

Mitigating Aflatoxin in Rwanda

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Abstract

On August 18th, 2021, the International Growth Centre and the Rwandan Ministry of Agriculture organised a webinar under the theme Market Driven Strategies for Mitigating Aflatoxin in Rwanda. The webinar highlighted Rwanda's progress towards mitigating aflatoxin and showcased innovative approaches used by neighbouring countries. The event was an opportunity for stakeholders to discuss Rwanda's key challenges in post-harvest management and assess the evidence on approaches that have (not) worked in similar contexts.

Keywords: Aflatoxin, Rwanda, mitigation strategies, APTECA

1. Summary of presentations

1.1. Illuminee Kamaraba- Division Manager for Crop Post-Harvest Management at Rwanda Agriculture and Livestock Resource Board ("RAB")

Kamaraba provided an overview of Rwanda's aflatoxin policy framework, challenges and priorities going forward. In her introduction, Kamaraba acknowledged the threat posed by aflatoxin for health, food security and agricultural productivity in Rwanda. Aflatoxin contamination results in food wastage due to rejection of grains at farm gate. It is also a leading cause of liver cancer and child stunting in Rwanda. For these reasons, aflatoxin receives the most attention among all mycotoxins. Aflatoxin is difficult to address because the risk factors driving contamination are multi-dimensional, and reversing contamination post-harvest is rarely effective.

Kamaraba outlined her institution's aflatoxin mitigation strategy from pre-to-post-harvest. At pre-harvest, RAB is expanding research and extension of improved varieties and modern production techniques. At post-harvest, RAB is investing in infrastructure and mechanization. In the 2019/20 FY, the Ministry of Agriculture allocated roughly one fifth of its budget to construct 890 drying shelters and 518 storage facilities country-wide. During this period, Kamaraba's institution observed that drying facilities were highly effective at managing moisture content to manageable levels. RAB's aflatoxin mitigation strategy

is embedded in a multi-stakeholder framework that incorporates food safety regulatory functions.

Kamaraba also discussed Rwanda's institutional, policy and regulatory framework for aflatoxin mitigation. The government has set up a technical working group on aflatoxin management under the authority of Minagri. An update of the 2011 post-harvest is also underway, and a new strategic plan for mitigating aflatoxin is under development. The government has also established a working group with private agro-process to increase access to food quality testing equipment.

Although the RAB has made significant strides towards mitigating aflatoxin in Rwanda, several challenges to mitigating aflatoxin remain. These include costs of mitigation technology, insufficient infrastructure, output market constraints, and unstandardized agro-processing machinery. Going forward, RAB will seek to improve the affordability of testing equipment, increase post-harvest equipment, increase access to output markets through contract farming, and develop an aflatoxin risk profile for Rwanda.

1.2. Konlambigue Matieyedou- Senior Agribusiness specialist and country representative for Institute of Tropical Agriculture ("IITA")

Konlambigue's presentation focused on lessons drawn from scaling up food safety technologies across Africa. Starting with the unique challenge posed by aflatoxin, Konlambigue noted that aflatoxin starts at pre-harvest and increases at post-harvest, where decontamination methods are not always viable. Thus

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IITA focused on pre-harvest and developed the Aflasafe™ bio-control technology to reduce aflatoxin contamination on farms.

IITA learned that identifying a sustainable pathway to scale for aflatoxin relies on a solid business case for farmers, incentives for the private sector, enabling factors from government, and opportunities for public-private partnership. Depending on the context, decision-makers can choose from three alternative pathways: commercial/private-led, public-led, and Public-Private Partnerships (PPPs). The process of scaling up biocontrol involves making decisions about the following: market suitability, partner selection, technology transfer, and last-mile distribution strategy. A continuous process of learning and adapting to lessons learned should inform each decision. To this end, IITA has built a multi-stakeholder ecosystem comprising policymakers, research agencies, regulatory agencies, and development partners to sustain the gains.

Konlambigue described IITA's progress in investing close to \$5 million to manufacture and distribute Aflasafe™ in 9 countries. Together these companies have sold more than 3,600 MT of Aflasafe™, equivalent to 360,000 hectares covered. He, however, noted that across all countries, the majority of Aflasafe™ sales occur between businesses, reflecting the higher value attached to food safety by sophisticated actors in agricultural value chains. By contrast, commercializing food safety products—that do not benefit yields to smallholders – is challenging. Further challenges to generating market incentives for food safety include lack of awareness, lack of affordable testing systems, and limited data on the impacts of aflatoxin in many countries.

In his conclusion, Konlambigue reiterated that food safety and nutrition innovations require a blend of commercial and non-commercial support for successful scale-up. Collaboration between the government and the private sector would provide a combination of policy and market incentives for food safety products that have limited commercial benefits to farmers, but significant benefits for health outcomes. When scaling up food safety technologies with the private sector, the government must focus on effective last-mile delivery by giving time-bound objectives with clear milestones, while maintaining the technology as a public good. Konlambigue summed up the three factors needed for successful scale-up: consumer behavioural change, market development, and enabling policy environment. He also called for further research to identify a suitable delivery model for Aflasafe™ in Rwanda.

1.3. Vivian Hoffmann- Senior Research Fellow, International Food Policy Research Institute

Dr. Hoffmann presented recent research evidence on the supply and demand for food safety. She started by asserting that the efficacy of food technology is heterogeneous across farms. For example, biocontrol and mobile drying may only be cost-effective for large-scale productive farmers. By contrast, drying sheets alongside improved on-farm storage are cost-effective for small-scale and less productive farmers. Off-farm options have also proven effective for market-oriented farmers supplying premium markets. For example, in Rwanda, Kumwe Harvest - recently acquired by Africa Improved Foods and one of

the largest off-takers for maize - purchases maize still on the cob and takes care of shelling and drying, including bearing all the costs entailed. Maize from this value chain is safe enough to use in the production of fortified foods targeted to expectant mothers and children at risk of malnutrition[14].

In studies on farmer's use of food safety practices in Kenya and Ghana, Dr. Hoffmann noted the significantly low uptake of different technologies can be attributed to low demand and unavailability on the market. A randomized control trial conducted in Ghana analysed the most important barriers to adoption of drying tarps among small scale farmers. They compared three factors: access to information, cost of the technology, and market incentives[10]. The results showed the cost was the leading barrier. Therefore, the most effective way to encourage uptake is to subsidize the cost for small-scale farmers. The researchers found that subsidies improved adoption of good farm practices in activities, other than drying resulting from the subsidy. Cost is a significant barrier to adoption of drying sheets and other technologies, such as mobile dryers and hermetic storage bags, in other settings as well[7].The researchers found access to information an effective driver of adoption of mobile dryers, but only for subsistence farmers. By contrast, commercial farmers improve uptake when strong market incentives are in place. Studies by other researchers have also found market incentives are highly effective for driving uptake[3, 2].

In studies on demand for food safety, Dr. Hoffmann considered two sources of market incentives: consumer demand and regulatory oversight. She presented evidence from Kenya showing that aflatoxin-safe food branding was ineffective in catalysing lasting changes in consumer behaviour[8]. Regulatory enforcement is an effective tool for encouraging compliance among formal sector firms. The threat of regulatory enforcement, even if unlikely, drives formal sector firms competing on quality to comply with standards to maintain their reputation. This likely contributes to the finding that in Kenya, maize flour milled by smaller-scale formal firms that compete on price, and unbranded, informally milled flour, are more likely to contain aflatoxin above the regulatory limits than large-scale formal sector firms [12]. The capacity to comply with regulations varies by firm size. Larger firms with higher grain throughput can conduct aflatoxin tests at lower unit costs than smaller firms, and generally have greater capacity to comply with food safety regulations.

In her conclusion, Dr. Hoffmann reiterated the effectiveness of subsidies towards driving uptake of aflatoxin mitigation technology. She stressed that subsidies do not depress long-term demand [13]. While developing aflatoxin regulations for human food, it is crucial to create a use for non-compliant grain, as otherwise, such grain will likely find its way to the informal sector, and ultimately be consumed by consumers unwilling or unable to pay for a premium product. One possible use for non-compliant grain is in animal feed. Despite high aflatoxin contamination, animal feed does not translate into high levels of contamination in animal products [6]. If higher levels of aflatoxins in the feed sectors are allowed, the government must develop a regulatory framework for binders. While consumer demand alone cannot drive aflatoxin demand, providing con-

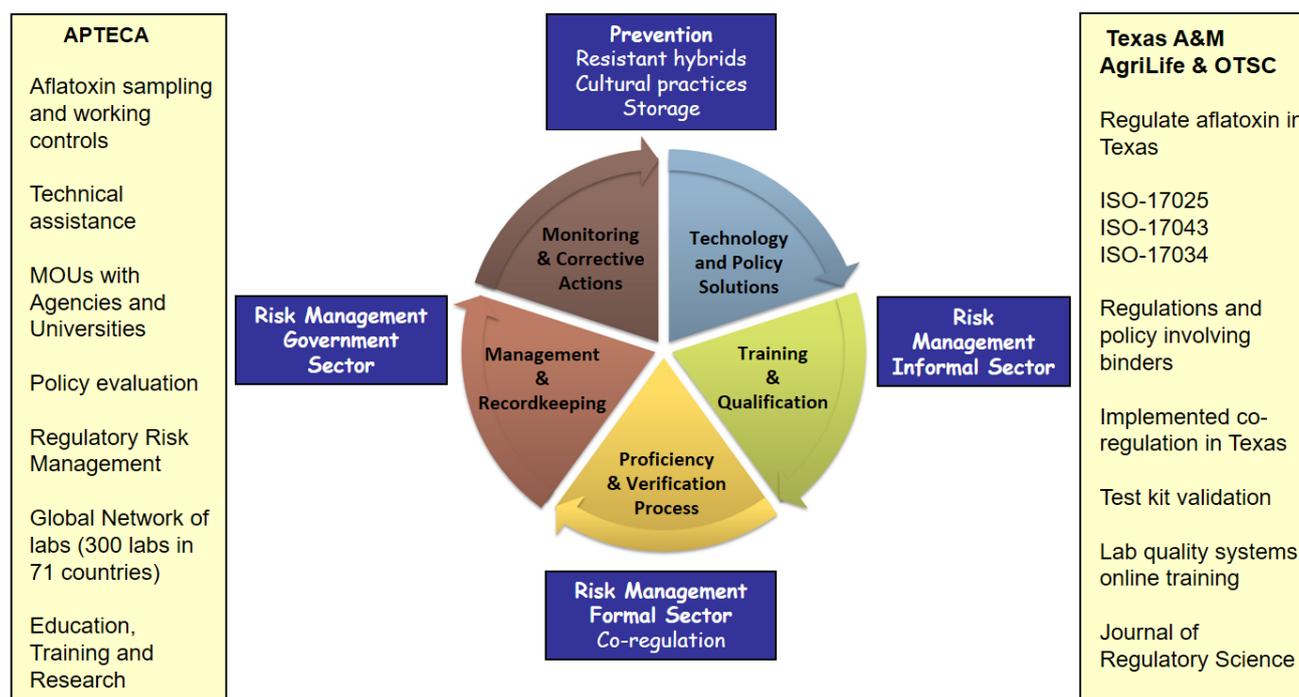


Figure 1: APTECA risk management cycle.

sumers with risk information would facilitate evidence-based buying decisions.

1.4. *Tim Herrman - Professor, State Chemist and Director at Office of the Texas State Chemist, Texas A&M AgriLife Research*

Dr. Herrman's presentation centred on The Aflatoxin Proficiency Testing and Control in Africa program (APTECA). APTECA utilizes a quality systems approach to measure and manage aflatoxin risk patterned after a similar program in Texas administered by the Office of the Texas State Chemist (OTSC), which is the state regulatory agency that administers the state's Commercial Feed Control Act that includes aflatoxin risk management. Both the Texas State Chemist aflatoxin risk management program and APTECA utilize official methods including government backed codes, standards and regulations for sampling, preparation, and measuring aflatoxin in grain and food products and validation of aflatoxin testing platforms [5].

1.4.1. *APTECA Mission and Vision*

In 2014, APTECA was introduced to Kenya under the premise that a quality systems approach to manage aflatoxin risk (Figure 1) is universal. By 2015, The APTECA program expanded to include 80% of the formal maize milling sector in Kenya [5]. The same year APTECA and its logo were registered with the Kenya Intellectual Property Institute to support marketing of aflatoxin safe food [9]. The APTECA vision is:

“A public-private partnership will manage aflatoxin risk through a connected and transparent

marketplace that delivers aflatoxin safe food and feed to all Africa.”

The APTECA approach to food protection and security by mitigating aflatoxin risk is captured in Figure 1. The inner circle of the diagram represents the elements of the aflatoxin risk management cycle including technology and policy solutions, training and qualification, proficiency and verification process, management and recordkeeping, monitoring and corrective action and closely mirrors the Demming Cycle of Plan, Do, Check, and Act. The external blocks list the market sectors supported by the APTECA program including production and storage by social enterprises, small holder farmers, and larger scale growers; small and medium scale food processing enterprises; the formal food processing sector; and government agencies. The outer boxes highlight core competencies of OTSC to the right and the APTECA activities listed to the left that facilitate the implementation of an aflatoxin risk management cycle using a quality systems approach across the different market and government sectors.

1.5. *Technology and Policy Solutions*

1.5.1. *Test Kit Validation*

Rapid aflatoxin test kits were validated at testing levels necessary to meet Texas requirements in 2010 using United States Dept. of Agriculture (USDA) test kit validation procedures. Specifically, aflatoxin testing levels were increased from 100 parts per billion (ppb) to 1000 ppb. The Federal Grain Inspection Service (FGIS) of USDA later approved aflatoxin test kits at this higher testing level for national use. OTSC developed

and distributed reference material to cover the increased testing range, supporting testing accuracy for Texas firms, test kit manufacturers, and APTECA participants globally.

1.5.2. APTECA Pre-harvest Preventive Controls

In 2016, APTECA initiated pre-harvest aflatoxin preventive controls including an evaluation of cultural practices in three production regions of Kenya including the Eastern Region, Rift Valley and Western Region in collaboration with a social enterprise (Shalaam) with approximately 40,000 members. Application of regression modeling and multivariate analysis led to identification of causal agents increasing aflatoxin risk that were conveyed via semi-annual reports to the social enterprise for communication to members including small holder farmers during 2016-2017. This collaboration led to further involvement with the Meru County Parliament and public health agency beginning in 2018 including construction of an aflatoxin testing lab in 2020 that offers affordable testing to the public.

1.5.3. Aflatoxin risk management policy

APTECA supported co-regulation policy development among Kenyan public and private stakeholders through conducting a series of high-level breakfast meetings in 2017. Participants in these discussions included senior leadership from the Agriculture Food Authority (AFA), Ministry of Agriculture (MOA), Kenya Plant Health Inspection Service (KEPHIS), Kenya Agriculture and Livestock Research Organization (KALRO), Kenya Bureau of Standards (KEBS), members of the Kenya Parliament, and industry stakeholders representing producers, grain millers, grain elevators, and animal feed manufacturers. These meetings culminated in a 5-day workshop and included regulatory mapping of agencies' aflatoxin risk management authority. Other significant outputs included establishing criteria for test kit validation within Kenya and a model bill to regulate aflatoxin risk (<http://apteca.tamu.edu/PolicyAndStrategy.aspx>). As an outgrowth of these technology and policy solutions, in 2018, APTECA began collaborations with public health agencies in Meru and Marsabit Counties and provided assistance in strategic planning, laws and government codes and schedules, testing verification, analyst qualification, and development of risk-based plans of work to mitigate aflatoxin in different market sectors (Figure 2). During the opening conference with the Meru County stakeholders hosted on the University of Nairobi campus, the Honorable Paul Mworio Baginne stated "Our people are facing easy deaths. I am glad and grateful that this project has taken place and that the people of Meru County are not going to die anymore from the poison in their food."

1.6. Training and Qualification

Since 2015, APTECA has conducted Aflatoxin Testing and Qualification Workshops in eastern and southern Africa. To date, 301 analysts from seven countries including Kenya, Rwanda, Uganda, Tanzania, Malawi, Zambia, and Zimbabwe have been qualified to accurately test aflatoxin using validated rapid test kit platforms. The workshop agenda included a morning session training participants in how to perform an aflatoxin test

and an afternoon qualification session where participants analyzed 6 samples with different aflatoxin content. Participants' performance in the qualification exercise were evaluated using the Dixon Outlier Test and those that passed the qualification exercise received a certificate and their name posted on the APTECA website (<http://apteca.tamu.edu/PDF/ParticipatingAnalysts.pdf>). The collaborating entities in this phase of the APTECA program included the Cereal Millers Association of Kenya (CMA), the Common Market for Eastern and Southern Africa (COMESA), Tanzania Bureau of Standards, Lilongwe University of Agriculture and Natural Resources (LUANAR), Malawi Grain Traders and Processors Association, University of Nairobi (UoN), World Food Program, Rwanda Agriculture Board, and Uganda Grain Traders and Millers Association. The participants and locations are listed on the APTECA website (apteca.tamu.edu).

1.7. Proficiency and Verification Process

In 2014, the proficiency testing (PT) portion of the APTECA program was implemented in Kenya and expanded to COMESA countries in 2015 and globally in collaboration with FAO in 2016. The reference material and aflatoxin proficiency testing programs were accredited under ISO 17043 and ISO 17034, respectively, in 2017. Since its establishment, the APTECA program has assisted 324 laboratories in 71 countries improve aflatoxin testing accuracy including 101 public health and regulatory agencies serving a population of approximately 5.3 billion, of whom 2.9 billion are in low and lower middle income countries based on World Bank lending group categories. In 2021, APTECA offered fumonisin proficiency testing to 50 laboratories in 21 countries including 10 countries in the low and lower middle income categories.

APTECA established ISO 17025 accredited laboratories on the International Livestock Research Institute (ILRI) in Nairobi and on the University of Nairobi Chiromo campuses in 2015 and 2017, respectively to support verification of stakeholder test results.

1.8. Management and Recordkeeping

Food safety plans and control charts are important elements of an aflatoxin risk management system and are implemented by APTECA participants. The food safety plan provides an auditable document and its implementation includes frequent analysis of reference material suitable for control charts and provide records for third party evaluation by APTECA. The evaluation of these plans and implementation records occurred in 2014, 2015, 2020 and 2021 among Cereal Millers Association members. APTECA adoption by Kenya county public health agencies enable aflatoxin monitoring and corrective actions including removal of aflatoxin contaminated product found in school food programs and hospitals and has help prevent importation of contaminated products entering Kenya's northern border.

Action Items and Future Collaborations Identified by Rwandan participants following the APTECA Presentation included:

- Expanded participation in the APTECA PT program,

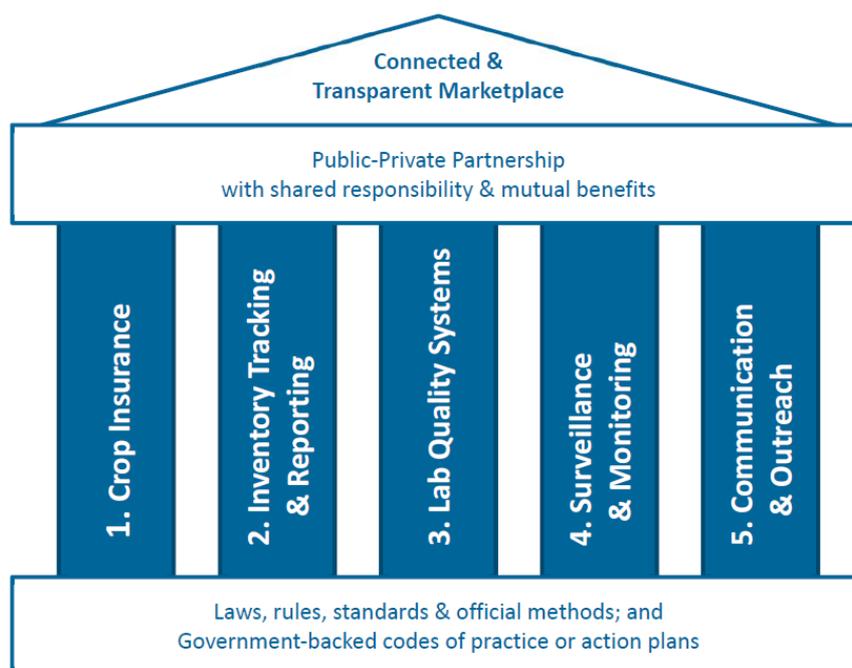


Figure 2: Pillars of a public-private partnership built upon laws, rules, standards and government-backed codes of practice that lead to a connected and transparent marketplace.

- Technical assistance to the formal and informal sector on testing and sampling,
- Assistance in ISO accreditation including development of a reference material production program,
- Assistance with agriculture and public health agencies in policy and risk management strategies.

2. Discussion and Questions

The vibrant discussion in the Q&A reflected participants' internalisation and engagement with the presentations. The comments centered around the cost effectiveness of Aflasafe, the need for coordinated aflatoxin data collection, and expanding focus to other mycotoxins. Herrman and Konlambigue stated that the threat posed by fumonisin is as pervasive as aflatoxin and is more challenging to measure. Herrman, however, noted the increasing accuracy of test kits, which allows for reliable tests for both aflatoxin and fumonisin. Konlambigue echoed previous speakers and reiterated the need for a more granular risk assessment for aflatoxin. Plugging the data gap calls for coordination between public and private actors in the agriculture and health sectors, for example, through Rwanda's Technical working group for aflatoxin. Dr. Hoffmann noted that drying and storage technologies, which proved effective for aflatoxins, simultaneously address other mycotoxins.

3. Supplemental Information

3.1. Event Details

Name of the Event: Market-Driven Strategies for Combating Aflatoxins in Rwanda

Date of the Event: August 18th, 2021

Modality of the Event: Online Webinar

Speakers: Dr. Charles Bucagu (Deputy Director General, Rwanda Agriculture and Animal Resources Board, Richard Newfarmer (Country Director for IGC Rwanda and Uganda); Illuminee Kamaraba (Division Manager for Crop Post Harvest Management); Konlambigue Matieye-dou (Country Representative for IITA Rwanda); Vivian Hoffmann (Senior Research Fellow, IFPRI); Tim Herrman (Professor, Texas A&M University)

Attendance: 43

Sponsoring Organizations(s): International Growth Center

3.2. Participants

- Byinshi Benjamin, Data Analyst, Vanguard Economics, Rwanda
- Gilberthe Uwera Benimana, Research Analyst, International Food Policy Research Institute, Rwanda
- Jonathan Bower, CE, International Grains Council, Rwanda

- Annie Chapados, Livelihoods Advisor, Foreign, Commonwealth & Development Office, Canada
- Duncan Cheruiyot, Row & Forage Cropping Systems Enterprise Lead, RICA, United States of America
- Regina Eddy, Partnership Development, United States Agency for International Development, United States of America
- Mukarugwiza Esperance, Deputy Team Leader for Improving Market Systems in Rwanda for Agriculture, Palladium, Rwanda
- Eric Gatera, CTA, MINAGRI, Rwanda
- Andre Gatete, Ag. Agriculture Production & Nutrition Policy Specialist, Ministry of Agriculture & Animal Resources, Rwanda
- Richard Habimana, Lecturer, University of Rwanda, Rwanda
- Jean Claude Hakizimana, Senior Research Fellow/Program Leader Rwanda, World Relief, Rwanda
- Patrice Hakizimana, Agriculture and Rural Development Specialist, United States Agency for International Development-Rwanda, Rwanda
- Britta Hansen, New Business Development Manager, Land O'Lakes Venture37 TRASE Project, United States
- Paul Hategekimana, Business Advisor, Agriterro, Rwanda
- Sabine Abewe Hategekimana, Animal Products Supply Chain & Market Analyst, Ministry of Agriculture & Animal Resources, Rwanda
- Linda Korir, Director, Zakenafrigue, Kenya
- Eugene Kwibuka, Agricultural Information & Communication Programme Manager, Ministry of Agriculture & Animal Resources, Rwanda
- John Lamb, Senior Advisor in Agribusiness & Food Security, Food Know, United States of America
- Carol Murekezi, SPS Advisor, Land O'Lakes Venture37 TRASE Project, Rwanda
- Narcisse Ndagihimana, Regional Director, International Development Organization-Hinga Weze, Rwanda
- Domnique Savio Nkunda, Food Processing Enterprise Lead, Rwanda Institute for Conservation Agriculture, Rwanda
- Peter Ntaganda, Advisor to the Minister of State, Ministry of Agriculture & Animal Resources, Rwanda
- Madjaliwa Nzamwita, Research Associate/Coordinator of Aflasafe project in Rwanda, Consultative Group for International Agricultural Research, United States
- Lakshmi Prasanna, Senior Scientist, Indian Council of Agricultural Research- India Institute of Rice Research, India
- Tunde Raji, Business Development Manager, Harvest Field Industries Nigeria Limited, Nigeria
- Kathryn Rendon, Managing Director, AflaSight, United States of America
- Gracie Rosenbach, Country Program Manager, International Food Policy Research Institute, Rwanda
- Raphael Rurangwa, Technical Advisor to National Agricultural Export Development Board, RAI, Rwanda
- Antoinette Sallah, Consultant, AE Consulting, United Kingdom
- Alexandra Sanderson, Director, Kumwe Consulting, Rwanda
- Mugabo Serge, International Food Policy Research Institute, Rwanda
- Margo Siemer, Private Enterprise Officer, United States Agency for International Development, United States of America
- Francois Sihimbiro, Consultant, EGIS, Rwanda
- Dr. Vince Sinining, Senior Advisor, Rwanda Action for Environment Protection and Promotion of Agricultural Sector, Rwanda
- David Spielman, Country Program Manager, International Food Policy Research Institute, Rwanda
- Dick Tinsley, Prof. Emeritus, Colorado State University, United States of America
- Bill Thomas, BEO, United States Agency for International Development- Bureau for Resilience & Food Security, United States of America
- Esther Tumuhairwe, Admin and Financial Assistant, International Food Policy Research Institute, Rwanda
- Jean de Dieu Umutoni, Business, Market and Finance Development Lead, Cultivating New Frontiers in Agriculture, Rwanda
- Aline Umwari, Field Operation, Vanguard Economics, Rwanda
- Carl Wahl, Senior Agriculture Advisor, United States Agency for International Development-Bureau for Humanitarian Assistance, United States America

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