number of buyers) are 1, 1.3 and 3, respectively (see Figure 20). The low value is due to the fact that these SMEs are new enterprises, they have been in business for less than three years on average (see Table 95 in Annex 3). They offer one service on average, mainly represented by retail of chemicals and fertiliser (see Table 101 in Annex 4). They deal with three buyers on average (see Table 100 in Annex 4).

Financial stability

The average score for financial stability is 2.3 indicating that there is space for improvement. Only scores assigned to two indicators were considered (use of formal credit, number of investments) since no information on annual business turnover was made available. Scores are 3.6 and 1, respectively (see Figure 20). These SMEs have good access to formal credit: 83% of SMEs get between 75% and 90% of their credit from formal credit institutions (see Table 103 in Annex 4).

They declared no investments made in the last three years (see Table 102 in Annex 4).

Human capital

The average score for human capital is 3.4. The scores assigned to the three indicators (percent of permanent employees; percent female and percent skilled employees) are to 3.6, 3 and 3.6, respectively (see Figure 20). Performance is moderate.

Technology

The score for technology is 1 with no investments made in the last three years. The scores assigned to the three indicators (investment in R&D, investment in building/storage; investment in equipment) are 1, 1 and 1, respectively (see Figure 20).

Figure 20: Input supply or agro-dealers' performance scorecard

Input supply companies

We have five input supply companies in our sample.

Business resilience

The average score of business resilience is 1.9, signalling low business resilience performances. The scores assigned to the three indicators (years in business, number

services provided, number of buyers) are 1, 1.8 and 3, respectively (see Figure 21). The low value is due to the fact that these SMEs are quite new enterprises, they have been in business for slightly more than three years on average (see Table 95 in Annex 3). They offer almost two services on average, mainly wholesale and countrywide distribution, and sales of improved or certified seeds (see Table 101 in Annex 4).On average, they interact with three buyers which indicates a good degree of market risk diversification (see Table 100 in Annex 4).

Financial stability

The average score for financial stability is 3.4 signalling moderate performance. The scores assigned to the three indicators (use of formal credit, annual turnover and number of investments) are 3.2, 3.5 and 3.6 (see Figure 21).These SMEs have an average annual turnover of 2.740.304 US$ (see Table 94 in Annex 3). They have good access to formal credit: 80% declared to get between 75-90% of credit from formal credit institutions (see Table 103 in Annex 4).

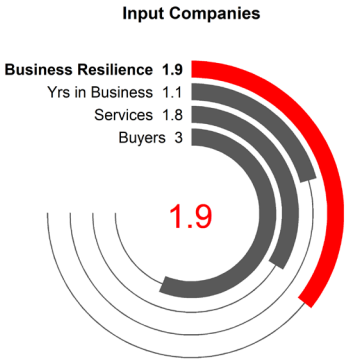
They made one investment on average in the last three years, mainly in the injection of working capital (see Table 102 in Annex 4).

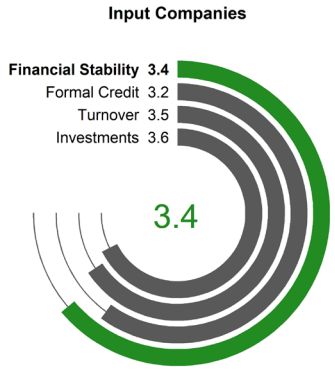
Human capital

The average score for human capital is 2.3. The scores assigned to the three indicators (percent of permanent employees; percent female and percent skilled employees) are respectively equal to 2.4, 2.2 and 2.4 (see Figure 21). This indicates a need for permanent, skilled and female employees.

Technology

The average score for technology is 1.4. The scores assigned to the three indicators (investment in R&D, investment in building/storage; investment in equipment) are 1, 1.6 and 1.6, respectively, signalling poor performance with regard to technology investments over the last three years (see Figure 21).





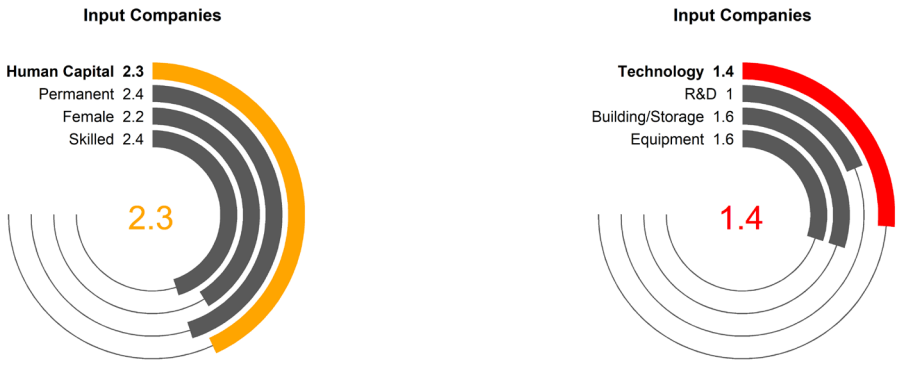


Figure 21: Input companies' performance scorecard

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Annex 1: List of key informants system analysis

Organisation	Respondent	Department /function	Topic discussed	Relation to AGRA
AGRA Rwanda	Prof. Daniel Rukazambuga	Seed systems coordinator	Seed systems	Staff
AGRA Rwanda	Barbara Mbabazi	Extension coordinator	Extension system	Staff
Rwanda Agriculture Board (RAB)	Dr. Claver Ngaboyisonga	Cereal programme Leader	Seed systems	Grantee
Ignite Seed Company	Norah Kamashazi	CEO	Seed Systems	Grantee
RISCO Seed Company	John Muvara	CEO	Seed Systems	Grantee
Ebenezer Mixed Farming and General merchandize Ltd	Martha Birungi	CEO	Seed Systems	Grantee
Seed Potato Fund	Salomon Mbarushimana	President	Seed Systems	Grantee
Private Sector Federation	Francois Nsengiyumva	Chamber of Agriculture	Seed system	Grantee
AGRA Nairobi	Dr. Jane Njuguna		Seed systems	Staff
Clinton Development Initiative	Angelique Tuyisenge	CEO	Extension System	Grantee
Rwanda Agriculture Board (RAB)	Dr. Charles Bacagu	Deputy Director General	Extension System	Grantee
CNFA	Emmanuel Ngomiraronka	Senior agricultural input advisor	Extension System	Grantee
Imbaraga farmers organsiation	Joseph Gararanga	Secretary General	Extension System	Grantee
Ministry of Local Government (MINALOC)	Alain Didier	Planning and performance contract specialist	Extension System	Informant
Rwanda Agriculture Board (RAB)	Dr. Clement Urinzwenimani	EGS breeder	Seed systems	Grantee
BK Techouse	Jean Claude Munyangabo	CEO	Extension System	Grantee

Annex 2: Data dictionary main indicators

Indicator	Definition
G2: Average number of months of adequate household food provision	The average number of months of adequate household food provision.
G6: Wealth assets index score	The DHS household wealth index is a composite measure of a household's cumulative living standard. It is composed of data on asset ownership, materials used for housing construction, and types of water access and sanitation facilities. Wealth index values typically range between -2 and 2, with 0 being on the centre of the distribution.
G6.1 Share of households in first wealth quintile (%)	The share of households in the first wealth quintile (based on the country average).
G6.2 Share of households in second wealth quintile (%)	The share of households in the second wealth quintile (based on the country average).
G6.3 Share of households in third wealth quintile (%)	The share of households in the thirds wealth quintile (based on the country average).
G6.4 Share of households in fourth wealth quintile (%)	The share of households in the fourth wealth quintile (based on the country average).
G6.5 Share of households in fifth wealth quintile (%)	The share of households in the fifth wealth quintile (based on the country average).
IWI International Wealth Index	The International Wealth Index (IWI) is the first comparable asset based wealth index covering the complete developing world. It is based on data for over 2.1 million households in 97 low and middle income countries. Based on DHS household wealth index variables.
1. Average yield (kg/ha)	The average harvest quantity of the crop in the main season (kg) divided by the amount of land on which the crop is cultivated (ha) per farm household. In case respondents reported production and cultivated area in different units, conversions to kilogrammes and hectares were made respectively.
3. Rate of application of target improved productivity technologies or management practices (indicator 14)	The percentage of farm households using improved varieties or inorganic fertiliser.
3.1 Adoption of improved varieties (%)	The percentage of farm households using improved OPVs or hybrids. Farm households cultivating varieties that could not be classified were counted as not using improved varieties.
3.2 Adoption of endorsed varieties (%)	The percentage of farm households using varieties that are endorsed by AGRA and its partners.
3.3 Number of seasons variety is recycled	The average number of seasons the variety has been recycled.
3.4 Adoption of endorsed planting practice (%)	The percentage of farm households using the specific spacing of seed as promoted by AGRA and partners.
3.5 Adoption of inorganic fertiliser (%)	The percentage of farm households applying inorganic fertiliser.
3.6 Adoption of endorsed fertiliser (%)	The percentage of farm households applying fertiliser endorsed by AGRA and its partners.

Indicator	Definition
3.7 Adoption of organic fertiliser (%)	The percentage of households applying organic fertiliser.
3.8 Adoption of inoculants (%)	The percentage of households applying inoculants.
3.9 Adoption of pest-management practices (%)	The percentage of households applying pesticides, herbicides or fungicides, or a combination of the three.
3.10 Adoption of endorsed post-harvest practices (%)	The percentage of households making use of a tarpaulin while drying and/or threshing their harvest.
3.11 Adoption of improved storage (%)	The percentage of households making use of improved storage facilities, such as PICS bags or silos.
3.12 Use of designated storage facilities (%)	The percentage of households storing their produce using storage at the farmer's organisation, a warehouse receipt system, or private storage.
3.13 Adoption of tablets to preserve quality of recycled seed (%)	The percentage of households using tablets to preserve the quality of their seed stock.
Additional indicator 2: Hectares under improved technologies or management practices (%)	The total land area under improved varieties or inorganic fertiliser as a share of the total land area on which the crop is cultivated.
3.14 Area under improved varieties (%)	The total number of has under improved varieties (hybrid or OPV) as a share of the total land area on which the crop is cultivated.
3.15 Area under inorganic fertiliser (%)	The total number of has on which inorganic fertiliser is applied for the cultivation of the crop as a share of the total land area on which the crop is cultivated.
3.16 Area under pesticides (%)	The total number of has on which pesticides, herbicides, or fungicides were applied for the cultivation of the crop as a share of the total land area on which the crop is cultivated.
4. Access to agricultural advisory extension support services (indicators 16)	The share of households that is visited by an agricultural extension agent during the last 12 months.
4.1 Average number of visits per year by agricultural advisory extension support services	The average number of visits by an agricultural extension agent during the last 12 months among farm households that have been visited at least once.
4.2. Received small seed pack (%) (additional indicator 4)	The percentage of households that received a promotional seed pack.
4.3 Used small seed pack (%) (additional indicator 4)	The percentage of households that used the seeds from the promotional seed pack received.
4.4 Distance to nearest agro-dealer (minutes) (additional indicator 1) (indicator 15)	The average distance to the nearest input supplier in minutes. Considers only households that could estimate this in minutes. Households that could only report this in distance are reported separately.
5. Nitrogen application (kg/ha)	The average amount of nitrogen (in kg) applied per ha of land on which the crop is cultivated.
5.1 Phosphorus application (kg/ha)	The average amount of phosphorus (in kg) applied per ha of land on which the crop is cultivated.
5.2 Potassium application (kg/ha)	The average amount of potassium (in kg) applied per ha of land on which the crop is cultivated.
Average fertiliser use (Total N + P + K, kg/ha) (Indicator 21)	The average sum of nitrogen, phosphorus and phosphorus (in kg) applied per ha of land on which the crop is cultivated.

Indicator	Definition
6. Percent of post-harvest losses (%) (indicator 22)	The share of harvest that is lost and thus not consumed, stored, given away, sold, bartered, or used as payment in kind.
10. Value of incremental sales as a result of AGRA (crop revenue) (US$)	The revenues from selling the crop, converted from local currency to US$ by using the 2018 average exchange rate.
13. Access to formal financial services (%)	The percentage of households that have access to formal financial services (either a bank account, a loan, or insurance)
13.1 Bank account (%)	The percentage of households that have a bank account.
13.2 Agricultural loan (%)	The percentage of households that took a loan from a formal financial institution in 2018. Formal financial institutions include banks, microfinance institutions, savings and credit cooperatives and mobile money.
13.3 Agricultural insurance (%)	The percentage of households that took crop insurance in 2018.
17. Average age of varieties used (years)	The average age of varieties used (in years).
33. Sale through structured trading facilities/arrangements (%) (indicators 30)	The sale through structured trading facilities or arrangements is defined as the number of households selling their harvest through formal contractual arrangements as a percentage of the total number of households selling at least some of their harvest.
33.1 Selling to traders/middlemen (%)	The percentage of farm households selling their harvest to traders/middlemen.
33.2 Selling to consumers (%)	The percentage of farm households selling their harvest to consumers.
33.3 Selling to friends/neighbours (%)	The percentage of farm households selling their harvest to friends/neighbours.
33.4 Selling to aggregation centre (%)	The percentage of farm households selling their harvest to aggregation centres.
33.5 Selling to farmer organisation (%)	The percentage of farm households selling their harvest to farm organisations
33.6 Selling to wholesalers (%)	The percentage of farm households selling their harvest to wholesalers.
33.7 Selling to processors (%)	The percentage of farm households selling their harvest to processors.
33.8 Selling to retailers (%)	The percentage of farm households selling their harvest to retailers.
33.9 Selling to company (undefined) (%)	The percentage of farm households selling their harvest to a company (in an undefined sector).
33.10 Selling to institutional buyers (%)	The percentage of farm households selling their harvest to institutional buyers.
37. Access to market information through formal channel (%)	The share of farm households receiving market information through formal channels (SMS, radio, television, farmer's organisation).

Numbering according to the terms of reference. In parenthesis numbering of AGRA's Theory of Change

Annex 3: Performance scorecard

Table 94: Business resilience performance scorecard

Business resilience		Performance Category 1	Performance Category 2	Performance Category 3	Performance Category 4
Years in business	Ranges (Years)	1-5	5-10	10-15	>15
	Score	1	2	3	4
Number of services	Ranges (#)	1	2	3	>3
	Score	1	2	3	4
Number of buyers	Ranges (#)	1	2	3	>3
	Score	1	2	3	4

Table 95: Financial sustainability performance scorecard

Financial sustainability		Category 1	Category 2	Category 3	Category 4
Percentage using formal credit	Ranges (%)	0%	0%-33%	33%-66%	>66%
	Score	1	2	3	4
Annual turnover (US$)	Ranges (thousands)	1-10	10-25	25-50	>50
	Score	1	2	3	4
Number of investments	Ranges (#)	0	1	3	>3
	Score	1	2	3	4

Table 96: Human capital performance scorecard

Human capital		Category 1	Category 2	Category 3	Category 4
% Female	Ranges (%)	0%	0%-33%	33%-66%	>66%
	Score	1	2	3	4
% Skilled	Ranges (%)	0%	0%-33%	33%-66%	>66%
	Score	1	2	3	4
% Permanent	Ranges (%)	0%	0%-33%	33%-66%	>66%
	Score	1	2	3	4
% Casual	Ranges (%)	0%	0%-33%	33%-66%	>66%
	Score	1	2	3	4

Table 97: Technology performance scorecard

Technology		Category 1	Category 2	Category 3	Category 4
Investments in R&D	Ranges (#)	0	-	-	1
	Score	1			4
Building storage	Ranges (#)	0	-	-	1
	Score	1			4
Equipment	Ranges (#)	0	-	-	1

Technology		Category 1	Category 2	Category 3	Category 4
	Score	1			4

Annex 4: SME descriptive statistics

Table 98: General SME characteristics

General SME Characteristics	Commercial Seed Producers	Seed Companies	Input Supply Agro-Dealers	Input Supply Companies
Years of business	1.90 (0.73)	2.5 (0.57)	2.83 (0.98)	3.6 (0.89)
Average number of commodities				
Commercialized/traded	2.20 (0.63)	1 0	- -	-
Processed	-	-	-	-
Transported	-	-	-	-
Commodities commercialized/traded				
Maize	80%	100%	-	-
Potatoes	20%	-	-	-
Permanent staff	12.1 (26.37)	3.5 (2.12)	1.83 (0.98)	8 (5.87)
Casual staff	167.14 (145.28)	118 (.)	3 (2.8)	37.25 (15.12)
Total annual turnover (USD)*	56838 (31335)	NA	5471 (.)	2740304 (3818806)
Observations	**10**	**2**	**7**	**5**

*Standard Deviation in parenthesis. *Incomplete information for Annual Turnover. Detailed information reported below.*
Commercial Seed Producers: 70%
Seed Companies: 0%
Input supply/Agro Dealers: 14%
Input companies: 40%

Table 99:SME employees

Employees	Commercial Seed Producers	Seed Companies	Input Supply Agro-Dealers	Input Supply Companies
Permanent Staff	12.1 (26.37)	3.5 (2.12)	1.83 (0.98)	8 (5.87)
Casual Staff	167.14 (145.28)	118 (-)	3 (2.8)	37.25 (15.12)
% Female(over total)	43%	19%	55%	23%
% Skilled(over total)	31%	4%	75%	33%
*Annual Salary Permanent (USD)**	200187 (480854)	NA	1969.74 (.)	50337.8 (.)
*Annual Salary Casual (USD)**	9132 (5731)	NA	NA	37425.06 (.)
*Daily Wage Casual (USD)**	1.38 (0.24)	1.64 (.)	1.27 (0.31)	3.28 (3.09)

*Standard Deviation in parenthesis. *Incomplete information for Annual Salary and Daily wage. Detailed information reported below.*
Commercial Seed Producers: Obs salary permanent workers: 70%; Obs salary casual workers 50%; Obs daily wage 100%
Seed Companies: Obs salary permanent workers: 0%; Obs salary casual workers 0%; Obs daily wage 50%
Input Supply agro dealers: Obs salary permanent workers: 14%; Obs salary casual workers 0%; Obs daily wage 42%
Input Supply companies: Obs salary permanent workers: 20%; Obs salary casual workers 20%; Obs daily wage 40%

Table 100: SME buyers

Buyers	Commercial Seed Producers	Seed Companies	Input Supply Agro-Dealers	Input Supply Companies
Projects, programs and government	90%	100%		
Farmer organizations, coops, associations	90%	100%	100%	100%
Individual buyers / producers	90%	100%	100%	100%
Traders, input suppliers, wholesalers	90%	100%	100%	100%
Average number of buyers	4 (0)	4 (0)	3 (0)	3 (0)
Observations	**10**	**2**	**7**	**5**

Table 101: SME services

SME Services	Commercial Seed Producers	Seed companies
Variety development	10%	50%
Breeder seed production	10%	
Production of early generation seed / foundation seed	20%	
Production of improved / certified seed	90%	100%
Production of noncertified seed	10%	
Sales of improved / certified seed	10%	50%
Sales of early generation seed / foundation seed	10%	
Average number of services provided	1.5 (1.26)	2 (1.41)
Observations	**10**	**2**

SME Services	Input supply agro dealers	Input companies
Retail (sales) of improved / certified seed	33%	40%
Retail (sales) of chemical fertilizers and pesticides	83%	20%
Advisory services / extension	16%	20%
Import of inputs		40%
Wholesale and country-wide distribution		40%
Manufacturing of inputs		20%
Average number of services provided	1.33 (0.51)	1.80 (1.30)
Observations	**7**	**5**

Investments	Commercial Seed Producers	Seed Companies	Input Supply Agro-Dealers	Input Supply Companies
Expansion of land area	40%			
Expansion of buildings and/or storage	30%			20%
Upgrading of equipment	30%			20%
Research & Development	10%			
Training of staff	80%	100%		100%
Increase / injection for working capital	30%			
Other				20%
No Investment	30%		100%	20%
Average number of investments	2.3 (2.11)	1 (0)	0	1.6 (0.89)
Observations	**10**	**2**	**7**	**5**

Table 102: SME investments

Investments	Commercial Seed Producers	Seed Companies	Input Supply Agro-Dealers	Input Supply Companies
Expansion of land area	40%			
Expansion of buildings and/or storage	30%			20%
Upgrading of equipment	30%			20%
Research & Development	10%			
Training of staff	80%	100%		100%
Increase / injection for working capital	30%			
Other				20%
No Investment	30%		100%	20%
Average number of investments	2.3 (2.11)	1 (0)	0	1.6 (0.89)
Observations	**10**	**2**	**7**	**5**

Table 103: Percentage of credit from formal sources

Access to formal credit	Commercial Seed Producers	Seed Companies	Input Supply Agro-Dealers	Input Supply Companies
0%				
<10%			16.67%	20%
10-25%	10%			20%
25-50%	20%	50%		
50-75%	20%			
75%-90%	50%		83.33%	80%
>90%		50%		
Observations	**10**	**2**	**7**	**5**

Table 104: AGRA support services

AGRA Services	Commercial Seed Producers	Seed Companies	Input Supply Agro-Dealers	Input Supply Companies
Grant	50%			20%
Loan/Credit				
Training	20%		84%	
Technical Assistance	10%			
No Service	50%	100%	16%	80%
Average Number AGRA Services	0.80 (1.03)	2 (0)	0.83 (0.40)	0.20 (0.44)
Observations	**10**	**2**	**7**	**5**

Annex 5: SMEs interviewed

Commercial seed producers	Seed companies	Input supply/agro-dealers	Input companies
Seeds of Trust	Kenya Seed Company	Kotuika	Yara Ltd
Sozo	Western Seed Company Ltd	Musabyimana Odette	Rwanda Fertiliser company
Top Quality Seeds Company	Western Seed Company Ltd	Mukamounga Laurence	Export Trading Group-Inputs Ltd
Horeko		Koduiru	Murphy Chemical Rwanda Ltd
Mudende Seeds Production Company		Nzeyalexis	Ets NKUBILI Alfred
Ignite Seeds Company Ltd		Agrovet- UBUMWE	
Nzeyalex Seed Company		Koaigi Indatwa	
Kilimo General business			
Ebenezer			
Rwanda Improved Seed Company			