



AGRESULTS NIGERIA AFLASAFE™ CHALLENGE PROJECT – FINAL REPORT

2013 – 2019

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TABLE OF CONTENTS

INTRODUCTION	1
Project Goals	1
PROJECT THEORY OF CHANGE.....	1
CONTEST DESIGN.....	2
Original Contest Design and Prize Structure.....	3
Original Verification Design	3
Pre-Launch Phase and Design Modifications.....	4
Final Contest Design and Prize Structure.....	5
PROJECT IMPLEMENTATION.....	6
Competitor Outreach and Engagement.....	8
Technical Assistance	8
Implementation Challenges and Adjustments.....	10
VERIFICATION	11
Sporulation Verification	12
Sampling Process	12
Aflasafe™ and Aflatoxin Testing.....	13
PRIZE DISTRIBUTION AND PAYMENTS	13
EMERGING TRENDS AND SHIFTS DURING THE COMPETITION.....	14
Changes in Competitor Business Models.....	14
Growing Confidence in the Technology.....	15
The Emergence of a Premium Market.....	15
Financial Challenges of Input Delivery.....	16
Partnerships and Advocacy among Competitors.....	16
Training, Inputs, and Access to New Markets for Smallholder Farmers.....	16
Competitor Investments	17
COMPLEMENTARY EFFORTS AND PROJECT CLOSEOUT	18
ATTC/HarvestField	18
Year 5 Project Extension in 2019	18
Cooperation Forum for Aflatoxin-Reduced Agricultural Products (CFARAP)	18
Project Closeout.....	19
The Government’s Role in Aflatoxin Regulation.....	19

PROJECT RESULTS AND IMPACT.....	19
EVALUATION FRAMEWORK AND ASSESSMENT	20
Evaluation Approach.....	21
Evaluation Findings	21
LEARNING	22
1. Lesson One.....	22
2. Lesson Two.....	23
3. Lesson Three	23
4. Lesson Four	23
CONCLUSION	24
APPENDIX.....	25
Secretariat and Evaluator Learning Materials	25
News and Blog Coverage of the Nigeria Aflasafe™ Challenge Project.....	26

INTRODUCTION

More than 4.5 billion people in developing countries are exposed to aflatoxins, one of the world’s most carcinogenic substances, through their diets. Produced by a group of molds called *Aspergillus fungi*, aflatoxins often contaminate groundnuts and grains such as maize. In Nigeria, 60% of maize has high levels of aflatoxin. Solutions exist: Biocontrol, which involves applying non-toxic strains of *Aspergillus* to push out the aflatoxin-producing strains and reduce contamination, has been proven effective. Developed by the International Institute of Tropical Agriculture (IITA), Aflasafe™ is one such product that can tackle aflatoxin strains in Nigeria. However, widespread contamination continues because not enough actors in the maize value chain know about the dangers of aflatoxins or possible solutions such as Aflasafe™.

The AgResults Nigeria Aflasafe™ Challenge Project (the “Project”), which ran from 2013 to 2019, used a Pay-for-Results (PfR) prize competition to motivate the private sector to overcome critical barriers preventing widespread adoption of Aflasafe™ among Nigerian smallholder farmers working in the maize sector. By providing an incentive, the Project successfully catalyzed private sector actors in Nigeria’s maize value chain to deliver Aflasafe™ to farmers. As more farmers learned how to correctly apply this biocontrol agent, they produced higher-quality maize with reduced levels of aflatoxins allowed by the U.S. By tying a monetary prize to a healthier and safer product, the Project increased awareness of aflatoxins and built market linkages that created a premium market.

This final report describes the Project’s goals, approach, results, and lessons learned.

Project Goals

1. Improve health outcomes by increasing consumption of aflatoxin-reduced maize through supply and demand increase.
2. Build a sustainable market for Aflasafe™ and aflatoxin-reduced maize.
3. Generate economic benefits for smallholder farmers through linkages to premium markets for aflatoxin-reduced maize.

PROJECT THEORY OF CHANGE

AgResults' Theory of Change rests on the idea that, if appropriately incentivized, the private sector will respond by creating and scaling new technologies to benefit smallholder farmers. Nigeria’s PfR incentive

Overall Project Results

- \$3,065,243 awarded in prizes
- 75,788 smallholder farmers reached
- 41 competitors participated
- 315,333MT of Aflasafe™-treated maize produced
- 213,510MT of Aflasafe™-treated maize aggregated
- 50,740MT of Aflasafe™-treated maize produced for home consumption
- 10.7% average market premium created

Lessons Learned

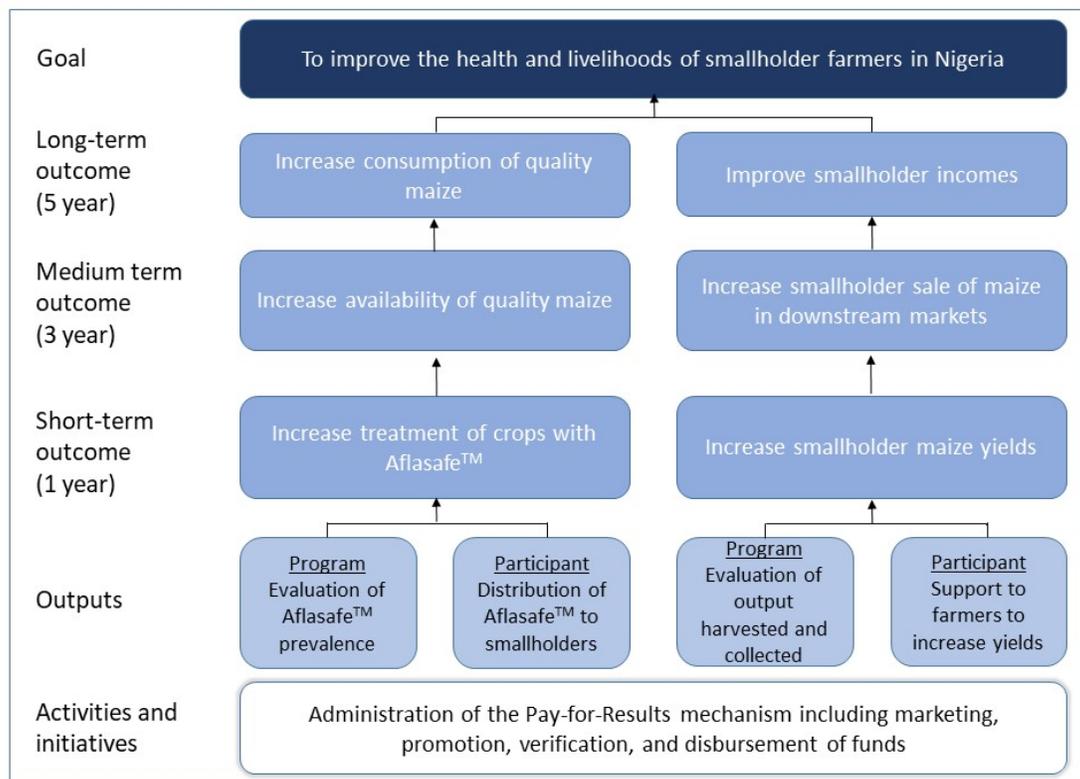
- An appropriate design can incentivize diverse private sector actors to participate and expand their operating model in a new or developing market targeted by the prize.
- Project design should build in time for early adopters to test a new product so they can be convinced of its utility before they commit to and adopt the product
- Prize verification can serve as a de facto quality certification of products or services, which can attract more participants to compete.
- A prize competition that incentivizes uptake of a specific agricultural product — even one where users may not readily see the benefits — can improve value chain relationships with smallholder farmers.

promoted the widespread use of Aflasafe™, ultimately aiming to improve the health and livelihoods of smallholder farmers in Nigeria. Aflatoxin-reduced maize would benefit smallholder farmers through two longer-term outcomes:

- Increase their consumption of higher-quality and healthier maize.
- Improve economic benefits by linking them to previously inaccessible premium markets.

The Project would increase awareness of aflatoxin contamination and inform farmers, processors, and other stakeholders in the value chain of the benefits of Aflasafe™. To increase smallholder farmer consumption of a healthier product, AgResults would incentivize the treatment of maize with Aflasafe™, which would increase the availability of this quality maize. AgResults would leverage the prize incentive to build a sustainable market for Aflasafe™, reducing the prevalence of aflatoxins in Nigeria. Once sufficient volume of maize was generated and public awareness as well as consumer demand grew, the Project aimed to encourage policy change to enforce domestic and international quality standards. Figure 1 illustrates the full Theory of Change, showing how the proposed intervention would spark a series of short-term outputs to achieve the Project’s long-term outcomes.

Figure 1: Nigeria Aflasafe™ Challenge Project Theory of Change



CONTEST DESIGN

Based on the Theory of Change articulated above, AgResults designed a results-based competition that would encourage private sector actors in the maize value chain, such as aggregators and offtakers, to work with smallholder farmers to properly apply Aflasafe™ to their maize. A verification process would

determine if competitors met the prescribed requirements to receive a prize payment. However, during a pre-launch phase in 2012, AgResults identified several issues that prompted changes to the original competition design, pushing the launch to 2013. This section explains how AgResults developed and honed the Nigeria contest design.

Original Contest Design and Prize Structure

Using the information from the Theory of Change, AgResults developed a prize structure to encourage private sector actors in the maize value chain such as aggregators and offtakers to work with smallholder farmers to properly use Aflasafe™ in their maize production. For every metric ton (MT) of aggregated maize that underwent laboratory testing and had a minimum required amount of Aflasafe™ strains present in the maize, competitors would receive a prize payment. If the maize passed testing, then the competitor would receive up to \$18.75 for every metric ton of Aflasafe™-treated maize. Maize with ≥69% Aflasafe™ would be eligible for the full prize amount. Maize with 50-69% Aflasafe™ prevalence would qualify for half of the prize and maize that contains <50% Aflasafe™ prevalence would not receive a prize. Competitors would receive prize payments each month after the Aflasafe™ testing was completed. Figure 2 on the next page illustrates the original contest design.

This per-unit prize aimed to incentivize widespread adoption of Aflasafe™ among smallholder farmers in Northern and Central Nigeria. To participate, competitors had to work with a minimum of 500 smallholder farmers to train them in proper use of the biocontrol agent. The participating smallholder farmers had to each cultivate 2 ha or less of land.

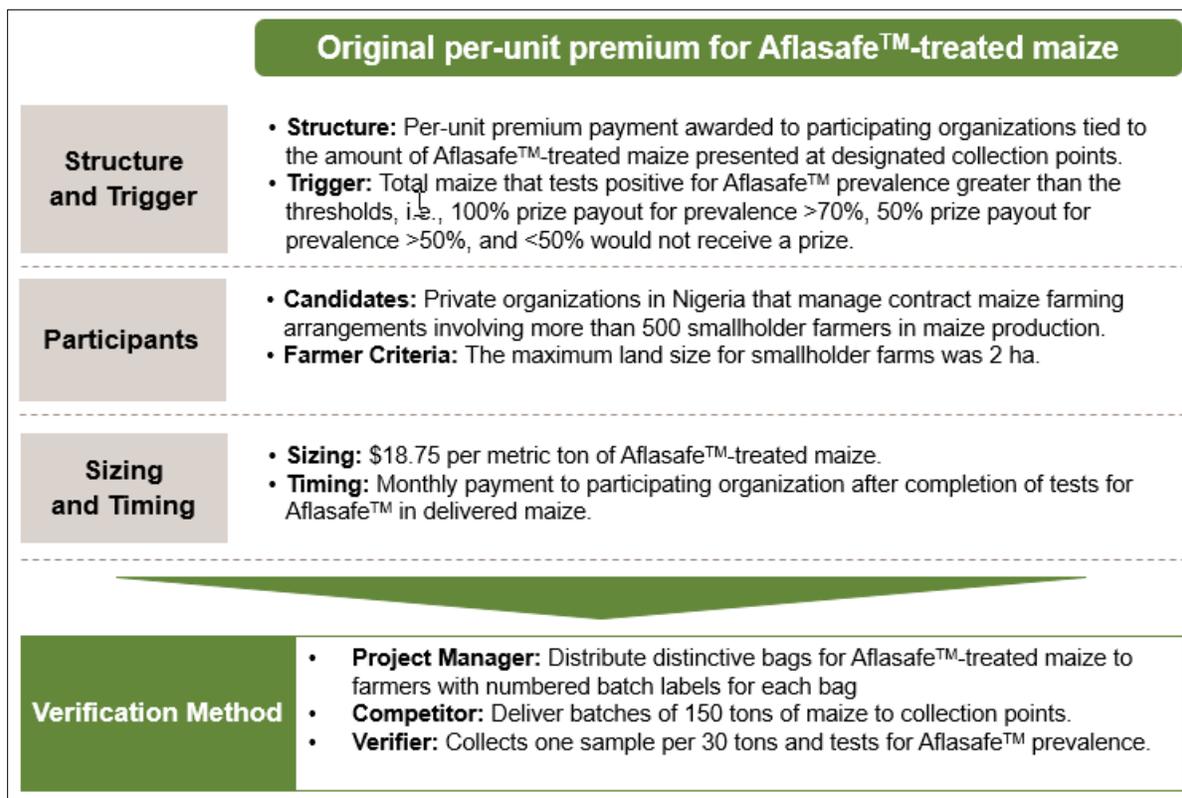
Original Verification Design

All AgResults projects include a verification process to determine if competitors meet the prescribed requirements to qualify for a prize. In Nigeria, AgResults used three verification processes to confirm if smallholder farmers properly applied Aflasafe™ to the aggregated maize. Figure 2 on the next page summarizes the original verification design:

1. **Field verification of sporulation¹:** During this process, the Project would inspect each farmer's field to verify appropriate application of Aflasafe™. Specifically, the Project would monitor Aflasafe™ grains with visible sporulation (i.e., green fungal growth) by the atoxigenic strains.
2. **Maize sampling:** During the field inspections, the Project Manager would collect a representative number of maize samples from each competitor for laboratory testing.
3. **Laboratory testing for aflatoxin and Aflasafe™ levels in the aggregated maize:** This process would test the collected samples for the prevalence of Aflasafe™, beyond simply reduced levels of aflatoxins, to determine if competitors had applied it properly and qualified for a prize.

¹ Aflasafe™ grains with visible sporulation (i.e., green fungal growth) by the atoxigenic strains were monitored. The fungal growth on the carrier (sorghum) typically occurs between 5 to 15 days after application.

Figure 2: Original Prize Structure and Verification Design



Pre-Launch Phase and Design Modifications

In 2012, the Project kicked off with a pre-launch phase during which the AgResults aimed to coordinate with the government, validate the business plan assumptions, finalize the verification approach, and reach out to potential competitors. This pre-launch phase design review identified several issues in the project’s design that prompted changes to the competition design, pushing the launch to 2013. Through conversations, stakeholders highlighted the need to modify the contest based on updated information (see Figure 3):

Figure 3: Modifications to the Nigeria Prize Structure

	Original Design	Situation	Modification
Prize Structure	Competitors with maize that has ≥69% Aflasafe™ prevalence will be eligible for the full prize amount. Maize with 50-69% Aflasafe™ prevalence qualifies for half of the prize. Competitors with maize that contains <50% Aflasafe™ prevalence would not receive a prize.	Testing was time-consuming, and segmenting prizes would further lengthen verification and delay prize payments. Given this, the Verifier recommended changing the testing to a pass/fail structure. This would lessen competitor confusion and make it simpler to segment the results.	Competitors that aggregated maize with ≥70% Aflasafe™ prevalence would be eligible for 100% of the prize. Maize with <70% of Aflasafe™ prevalence would not qualify for any prize.

Frequency of Prize Payouts	Prizes would be paid to qualified competitors each month after the Aflasafe™ tests were completed.	Verification was time-consuming and costly, and the number of samples collected for testing were based on the total volume of maize aggregated, which led to the annualization of testing and prize payments.	Due to the time required to conduct laboratory testing, participating competitors would receive prize payments annually after the Aflasafe™ tests were finalized, compiled, and reviewed.
Competition Area	The competitors had to work with smallholder farmers in North and Central Nigeria.	The Feed Producers Association and the Poultry Producers Association lobbied for an expansion of the Project to include potential competitors from the Southern provinces.	The Project expanded to include competitors across Nigeria.
Farmer Criteria	The maximum size for smallholder farms was 2 ha.	Many smallholder farmers had more land or multiple crops planted concurrently and would not qualify as beneficiaries under these criteria.	The Project increased the maximum acceptable size of smallholder farms to 10 ha. However, no more than 5% of each competitor's farmer population could be above 5 ha. This way, the Project could focus on increasing yield and income of farmers with smaller plots of land.
Implementer Criteria	Only competitors with a minimum of 500 farmers could join the competition.	Because the contest format was unfamiliar, most companies wanted to initially join with fewer farmers until they tested the efficacy of Aflasafe™. Only then did they feel comfortable gradually increasing the number of smallholder farmers.	The Project reduced the minimum farmer competitors had to work with from 500 to 300 farmers.

Final Contest Design and Prize Structure

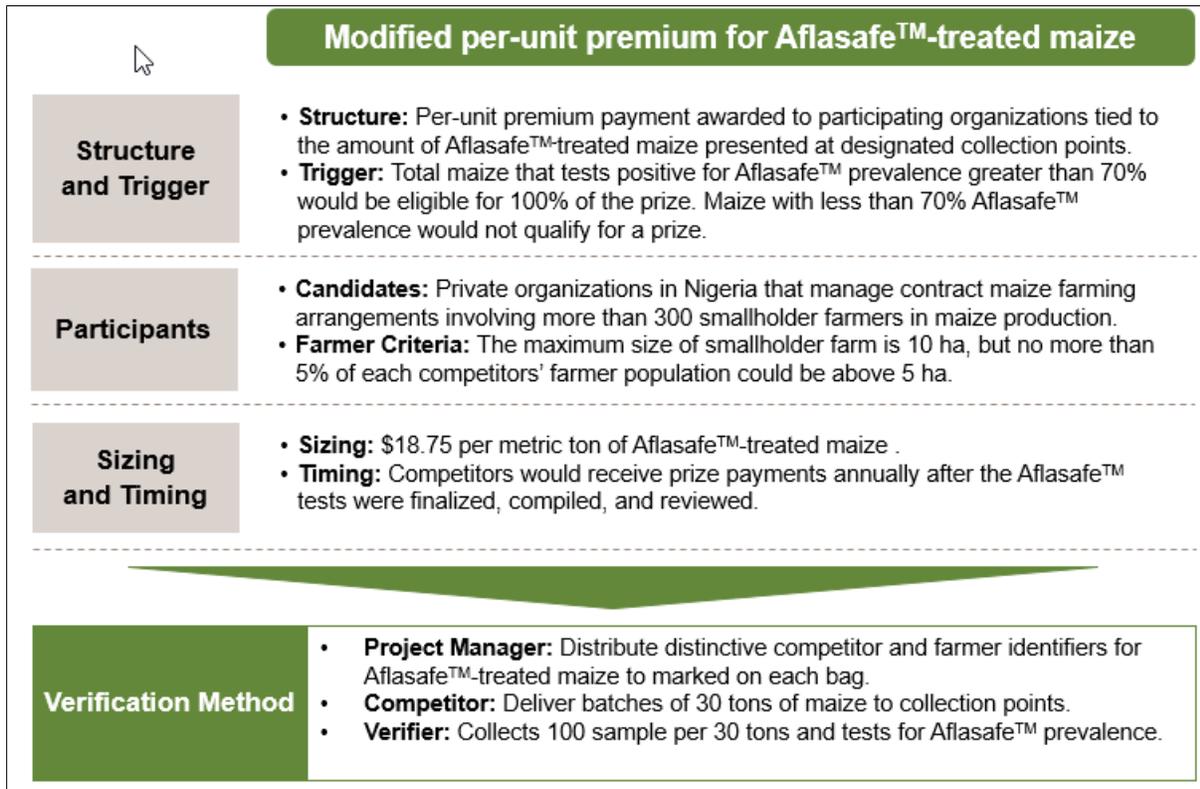
As Figure 3 shows, AgResults modified the design to better reflect the local situation and influences. Some elements remained the same, such as competitors receiving a prize for every metric ton (MT) of aggregated maize that underwent laboratory testing and had a minimum required amount of Aflasafe™ strains present. If the maize passed testing, then the competitor would receive up to \$18.75 for every metric ton of Aflasafe™-treated maize. Yet there were also some changes: Maize with $\geq 70\%$ Aflasafe™ would be eligible for the full prize amount, and maize that contains $< 70\%$ Aflasafe™ prevalence would simply not receive a prize. Competitors would receive prize payments each year after the Aflasafe™ testing was completed.

To participate, competitors had to work with a minimum of 300 smallholder farmers to train them in proper use of the biocontrol agent. The participating smallholder farmers could be located anywhere in Nigeria and cultivate up to 10 ha of land. However, no more than 5% of each competitor's farmer

population could be above 5 ha to ensure the Project focused on increasing yield and income of farmers with smaller plots of land. Figure 4 illustrates the final prize structure in more detail.

Following these changes, the Nigeria Project launched on April 2013 in an event that brought together members of the local Advisory Committee, aggregators, the Project Manager, and the Verifier.

Figure 4: Final Prize Structure and Verification Design



PROJECT IMPLEMENTATION

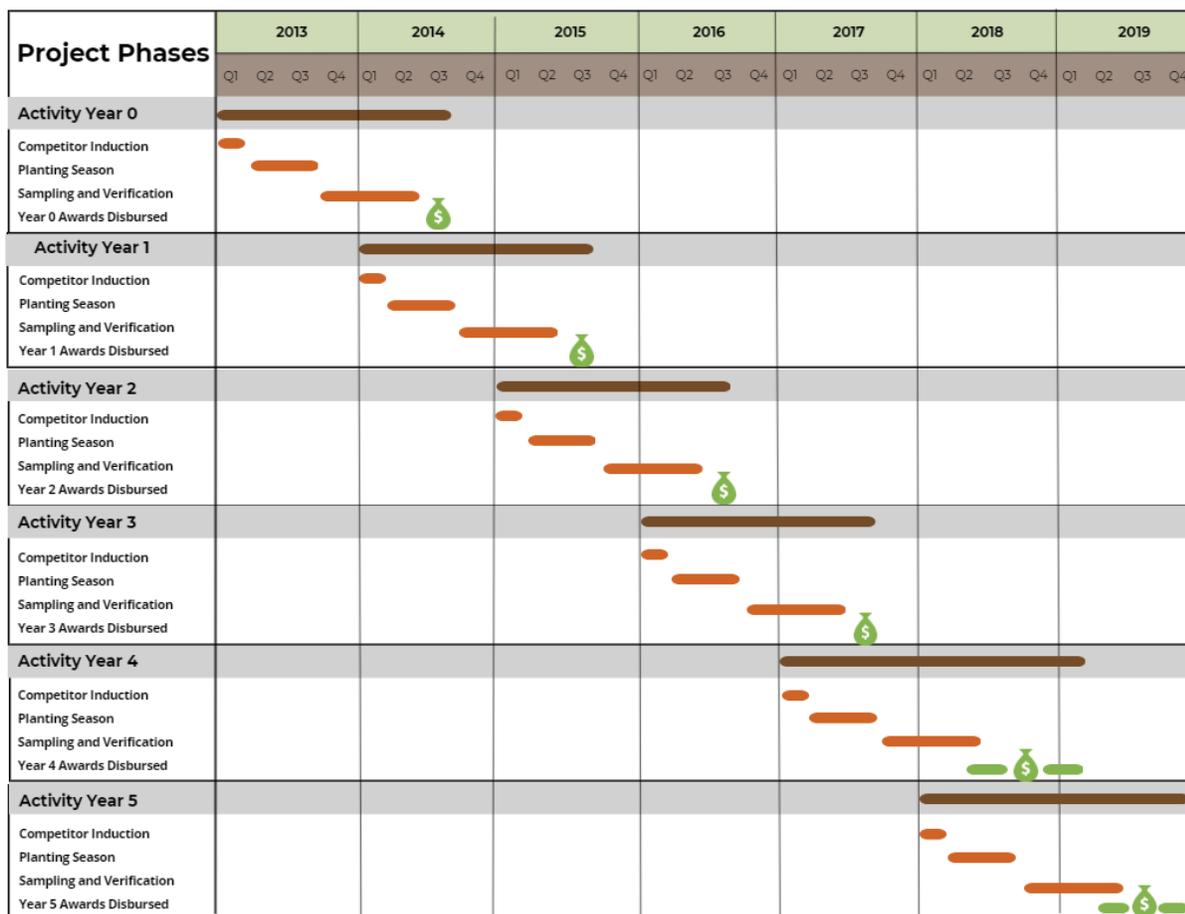
After the Project launch, implementation kicked off in April 2013, first with competitor selection and then a series of activities such as capacity building workshops and innovation platforms to strengthen individual companies and establish relationships. The Project Manager primarily led these activities with oversight from AgResults. These annual activities aimed to jumpstart a market and positioned the competitors to conduct mandatory Project activities, such as delivering inputs and training to smallholder farmers, aggregating maize, and providing samples of maize for testing. The verification process determined which competitors qualified to receive prize payments. During the competition, several implementation challenges arose – fall army worm infestations, conflict in the North, and limited access to finance – that impacted competitors’ ability to participate.

A Note on Timing: Year 0 and Year 5

AgResults adjusted the Project’s timeline in two ways: During the first year, three issues slowed participation and delayed competitor distribution of Aflasafe™ to smallholder farmers. First, competitors were reluctant to adopt a new product without first testing and demonstrating its efficacy. Second, some aggregators were in the incipient stages of aggregation and still acquiring warehouses for storage. Third, the Project was still figuring out how to gather and mark maize samples for verification. Due to these issues, AgResults decided to reframe this baseline year as “Year 0.” By the following year, these initial start-up issues had been resolved, sparking slow growth in “Year 1.”

In the competition’s planned final year (Year 4, 2018), AgResults decided to extend the Project by a year to investigate competitors’ and farmers’ response to a lower prize incentive as the market for aflatoxin-reduced maize developed. Year 5 is discussed further in this report. Figure 5 shows the full competition timeline.

Figure 5: Nigeria Aflasafe™ Challenge Project Timeline



This section explores implementation in detail and covers the following topics:

- Competitor outreach and engagement
- Technical assistance
- Competitor activities
- Responses to implementation challenges

Competitor Outreach and Engagement

To identify suitable applicants for the competition's first year in 2013, the Project engaged a selection committee comprising the Project Manager (PM), a member of the AgResults Advisory Council, and an external agribusiness consultant. In the first stage of selection, each committee member scored the applications individually and collectively developed a shortlist by comparing and calculating their scores for each applicant. Only those that passed this initial process moved to the second stage.

In the second stage, the PM conducted field visits to the potential competitors to verify the information in their application. These trips confirmed that interested companies had the appropriate registration documentation and were in good financial standing to participate. Both stages of the selection process were essential to reduce the chances of selecting fake companies and to ensure that potential competitors had the capacity to participate in a prize competition. Applicants that met all the selection criteria were accepted into the competition.

The competition engaged a diverse pool of private sector actors, some of which were grain traders or input providers, to develop as “aggregators.” This term referred to competitors that had to perform the following actions to qualify for a prize:

- Work with a minimum number of smallholder farmers (300) with no more than 10 ha of land per smallholder farmer
- Provide Aflasafe™ to participating smallholder farmers
- Provide technical assistance to participating smallholder farmers
- Provide some or all required inputs as production finance for smallholder farmers to repay after harvest
- Aggregate (store, handle, market) Aflasafe™-treated maize and deliver to end consumers such as feed mills, fish producers, poultry operations, and human consumption food processors

After the first year, the Project distributed a request for applications (RFA) annually to private sector agribusiness companies as well as through print media. The RFA explained the terms of the competition, including eligibility and participation requirements, verification, and incentive payments. New potential participants followed same selection process as in the first year of the competition.

Technical Assistance

Following initial competitor outreach and engagement, AgResults conducted technical assistance in the form of induction and capacity building workshops and innovation platforms. These “push” activities laid the foundation for competitors to build relationships with other actors in the maize value chain and perform mandatory Project activities.

Induction and Capacity Building Workshops

Given the complexities of applying Aflasafe™, the Project led induction and capacity building workshops for competitors to learn more about the Project as well as proper use of the technology. These workshops taught competitors how to combine technical assistance with input provisions and promote the use of improved seed and inputs to increase productivity and yields.

AgResults aimed to shift long-term behaviors of private sector actors involved in the maize sector, so in the first year, the Project held a Competitor Induction and Capacity Development workshop to disseminate detailed information about the PFR initiative. The workshop trained competitors and farmers on the proper use of Aflasafe™ and shared good agronomic practices to increase maize production. It also

provided competitors with agribusiness principles for proper organizational management as it related to the competition. By providing some “push” technical assistance, the Project enabled private sector actors along the value chain to get up to a minimum standard of maize practices.

The workshop also formally welcomed participants into the competition through the official signing of their competitor agreement with the PM. The PM reviewed each party’s responsibilities, focusing on verification and implementation. Competitors used this time to ask clarifying questions before the contest launched. Following positive feedback, the PM conducted similar events in subsequent years.

Innovation Platforms

Beyond building individual competitor capacity, AgResults was keen to strengthen business linkages between different actors along the maize value chain. Starting in the first year, the Project held annual Innovation Platforms to facilitate business relationships between the competitors and food processors (flour mills and snack producers), feed producers (fish and poultry feed), and international exporters. These gatherings helped competitors engage with buyers and market their products to fit the competitors’ business models. Although the Project organized the platforms, participation in these events was individually funded by the competitors.

Through the Innovation Platforms, competitors gained a better understanding of market challenges by discussing market requirements (quality, quantity, and time of sales) with buyers as well as supply and demand of aflatoxin-reduced maize. As a result, competitors strengthened their business relationships with end users of maize. These forums also allowed competitors to discuss common business challenges and learn from each other.

Competitor Activities

During each season, in addition to delivering inputs to farmers, leading Aflasafe™ application training, and aggregating maize, competitors had to provide samples of aggregated Aflasafe™-treated maize for verification testing. A key activity was for competitors to not only deliver Aflasafe™ to farmers but also train them on the proper application. However, farmers initially refused to use Aflasafe™ without access to other inputs that would increase their productivity, such as improved seed and fertilizer. They were cautious about the efficacy of Aflasafe™ and its incremental cost.

The Project design accounted for this, requiring competitors to facilitate farmers’ access to Aflasafe™ as well as yield-enhancing inputs and technical assistance, such as seeds, fertilizer, and improved management practices. Essentially, this meant that competitors would give these inputs to the farmers on credit. The rationale was that since the market wasn't developed and there wasn't yet a price differential for aflatoxin-reduced maize, the cost of Aflasafe™ had to be offset through productivity increases that those inputs enabled. Over time, market awareness of and demand for aflatoxin-reduced maize increased, driving up the market price differential, and farmers could justify the incremental cost of Aflasafe™. As a result, competitors began packaging Aflasafe™ with other established inputs to increase collective use.

Competitors were well-positioned to benefit their farmers in several ways: They provided inputs, training, and access to improved technologies to increase productivity. Because of their position in the market, competitors also connected farmers with buyers in premium markets and negotiated better prices for aflatoxin-reduced maize by marketing the benefits to big buyers. By learning improved agronomic practices and accessing better inputs, farmers increased maize yield and quality, which in turn boosted their incomes.

To meet verification requirements throughout the Project, competitors provided samples of the aggregated maize they collected between November and April for verification testing. Testing took place when competitors aggregated a truckload or more (30MT) of Aflasafe™-treated maize. The verification process would confirm the total amount of Aflasafe™-treated maize aggregated, as well as the levels of Aflasafe™ and aflatoxins in the maize. Results from the robust verification process provided competitors with the quality standards confirmation they needed to market their maize to buyers at a premium. In this way, verification acted as a marketing bridge between the smallholder farmers and buyers to drive awareness of the benefits of aflatoxin-reduced maize as well as a sustainable, lucrative market that benefited all parties.

Over the course of the Project, competitors had to adapt their varied business models to maximize the likelihood of scaling up the use of Aflasafe™ among their farmers. Only half of the competitors had pre-established relationships with smallholder farmers or business models that provided farmers with training and inputs as well as maize aggregation. Some provided supplies and feed to fish and poultry farmers while others were commodity traders. Figure 6 summarizes the diverse competitor pool and how they expanded their business models to better participate in the competition.

Figure 6: Competitor Categories and Shifts in Business Models

Competitor Profiles	Original Business Model	New Services
Agriculture consultancy	Outgrower management of cash crops farmers	<ul style="list-style-type: none"> • Added maize to their portfolio • Organized farmers into clusters to provide training and inputs
Commodity traders/ Commodity exchange	Commodity trading and small-scale integrated farming	<ul style="list-style-type: none"> • Provided inputs (fertilizer, Aflasafe™, training, market access) to farmers on credit • Engaged in maize resale from partner SHF instead of grain trading
Socially focused enterprise	Farming service provider offering farmers comprehensive assistance	<ul style="list-style-type: none"> • Added Aflasafe™ to the inputs package
Input supplier	Seed supplier to SHFs	<ul style="list-style-type: none"> • Trained on use of Aflasafe™ and other inputs
Feed producer and supplier	Maize-based fish and poultry feed producer and supplier	<ul style="list-style-type: none"> • Worked with SHFs to provide inputs (seed, fertilizer, Aflasafe™) and helped with land preparation
Equipment sales	Poultry farming equipment sales	<ul style="list-style-type: none"> • Provided SHFs with inputs, access to heavy machinery, and training on Aflasafe™
Maize producer	SHF-driven maize producer	<ul style="list-style-type: none"> • Provided training on Aflasafe™, post-harvest storage banks, cleaning of maize, market linkages

Implementation Challenges and Adjustments

Competitors faced three significant challenges that impacted their ability to participate or increase aggregation: (1) reduced yields caused by fall army worm, (2) limited access to farmers due to conflicts in the North, and (3) limited access to finance. As these challenges arose, the Project sought out ways to mitigate the impact and address the underlying issues.

Fall Army Worm

During the 2016-2017 season, fall army worm infestations drove down maize productivity and quality, so competitors couldn't aggregate as much maize. Previous investments made by competitors to provide farmers with inputs were lost. This situation discouraged some competitors, some of whom received smaller prizes that season than they may have under normal circumstances.

Conflict in the North

Ongoing conflict between herdsmen and farmers in Northern Nigeria had led to government curfews, reducing farmers' ability to maintain productivity and competitors' ability to engage with their farmers. These conflicts destroyed some fields, which impacted sporulation verification and other verification activities. The conflicts affected competitors for several years, reducing farmer participation and maize aggregation in this region.

Limited Access to Finance

In the Project's first year, many competitors faced significant challenges accessing finance, which in turn affected how they provided farmer training, inputs, and technical support; increased aggregation amounts through advance purchase agreements with farmers; and tapped into cash flow to withstand market fluctuations or bad crops. Since the competitors did not have the capital to pay their farmers part of or all the market price for the maize they received, they aggregated less. But accessing loans in Nigeria, especially in the agriculture sector, is difficult: Financial institutions are risk-averse in providing agricultural loans, and loans have high interest rates and require significant collateral, barring many small- and medium-sized enterprises from accessing that finance. Many of the competitors were not large enough or did not have sufficient credit history to qualify for loans, and many banks would not provide agricultural loans without a loan guarantee.

Given these challenges, the Project considered providing an incentive to help competitors deliver technical services and improved inputs to their farmers. AgResults explored two options to facilitate a loan guarantee program that could increase competitors' access to finance:

- **Collateralized Letter of Credit (LOC) with a commercial bank:** A commercial bank could administer the program and guarantee repayment up to 50% of the principle on a defaulted loan. However, because AgResults could not serve as an Account Party and commercial banks charged high fees, this option was not successful.
- **USAID DCA Loan Guarantee Program:** USAID established a loan guarantee program with three Nigerian banks, but high interest rates made the loans unaffordable.

In Fall 2016, after consultation with DFID and USAID representatives and their local representatives, it became clear the level of effort was too high for AgResults' scope. Subsequently, the Project no longer pursued a loan guarantee program to address access to finance issues. Ultimately, these financial constraints forced some competitors to drop out: Of the 41 competitors 15 reported that they dropped out due to financial constraints.

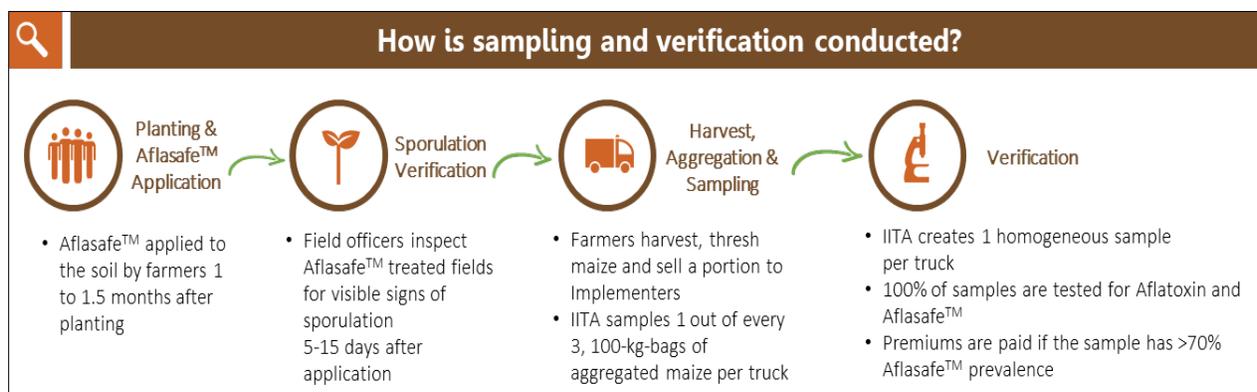
VERIFICATION

After the competitors aggregated maize from their farmers each season, the Project conducted a robust verification process to determine which competitors were eligible for the per-unit prize of \$18.75/MT

based on the prevalence of Aflasafe™. As the Contest Design Verification section explained, verification comprised three processes: (1) field verification to see if Aflasafe™ was applied to the maize at the appropriate time, (2) maize sampling process to collect a representative number of samples for laboratory testing, and (3) laboratory testing for aflatoxin and Aflasafe™ levels in the aggregated maize.

Verification followed the three steps outlined in Figure 7, beginning with sporulation verification conducting during the growing season, followed by aggregation sampling when the Verifier collected samples for testing, and finally Aflasafe™ and aflatoxin testing to confirm appropriate application.

Figure 7: Steps for Verification in Nigeria



Sporulation Verification

Before testing the maize, the Project verified Aflasafe™ application using sporulation verification of farmers' fields. The Project team visited the farmer's field to inspect if they applied Aflasafe™ appropriately as well as if competitors accurately reported field size and location and Aflasafe™ application dates.

Sampling Process

In the first year of the competition, the Project tested each bag of maize aggregated. Based on lessons learned during this first year and to streamline the process and reduce the burden on competitors and the Verifier, the Project developed a sampling protocol to compensate for the variability in maize quality among a given competitor's farmers. To reduce the variability, the Project sampled more bags (more incremental samples with less weight from each lot), and analyzed the whole aggregated sample representing 30MT (300 100kg bags) of maize, the equivalent of a truckload. The Project sampled 100 bags from each truckload, giving a 90% confidence level that the collected samples were representative of the 30MT lot with a margin of error of $\pm 7\%$. This equated to a confidence level higher than 99% with a margin of error of $\pm 1\%$, which was representative of the total number of bags aggregated over the five-month verification period.

A 50g sample was taken from every sample bag (every 3 bags in the truck). Each bag was numbered randomly to avoid sampling bias and tagged with a farmer identifier to indicate the source of the sample. This individual testing enabled competitors to know which farmers were properly applying Aflasafe™ and which farmers needed further training or support during the planting season. Through this process, many competitors reduced the percentage of failed samples and increased the volume of maize that qualified for a prize.

Aflasafe™ and Aflatoxin Testing

To test if farmers had properly applied Aflasafe™, the Project developed a scientific protocol to periodically collect samples and test the aggregated maize. The protocols measured 1) aflatoxins levels, 2) adoption, and 3) efficacy of Aflasafe™. To closely track the impact of Aflasafe™, the Project collected and tagged the samples with farmers' details and date of delivery. The samples were used to determine incidences of the four atoxigenic strains that compose Aflasafe™ using microbiological methods through the vegetative compatibility group (VCG) test. For all samples collected during the reporting period (2013-2019), DNA was extracted and sent to USDA-ARS Aflatoxin Reduction in Crops Laboratory for pyrosequencing analysis. The pyrosequencing method rapidly and independently verified Aflasafe™ strain prevalence in the maize and, in selected cases, was crosschecked with VCG results for confirmation.

For a competitor to qualify for the prize, at least 70% of each sample tested needed to be composed of the Aflasafe™ strain. The non-treated samples tested would have less than 70% of the non-toxic *Aspergillus* strains from Aflasafe™, making those samples ineligible for a prize. These tests showed that if Aflasafe™ was properly applied, the Aflasafe™ *Aspergillus* strains dominated and would push out the aflatoxins in most treated fields. This verification process would identify every metric ton that tested positive for Aflasafe™ and which competitors qualified for a prize payment.

PRIZE DISTRIBUTION AND PAYMENTS

After verification was completed each year, the Project compared the testing results with the data collected from the competitors, which included the number of samples collected, total maize production based on the numbers of farmers, farm sizes, and annual average yield. This way, the Verifier could crosscheck the data before finalizing the verification process and show the competitors which data was used to determine the prize amounts. This step also allowed competitors to review the results with the Verifier and identify which farmers needed assistance in the following years. The Project used these verification results to determine the amount of maize that qualified competitors to receive prize payments (\$18.75/MT from 2013-2018). In 2019 the testing approach remained the same, but competitors received US \$9.38 per metric ton of aggregated Aflasafe™-treated maize as per the reduced prize in the final year.

The Project determined prize payments based on the results of the sampled maize:

- If Aflasafe™ strains made up at least 70% of the recovered fungal communities from samples taken from any given truck, AgResults would pay 100% of the prize.
- If Aflasafe™ strains did not make up 70% of the examined fungal communities from samples taken from a given truck, AgResults would pay 0% of the prize.

Prize Calculation Example

Consider the following example: During the aggregation period from November to July, the Verifier collected samples from the 1000MT of Aflasafe™-treated maize aggregated by Competitor A. The Verifier tested the 1000MT samples and, based on the results of the VCG and pyrosequencing tests, determined that 900MT of maize were properly treated with Aflasafe™. With 70% or more of the Aflasafe™ strains prevalent, these 900MT are eligible for a prize payment to Competitor A. However, 100MT had less than 70% prevalence of the Aflasafe™ strains and did not qualify for a prize:

- **Total Maize Aggregated During Year 1:** 1000MT
- **Total Maize with at least 70% or more Aflasafe™ Prevalence Eligible for Prize:** 900MT
- **Total Maize with less than 70% Aflasafe™ Prevalence Ineligible for Prize:** 100MT
- **Prize per-MT (in Years 0-4):** \$18.75/MT
- **Prize Award given to Competitor A:** 900MT Aflasafe™-treated maize x \$18.75 = **\$16,875**

EMERGING TRENDS AND SHIFTS DURING THE COMPETITION

During the competition, several trends emerged, impacting competitor business models and partnerships, financial access, awareness of aflatoxins and Aflasafe™, and the market for high-quality maize. Although none of these shifts were direct Project goals, they illustrated deeper changes in the market system sparked by the prize competition.

Changes in Competitor Business Models

To succeed, all competitors had to adapt their business models, regardless of prior experience with smallholder farmers. At the beginning of the Project, most competitors were not aware of aflatoxins or were not trading aflatoxin-reduced maize. Because the competition required that aggregators provide smallholder farmers with inputs and technical assistance as well as buy back the maize, many competitors had to change their business models. Through Project support, competitors developed agribusiness management approaches suitable for their businesses that met project requirements. These management approaches included creating organizational strategic plans and business plans as well as identifying sustainable access to finance or credit to increase profit and scalability. Others began using technology in a new way to engage with their farmers. For example, some large competitors developed a mobile phone tracking system that provided technical assistance through tracking of grower activity and application of inputs. These competitors also provided some degree of production credit in the form of input provision.

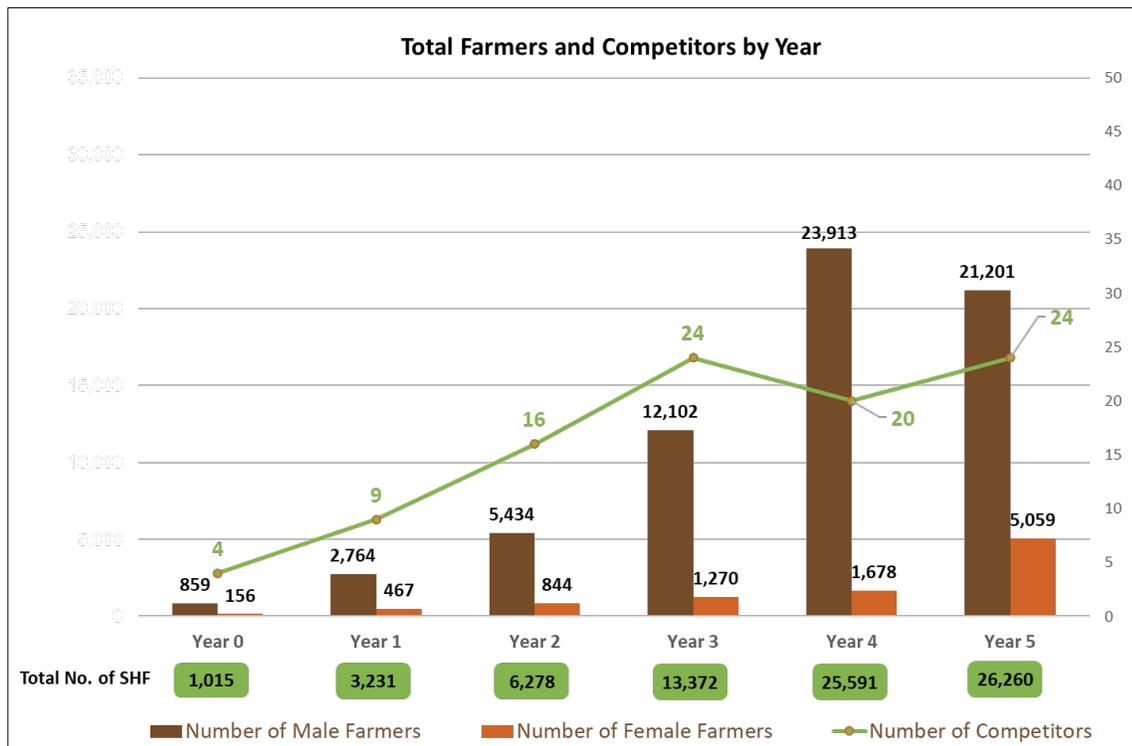
The capacity building workshops encouraged competitors to shift from a supply-driven approach to a demand-driven approach with their farmers that positioned them to produce maize that met buyers' requirements for aflatoxin-reduced maize — specifically the level of aflatoxins they could not exceed. As their relationships with smallholder farmers strengthened, competitors learned to identify different markets and buyers and meet their specific requirements. Connections made through the Innovation Platforms helped grow competitors' networks. Over time, some competitors reached out to other buyers outside of those that attended the Innovation Platforms to further expand their buyer pools and increase their access to the premium market for aflatoxin-reduced maize.

Growing Confidence in the Technology

In the competition's initial years, few companies were willing to enter because they had neither enough awareness of aflatoxins nor enough confidence in Aflasafe™ as a proven solution. Even when new competitors joined, they consistently did not involve all their farmers right away. This hesitation to invest and participate lifted only after they tested the technology themselves: First competitors tested Aflasafe™ on their land; then farmers tested Aflasafe™ on a small portion of their land. Once both groups observed the benefits firsthand, they were ready to adopt Aflasafe™ more widely. Accordingly, the Project saw a dramatic increase in adoption.

However, because early participation was so low, the Project decided to reframe the first year as a baseline year, calling it “Year 0.” As Figure 8 below shows, adoption rates were slow in Years 0 to 2 as these tests occurred. As awareness and confidence grew among both competitors and farmers, Years 3 and 4 experienced much higher adoption rates. It was during these years that a premium market for aflatoxin-reduced maize began to emerge.

Figure 8: Yearly Competitor and Farmer Growth



The Emergence of a Premium Market

Low initial participation in the competition also stemmed from the lack of a premium market for aflatoxin-reduced maize: If there was no such market, there was no economic incentive to invest in additional inputs. In Nigeria, there was minimal awareness of the dangers of aflatoxin contamination and few government regulations to manage aflatoxin levels in crops. Regulators in Nigeria did not have the capacity to enforce limits on aflatoxin contamination and were hesitant that even if they did, such

regulations – and the lack of production alternatives – could increase food insecurity. These factors combined to reduce any buyer incentive to pay more for a new product.

However, the competition’s per-unit prize provided the exact incentive needed to drive the adoption of Aflasafe™ and identify buyers who demanded higher-quality maize, such as food processors, feed producers, and international buyers. As the linkages between aggregators and farmers grew, so did community awareness of the impacts of aflatoxin consumption. Through these efforts, the Project helped to create domestic and international markets for aflatoxin-reduced maize. As supply increased and demand rose, a premium for aflatoxin-reduced maize emerged, and a new market was carved out among export markets, processors, and animal feed producers.

Financial Challenges of Input Delivery

As the section on “Competitor Activities” illustrates, because most smallholder farmers did not initially buy in to using Aflasafe™, they were hesitant to incorporate the biocontrol agent into their practices without having access to other inputs. Yet providing access to other inputs increased the financial burden on competitors: Some were delivering training and inputs to farmers but struggled to access the financial resources to aggregate the maize produced. Others, such as processors, had no experience providing trainings and inputs and were forced to change their business model and their relationship with farmers if they wanted to qualify for the prize. The competitors that adjusted their approach and provided farmers with both inputs and training helped farmers increase their yield, increasing the amount of maize aggregated and the prize that competitors received.

Partnerships and Advocacy among Competitors

Through the Project’s workshops and events, competitors established relationships with one another and regularly discussed contest challenges. From these interactions, they created an advocacy committee to lobby the government to set a standard for aflatoxin levels in crops. They first focused their efforts locally and regionally to influence policies that directly impacted their operations. This collaboration evolved into a broader partnership: When their supplies were limited, the committee of competitors worked together to access maize. By the end of the competition, demand for aflatoxin-reduced maize had gone up, and although some competitors had higher demand than supply, the partnership enabled them to collectively access enough maize to meet buyer requests.

Training, Inputs, and Access to New Markets for Smallholder Farmers

Because the Project emphasized good agricultural practices, smallholder maize farmers in Nigeria benefited from better training and inputs that in turn allowed them to access new formal markets. The Project’s annual trainings gave farmers firsthand experience on the proper use of Aflasafe™ and taught them about its benefits. Competitors and farmers valued these annual training sessions for both new and old participants because it reduced some of the training burden placed on the competitor, especially as the number of farmers increased. Hands-on training also persuaded farmers of the efficacy of Aflasafe™; with more trust came wider use, increasing the supply of Aflasafe™-treated maize that competitors could aggregate. As farmers saw the results of demonstration plots and the price premiums for aflatoxin-reduced maize, their initial reluctance faded, and they began widely adopting the product.

With increased aggregation levels and scale, some competitors found different ways to provide farmers inputs on credit through payments upon harvest. This way, competitors could help many of their smallholder farmers at the same time and provide them with inputs they normally could not access. A closer relationship between competitors and farmers emerged, and competitors began facilitating farmer

access to more prominent buyers. Farmers’ bargaining power strengthened as they gained access to premium markets, and some began moving away from selling their maize at the lower prices previously offered at the farm gate. Increased access to finance through these stronger relationships deterred farmers from side-selling, leaving more maize for competitors to aggregate for bigger prize payments.

With a stronger footing, smallholder farmers began transitioning from selling in the informal market to the formal market. Formal market sales increased from 54% in 2013 to 66% in 2017; in this same stretch, informal market sales decreased from 38% to 7%. By providing farmers with access to credit and finance, competitors could honor their sales agreement and strengthen their relationships with farmers throughout the life of the Project.

Competitor Investments

When prizes were distributed annually, most competitors reinvested it into their companies or into efforts to help farmers grow and access additional market premiums. To increase production, competitors invested their prizes in technology or equipment, storage, training, inputs, staff, and vehicles; they also invested to cover bad debt. Cumulatively, they spent more than 683,019,293 Naira in these investments (based on the fluctuating value of the Naira during the Project, this ranged from US\$1.75 million to \$3 million). Figure 9 breaks down the investments and illustrates how each benefited smallholder farmers.

Figure 9: Competitor Investments and Farmer Benefits

Investments	Benefits to Smallholder Farmers	Percentage of Overall Investments
Inputs	Supplied farmers with inputs including Aflasafe™, improved seed, and different types of herbicides and fertilizer	40%
Storage	Rented or built storage facilities for maize aggregation and safekeeping	32%
Technology/Equipment	Purchased or rented farm machinery and equipment (land preparation and harvest) and provided access to farmers to increase productivity and efficiency	9%
Training	Supplemented Project workshops and training on agribusiness, organizational management, and good agronomic practices to increase productivity	7%
Vehicles/Motorbikes	Purchased vehicles and motorbikes to more easily access farmers and effectively and efficiently monitor fields	5%
Staff	Hired additional field staff to support the overall expansion of their agribusiness and increase access to additional farmers	5%
Input Financing and Other Investments	Covered the cost of bad debt for input financing to farmers and made other minor investments to increase productivity and reduce risk	2%

COMPLEMENTARY EFFORTS AND PROJECT CLOSEOUT

As the Project progressed, several complementary efforts in Nigeria further increased awareness of aflatoxins and Aflasafe™, including the Aflasafe™ Technology Transfer and Commercialization (ATTC) project and the Cooperation Forum for Aflatoxin-reduced Agricultural Products (CFARAP). These efforts, along with a year-long competition extension to test post-Project sustainability, strengthened the enabling environment for Aflasafe™ uptake. By the time the Project closed in 2019, although government regulation was still nascent, it was clear that the demand for higher-quality maize and the accompanying health and nutritional benefits was only growing stronger.

ATTC/HarvestField

In late 2015, USAID and the Bill and Melinda Gates Foundation funded the Aflasafe™ Technology Transfer and Commercialization (ATTC) project to facilitate the responsible transfer of Aflasafe™ from IITA, a research institution, to private sector manufacturers and distributors that were better positioned to increase the scale of Aflasafe™ production and distribution. ATTC aimed to scale Aflasafe™ production and distribution in 11 additional countries, including Nigeria. As demand for Aflasafe™ increased, IITA and ATTC identified HarvestField (HIL), a private sector input provider, to take over production, distribution, and sales in Nigeria. The technology transfer from IITA to HIL began in 2016 and continued through 2019. During this time, AgResults raised competitor awareness of ATTC and informed them that Aflasafe™ production and distribution was transferring from IITA to HarvestField (HIL). In the competition's final year, IITA transferred all Aflasafe™ sales to HIL and worked with HIL to build a production facility in Lagos. At the end of the competition, HIL was stocking Aflasafe™ at outlets increasing the product's availability, and 14 competitors had placed Aflasafe™ orders for the 2019-2020 planting season.

Year 5 Project Extension in 2019

In its original design, the Project was supposed to end after four years, but to expand the reach of aflatoxin-reduced maize and drive up awareness, AgResults extended the competition to a fifth year. The additional year would provide insight into the sustainability of the Project's impact on the market for aflatoxin-reduced maize. In Year 5, which covered the 2018-2019 planting season, the prize incentive was reduced by 50% from US\$18.75 to US\$9.38. Although the prize was reduced, the Project still provided technical assistance to competitors, and competitors were still required to deliver training to their farmers. By adding a Year 5, new competitors joined, and legacy competitors gained one more year to further expand their reach and test the viability of their business models. Increases in smallholder farmer participation and in maize aggregation during this year signaled that competitors would continue working with farmers to promote the use of Aflasafe™ even after the contest ended.

Cooperation Forum for Aflatoxin-Reduced Agricultural Products (CFARAP)

At the end of the Project, IITA created a central coordinated network of stakeholders to strengthen the aflatoxin-reduced maize and groundnut value chain in Nigeria called the Cooperation Forum for Aflatoxin-reduced Agricultural Products (CFARAP). This forum, which has endured beyond the Project, aims to improve access to safer food and to improve public health through responsible cropping practices and advocacy for favorable policies and legislation. CFARAP facilitates business and financial linkages, helping agricultural entrepreneurs improve the livelihoods of smallholder farmers by creating markets for aflatoxin-reduced products and credit assistance. CFARAP also provides stakeholders with trainings and workshops on aflatoxin awareness and good farming practices, using an online platform to cultivate stronger networks among stakeholders — including buyers, input suppliers, financial institutions, policymakers, and research institutions.

Project Closeout

On September 12, 2019, the Project held its official closeout event in Abuja to recognize how the six-year prize competition promoted the delivery and adoption of Aflasafe™ and transformed the maize sector. The event brought together stakeholders from the maize sector to reflect on aggregators' efforts to transform their business models to compete and create a premium market for aflatoxin-reduced maize. A representative of the Ministry of Agriculture and Rural Development reflected on the project's achievements and the country's ongoing need to tackle aflatoxin contamination using the biocontrol technology of Aflasafe™ and the project's achievements. Government officials, competitors, other private sector actors, and smallholder farmers shared their experiences and reflected on the benefits of adopting Aflasafe™. All stakeholders expressed the need for higher volumes of aflatoxin-reduced maize and shared their plans to increase the use of Aflasafe™ — underlining the chances of sustainability.

The Government's Role in Aflatoxin Regulation

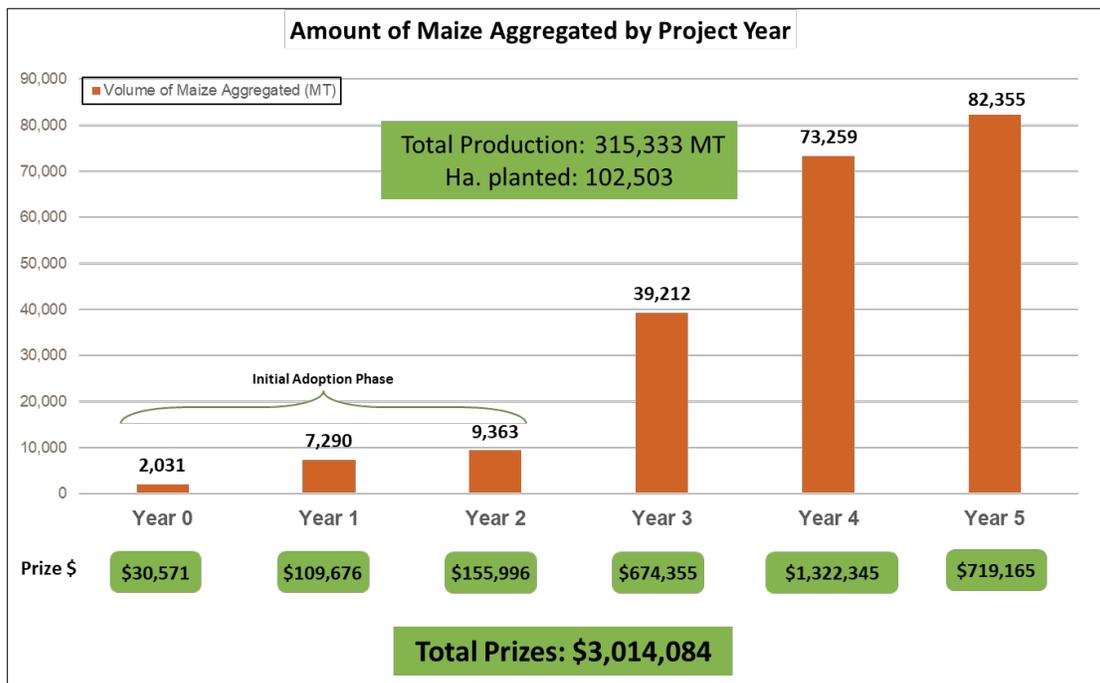
The Project aimed to give the Government of Nigeria a solution to the problem of aflatoxin-contaminated maize: Once the Project generated sufficient volume of aflatoxin-reduced maize *and* raised awareness of its benefits, the government would lead three activities to further this cause: 1) promote awareness of the benefits of Aflasafe™; 2) establish policy reforms to encourage its widespread use; and 3) implement programs to establish maize quality standards and monitor their compliance. Although the Project certainly advanced the first activity with Aflasafe™ being added to government input packages, policy reform and quality testing have not yet been achieved. Grain traders do not have access to Aflasafe™ prevalence testing but are now using aflatoxin testing to identify and promote aflatoxin-reduced grain.

PROJECT RESULTS AND IMPACT

During the competition's six years, 41 agricultural enterprises worked with 75,788 farmers who bought and applied over 1,575.9 MT of Aflasafe™. These farmers applied Aflasafe™ to more than 102,505 hectares and produced more than 315,333 MT of maize with low levels of aflatoxin contamination. Of this, farmers kept more than 50,740 MT for home consumption, and competitors aggregated 213,413 MT. The aggregated maize reflected noticeable nutritional benefits: 93% had more than 70% Aflasafe™ prevalence, and more than 90% had an average of aflatoxin levels below U.S. standards of 20 parts per billion. Based on these results, the competitors received US \$3,014,094 in prizes across the six years.

Beyond the nutritional benefits, there were significant economic benefits: On average, aflatoxin-reduced maize sold in the formal market earned a market premium of 10.7%. Figure 10 on the next page illustrates how the increased awareness and adoption drove aggregation and, in turn, prizes won by the competitors. (See Figure 8 on p. 15 for details on the total number of farmers and competitors by year.)

Figure 10: Annual Maize Aggregation Amounts in Nigeria



As Figure 10 shows, the PfR competition was a strong enough incentive for private sector actors to work with smallholder farmers and leverage a proven technology to create a market for aflatoxin-reduced maize. The participating competitors successfully bridged the gap between smallholder farmers and created a premium market for higher-quality maize with lower levels of aflatoxins.

The Project also revolutionized linkages between competitors and their smallholder farmers, enhancing livelihoods and helping some farmers progress beyond subsistence farming. The average amount of aggregated maize increased exponentially each year, from an average of 508 tons per competitor in the first year to 3,431 tons per competitor in the final year. The percentage that was annually aggregated for the formal market also grew from 36% in the first year to 64.6% in the final year, with the level of aggregation above 50% beginning in Year 2.

Based on evidence gathered by the Project, Aflasafe™ safely and effectively reduced aflatoxin levels in maize, and smallholder farmers retained a portion of their maize for home consumption. Seeing the benefits of Aflasafe™ on smallholder farmers' health and livelihoods, the Nigerian government has included the biocontrol product as a subsidized input since the Project ended. To illustrate the growing role of the public sector in this effort, during the 2019-2020 planting season, the Nigerian government purchased more than 80% of the Aflasafe™ sold; less than 20% was purchased by private sector buyers.

EVALUATION FRAMEWORK AND ASSESSMENT

In parallel to project implementation, Abt Associates, in partnership with Denise Mainville Consulting, serves as one of the External Evaluators for AgResults. The evaluator employs a common framework to examine how each Challenge Project incentivizes the private sector to develop markets and agricultural technologies that enhance the welfare of smallholder farmers.

Evaluation Approach

The evaluator used mixed methods to evaluate the Challenge Project in Nigeria. To assess the Project's impact on the market for Aflasafe™-treated maize, as well as the likely sustainability of that market, the evaluator used qualitative methods. To estimate the Project's impact on smallholder maize farmers' uptake of Aflasafe™, net maize revenue, and demand for Aflasafe™-treated maize, the evaluator used a quasi-experimental design. The evaluator also drew on cost and monitoring data to evaluate the Project's cost-effectiveness and scale.

Evaluation Findings

- **Development of the market for Aflasafe™-treated maize:** The Project actively engaged a diverse set of private sector actors to create a niche market for Aflasafe™-treated maize. That market reflected niche demand for treated maize, a burgeoning supply base, and preconditions for further expanding demand through regulatory enforcement and greater awareness creation.
- **Impacts on smallholder farmer adoption of Aflasafe™:** The Project positively impacted the uptake of Aflasafe™. Smallholder farmers pre-identified by competitors as likely to engage with the Project were 56 percent more likely to use Aflasafe™ than similar smallholder farmers in different geographic areas where competitors did not operate (57 percent compared to 1 percent).
- **Impacts on smallholder farmer revenue:** Among farmers pre-identified by competitors as likely to engage with the Project, the Project increased farmer average annual net revenue from maize by 16 percent (an increase of US\$318, from US\$1,987 to US\$2,305).
- **Impacts on smallholder farmer demand for Aflasafe™-treated maize:** Among farmers pre-identified by competitors as likely to engage, the Project increased the amount of Aflasafe™-treated maize consumed by 0.02 kg per person per day, about 12 percent of the average amount of maize consumed per person per day. Half of the smallholder farmers who used Aflasafe™ knew that aflatoxins are a health risk, but only 6 percent of household cooks (usually the wife) knew that aflatoxins are a health risk. The evaluation noted that with the availability of favorable markets for Aflasafe™-treated maize (usually through competitors) and the lack of knowledge about aflatoxins, smallholder farmers may have preferred to sell Aflasafe™-treated maize rather than consume it. The evaluation did not track the Project's effect on health outcomes.
- **Cost-effectiveness:** Cost-effectiveness is the measure of cost per unit of impact. In this case, evaluators looked at impact from two perspectives: households reached (farmers who applied Aflasafe™ in at least one crop) and maize produced (metric tons of Aflasafe™-treated maize). The cost per household reached was US\$134, while the cost per metric ton of Aflasafe™-treated maize was US\$48.
- **Sustainability:** Although competitors showed substantial enthusiasm for and commitment to continuing the Aflasafe™-treated maize market, the evaluator's analysis suggests that competitors' investment is likely to decline after the Project has ended. Two major and related factors contributed to this finding. First, competitors face financial risk due to the endemic instability of Nigeria's maize markets, which is regularly affected by changes in climate (drought) and import/export policies. Without the AgResults incentive, investment in Aflasafe™-treated

maize is relatively less favorable than investment in standard maize. Second, delays in government efforts to more systematically enforce aflatoxin standards and to raise awareness of the health risks—as well as the lack of available aflatoxin testing — is hampering continued growth in demand for Aflasafe™-treated maize.

Complete findings are available in the evaluation’s [final report](#).

LEARNING

The Project illuminated four main lessons on how a PfR prize competition can succeed and what can help or hinder competitors. This section explores those lessons in more detail.

Key Lessons Learned

1. An appropriate design can incentivize diverse private sector actors to participate and expand their operating model in a new or developing market targeted by the prize.
2. Project design should build in time for early adopters to test a new product so they can be convinced of its utility before they commit to and adopt the product
3. Prize verification can serve as a *de facto* quality certification of products or services, which can attract more participants to compete.
4. A prize competition that incentivizes uptake of a specific agricultural product — even one where users may not readily see the benefits — can improve value chain relationships with smallholder farmers.

1. Lesson One

An appropriate design can incentivize diverse private sector actors to participate and expand their operating model in a new or developing market targeted by the prize.

Design Assumption: Initial participants in the Pay-for-Results prize competition would only include the largest maize outgrowers in Nigeria whose business models already positioned them well to compete. They would provide support to their farmers by facilitating access to key inputs and acting as the primary maize buyers of this maize.

What We Learned: Because the competition required participants to not only provide Aflasafe™ to smallholder farmers but also aggregate the maize for Aflasafe™ prevalence testing, many diverse actors in the maize value chain were in a position to compete, but all had to adjust their business models to qualify for a prize. Before the Project, many competitors worked with farmers either by providing inputs or purchasing maize for food or animal consumption — but not both.

The Project’s business plan assumed that large seed companies that already worked with many farmers and contract farmers would dominate the competition. Yet most competitors joined with fewer farmers than projected. These competitors leveraged initial prizes and the exposure they got through the Project to access resources and drive growth — albeit at a slower rate. Some smaller actors still struggled to scale and aggregate enough maize as well as provide high-value inputs and technical support.

Competitors had to aggregate maize from farmers who had applied Aflasafe™ correctly, but first, they had to show farmers that buyers would indeed offtake the treated maize after harvest. This motivated competitors to expand their business models to increase their chances of getting a prize at the end of each sales period. Because competitors could build these relationships with farmers in many ways,

the Project successfully attracted a diverse range of actors working along the maize value chain, from input providers to feed producers to commodity traders. Along the way, they improved their relationships with smallholder farmers and increased their access to inputs and premium markets.

2. Lesson Two

Project design should build in time for early adopters to test a new product so they can be convinced of its utility before they commit to and adopt the product.

Design Assumption: The prize was a large enough incentive that competitors and farmers would quickly adopt Aflasafe™ and take it to scale.

What We Learned: Because smallholder farmers are typically risk-averse, they needed time to observe the efficacy of the product firsthand; only then could the prize competition succeed. Competitors that joined the Project initially worked with a small number of farmers because they wanted to test the product and see evidence that it worked before promoting it more widely among all their farmers. Some competitors said they were unwilling to roll out and promote a product to their farmers without testing it themselves because they did not want to risk losing their farmers' trust.

Because so many competitors insisted on testing Aflasafe™ on demonstration plots early on, adoption and participation were limited in the first few years of the competition. This delay taught AgResults that building in time for early adopters to test a new product would expand the competitor pool as late adopters observed the benefits of the investment and risks taken by more pioneering companies

3. Lesson Three

Prize verification can serve as a *de facto* quality certification of products or services, which can attract more participants to compete.

Design Assumption: Because verification was developed solely for Project purposes, its only goal was to test and report essential data required to determine whether the maize collected met the competition criteria to receive an award. Verification could identify any irregularities in competitors' conduct and prevent gaming.

What We Learned: The mandatory aflatoxin and Aflasafe™ testing benefited competitors on multiple levels, positioning them not only to earn prize payments but also to prove that their maize met domestic and international buyers' quality standards. First, passing verification awarded them with a prize, motivating them to continue participating and to engage more farmers, in turn increasing the amount of aggregated maize. Second, the verification results enabled competitors to prove to new buyers that their maize met EU and US aflatoxin standards. This *de facto* certification has opened new markets for maize aggregators in Nigeria. Such efforts laid the groundwork for new relationships that will last beyond the life of the Project and ensure the sustainability of Aflasafe™. Although Aflasafe™ prevalence testing is not commonly available currently, grain traders and former competitors are now testing maize for aflatoxin presence and using this as a proxy for the prior verification testing.

4. Lesson Four

Prize verification can serve as a *de facto* quality certification of products or services, which can attract more participants to compete.

Design Assumption: Participation in the competition would lead to long-term health impacts by reducing aflatoxin exposure among smallholder farmers and other consumers. The competition would also drive economic impacts by increasing yields and prompting premium payments for aflatoxin-reduced maize.

What We Learned: Once the Project convinced farmers how aflatoxins could threaten nutrition and health, it spurred stronger relationships among private sector actors and smallholder farmers in the maize value chain. The prize competition incentivized private sector actors to increase smallholder farmer adoption of Aflasafe™ and reduce aflatoxin levels. To do this, the Project required competitors to develop and sustain relationships with farmers as they taught them best practices around Aflasafe™ application. Once farmers adopted Aflasafe™ and improved the quality of their maize, they gained access to other buyers along the value chain that also demanded aflatoxin-reduced maize. In this way, farmers improved their practices and successfully tapped into a bigger market with higher premiums, transforming the ways they could interact with others in the value chain overall.

CONCLUSION

In 2013, few maize producers and farmers in Nigeria knew about aflatoxin contamination. They would not invest in technologies aimed to reduce aflatoxin unless there was a market for aflatoxin-safe crops. At the same time, most government regulators did not enforce limits on aflatoxin contamination due to the lack of policies as well as insufficient infrastructure and personnel to quantify aflatoxins.

Despite these challenges and difficulties in meeting targets in the initial years, over six years the Project exceeded its primary core objectives and laid the foundation for a sustainable market for high-quality maize accessible by the country's many smallholder farmers. By emphasizing proper application of Aflasafe™ through training, the competition encouraged a diverse set of actors along the maize value chain to rethink their relationships with farmers in ways that benefited both groups. Through the competition as well as complementary efforts such as the ATTC project and the governments subsidy program, the availability and use of Aflasafe™ has dramatically increased, leading to lasting health and economic benefits for smallholder farmers.

Competition Results and Observations

- \$3,065,243 awarded in prizes
- 75,788 smallholder farmers reached
- 41 competitors
- 315,333MT of Aflasafe™-treated maize produced
- 213,510MT of Aflasafe™-treated maize
- 50,740MT of Aflasafe™-treated maize produced for home consumption
- 10.7% average market premium created

About AgResults

The Nigeria Aflasafe™ Challenge Project was part of AgResults, a \$152 million multi-donor initiative between the governments of Australia, Canada, the United Kingdom, the United States, the Bill & Melinda Gates Foundation, and the World Bank to incentivize the private sector to overcome market barriers and develop solutions to food security and agricultural challenges that disproportionately affect people living in poverty. AgResults designs and implements agricultural development prize competitions, which are innovative development finance programs that incentivize the private sector to work towards a defined goal to receive a monetary award.

APPENDIX

Secretariat and Evaluator Learning Materials

Secretariat	
The Pay-for-Results Challenge in Nigeria: Incentivizing New Technology Use for Sustainable Markets and Development Impact (January 2018)	The Nigeria Aflasafe™ Challenge Project was the first AgResults Pay-for-Results prize contest. This Lessons Learned article outlines the project's development objectives and reflects on the role and value of the PforR structure.
The Nigeria Aflasafe™ Maize Challenge: Competitor Perspectives (December 2018)	What were some of the challenges and opportunities that arose among the private sector companies that participated in the Nigeria Aflasafe™ Challenge Project? This Lessons Learned article shares insights that emerged from discussing competitors' experiences and perspectives.
Evaluator	
Evaluation Design: Nigeria Aflasafe™ Challenge Project (December 2014)	The evaluation design for the Nigeria Aflasafe™ Challenge Project lays out the approach to assess the project's influence in stimulating a smallholder-inclusive market for Aflasafe™-treated maize. Evaluators assess market impact using a structure-conduct-performance framework. To evaluate smallholder benefits, the design proposes a randomized control trial (later adapted to a quasi-experimental design).
Evaluator Lessons Learned #3: Nigeria Aflasafe™ Project Evaluation Findings (October 2018)	This October 2018 brief summarizes evaluation findings of the AgResults Nigeria Aflasafe™ Challenge Project. AgResults' external evaluators found that the competition led to the creation of a niche market for Aflasafe™-treated maize and an increase in net income from maize among the smallholder farmers reached by the project.
Evaluation Final Report: Nigeria Aflasafe™ Challenge Project (February 2019)	This evaluation for the Nigeria Aflasafe™ Challenge Project, conducted after Year 3, found that the project succeeded in creating a niche market for Aflasafe™-treated maize. Aflasafe™ adoption increased by 56 percentage points, and average net income from maize increased by 16 percent. The evaluation found that it cost the project \$43-85 to increase farmer income by \$100 annually.
Project Manager	
"Ground-truthing" Efficacy of Biological Control for Aflatoxin Mitigation in Farmers' Fields in Nigeria: From Field Trials to Commercial Usage, a 10-Year Study (November 2019)	This Frontiers in Microbiology report by the International Institute of Tropical Agriculture (IITA) shares findings from a large-scale, long-term efficacy study of an aflatoxin biocontrol technology, which has been adapted and improved for use in maize and groundnut in sub-Saharan Africa and specifically Nigeria. Results indicate that efficacy of the biocontrol product in limiting aflatoxin contamination is stable regardless of environment and cropping system. The biocontrol technology allows farmers across Nigeria

	to produce safer crops for consumption and increases potential for access to premium markets that require aflatoxin-compliant crops.
Monitoring <i>Aspergillus flavus</i> Genotypes in a Multi-Genotype Aflatoxin Biocontrol Product with Quantitative Pyrosequencing (November 2019)	In this study published in <i>Frontiers in Microbiology</i> , the International Institute of Tropical Agriculture (IITA) developed quantitative pyrosequencing assays for rapid simultaneous quantification of proportions of four <i>A. flavus</i> biocontrol genotypes within complex populations of <i>A. flavus</i> associated with maize crops in Nigeria to facilitate payment of farmer incentives for Aflasafe™ use.

News and Blog Coverage of the Nigeria Aflasafe™ Challenge Project

- [The Conundrum of Defining Pay-for-Results Prizes: When is a Prize Too Large or Too Small?](#) (January 30, 2020)
- [Nigerian Maize Sector Recognizes Role of AgResults Competition to Boost Crop Quality and Prices](#) (September 19, 2019)
- [Fueling the Nigerian Maize Sector with a Pay-for-Results “Nudge”](#) (May 31, 2019)
- [Development Experts Convene to Discuss Pay-for-Results Experiences in Dynamic “Power Talks” Event](#) (April 11, 2019)
- [Assessing the Impact of Prize Competitions to Increase Adoption of Aflasafe™](#) (March 20, 2019)
- [A Dynamic Discussion on Prize Competitions and Market Systems with the BEAM Exchange](#) (March 13, 2019)
- [AgResults Hosts Webinar on Prize Competitions and Market Systems Development on March 11](#) (February 25, 2019)
- [The Benefit of Hindsight: How Market Systems Theory Could Have Predicted Aflasafe™ Uptake in Nigeria](#) (December 17, 2018)
- [Nigeria Grain Aggregator Uses AgResults Prize to Invest in New Cleaning Facility](#) (December 13, 2018)
- [How Innovation is Redefining Global Agricultural Development](#) (December 3, 2018)
- [Prizes in Nigeria Pilot Exceed Projections](#) (March 1, 2018)
- [AgResults Paves Way to Scale Aflasafe™](#) (December 11, 2017)
- [Notes from the Evaluator: Initial Findings from AgResults Nigeria Pilot](#) (December 11, 2017)
- [AgResults to Extend the Nigeria Aflasafe™ Pilot for Another Year](#) (September 9, 2017)
- [US-Developed Technology Scaling in Markets Across Nigeria](#) (June 2, 2017)
- [External Evaluator Update: Looking Back on the Randomized Control Trial \(RCT\) in Nigeria](#) (June 2, 2017)
- [African Leaders from the East African Community Visit AgResults Nigeria Aflasafe™ Pilot and Endorse Aflasafe](#) (April 28, 2017)
- [Despite Violence, Nigeria Pilot Continues to Serve Smallholders](#) (February 13, 2017)
- [Nigeria Year 1 Verification Results](#) (October 2, 2015)
- [AgResults Welcomes New Implementers to the Nigeria Aflasafe™ Pilot](#) (May 27, 2015)