AgResults External Evaluation

Lessons Learnt and Summary of Evaluation Findings

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Contents

List of Acronyms ..... **ii**

Executive Summary ..... **iii**

Motivation for the PfR's focus on the private sector iii
The role of external evaluation iii
Findings iii
Lessons learnt vi

1. Introduction **1**

1.1 Motivation for pull mechanisms and the theory of change 2
1.2 AgResults prize competitions and their targeted markets 3
1.3 The role of evaluation research in the AgResults initiative 5

2. Summary of Findings **8**

2.1 Impacts on markets 8
2.2 Impacts on smallholder farmers 11
2.3 Cost and cost-effectiveness 19

3. Lessons learnt: best practices for sponsors of prize competitions **24**

3.1 Deciding whether a PfR competition is an appropriate program design option 24
3.2 Designing an effective theory of change 26
3.3 Designing to increase market impact 29
3.4 Designing to maximise smallholder farmer impact 30
3.5 Reflections on independent evaluation 33

Appendix A. Bibliography of AgResults Evaluation Resources **A-1**

Appendix B. AgResults Projects Pending Evaluation **B-1**

List of Exhibits

Exhibit ES-1. AgResults projects evaluated as of December 2024 iv
Exhibit 1-1. AgResults team 2
Exhibit 1-2. AgResults' theory of change 3
Exhibit 1-3. External evaluation results 4
Exhibit 1-4. AgResults Evaluation Methods 6
Exhibit 1-5. Future evaluation deliverables 7
Exhibit 2-1. Smallholder farmer role and intended impacts 16
Exhibit 2-2. AgResults prize competition costs (in millions of U.S. dollars, nominal) 20
Exhibit 2-3. Cost-effectiveness analyses to date 21

List of Acronyms

FCDO	Foreign, Commonwealth & Development Office
FMD	Foot and Mouth Disease
GHG	Greenhouse gas
MT	Metric tonne
ORSRE	*Organe de Régulation du Système de Récépissé d'Entrepôt de Marchandise* (Senegalese WRS Regulatory Body)
PfR	Pay-for-Results
RCT	Randomised controlled trial
SCP	Structure, Conduct, Performance
WRS	Warehouse Receipt System

Executive Summary

In 2010, G20 leaders called for a new initiative to test "result-based mechanisms" that would leverage private sector "creativity and resources" to address food security and agricultural development.[1] In response to that call, the multi-donor AgResults initiative is testing the efficacy of results-based prizes to drive agricultural technology development and its adoption by smallholder farmers. With funding from the Governments of Australia, Canada, the United Kingdom, and the United States, and from the Bill & Melinda Gates Foundation, the $152M AgResults initiative aims to design, test, and evaluate the success of 10 Pay-for-Results (PfR) prize competitions focusing on agricultural development. Since its inception in 2013, the AgResults portfolio has completed seven PfR challenge projects, of which six have been externally evaluated thus far. This report summarises the external evaluations' findings and lessons learnt from these six challenge projects. Appendix A lists the external evaluation's publications, which are synthesised here. This report also synthesises, and sometime quotes, feedback from semi-structured interviews the evaluators conducted with current and former AgResults stakeholders in November 2024.

Motivation for the PfR's focus on the private sector

The goal of AgResults initiatives is to spur local approaches to create sustainable, smallholder-inclusive markets for new technologies that ultimately benefit smallholders, consumers, and the private sector alike while addressing key development goals such as improved food stability and nutrition and reduction of greenhouse gas (GHG) emissions. The hypothesis of the PfR approach's promise as a development tool is that (1) private sector companies' knowledge of their suppliers and consumers positions them well to creatively overcome previous market constraints; and (2) the prospect of a sufficiently large cash reward would entice these companies to overcome the prior reasons for not engaging in the donor's target market; and (3) once established, the existence of this market would obtain sustained development impact beyond the PfR project's conclusion. Thus, the PfR approach promotes both localisation and sustained impact. In addition, the PfR approach may be cost-effective compared to other approaches because donors only incur the cost of achieving results if private sector actors verifiably meet the donors' pre-specified results.

The role of external evaluation

Every AgResults project had a Project Manager and an independent, third-party Verifier that assessed private sector actors' achievement of results (i.e., prize award eligibility). Also, at the outset, AgResults planned to have impact evaluations for every project in its portfolio that would be independent of both project management and verification. All evaluations aimed to identify the contribution of AgResults to changes in the target market, and most evaluations were designed to measure the impacts on smallholder farmers, which involved establishing a counterfactual of what outcomes would have been like without the program. As independent evaluators collecting evidence and following progress, the evaluation team could assist donors throughout the PfR programs' lifecycle to synthesize lessons and make key decisions, such as terminating projects that were unsuccessful.

Findings

This report reviews findings and lessons from the six AgResults projects with completed external evaluations as of December 2024. (Four AgResults projects are not covered by this document: one focusing on dairy productivity in Tanzania has ended but its evaluation was not yet complete when this

[1] The G20, or Group of Twenty, is a group of 19 countries plus the European Union. These countries have some of the world's largest economies. The G20 meets regularly to discuss and coordinate global policies on trade, health, climate, and other important issues.

report was written; three additional projects, one focusing on aquaculture in Indonesia and two focused on livestock vaccines, are ongoing.) These six projects are listed in Exhibit ES-1.

Exhibit ES-1. AgResults projects evaluated as of December 2024

Character-istic	Nigeria	Kenya	Zambia	Uganda	Vietnam	Senegal
Project [a]	Aflasafe Challenge Project	On-Farm Storage Challenge Project	Biofortified Maize Challenge Project	Legume Seeds Challenge Project	Emissions Reduction Challenge Project	Crop Storage Finance Challenge Project
Prize period	2013-2019	2015-2018	2014-2018	2017-2018	2017-2020	2020-2024
Tech-nology	Aflasafe, a biocontrol product to reduce proliferation of aflatoxins in maize	On-farm grain storage devices with a capacity up to 540 kg that prevent grain loss due to pests	Biofortified (pro-Vitamin A) maize, an alternative to white maize that can help prevent Vitamin A deficiency	Quality-verified legume seed, which can produce higher yields than commonly used, lower quality seed	Competitor-developed rice farming strategies that result in lower GHG emissions than typical	Warehouse receipt system where receipts for storage can be used as collateral to ask for a loan
Target market for develop-ment	Aflasafe-treated/ aflatoxin-reduced maize	Improved on-farm storage devices for smallholder farmers to use for storing food staples	Pro-Vitamin A maize meal	Quality legume seed	N/A	Quality warehouse
AgResults funds expended on project [b]	$9.83 million	$9.11 million	$2.5 million	$2.57 million	$7.7 million	$2.19 million
Prize awards [b]	$3.01 million	$6.25 million	$0.61 million	$0	$3.01 million	$0.02 million
Partici-pating compe-titors	41 maize aggregators	9 storage device suppliers	2 seed companies and 9 maize millers	7 seed companies	11 seed and fertiliser companies, aggregators	64 operators initially completed the expression of interest
Number of competi-tors who won prizes	41	3	2 seed companies, 0 millers	0 (due to project termination)	3 in Phase 1 (develop-ment), 4 in Phase 2 (adoption)	37 producer organisations received Phase 1 prize
Number of farmers adopting the tech-nology due to AgResults (evaluator estimate)	75,788	220,477	Not investigated	Not investigated	28,031	Not investigated

[a] See the Projects tab on the AgResults website (agresults.org) for a full description of each project.
[b] AgResults Trustee Report, Steering Committee Meeting, November 18, 2024.

Market impact. Three of the six AgResults projects evaluated thus far successfully engaged the private sector. In these projects, multiple private sector entities achieved the pre-specified results and won cash prizes. AgResults was most successful in engaging the private sector when the private sector perceived a strong business case for investing in the market. However, successful market impact during the project did not always lead to sustained engagement in the market after project closure. Of the three projects with market impact, one was found to have sustained market impacts in terms of continued sales and smallholder use of AgResults-specific technologies a few years after the project's close (Kenya). A second resulted in sustained investment in technology development, but the adherence of the evolving technologies to AgResults' original development goal is unclear (Vietnam). A third failed to achieve sustained impact due to poor economic incentives (Nigeria).

The other half of the six AgResults projects evaluated thus far (in Zambia, Uganda, and Senegal) were terminated early after it became clear that private sector actors would not be able to overcome local market constraints.

Macro-economic factors, government at all levels, institutions, and the structure of a market value chain all contribute to the competitors' ability to effect change. AgResults demonstrated that PfR mechanisms are most effective where the market failure is relatively simple, i.e. not due to wider failures in secondary markets or government failures to support competitive markets, consumer confidence, or public health. In the terminated projects, private sector actors faced challenges that included the lack of consumer trust in quality certification and lack of consumer awareness about health issues. Also, private sector actors in terminated projects often faced business failures that a short-term prize competition could not correct, for example, a lack of appropriate infrastructure for cost and sales reporting and/or slim profit margins as a result of government purchase, import, and export policy.

Smallholder impact. The three projects with market impact also produced significantly positive impacts on smallholder use of the promoted technologies. AgResults included smallholder farmers in targeted markets by setting explicit project rules or by leveraging the smallholder farmer-inclusive nature of the underlying markets. Two of the successful projects significantly benefited smallholder income (Nigeria and Vietnam), but neither of these was the project with sustained market impacts. Notably, the PfR approach left farmers with some gaps in their knowledge about use, consumption, and health benefits of the technologies. One project (Senegal) also highlighted that PfR can induce private actors to focus on farmers expected to be "higher performers", thus potentially targeting different beneficiaries than the development goal intended. Several projects highlighted that PfR can result in gender-differentiated outcomes, for example with women more likely to report that the technology resulted in reduced farm/storage labor (Kenya) or less likely to understand the health benefits of the technologies (Nigeria).

Cost-effectiveness. Due to high up-front costs, cost-effectiveness was relatively low during the project. For the completed projects, it cost around $85 for each farmer who adopted the promoted technology. For projects that were not cancelled early, cost per farmer tended to be near the range expected at the beginning of the projects. However, the real potential for cost-effectiveness in AgResults comes from the promise that the market will sustain after the project ends, delivering continued benefits and improving cost-effectiveness in the long term.

Lessons learnt

This document summarizes the lessons learnt from these projects in a solution-focused manner by offering a summary of best practices for sponsors of PfR projects. These lessons regard project-specific initiatives, rather than lessons for the management of a portfolio of projects using the AgResults model.[2]

To decide whether a PfR approach is appropriate:

- **Ensure that constraints critical to market development are within the competitors' manageable interest.** AgResults projects highlighted that competitors can be creative within the bounds of macro-economic factors, government policy at all levels, consumer trust in labelling, and other factors outside of the competitor's influence. A robust political economy analysis can help the project designer assess many factors that might enable or hinder the success of a PfR mechanism.
- **Confirm that there is a plausible business case for potential competitors to engage in the market.** In the context of a supportive enabling environment, firms will likely see a business case if there is evidence of strong potential demand, if they see potential to develop supply that can meet that demand cost-effectively, and if the prize parameters tip the risk/reward ratio in their favour.
- **Provide agile program management**. Compared to a grant-based funding mechanism, for example, AgResults demonstrated that project plans for PfR are less predictable because the prize specifications may need to adjust. Program sponsors need to have budgets and goals that allow for significant uncertainty in whether prizes will be awarded; agencies with strict annual budgets may lack flexibility to reallocate unpaid prize funds.
- **Consider cost-effectiveness during the design phase.** PfR project sponsors should continuously measure cost-effectiveness and set clear benchmarks. While the PfR model avoids some traditional costs, it incurs others like project management and verification. The key to cost-effectiveness lies in creating sustainable markets that provide long-term benefits, offsetting high initial costs.

On the importance of an effective theory of change:

- **For success in market selection, plan to conduct significant ex-ante, unbiased research into the assumptions that support theory of change**. A theory of change reflects a thorough understanding of the market, the expected causal logic linking the prize structure, the competitors' expected activities in response to the prize structure, the growth of a market, and the development impact. Ex-ante research should robustly test the assumptions of the theory of change using a structured approach such as Structure Conduct Performance, a political economy analysis, or qualitative process tracing. The evaluation of the theory of change should be independent and unbiased, i.e. not a search for evidence that supports the theory.
- **Adapt prize rules if necessary.** Although changes to prize rules can be cumbersome to communicate to all parties, sometimes it becomes clear during PfR implementation that the prize is not working well and changes are necessary. For example, the prize may no longer be relevant or enticing due to unexpected external market volatility. Or, the prize might be ineffective because it is based on assumptions in the project's theory of change that are not valid or incomplete.
- **Consider whether overlapping programs (e.g., a program to subsidise distribution of the technology) might boost or interfere with market development.** The subsidised distribution of

[2] Topics to consider regarding a portfolio of projects are cost- efficient management structures, the choice of whether to test un/related projects using different prize structures and compare their outcomes, and the choice of whether to test un/related projects in different country contexts and compare their outcomes.

targeted technologies is a prime example of ways that a parallel program can undermine the development of a market. While concurrently running programs are most problematic, programs that run before the PfR competition can also have an impact by creating expectations of low-cost provision of a technology or service.

- **Consider how the prize structure will affect competitors' focus.** For example, a prize for aggregating a healthier product (for example, aflatoxin-free maize) with no concurrent prize for educating consumers about health may undermine the project's ability to achieve all development goals.
- **Consider how the prize structure and contest rules affect evaluation opportunities**. A rigorous causal analysis can help donors understand if the outcomes associated with the program would have occurred absent the program. The ideal way to discover the impact of an intervention is to compare its effects in one setting to a setting that is otherwise identical, except for the presence of the intervention. While it can be difficult to conduct field experiments within the context of a market-focused PfR, the AgResults evaluation included two randomized control studies, revealing that that random assignment, if planned, must be integrated into incentives or contracts to ensure evaluation integrity.

To increase market impact:

- **Select enough competitors that can realise the desired market scale and structure.** In AgResults' three successful projects to date, multiple firms achieved prize-qualifying results, resulting in markets characterized by competition. PfR approaches that begin with an early phase where potential firms (competitors, solvers) must first apply to participate can aid in ensuring that multiple competitors have sufficient readiness to participate.
- **Choose the prize type, prize payout frequency, and duration of the competition to promote the desired market structure.** For example, AgResults demonstrated that per-unit prizes promote continued participation of relatively small-scale actors. AgResults projects also demonstrated that relatively frequent (seasonal or annual) prize payouts enable firms to re-invest their prize earnings to make further gains in the market and that the duration of the competition should reflect the number of years it takes to make the needed investments to overcome key constraints.
- **Explore ways to increase participation of under-represented firms, such as women-owned or women-managed firms.** Increasing the diversity of the competitor pool can increase the diversity of approaches, solutions, and beneficiaries that are reached.

To maximise smallholder impact:

- **Tailor the competition rules to incentivise competitors to engage the intended beneficiary group.** The technologies that PfR prize competitions promote may be attractive to diverse types of farmers, not just smallholder farmers, which could lead competitors to maximise their gains by selling to wealthier or larger-volume buyers or producers. However, in all cases, AgResults successfully defined other competition parameters consistent with maximising sales to the intended beneficiary groups—smallholder farmers.
- **Verify that the technology under consideration can have a significant development impact on the target group if adopted at scale.** AgResults demonstrated that successful smallholder-inclusive efforts do not guarantee development impact. One project found that while smallholders used the new technology, there were no significant effects on the intended outcome: farmer income. Another project demonstrated that smallholder use of technology did not result in health impacts because farmers sold almost all their Aflasafe-treated maize, and most did not learn about the dangers of aflatoxins and the promise of Aflasafe to mitigate aflatoxins.

- **Early in the project rollout, allow the private sector to work with well-resourced farmers to promote early success and increase a technology's visibility.** Although all projects targeted smallholder farmers, several examples show the effectiveness of targeting smallholder farmers with relatively larger plots of lands, or who are integrated into local markets through their membership in farmer cooperatives. While early success and visibility is helpful, we also advise the next lesson learnt:
- **Prioritize opportunities to include farmers who have lower rates of market integration, such as very poor farmers and women farmers, recognizing that including these groups may involve additional cost and complexity.** Gender outcomes can be improved through proactive design strategies. These include incorporating gender inquiries and household-level analysis during project scoping, which can help identify gendered patterns of behaviour to consider during project design. Conditioning prizes specifically on inclusion of certain groups could lead to gaming or impede sustainability, but it still may be possible to achieve social inclusion goals by choosing markets or technologies that disproportionately appeal to or benefit those groups.
- **Consider prize structures that will incentivise competitors to help farmers fully benefit from the technology, not just adopt it.** Often, the evaluation found incomplete understanding of the AgResults technology among smallholder farmers. If competitors are not already motivated to provide adequate training (e.g., because they intend to buy back a derivative product and thus want to optimise production volumes or quality), the project must verify whether training was provided.

1. Introduction

AgResults is a US$152 million multilateral initiative that tests the use of payment-for-results (PfR) prize competitions as a means of catalysing markets for high-impact agricultural innovations that benefit smallholder farmers in developing countries. Donor-sponsored PfR prize competitions (a type of pull mechanism) are designed to harness private sector ingenuity and resources to catalyse the development of the market. AgResults offers conditional prizes to private sector actors ('competitors') to encourage them to engage in markets for these innovations, with the ultimate goal of developing markets that serve smallholder farmers both during and beyond the life of the project. Technologies are selected for their potential contributions to improved food security and food safety, increased farmer incomes, and better health and nutrition. To date, AgResults has designed and implemented ten prize competitions, of which seven are complete and three are ongoing. In each case, the 'competitors' are private sector entities that compete for the prizes.

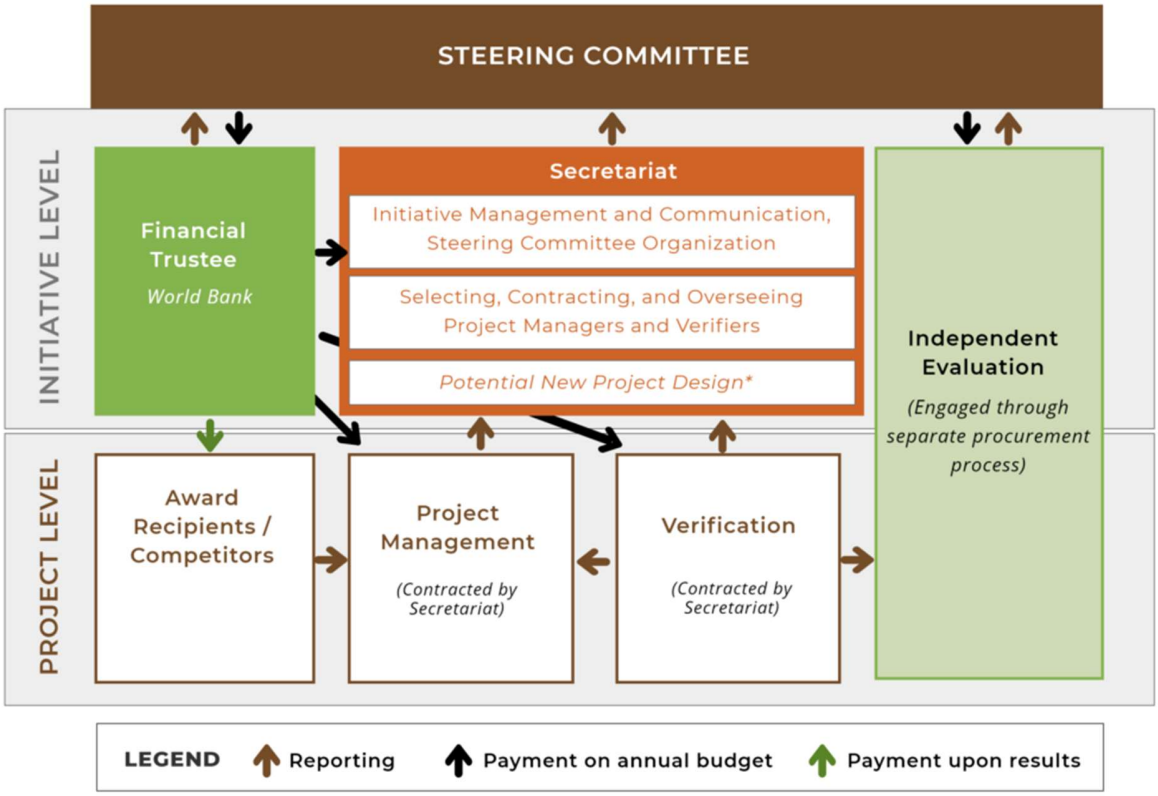
A Brief History of AgResults

In 2010, G20 leaders called for "innovative, results-based mechanisms […] to harness the creativity and resources of the private sector in achieving breakthrough innovations in food security and agriculture development in poor countries." In 2012 at the G20 Summit in Los Cabos, Mexico, a group of countries including Australia, Canada, the United Kingdom, and the United States, in partnership with the Bill and Melinda Gates Foundation, created AgResults.

AgResults is funded by the governments of Australia, Canada, the United Kingdom, and the United States, and by the Bill & Melinda Gates Foundation. The funds are managed through a Financial Intermediary Fund operated by the World Bank as Trustee. The Trustee provides financial intermediary services. The AgResults team comprises the Steering Committee, the Secretariat, project-specific Project Managers, project-specific Verifiers, and the External Evaluators and is depicted in Exhibit 1-1. Representatives from the prize-sponsoring groups and the trustee form the Steering Committee. The Steering Committee oversees the implementation of AgResults and is composed of the five donors and the Trustee. The Steering Committee is responsible for strategic oversight of the initiative, including endorsement of key management decisions, approval of concepts and business plans for proposed projects, and monitoring of projects and the overall initiative.

The Secretariat is responsible for implementing the initiative, including proposing and designing new competitions, and reports to the Steering Committee. The Secretariat designed each PfR prize competition after the initial three with market potential and the Steering Committee's development goals in mind, and these designs were assessed by the Steering Committee and outside experts. (The first three projects were designed by other entities specifically contracted for those designs.) For each project, the Steering Committee approves a project-specific, independent Verifier who assesses and audits competitors' results, and therefore determines/confirms the size of prize payments to each competitor. The External Evaluator's role is to use rigorous scientific tools to determine to what extent the prize competitions achieve their objectives to produce private sector behaviours and social outcomes different from, and better than, what would have happened in the absence of the AgResults initiative. The External Evaluator is contracted directly by the Steering Committee to ensure independence from the implementation activities.

Exhibit 1-1. AgResults team



Source: https://agresults.org/about

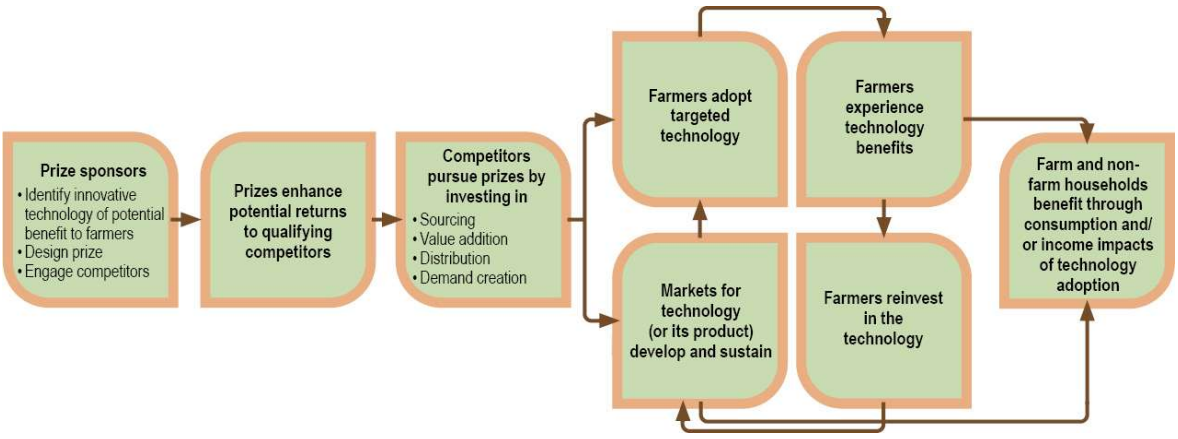
1.1 Motivation for pull mechanisms and the theory of change

The motivation for the AgResults pull mechanisms is to harness the private sector's regional or local expertise to overcome critical constraints in adopting new technologies. The hypothesis behind pull mechanisms is that the incentive would motivate the private sector who know their customers and supply chains well enough to identify adequate and scalable market solutions where, in the long run, profit-driven motives ensure sustained adoption of the new technology. The theory behind the PfR approach is that prize competitions will help the private sector overcome initial investment risk that has otherwise prohibited them from integrating the new technology into their existing business models. The general theory of change for AgResults, depicted in Exhibit 1-2, has the following elements:

- Prize sponsors are well suited to identify the applicability, promise, and safety of innovative technologies that will benefit smallholder farmers and collaborate on a prize design that would engage competitors in the geographic region of focus.
- The prospect of a financial prize increases potential competitors' return-on-investment.
- Private sector actors, or 'competitors', pursue prizes by investing in the targeted technology, its associated input procurement, and any prize-required levels of demand creation and distribution.
- Due to prize specifications, competitors focus on increasing smallholder farmers' adoption of the technology.

- Smallholder farmers experience benefits from the technology that may include improved yield, improved health, or improved farm income. Due to these benefits, the smallholder farmers continue to use and even reinvest in the technology, thus sustaining a market for it.
- Smallholder farmers and competitors alike realize gains from the new technology even after the prize competition concludes. These benefits accrue because there is now an established demand for the derivative product and the private sector actors have already made the up-front investments required to create and sustain a market for the new technology.

Exhibit 1-2. AgResults' project-level theory of change



Note: For simplicity, this diagram includes only the basic inputs, outputs, outcomes, and impacts expected to take place within an AgResults project. See Section 3.2 for discussion on constructing a theory of change.

1.2 AgResults prize competitions and their targeted markets

Each AgResults project is built around an innovative technology with the potential to be both highly beneficial to smallholder farmers and of commercial interest to the private sector in a particular location. This report discusses external evaluation results from the six technology adoption prize competitions evaluated as of 2024, listed in Exhibit 1-3. All six targeted staple crops: maize in Nigeria, Zambia, and Kenya; rice in Vietnam; legumes in Uganda; varied staple crops in Senegal. Of these, one project had clearly sustained impact: grain storage bags in Kenya. Two other projects were successful but involve less clear evidence of sustained impact: Aflasafe use on maize in Nigeria and emissions-reducing rice farming practices in Vietnam. Half of the projects targeting staple crops were cancelled before significant prizes were awarded: Zambia (maize), Uganda (legumes), and Senegal (storage-based finance for various staple crops).

Appendix B lists AgResults projects for which the evaluations are not complete and which are therefore not covered in this report. Two of these competitions target higher-value products than staple crops (dairy in Tanzania and fish in Indonesia). The other two projects focus on livestock vaccines (for Brucellosis and Foot and Mouth Disease).

Exhibit 1-3. External evaluation results

	End Prize Awarded	Smallholder Impact		Sustainable
Kenya AgResults offered cash prizes to private sector firms based on the volume of improved on-farm storage capacity they sold over a three-year period. Nine competitors engaged with the competition, resulting in a 23 percentage point increase in farmer use of these storage technologies. Farmer income and consumption were not impacted, but many farmers preferred the storage technologies to use of pesticide powder for storage. Following AgResults' conclusion, the market continued to perform well in areas of direct relevance to farmers such as availability, quality, price, and responsiveness to evolving farmer needs; it also performed well with respect to profitability, competitiveness, and sustainability.	✓	✓ ✗		✓
Nigeria AgResults offered cash prizes to private sector firms that aggregated maize treated with Aflasafe, a biocontrol product that reduces proliferation of aflatoxins in maize. Forty-one aggregators earned a prize, and roughly 76,000 farmers adopted Aflasafe as a result of this initiative. In the final year of the competition, competitors aggregated more than 81,000 MT of Aflasafe-treated maize, accounting for 1 percent of maize produced in Nigeria that year. Three years after project completion, both the Secretariat and External Evaluator concluded that its impacts were not sustained due to poor regulatory enforcement and lack of public awareness of aflatoxins as a health issue, exacerbated by widespread instability and a deteriorating national economic situation.	✓	✓ ✓ ✗		✓
Senegal AgResults offered cash prize incentives to warehouse owners or operators who received a license to operate under the Senegal Warehouse Receipt System (WRS) (prize 1), and then offered cash prizes based on the value of sales when staple crops were stored in their warehouse under the WRS for a minimum period of time (prize 2). The project was terminated early because implementation involved many stakeholders, it was complex to make it work, and it was unlikely to benefit smallholder farmers, notably due to indirect storage practices and price uncertainty.		✗ ✗ ✗		
Uganda AgResults offered cash prizes to incentivize seed companies to produce and sell quality-verified bean and soybean varieties. The project was terminated early because seed companies could not overcome consumer distrust stemming from a lack of trusted certification, with buyers being unable to differentiate high-quality seed from poor-quality seed.		✗ ✗ ✗		
Vietnam AgResults offered cash prizes for the development/specification of rice farming methods that reduce GHG emissions compared to typical methods, and then offered cash prizes to private sector actors who spurred farmers to adopt the approved methods. At project conclusion, fewer than 1 percent of smallholder farmers in the targeted area followed the approved methods exactly. Smallholders who collaborated with competitors had, on average, 14 percent higher rice yields.	✓	✓ ✓		✓
Zambia AgResults offered cash prize incentives to maize seed companies to produce a hybrid variety high in vitamin A. The project did not solicit sufficient response and the AgResults Steering Committee acted on the Secretariat's recommendation to close the project early.		✗ ✗ ✗		

Adoption Income Health Nutrition

Low Impact High Impact

1.3 The role of evaluation research in the AgResults initiative

AgResults has dual mandates of achieving impact and generating learning about the use of PfR prize competitions. From inception, AgResults was designed with a strong evaluation component, making it unique compared to other large initiatives. Notable features include:

- At the outset, AgResults planned to have impact evaluations for every project in its portfolio.
- The External Evaluators were hired prior to project implementation, allowing evaluation activities to be planned and integrated into projects from the beginning.
- The evaluations were comprehensive, including qualitative and quantitative elements. All evaluations aimed to identify the contribution of AgResults to changes in the target market, and most evaluations were designed to measure the impacts on smallholder farmers, which involves establishing a counterfactual of what outcomes would have been like without the program.
- Evaluators were hired independently by the Steering Committee (specifically with funds provided by one of the Steering Committee members, FCDO), so that the External Evaluators had true independence.
- The External Evaluators were invited to contribute to bi-annual Steering Committee meetings, both presenting results from formal evaluation activities as well as providing input on project design and implementation.

Two External Evaluators were contracted for AgResults: Abt Global and IDinsight. Abt developed the evaluation framework for the project and conducted evaluations for AgResults projects in Kenya, Nigeria, Zambia, Uganda, Vietnam, and Tanzania, as well as the Brucellosis project. IDinsight was hired in 2019 to conduct evaluations of the Indonesia, Senegal, and Foot and Mouth Disease (FMD) vaccine projects.

The AgResults evaluation framework is based on economic principles related to the functioning and behaviour of both individual market actors—including smallholder farmers—and agricultural markets as a whole. Both Abt and IDinsight applied the same general evaluation framework to each project evaluation, allowing comparison of results across projects and generalisation of best practices from AgResults as a whole. The general evaluation framework is designed around these areas of inquiry:

- **Market impact**. How has the project affected private sector engagement in the market, particularly its investment in the development of a sustainable and smallholder farmer-inclusive market for the targeted technology?

  The evaluators studied market impacts using a qualitative approach of interviewing project participants and other market participants to understand if, how, and why the AgResults projects changed the behaviour of market participants, and if these changes were likely to continue past the end of the project.

- **Smallholder farmer impact.** How has the project affected smallholder farmers' adoption of and benefits from the technology?

  The evaluators measured smallholder impacts using quantitative impact evaluations in which they compared project participants to a counterfactual.

- **Cost-effectiveness.** What indications are there of the cost-effectiveness of the PfR approach?

  The evaluators measured cost-effectiveness for smallholder outcomes using the results of the quantitative impact evaluation combined with data on implementation costs.

- **Lessons.** What lessons can be learnt from the project about best practices in the design and implementation of PfR competitions? The evaluators identified lessons by synthesizing findings

across the AgResults projects. For this report, the evaluators also interviewed eight current and former Steering Committee members and Secretariat staff.

Details on the methods of each evaluation are provided in Exhibit 1-4. Appendix A lists project-specific reports that provide more details.

Exhibit 1-4. AgResults Evaluation Methods

Character-istic	Nigeria	Kenya	Zambia	Uganda	Vietnam	Senegal
Project [a]	Aflasafe Challenge Project	On-Farm Storage Challenge Project	Biofortified Maize Challenge Project	Legume Seeds Challenge Project	Emissions Reduction Challenge Project	Crop Storage Finance Challenge Project
Market Impact: Study Design	Pre-post comparison using SCP	Pre-post comparison using SCP	Baseline SCP	Baseline SCP	Pre-post comparison using SCP	Qualitative "process tracing"
Market Impact: Sample	348 baseline, 223 endline	212 baseline, 88 endline	224 baseline, 31 project close-out	125 baseline	121 baseline, 95 endline	57 baseline, 35 midline
Smallholder Farmer Impact; Study Design	Matched comparison	Comparative interrupted time series	N/A (project cancelled)	N/A (project cancelled)	Cluster randomised controlled trial (RCT; adoption); matched comparison (income)	N/A (project cancelled)
Smallholder Farmer Impact; Sample	1,823 households	4,091 households	1,103 urban consumers (baseline only)	1,714 households (baseline only)	524 farmer diaries (adoption) 2201 farmers (income survey)	2,248 households (baseline online)

Note: SCP stands for the Structure, Conduct, Performance conceptual framework for qualitative market research.
[a] See the Projects tab on the AgResults website (agresults.org) for a full description of each project.

As of the writing of this report, the external evaluation has several pending deliverables through 2028, which include final evaluation reports for some of the AgResults projects whose evaluations were not finished in time to be included in this report (Tanzania and FMD), a cross-cutting cost-effectiveness report, and an updated lessons learnt report at the conclusion of the AgResults project. Exhibit 1-5 lists the pending evaluation deliverables.

Exhibit 1-5. Future evaluation deliverables

Deliverable Name	Approximate Delivery Date
Tanzania Endline Report	Q1 2025
FMD Midline Evaluation Report	Q4 2025
Cost-Effectiveness Initial Analysis	Q4 2025
Tanzania Sustainability Report	Q4 2026
FMD Endline Report	Q4 2028
Cost-Effectiveness Analysis Final Report	Q4 2028
Lessons Learnt Final Report	Q4 2028

2. Summary of Findings

This chapter summarizes the findings of the external evaluations with regards to the projects' impacts on markets, impacts on smallholder farmers, and projects' cost-effectiveness. The findings are summarized by main takeaways, with examples taken from across the six projects for which evaluations have been completed as of December 2024.

2.1 Impacts on markets

AgResults offers evidence that PfR approaches can spur the development or growth of markets in scenarios that satisfy certain supply, demand, and enabling environment conditions. We explore these in detail below. These conclusions follow from the evaluation findings regarding market scale, private sector engagement, inclusiveness, and sustainability.

In some projects, AgResults successfully catalysed private sector engagement in markets for AgResults technologies or for products produced using those technologies.

AgResults successfully catalysed private sector engagement in three of the six projects for which evaluations were complete by December 2024: Nigeria, Kenya, and Vietnam. In the three successful cases, multiple independent companies participated in the PfR and met eligibility criteria for prize awards.

In Nigeria, AgResults led to the development of a niche market for Aflasafe-treated/aflatoxin-reduced maize. A diverse group of participating firms recruited smallholder farmers to produce Aflasafe-treated maize and supported their production activities; invested in value-addition activities such as transport, processing, and branding; and developed demand by marketing directly to buyers in domestic feed and food and export industries. In the final year of the project, the 24 competitors aggregated more than 81,000 metric tonnes (MT) of Aflasafe-treated/aflatoxin-reduced maize, accounting for 1 percent of maize produced in Nigeria that year.

In Kenya, AgResults catalysed the development of a market for improved on-farm storage, with substantial increases in both supply of and demand for improved on-farm storage. Diverse domestic and international firms invested to overcome key barriers to entry in the market—particularly last-mile distribution systems and demand creation. Nine competitors participated, with three qualifying for prize awards.

In Vietnam, AgResults succeeded in engaging the private sector in developing and disseminating GHG emissions-reducing technology packages. Eleven competitors developed and submitted candidate technology packages in Phase 1 of the project. Of these eleven, six companies' technology packages qualified for Phase 2 by demonstrating improvement in rice yield and reduction in GHG emissions. Of the six qualified competitors, four chose to participate in Phase 2 of the project, which awarded prizes for successful technology adoption. The four competitors pursued diverse strategies to promote uptake of their respective technology packages.

In Zambia, AgResults played a role in the development of a small niche market for pro-Vitamin A maize. AgResults invited maize millers to apply to participate; of these, AgResults awarded four millers $50,000 each as a "marketing and promotion grant". Despite these grants, competitors struggled to purchase sufficient pro-Vitamin A maize to mill and sell because of a lack of seed supply—there was not enough pro-Vitamin A maize seed available for farmers to boost production. To address this, the design team added a prize incentivize seed companies to sell pro-Vitamin A maize seed; two seed companies met prize criteria and received those prizes. Ultimately, however, none of the competitors were able to meet prize criteria for volume of milled pro-Vitamin A maize sold and the Zambia project was terminated early.

In Uganda, AgResults sought to spur the market for improved legume seed. Six competitors signed up for the competition in Phase 1, and four of them sold eligible seed; eight competitors participated in Phase 2, and two of them sold eligible seed. However, no competitor received prizes because the Verifier struggled to confirm seed sales due to weak accounting systems and lack of sales documentation. Competitors did not have processes to separately track the sale of prize-eligible seed from the sale of non-eligible seed. The project was terminated early.

In Senegal, AgResults sought to enhance warehouse solutions for smallholder farmers. To begin, the Project Manager launched an expression of interest to participate in the warehouse receipt system (WRS), and the competition attracted 186 operators. Of these, 64 submitted a complete dossier (including proof of ownership or long-term rent of the warehouse). Ultimately, 37 producer organisations were successfully licensed by the *Organe de Régulation du Système de Récépissé d'Entrepôt de Marchandise* (ORSRE), the Senegalese WRS regulatory body. Two collateral managers and three financial institutions also signed memorandums of understanding to collaborate with the ORSRE, ensuring that the WRS could operate. However, the Phase 1 prize, which aimed to incentivise low-quality warehouses to upgrade and participate, generated a windfall effect more than increasing the supply of quality warehouses. This is because all warehouses that entered the competition were already at or near the required quality standards, so they only required minor, inexpensive upgrades. Also, producers were wary of storing crops because while the competition was ongoing, the price of the main stored crop (cashews) actually went down.

AgResults was most successful in engaging the private sector when the private sector perceived a strong business case for investing in the market.

A challenge in designing prize competitions is that the prize sponsors cannot have full insight into the cost/profit margins of private firms or into private firms' readiness to innovate. The Nigeria, Kenya, and Vietnam projects offer examples where numerous private sector actors already had an interest in the market (Kenya and Vietnam) or were enthusiastic and motivated once they learned of the market and its potential (Nigeria). These actors, who became AgResults 'competitors', saw the AgResults competition and incentive as a motivation to invest in the market at scale, but they were also keenly interested in the underlying potential of the market, independent of the AgResults incentive. In Zambia and Uganda, in contrast, the lack of an underlying business case for investing in the market spurred lacklustre investment, despite the presence of the AgResults incentive. In Zambia, there was initially a tepid response among millers. They had no experience in developing either demand or supply for a differentiated product, and they were concerned about the tendency for consumers to confuse pro-Vitamin A maize (which is orange in colour) with the yellow maize they perceive as low quality. In Uganda, the lack of an effective quality certification (labelling) system for legume seed created a weak business case for seed companies to invest in increasing their production of quality legume seed.

In Senegal, collateral managers were engaged and saw a clear opportunity to develop third-party storage management; however, financial institutions were reluctant to adapt their processes to WRS rules. This created friction and WRS implementation delays, jeopardizing its benefit for producer organisations. Among farmers, while large, structured producer organisations were able to see the business case and did not have financing constraints, the smaller producer organisations that could have benefited from WRS-based loans were mostly unable to overcome the constraints to participate.

AgResults was most successful in catalysing market development in projects where the key constraints were within the manageable interest of the private sector once incentivised by the prize.

In Nigeria, Kenya, and Vietnam, private sector firms were able to overcome demand and supply constraints, such as lack of awareness and the lack of last-mile distribution systems. However, in Uganda private sector firms were unable to overcome the enabling environment challenge of unregulated labelling. The lack of trusted certification resulted in a classic 'market for lemons' problem, with buyers

being unable to differentiate high-quality seed from poor-quality seed, causing downward pressure on prices that made it difficult for high-quality seed to compete in the market. The Zambia pro-Vitamin A project failed because millers did not see a strong business case, even after receiving $50,000 grants from AgResults, to shift their business model to one that actively sources a differentiated maize variety and actively markets a new product to urban consumers. In Senegal, demand for warehouse storage was limited because of low loss rates when storing at home, the worry of declining prices of the main stored crop (cashews), and the fact that warehouse storage is costly and more constraining. Despite Phase 2 prize intentions to incentivise storage adoption by smallholder farmers, producer organisations did not manage to change storage practices to attract more individual storage.

The enabling environment influenced the development and sustainability of markets for AgResults-targeted technologies.

A supportive enabling environment facilitated market development, as seen for example in Kenya and Vietnam. In Kenya, the improved on-farm storage solutions proved popular with smallholder farmers, but they could not access new maize market opportunities and did not increase their revenue or profit. In Vietnam, smallholder farmers' activity was already heavily influenced by their cooperative leaders, so AgResults competitors' coordination with these cooperative leaders greatly facilitated technology adoption. In Uganda, however, the government seed certification program was unable to certify seed quality effectively, and the enabling environment itself was a binding constraint to the market's development. In this case, the project was unable to progress because of the intractability of this constraint.

In Nigeria, while the project was successful overall, the sustainability of its impact was compromised due to several factors. These were a continued lack of public health focus on aflatoxins, the availability of a trusted substitute product for the poultry industry that seeks toxin-free maize (clay mycotoxin binders), low profit margins, and a weakening economy. Similarly, in nearly all AgResults projects, the prospect of subsidised provision of the technology (or of a close substitute to the technology) also affected the market's development at different points. In Zambia, the AgResults Secretariat cited the destabilising influence of the Zambian government's heavy involvement in the market for white maize, a substitute for pro-Vitamin A maize, as a factor limiting investment in pro-Vitamin A maize and driving weak project results.

In Senegal, implementation issues were largely due to a complex environment that required many different stakeholders to be engaged and willing to abide by the rules. We observed that the core barriers to increased storage were not primarily financial (which could be addressed with financial incentives), but rather procedural. Cooperatives often struggled with navigating the application processes for ORSRE certification and understanding the requirements necessary for participating in the WRS. This bureaucratic complexity hindered the effectiveness of the "pull" model and required a strong "push" component. Each season of the project saw mismanagement involving one or more key financial institutions, leading to significant delays and disruptions. And ORSRE had procedural requirements for warehouse certification, including inspections, paperwork, and bureaucratic steps, which proved difficult for cooperatives to navigate.

There are mixed indications about the likely sustainability of markets catalysed by AgResults.

For sustainability, we consider the three AgResults projects where markets were successfully catalysed by AgResults.

In Nigeria, despite AgResults project participants' enthusiasm for remaining engaged in the market, sustainability of the market for Aflasafe-treated/aflatoxin-reduced maize is threatened by a large set of factors including the endemic instability in Nigeria's broader maize markets, the subsidised delivery of

Aflasafe by government entities, and delays in government efforts to increase enforcement of aflatoxin standards and increase awareness about the benefits of Aflasafe-treated/aflatoxin-reduced maize among consumers.

In Kenya, the market has sustained and grown since the end of AgResults. Competitors have continued to invest to increase their market penetration, there are several new entrants in the market, and there has been continued product innovation with several new on-farm storage devices being released into the market. The scale of the market has increased by more than 250 percent since AgResults' conclusion according to self-reported data from only three former AgResults competitors (i.e., less than half the on-farm storage suppliers currently active in the market).[3]

In Vietnam, two years after the conclusion of the AgResults project, AgResults-inspired rice cultivation practices were used on 2.7 times more hectares than at the close of the project, albeit with two of the four AgResults competitors and in areas where water drainage infrastructure (not affected by AgResults) was most amenable and where cooperative leaders continued to actively engage with, or even manage, the smallholders. No entity has tested the effects on GHG emissions reductions of smallholders' and competitors' adaptations and slight revisions to the AgResults-verified rice cultivation technologies.

2.2 Impacts on smallholder farmers

The ultimate aim of AgResults is to create sustained markets for technologies that benefit smallholder farmers. Each project had a plan to encourage the private sector to engage smallholder farmers with the targeted technology, which was intended to lead to welfare enhancements—either income increases, consumption of more or better-quality food, or both.

AgResults mostly successfully included smallholder farmers in targeted markets, either through explicit project rules or by leveraging the smallholder farmer-inclusive nature of the underlying markets.

In all projects, contest rules specified that only procurement from, sales to, or technology adoption of, smallholder farmers would qualify competitors for prizes. In Nigeria, competitors were required to source maize from farmers with fewer than 10 hectares. By project end, competitors were sourcing maize from more than 26,000 smallholder farmers, and the independent evaluation found a 56 percentage point increase in Aflasafe use among smallholder farmers (Exhibit 2-1).

In Kenya, qualifying storage devices were limited to 540 kg capacity (the amount of grain the project estimated the average smallholder farmer's family consumes in a year), and only sales made to farmers with fewer than 5 hectares were counted. Project verification data showed that more than 90 percent of the storage devices purchased went to smallholder farmers. The independent evaluation showed that 220,000 more smallholder farmers obtained improved on-farm storage technologies than would have in the absence of the project, representing a 23 percentage point increase in technology use in the Eastern region, and a 6 percentage point increase in the Rift Valley region (Exhibit 2-1).

In Vietnam, prizes were awarded to firms according to number of farmers engaged and farmers' repeated use of the technology packages, as well as GHG emissions reduction and yield increase. To increase the likelihood of engaging smallholder farmers, the challenge focused on Thai Binh province in the Red River Delta region of northern Vietnam, which has a high density of smallholder farmers—approximately

[3] Denise Mainville and Betsy Ness-Edelstein, *AgResults Evaluation: Kenya On-Farm Storage Challenge Project, Sustainability Assessment,* Rockville, MD: Abt Associates, prepared for the U.K. Foreign, Commonwealth, and Development Office and the AgResults Steering Committee, 2021.

2.5 million farms. It also has the highest concentration of rice farmer cooperatives in the country, enabling the coordination of farmer groups.

In Uganda and Zambia, competitors had no specific directive to engage smallholder farmers; nonetheless, they were integral to the underlying market in which the projects acted. In Uganda, close to 90 percent of legume farmers are smallholders. In Zambia, smallholder farmers are responsible for nearly all maize produced for human consumption.

In Senegal, the competition rules planned for a maximum storage threshold by producer (30 MT) to ensure that stocks would be owned by smallholder farmers and not by intermediaries or large farmers. However, because smallholder farmers did not own stocks in warehouses in the first place, the Senegal competition was by design unlikely to directly benefit smallholder farmers. There was an indirect expectation that producer organisations would share the benefit of WRS participation with their members, but there was no obligation for prize-sharing.

The prize design need not specify *how* competitors engage smallholder farmers- in fact, a solution-agnostic approach can be a deliberate design decision that offers local actors more flexibility. In Nigeria, competitors usually organized farmers in community clusters, training them and advancing inputs (including Aflasafe) to facilitate their production and contracts to purchase the Aflasafe-treated maize at harvest. In Kenya, competitors were required to charge buyers the full market price of the storage device but found other ways to encourage adoption. Their strategies included media promotion; contracting of sales agents; and promotional incentives to distributors, retailers, and farmers to further increase sales. In Vietnam, competitors engaged with cooperative leaders. Once a cooperative agreed to work with a competitor, they would identify a potential contiguous area of land,[4] and then recruit individual farmers who had plots within that area. If an individual farmer declined or was unable to participate, the cooperative leader would help to arrange a temporary exchange of land with another farmer who would cultivate the land for the duration of AgResults.

Technology uptake sometimes, but not always, led to increases in farmer incomes during the project period.

In Nigeria, the primary benefit of the technology to smallholder farmers was income: average net revenue from maize among households targeted by AgResults competitors increased 16 percent, largely due to price premiums for maize that the competitors purchased from farmers (Exhibit 2-1). In Kenya, AgResults led to a maize revenue increase ranging, on average, from 2 to 11 percent, depending on region. However, unlike the targeted Nigerian farmers for whom maize represented a primary income source, maize sales for the average household in the targeted regions in Kenya represented less than 1 percent of total income. The AgResults Kenya project did, however, lead to a household's being 6.7 percentage points less likely to purchase any maize for consumption. In Vietnam, engaging in AgResults increased the likelihood that a farmer sold rice and average net revenue from rice production.

The sustainability analyses conducted years after project implementation did not include data collection from smallholder farmers, so we do not know if they continued to sell their harvest for profit. Instead, we can extrapolate from the findings at project conclusion. In Nigeria, the increase in net agricultural income during the project was driven by a modest price premium for maize and by farmers' decisions to sell more maize to the competitor. The comparison group obtained similar maize yields as the AgResults farmers, but on average kept more maize for household consumption. If AgResults farmers in Nigeria managed to maintain their connections to maize aggregators, they may have benefited from sustained income increases even absent price premiums. The case for sustained income increases in Vietnam is similar: as long as the farmers maintained a connection to aggregators after the end of the AgResults project, they

[4] The parcel had to be a minimum of 1500 square meters to allow for verification.

would have a possibility of maintaining their increased revenue from using the technology. For Vietnam, farmers engaged with AgResults competitors enjoyed steeply discounted prices on agricultural inputs from AgResults competitors, but the evaluation team found that even absent those discounted prices, the farmers would have obtained higher net incomes because they also obtained higher yields.

Some farmers also reported non-financial benefits related to adoption of the technology.

In Kenya, AgResults had muted income impacts, but non-financial benefits were more prominent. Farmers generally used their improved storage devices to store grain for their own consumption and were pleased that the new technologies did not require pesticides, unlike typical storage bags. This led to improved taste, labour savings on management of farmers' stored food stocks, and improved peace of mind knowing that their products were safe from pests. In Vietnam, few farmers reported any challenges with the competitors' AgResults cultivation practices, and many farmers reported positive outcomes from adopting competitors' AgResults cultivation practices including, variously, improved plant health, rice quality, and yields, and reduced production expenditures and labour requirements.[5] By contrast, non-financial benefits were not prominent in Nigeria (farmers' consumption of Aflasafe-treated maize rose by an average of 0.02 kilograms per day, or 13 percent).

The PfR approach left farmers with some gaps in their knowledge about use, consumption, and health benefits of the technologies.

Depending on the technology, farmers' understanding of correct use and the technology's potential benefits may be important for farmers to reap the technology's full benefit. In Nigeria, competitors' interest was in buying Aflasafe-treated maize back from farmers, so there was no motivation for them to teach farmers about the dangers of aflatoxins and the health benefits of using Aflasafe. Accordingly, only 25 percent of farmers targeted by AgResults competitors knew how Aflasafe works, and 23 percent understood the health risks of aflatoxins. Among cooks in the households targeted by AgResults, only 6 percent understood the health risks of aflatoxins. As a result, most farmers using Aflasafe did not adjust their consumption toward treated maize, thus missing out on its health benefits.

In Kenya, competitors had an incentive to teach farmers to use their products correctly so that the farmers would have good results and continue to buy them. Indeed, the majority of farmers using improved storage reported that they had received some training in proper use. However, when asked to describe how to properly use their device, their average knowledge scores were between 54 and 67 out of 100 (varies by region), where 100 out of 100 would indicate the farmer accurately described or demonstrated all of the steps involved in using their device correctly. This indicates room for improvement, though it was beyond the scope of the evaluation to assess whether on-farm storage devices are effective if farmers use them imperfectly.

In Vietnam, farmers had limited awareness of climate change issues, the role that rice production played in climate change, and the potential for the specific technology components to reduce emissions. However, in this case farmers' knowledge of climate change and emissions was not directly related to whether and how they benefitted from the technologies.

[5] Many farmers interviewed had been using specific practices for a long time—sometimes for 10 years or more—and therefore many do not directly attribute the benefit to the specific combination of requirements specified by AgResults competitors.

Women tend to be less integrated in market value chains.

The AgResults projects discussed in this report did not have specific gender-inclusion goals,[6] although as a learning initiative it did examine how the projects performed in terms of social inclusion.[7] Across the AgResults countries, women and women-headed households tended to be less integrated into both input and output markets for the projects' targeted technologies at the time of project launches.

In Nigeria, the participation of women fluctuated annually and varied widely among individual competitors. In the project's final year, women represented 19 percent of the smallholder farmers supplying AgResults competitors but ranged from 0 to 100 percent of the competitors' farmer bases.

In Kenya, despite lower levels of awareness of improved on-farm storage at the outset, women-headed households had 3.7 percent higher uptake of improved on-farm storage than male-headed households (29 percent vs. 26 percent) by the end of the project. Women are often responsible for managing household food stores and expressed particularly high levels of satisfaction with improved on-farm storage because it reduced labour, was relatively inexpensive, was perceived to directly impact household food security, and provided peace of mind.

In Vietnam, there was no evidence of gendered patterns of participation, production, or perceptions of the AgResults technologies.

In Senegal, women farmers constituted approximately 28 percent of the farmers who were members of producer organisations and who were identified and sampled under the project. At baseline, women farmers' income from crop production was significantly lower than men farmers' ($718 vs. $1,792), driven primarily by land size cultivated being significantly larger for men farmers. Most of the women farmers interviewed were working on their husbands' land and mainly produced what was to be consumed in the household (i.e. with less intention to store and likelihood to participate in the WRS).

Certain farmer benefits were not realised to the extent projected, underscoring how farmer response to new technologies may differ from expectations.

In Kenya, AgResults assumed that farmers faced high post-harvest loss of grains prior to the project, while on average this proved not to be the case. Prior to AgResults, pesticide dust was widely used. Self-reported losses suggest it was effective, and losses at baseline were minimal compared to project assumptions. In other words, the project design's expected use cases differed substantially from how farmers used the technology in practice. The design hypothesised that farmers who used improved storage would be able to store their maize longer until prices increased after harvest time and sell it for more money. But evaluation findings suggest this shift in farmer behaviour did not materialise. Farmers who sold maize were already preventing losses in maize they planned to sell, and a majority (more than three-quarters) of farmers did not report selling any maize at all. For farmers who did sell, a host of economic considerations drove them to sell around harvest time (school fees, presence of buyers, lack of available credit, and other factors)—but lack of storage was not one of them. Rather, household consumption was the main use case for improved on-farm storage, and farmers continued to use pesticide dust for maize they planned to sell.

For Nigeria, the project intended that farmers would consume their Aflasafe-treated maize. However, farmers tended to sell their Aflasafe-treated maize rather than consume it despite its health benefits. The project's design had not anticipated that farmers might not become aware of Aflasafe's health benefits

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6 For the Senegal project, the implementation team hired a gender expert to examine whether the project design could be updated to be gender inclusive.

7 Denise Mainville, Incorporating a Gender Lens into Challenge Project Design, *Evaluator's Lessons Learned Series,* Issue 5, Rockville, MD: Abt Associates and Denise Mainville Consulting, October 2020.

and that they would be primarily motivated by the income potential from selling their Aflasafe-treated maize. As a consequence, farmers may not have gained the health benefits associated with consuming aflatoxin-free maize.

Exhibit 2-1. Smallholder farmer role and intended impacts

	Nigeria	Kenya	Zambia	Uganda	Vietnam	Senegal
Project	Aflasafe	On-Farm Storage	Biofortified Maize	Legume Seed	Emissions Reduction	Crop Storage Finance
Smallholder farmer role	Producer	Buyer	Producer	Buyer	Producer	User
Smallholder farmer technology use at baseline	<1%	<3%	<1%	9%[a]	1%	13% using storage 0% using WRS-based storage
Smallholder farmer technology use at endline	AgResults increased Aflasafe uptake by 56 percentage points among smallholder farmers in AgResults villages.	AgResults contributed to a 23 percentage point increase in adoption in Eastern and a 6 percentage point increase in Rift Valley over what was projected to happen in the project's absence.	<1%	9%[a]	6% The project engaged roughly 7% of smallholder farmers in the AgResults areas.	N/A, project cancelled
Intended economic impact on smallholder farmers	Increased income from access to premium market	Increased income from well-timed maize sales and lower expenditure on maize for consumption enabled by reduced grain losses	None	Increased income from legume sales, driven by higher yields	Increased income security from collaboration with competitors	Increased net farmer income from total crop production
Economic impact on smallholder farmers	Among adopters, average annual net income from maize increased by US$318 or 16% per farmer.	Among adopters, gross annual maize revenue increased US$1.69 but there is no evidence of an impact on net revenue.	N/A, project cancelled	N/A, project cancelled	Among adopters, net value of rice crop increased 10% (VND 85). Because AgResults increased the likelihood they sold their harvest, their average net sales revenue increased 450% (VND 350).	N N/A, project cancelled

	Nigeria	Kenya	Zambia	Uganda	Vietnam	Senegal
Intended consumption impact of smallholder farmers	Reduction in health impacts of aflatoxins through consumption of Aflasafe-treated maize by farmers who grow Aflasafe-treated maize	More maize available for home consumption and decreased use of pesticides	Reduced Vitamin A deficiency through consumption of pro-Vitamin A maize by smallholder farmers who grow pro-Vitamin A maize	Increased legume consumption by smallholder farmers who increase their legume production	None intended	None intended
Consumption impact on smallholder farmers	Adoption increased the amount of Aflasafe-treated maize consumed by .04 kg per person per day, roughly 24% of the average person's daily maize consumption.	Adoption made farmers 6.7 percentage points less likely to purchase maize for consumption.	N/A, project cancelled	N/A, project cancelled	Adoption increased yields by 14% and increased net harvest values by 11%.	N/A, project cancelled
Non-financial benefits	**Moderate** Improved market access and sales terms.	**Moderate** Some farmers reported labour savings, 'peace of mind', and 'better taste' because of reduced use of pesticides.	N/A, project cancelled	N/A, project cancelled	There was no clear pattern of non-financial benefits.	N/A, project cancelled
Farmer knowledge	**Limited** Only about a quarter of farmers targeted by AgResults competitors (and only 6% of the cooks in their households) knew how Aflasafe worked or understood the health risks of aflatoxins.	**Limited** Average knowledge scores of proper use among adopters were between 54 and 67 out of 100 depending on region, indicating a knowledge gap.	N/A, project cancelled	N/A, project cancelled	Farmers had little awareness of the role of rice production in climate change and the potential for new technologies to reduce emissions.	N/A, project cancelled

	Nigeria	Kenya	Zambia	Uganda	Vietnam	Senegal
Differentiated impacts on female farmers	Competitors varied widely in their engagement of women farmers, from 0 to 100%, averaging 19% female farmer participation across the project.	Women-headed households had 3.7% higher uptake of improved on-farm storage than male-headed households (29.3% vs 25.6%) by the end of the project.	N/A, project cancelled	N/A, project cancelled	No clear pattern of gender-differentiated outcomes.	N/A, project cancelled
Deviations from expected impacts	Farmers were far less likely to consume Aflasafe-treated maize than expected—only 13% of maize consumed by targeted farmers was Aflasafe-treated. They largely chose to sell it instead.	Farmers did not tend to store their maize longer in order to sell it later when market prices improved. Instead, they typically used improved storage devices for maize they intended to consume. The minority of farmers who sold maize continued to use non-improved, traditional storage methods for the portion they intended to sell.	N/A, project cancelled	N/A, project cancelled	There is no strong evidence base related to impact on emissions. The Verifier's best estimate is a 3-10% reduction (smaller than the goal of 30%). Farmers' choice of production technologies greatly influenced by the role of the local cooperative.	N/A, project cancelled

[a] While 22% of farmers self-reported planting improved varieties of legume seed, our seed quality analysis revealed that only 9% of farmers' seed actually met the relevant quality standards. This difference is due to Uganda's lack of effective quality certification. For details, see Abt Associates, *AgResults Evaluation Baseline Report: Uganda Legume Seed Project,* August 2018.

2.3 Cost and cost-effectiveness

Cost-effectiveness analysis is a useful tool for measuring the efficiency of PfR projects, (1) against ex-ante expectation and (2) against alternatives aimed at similar outcomes.

Two major factors distinguish AgResults, and the PfR model in general, from traditional "push" initiatives. First, PfR does not directly design, promote, or deliver agricultural technology to smallholder farmers. This reduces some costs and risk associated with making payments for services that do not deliver impacts. However, it introduces other costs, such as complex project design and management, and may introduce other risks of the PfR system not functioning correctly. Second, PfR aims to create sustainable markets for agricultural technology that continue to grow beyond projects' end, resulting in sustained adoption and benefits flows, and reducing the costs per unit of impact over time. Cost and cost-effectiveness analysis can help to understand how these factors interact, provide some short-term indication of project success, and serve as an entry point for assessing the efficiency of PfR vis-à-vis other models.

A benefit to the PfR approach is that by shifting the design and dissemination of agricultural innovation to private sector firms, the model may reduce financial risk to funders and implementers of paying for results that are not achieved. At the same time, PfR projects involve costs that traditional "push" projects do not, especially prizes, verification expenses, and potentially higher costs of project management. Therefore, cost-effectiveness analysis is a useful tool for measuring the efficiency of PfR projects, both (1) against ex-ante expectation and (2) against alternative programs aimed at similar outcomes, but using different methods. Thus far, AgResults' cost-effectiveness results have been deliberately limited in scope, and focused on comparing cost-effectiveness to ex-ante expectations. There is an opportunity to expand on the current findings to facilitate comparison to alternative program approaches.

In terms of the external validity of cost-effectiveness findings, if traditional development projects intend to reach the same results in the same geographic regions, the associated projects' expected costs per targeted result could be compared with those of AgResults. More broadly, comparisons might focus on comparing different approaches to promoting uptake or market development of similar technologies in similar environments, rather than across implementation contexts and technologies. Either objective requires carefully constructed and framed cost-effectiveness analysis.

PfR projects have significant up-front costs.

While PfR projects avoid many of the costs related to design and delivery associated with traditional development programs, they still involve substantial up-front investments from donors. Exhibit 2-2 summarizes disaggregated cost data for six concluded projects. *Project management* involves coordination between the sponsor and an implementation partner, communications with potential competitors and stakeholders, coordination and sometimes selection of entrants to the competition, ongoing monitoring, event planning (e.g., prize ceremonies), and reporting. *Verification costs* depend heavily on how difficult it is to confirm the compliance with prize criteria. Some prize criteria (e.g., chemical verification of the presence of Aflasafe in harvested maize) are more complex and expensive than other prize criteria (e.g., sale of storage bags to smallholder farmers). Verification costs were highest in Vietnam (39 percent of that project's total costs) and lowest in Kenya (7 percent of that project's total costs). The *amount spent on prizes* is an essential part of the model and must be high enough to motivate competitors.

Exhibit 2-2. AgResults prize competition costs (in millions of U.S. dollars, normalized)

	Nigeria (Aflasafe)	Kenya (On-Farm Storage)	Zambia (Biofortified Maize) *	Uganda (Legume Seed) *	Vietnam	Senegal*	Total
Initial expected total cost, including prizes	**US$11.9**	**US$10.3**	**US$5.5**	**US$4.4**	**US$7.5**	**US$6.9**	**US$46.5**
Amount spent on prizes	3.0 (30%)	6.3 (69%)	0.6 (24%)	0.0 (0%)	1.2 (33%)	0.2 (9%)	**11.3 (38%)**
Verification costs	2.6 (26%)	0.6 (7%)	0.3 (10%)	0.8 (32%)	1.4 (39%)	0.7 (32%)	**6.4 (21%)**
Project management costs	4.3 (44%)	2.2 (25%)	1.6 (66%)	1.7 (68%)	1.0 (29%)	1.3 (59%)	**12.1 (40%)**
Actual total project cost	**9.9 (100%)**	**9.1 (100%)**	**2.5 (100%)**	**2.6 (100%)**	**3.6 (100%)**	**2.2 (100%)**	**29.9 (100%)**

Sources: AgResults Trustee Report, Steering Committee Meeting October 5, 2020 (actual costs) and the initial Business Plans for each AgResults project.
Note: Design costs are not included, as precise design cost information is not available. The estimated design costs for Nigeria, Kenya, and Zambia were US$0.48 million each, and the estimated design cost for Uganda was US$0.4 million.
*Project was terminated early.

The evaluations found support for the idea that at the project level, PfR can be less costly than traditional approaches, though project expenditures on management and verification can still be considerable. However, because knowing ex-ante which projects will succeed is challenging, it is most instructive to look at the cost breakdowns at the portfolio level. In the three projects that were terminated early (Zambia, Senegal, and Uganda), sponsors' costs for management, verification, and initial prizes amounted to 43 percent of what sponsors had planned to spend on the projects. Further, across the combined first four AgResults projects attempted, prize award costs roughly equalled management costs. These findings suggest that if a sponsor hosts a portfolio of projects, the management costs alone will be a significant proportion of the budget because several projects may not succeed. Whether PfR projects have higher up-front costs than traditional interventions or whether they fail at a higher rate are empirical questions beyond the scope of this analysis. However, the fact that when PfR projects do succeed they also create sustainable markets that allow benefits to grow and accumulate may offset costs associated with *potentially* higher failure rates for PfR projects, a point which we elaborate below.

The average cost of adoption per AgResults technology is objectively "low", but cost-benefit is elusive .

The cost-effectiveness analyses for completed projects examine two types of metrics: (1) cost per smallholder who adopted the technology because of AgResults, and (2) cost per unit increase in various output and outcomes attributable to AgResults. The first cost-effectiveness metric is available for every project, and is comparable to ex-ante adoption targets, and across projects. The second set of metrics are idiosyncratic and are difficult to compare across projects. Exhibit 2-3 summarizes the results of all cost-effectiveness metrics calculated for completed projects to date.

Exhibit 2-3. Cost-effectiveness analyses to date

	Nigeria	Kenya	Vietnam
Effects & Costs			
Adoption (Number of farmers)	**75,788** (adoption of Aflasafe maize)	**220,477** (adoption of on-farm storage)	**28,031** (farmers using at least once)
Outputs/ Outcomes	**315,333 MT** of Aflasafe maize produced	**358,000 MT** of storage capacity added	**4,765 ha** of rice farm area treated **US$39** increase in net value per hectare of rice cultivated
Costs	US$9.9 million	US$9.1 million	US$3.6 million
Cost-effectiveness			
Adoption	**US$134** (cost per adopting farmer)	**US$39** (cost per adopting farmer)	**US$128** (cost per farmer using at least once)
Outputs/ Outcomes	**US$34** (cost per MT of Aflasafe-treated maize) **US$43-85** (cost to increase smallholders' net income from maize by $100)	**US$25.40** (cost per MT of added storage)	**US$756** (cost per treated hectare, phases 1 & 2)
Contextualisation			
Comparison to expected cost-effectiveness	Ex-ante estimate of US$340 per adoption by a smallholder farmer.	Ex-ante estimate of US$21 per adoption by a smallholder farmer.	Project estimated 25-30K farmers to adopt; cost per adoption broadly aligned with expectation.
Comparison to benchmarks	Market price of Aflasafe to produce 1 MT of treated maize is US$4.60.	N/A	Cost per hectare is roughly in line with other emissions reduction initiatives.

Note: All project costs are recorded here are normalized to 2017 US dollars and annualized using a discount rate of 12 percent. .

Cost per adoption is objectively low. Across the three projects with completed evaluations, the average cost per adoption of AgResults technology is US$69.69. Including the cost of terminated projects increases the cost per adoption to US$92.19. These numbers are useful insofar as downstream benefits to farmers are comparable across projects. Except for Vietnam, costs per adoption exceeded the estimated cost per adoption. In the sections that follow, we attempt to contextualize the cost per adoption figure against currently available benchmarks and describe extensions to the cost-effectiveness exercise that would further quantify the benefits. Note also that overall costs are much lower for the cancelled projects, largely owing to lower expenditure on prizes. We have noted elsewhere that the cost of management and prizes may replace many of the implementation expenses that push projects incur. Therefore, Project Managers should maximize the potential cost advantages the PfR model enjoys by using robust monitoring and process evaluation early on to cancel projects that show signs of failing to be impactful.

Project-level cost-effectiveness results were mixed.

While cost per adoption is broadly aligned with expectations at the project level, costs per unit of technology adopted tend to be higher than expected, or high relative to available benchmarks.

In **Nigeria**, the discounted total project cost per added smallholder farmer using Aflasafe was US$134, and the total cost per added metric tonne of Aflasafe-treated maize was US$34 over the project's five years. This is well under the project's initial estimate that it would cost US$340 per added smallholder farmer. However, that gain in efficiency should be considered alongside the fact that the market price of Aflasafe needed to create one metric tonne of treated maize is roughly US$4.60. Overall, the project was judged cost-effective. At the end of year three, it cost approximately US$43-US$85 to increase smallholders' net income from maize by US$100.

In **Kenya**, the total discounted cost per added smallholder farmer was US$39, roughly 80 percent more than the project's initial estimate of US$21 per smallholder. The cost per added metric tonne of storage capacity came to US$25.40. A sustainability assessment, conducted two and a half years after the project's conclusion, estimated the market had expanded more than 250 percent since AgResults' conclusion. Accounting for those additional sales of improved on-farm storage significantly decreased the project's cost per unit of output to US$7.15 per metric tonne, increasing its cost-effectiveness.

In addition to the adoption and storage capacity outcomes, the Kenya project reported other impacts that were not included in the cost-effectiveness analysis. Notably, the benefit/cost ratio (using the increase in gross maize revenue attributable to AgResults) comes to approximately 0.04. As the market continued to expand beyond the end of the project, it's likely that this benefit/cost ratio does not fully capture the benefit to the consumer in terms of preferences/taste. However, in terms of addressing a development goal of improved smallholder economic well-being, a benefit/cost ratio of 0.04 is well below any acceptable threshold, which would require that benefits are at least greater than costs, resulting in a ratio above 1.

In **Vietnam**, the endline evaluation found a cost of US$128 per unique farmer who used an AgResults technology package at least once. The count of farmers who adopted was 28,031, which is aligned with pre-project expectations of engaging 25,000-30,000 smallholders. Therefore, in terms of adoption, observed cost-efficiency broadly aligns with expectations, assuming that total costs are also consistent. However, prize sponsors paid US$756 per hectare of rice cultivated using an AgResults technology package.

We can contextualize these findings against two benchmarks. First, farmers' discounted average impact on net value per hectare of rice was US$39, which is clearly much lower than the US$756 that AgResults paid. However, the per-hectare project cost is roughly aligned with other emissions reduction initiatives, specifically a 2019 initiative of the Consultative Group on International Agricultural Research to establish alternate wetting and drying practices at a cost of US$412 per hectare, and a World Bank project promoting the "One Must Do, Five Reductions" model at a cost of US$1495 per hectare.

End-of-project cost-effectiveness estimates can understate the project's eventual cost effectiveness.

The countervailing force to the (potentially) elevated up-front costs of PfR projects described above is the fact that successful initiatives will result in a sustainable, growing market. This contrasts traditional interventions, where the flow of benefits stops or stagnates when the project ends or when donor support is withdrawn. For this reason, the cost-effectiveness results reported above may understate eventual cost-effectiveness. To the extent that the markets for AgResults technologies are sustained, project costs per targeted output will decline, and cost-effectiveness will improve as additional households adopt the

technology after the project ends.[8] The existing evaluations report cost-effectiveness analysis based on results reached by a particular point in time (endline), and as such those estimates did not encompass results that continue to accrue after the projects concluded. To fully capture cost-effectiveness, analyses should account for systemic changes that PfR projects might catalyse by attempting to measure or model market growth.

Some projects (notably Kenya on-farm storage) have sustainability reports that capture at least some of the post-project benefits. However, the sustainability reports are already several years old, and do not capture subsequent growth.

Extensions to cost-effectiveness analysis can provide useful information to decision makers.

Several extensions to the current cost-effectiveness analysis might provide useful inputs to project designers and other stakeholders. Some of these may be applied retroactively to AgResults, whereas others may need to be included in the design of future initiatives.

Cost-effectiveness estimates should be made comparable to relevant benchmarks. The benchmarks may be ex-ante expectations for cost-effectiveness, specific goals or targets, or cost-effectiveness ratios for programs or program types aimed at the same outcomes. All AgResults projects with completed impact evaluations report one common metric: cost per adoption.

In addition, it is desirable to measure outcomes in an aggregable metric, which allows for benefits to be summed up at the project level (and possibly the portfolio level) to fully account for them. The aggregation problem can be effectively addressed by expressing outcomes in a common unit of account, typically U.S. dollars (cost-benefit analysis). Most of the AgResults projects have (or will have) estimated impacts on farmer income, measured in dollars and therefore aggregable and comparable. In addition, most AgResults projects have welfare-improving impacts that are not measured in dollars but nonetheless contribute to the project's total impact. Converting these to monetary units would facilitate summing up all a project's impacts and calculating an overall cost-benefit ratio.

Finally, as noted above, one of the primary goals of AgResults, and of the PfR model generally, is to create sustainable markets. The AgResults Steering Committee has pointed out that **cost per dollar of private sector investment** would provide a very useful measurement of the effectiveness of the model. They have also noted that competitors may enjoy unmeasured benefits that contribute to a sustainable market, such as increased publicity, enhanced professional networks, and expanded connections with farmer cooperatives.

[8] Several methods exist for estimating future benefits and, in the case of monetary benefits, discounting them to net present value. For a general guide, see *Cost-benefit analysis for development: A practical guide. Mandaluyong City, Philippines: Asian Development Bank, 2013.*

3. Lessons learnt: Best practices for sponsors of prize competitions

In this section, we draw upon our findings to present generalised best practices that can be applied toward the design of future PfR initiatives that aim to create a market to scale up use of novel technology. We organise these in four categories—best practices to help prize sponsors (1) decide whether a PfR competition is an appropriate program design option, (2) design an effective theory of change, (3) design a PfR competition to increase market impact, and (4) design a PfR competition to maximise smallholder farmer impact. We also discuss what can appear to be trade-offs between designing for market impact and development impact.

3.1 Deciding whether a PfR competition is an appropriate program design option

One of the first questions designers must consider is whether a prize approach is an appropriate design option for a particular problem or to promote a potential solution to a problem.

Ensure that constraints critical to market development are within the competitors' manageable interest.

For a PfR project to succeed, its private sector partners (competitors) must have the capacity to overcome the most binding constraints to the market's development. Macro-economic factors, government at all levels, institutions, and the structure of a market value chain all contribute to the competitors' ability to effect change. In general, AgResults has shown that a PfR approach can catalyse development of a market, but only if the enabling environment is adequate to support the market. The Kenya project provides an example where a strong enabling environment—with adequate yet not excessive quality control and verification—provided a supportive framework in which the competitors could profitably expand sales of improved on-farm storage technologies to smallholder farmers. In Vietnam, strong local leadership of cooperatives facilitated the coordination of water management, which was critical for the competitors' rice farming technologies, but there was little ownership or consequence regarding the management of post-harvest residue, thus leaving in place the practice of burning rice stubble.

There are several examples from AgResults where competitors were not able to overcome constraints. The Uganda project is an example where a weak enabling environment—specifically the lack of effective quality certification—undermined the business case for seed companies to expand their production and sale of quality legume seeds. In Senegal, establishing a successful warehouse receipt system required careful coordination between many actors (government, financial sector, collateral managers, warehouse owners), most of whom were not incentivised by AgResults. As a result, the establishment of the system was frequently delayed and failed to provide the envisioned access to finance. In Nigeria, after what appeared to be a successful prize competition, the most dominant competitor (and others) ceased using the technology at project end due in large part to low profit margins, a weakening economy, the availability of a trusted substitute product for the poultry industry that seeks toxin-free maize (clay mycotoxin binders), and lack of a public health focus on aflatoxins. The implication for prize sponsors is that it is critical to ensure that the enabling environment is adequate to support the development of the target market.

Confirm that there is a plausible business case for potential competitors to engage in the market.

Prize sponsors must also be able to assess the attractiveness of the potential market from the private sector's point of view: is there a business case, and will it be sustained after prize conditions have been

met and the prize competition ends? One notion of PfR is that the results-based approach is open to solvers of all types, that is, it is solver-agnostic. However, as PfR designers develop and fully articulate the goal of a PfR project and its prize specifications, they essentially narrow the possible set of private sector actors who will participate. Still, AgResults has shown that in every context it has tested, the set of private sector actors who participate can be diverse and is not perfectly predictable.

In the context of a supportive enabling environment, firms will likely see a business case if there is evidence of strong potential demand, if they see potential to develop supply that can meet that demand cost-effectively, and if the prize parameters tip the risk/reward ratio in their favour. Given that demand for technologies benefitting smallholder farmers is often uncertain, prize sponsors have an important role to play in creating awareness of the potential demand.

In Nigeria, for example, maize aggregators who were often unaware of aflatoxins as a problem, and broadly unaware of Aflasafe as a potential solution, were easily recruited to compete in the project once they were made aware of the potential market for Aflasafe-treated maize. Similarly, in Kenya, several competitors reported a long-standing interest in investing in smallholder farmers as a market for improved on-farm storage, although none of them had yet engaged with the intensity that was stimulated by the prize competition. In both Nigeria and Kenya, where private sector actors were able to see a potential business case, the PfR incentive played a critical role in offsetting the risk that inhibited them from investing at scale. However, only in Kenya was the business case sustained. In contrast, the business case in Nigeria was not sustained due to factors discussed in the lesson above (weakening economic situation; availability of an alternative trusted solution; continued lack of public health focus; lack of government and private sector interest in producing AflaSafe).

In Zambia and Uganda, most potential competitors had to be convinced of the business case for the targeted technology, and their investment was tepid as a result. Similarly in Senegal, most warehouses that entered the competition were in good shape, and smallholder farmers still did not see the value of adopting warehouse storage versus their traditional practice of home storing. In Vietnam, competitors were motivated by the prize to expand the rice cultivation practices among coordinated farmer cooperatives. After this coordination was established, half of the competitors maintained or grew their farmer networks after project end. However, no competitor had a clear understanding of which components of their rice cultivation practices led to reduced GHG emissions. All competitors reported making continuous adjustments to their rice cultivation recommendations, thus deviating from the approved technologies. We were unable to assess whether these adjustments increased or decreased GHG emissions.

Provide agile program management.

Steering Committee members and the Secretariat alike affirm that it is important to provide agile program management, particularly in the case where a main agenda is learning. All AgResults projects saw adjustment in prize rules, and for projects that were not successful in awarding prizes, AgResults had the flexibility to reallocate resources to design alternative and more promising PfR projects. Therefore, we highlight that project sponsors should consider their own organisation's adaptability with regards to program management. Most importantly, program sponsors need to have budgets and goals that allow for significant uncertainty in whether prizes will be awarded. That is, sponsors should be prepared for the possibility of failure of a specific PfR project and have the flexibility to reallocate dedicated prize award budgets for alternative PfR projects or other initiatives. Sponsors should also be prepared for the possibility of failure. One AgResults colleague shared, *Failure in Pay for Results is a lot more tolerable [than in non-PfR projects]. It's not as bad. We never were ashamed to go to the Steering Committee and say it is not working, we need to pull the plug. If it failed, it failed. Whereas in the other communities sometimes you don't want to fail so you don't want to admit when something is really not working.*

Before declaring failure, project managers can also adjust the PfR project's specifications. Compared to a grant-based funding mechanism, for example, the project plans for PfR are less predictable because the prize specifications may need to adjust. One AgResults Steering Committee member shared this reflection:

Donors like to have control and to have control up front. They like to have all the answers. They really want a nice buttoned up theory of change. What we found, generally true with international development projects but especially working with private sector, is that we are not going to know everything up front. More often than not we got thrown a curve ball. Do some basic due diligence and get a good frame and relatively good design. You shouldn't spin your wheels on the 8 months for hard questions that are going to change.

Another Steering Committee member remarked, *The main thing we learned on designs was that they don't stop. It's not like you have a design, it's perfect, and you go on.*

The next section describes best practices for designing an effective theory of change about prize effectiveness, as well as the occasional need to adjust prize rules even after the public launch of a project.

Consider cost-effectiveness during the design phase.

PfR project sponsors and designers should incorporate continuous cost-effectiveness measurement from the project's inception and set clear benchmarks and decision rules to aid with the "agile program management" described above. The PfR model avoids some of the cost associated with traditional programs, such as design, promotion, and delivery of agricultural technology. However, it replaces these costs with others that can be equally, or even more, burdensome in the short run: project management, prize, and verification. The eventual cost-effectiveness depends on the creation of sustainable markets that allow benefits to accumulate after the competition ends, which can offset relatively high up-front costs.

It is not clear whether PfR projects have systematically higher up-front costs or failure rates than traditional programs. However, project designers should be able to compare start-up costs to non-PfR strategies aimed at the same output or outcomes. At the same time, designers should invest in monitoring systems aimed at determining whether competitors have the capacity to overcome binding constraints to market development, as described above. Good project design will include process monitoring metrics that allow managers to identify early whether competitors are on track to meet expectations in terms of "cost per adoption" and "cost per unit" of outcomes and outputs.

3.2 Designing an effective theory of change

For success in market selection, plan to conduct significant ex-ante research into the theory of change.

The design team at the AgResults Secretariat designed their programs with market potential in mind, and these designs were assessed by the Steering Committee and outside experts. Ex-ante, all of the projects seemed to have the potential to catalyse sustainable markets. But despite the best efforts, many of the projects were not successful.

This leads to two high-level reflections on designing pull programs:

- Project planners and designers should spend significant time and effort assessing a market's suitability for pull projects. This should include a detailed theory of change, with significant, robust, and independent effort to assess the theory of change's core assumptions. (See more in the following section.)

- Despite best efforts, there is likely to be a non-trivial failure rate for pull projects, since it is impossible to know with certainty how markets will respond to incentives.

The suitability for a PfR prize competition is best examined by articulating and testing the validity of a theory of change. A well-articulated theory of change reflects a thorough understanding of the market, the causal logic by which the incentive structure will motivate competitors to engage in the market, the expected development impacts for farmers, and the underlying assumption. While this is true of any development program, it is critical for a PfR project since certain parameters must be defined at the outset. The theory of change should lay out the expected causal logic linking the prize structure, the competitors' expected activities in response to the prize structure, the growth of a market, and the development impact. Underlying assumptions (e.g., about the private sector's likely response to the incentive or the impact of the country's regulatory framework on the market's development) should be clearly articulated.

The ex-ante research should not look for evidence to confirm a theory of change; instead, it should be unbiased and thorough. Academically-vetted qualitative research methodologies can offer a research approach that is thorough, unbiased, and robust. Examples of these approaches are political economy analysis, Structure-Conduct-Performance analysis, and process tracing.

Each AgResults project was fronted by ex-ante analysis and depiction of how each project would achieve its goals. In hindsight, evaluation results from these earlier AgResults Projects reveal room for tightening of the causal logic and explicitly stating assumptions. For example, in Zambia the original design was to catalyse development of an urban market for pro-Vitamin A maize, supplied by smallholder farmer producers. This plan was difficult to realize in practice because slim profit margins did not motivate maize processors, who had little experience marketing new products to urban consumers and no practice of cultivating relationships with smallholder farmer groups in order to invest in differentiated maize types. In Senegal, a key piece of the theory of change was that the prices of commodities reliably increased over the season, leading to income opportunities for storing crops. During project implementation we learned that this increase is not reliable for all crops. The project did not have any provisions in place for falling crop prices, as happened during the project's first cashew campaign.

Adapt prize rules if necessary.

Public announcements about PfR opportunities are necessarily strategic and carefully planned. It is important to check in with all parties about potential changes in prize rules; otherwise, perceptions of trust and fairness might be damaged if a competitor with an existing advantage would be disadvantaged by potential rule changes. Although changes to prize rules can be cumbersome, sometimes in the course of PfR implementation, it becomes clear that the prize is not working well and changes are necessary. For example, the prize may no longer be relevant or enticing due to unexpected external market volatility. Or the prize might be ineffective because it is based on assumptions in the project's theory of change that are incomplete or not valid. One AgResults staff person reported, *We were able to constantly adjust the parameters and the rules, the terms of engagement with competitors.*

AgResults offers a few examples of projects changing their prize rules midway through implementation. In Uganda, the PfR was redesigned after the initial design encountered two major roadblocks. First, the initial design offered a prize after five years, but seed companies found the required investment too risky. Legumes accounted for a small percentage of their revenue, and an uncertain prize outcome was not large enough for them to displace their investment in hybrid maize seed sales, which provided a larger share of their revenue. Therefore, the design committee revised the prize, offering annualized prizes that would allow companies to leverage capital in a timelier manner. The final design also offered competitors cold storage so that competitors could store and carry over unsold seed from one year to the next, further minimizing investment risk.

Second, after the Uganda PfR project's initial design was announced, the evaluation team conducted its initial qualitative assessment and found a market for legume seed that was plagued with rampant counterfeiting. Initially, the project had planned to reward sales of seeds that were defined as "quality seed" from Uganda's Seed Certification Unit. However, that entity did not have the resources to test germination quality, genetic purity, and physical purity. Revising the design, AgResults planned to reward sales of seeds that met standards established by the International Seed Testing Association and the Common Market for Eastern and Southern Africa. AgResults also switched its verification plan from a reliance on government quality certification to a private entity, AgVerify.

In Senegal, the WRS regulatory body's own agenda made it initially challenging for the implementation of the competition, with financial institutions not ready to accept warehouse receipts from any licensed warehouses. To overcome this challenge, the Project Manager developed a "preselection" step to screen out potential competitors who would not be able to operate the WRS when licensed.

Consider whether overlapping programs (e.g., a program to subsidise distribution of the technology) might boost or interfere with market development.

Private sector-driven solutions to development problems can be undermined when faced with competition from public programs that are not subject to market or commercial constraints. The subsidised distribution of targeted technologies is a prime example of ways that a parallel program can undermine the development of a market. While concurrently running programs are most problematic, programs that run before the PfR competition can also have an impact by creating expectations of low-cost provision of a technology or service. For example, the Ugandan Government National Agricultural Advisory Services purchased legume seeds and freely distributed them to farmers under "Operation Wealth Creation" beginning in 2013, two years before the AgResults Uganda project began.

There are examples where overlapping programs can be a boost to efforts; for example, the development of a low-cost way to measure GHG emissions could have augmented competitors' interest in sustainability in Vietnam, ensuring that their ongoing amendments to the technology led to lower (or at least not increased) emissions and perhaps even made them eligible to trade in carbon credits.

Consider how the prize structure will affect competitors' focus.

Prize competitions should carefully consider how best to incentivise achievement of the main development outcome, which is always a balance of priorities. For example, the Nigeria competition rewarded collection of Aflasafe-treated maize from smallholders, but there was no emphasis on smallholder education about health risks and the importance of consuming aflatoxin-free maize. As a result, few farmers gained an understanding of aflatoxins as a health issue, and most chose to sell their treated maize to earn the higher profit margin. As another example, the AgResults Vietnam competition used a prize structure where winners received prizes proportionate to their results with respect to multiple outcomes: yield, emissions, farmers reached, and repeat farmers engaged. Of these, emissions were weighted at 20 percent. The grand prize winner did not have the lowest-emitting technology but ultimately won by disseminating its technology package to large numbers of repeat farmers.

Consider how the prize structure and contest rules affect evaluation opportunities.

The independent or external verifier assesses whether competitors have met prize eligibility criteria. An independent evaluator can help a donor assess whether the PfR's specific activities can be credited for generating the outcomes of interest. In particular, a rigorous causal analysis can help donors understand if the outcomes associated with the project would have occurred absent the project. The ideal way to discover an intervention's impact is to compare its effects in one setting to a setting that is otherwise identical, except for the presence of the intervention. The laboratory sciences use highly controlled

settings to conduct experiments; social sciences often use "field" experiments, which compare two settings that are less controlled but highly similar except for the presence of the intervention being tested.

While it can be difficult to conduct field experiments within the context of a market-focused PfR, the AgResults evaluation included two RCT studies (one of which was successful) and several quasi-experimental studies. Based on our experience, we found that random assignment, if planned, must be integrated into incentives or contracts. The evaluator should try to establish a counterfactual whenever possible and protect it from spillover influence from the project. Yet a counterfactual may create challenges for the project's aim to provide private sector firms as much latitude as possible in determining where they work. Unless the evaluator and implementer can balance these competing priorities, project implementation will suffer, or the evaluation will miss an opportunity to produce high-quality evidence.

An experience from AgResults is instructive in this regard: In Nigeria, AgResults had a promising set-up for an RCT except that cash incentive prizes (i.e., the main intervention) were not linked to the RCT design. Thus, there was no direct incentive for the private sector actors to abide by the RCT design. By the third year of the project, the fraction of farmers reached in the treatment areas was roughly equal to the fraction of farmers reached in the control areas, resulting in near-zero contrast between the treatment and comparison groups. To avoid similar issues, the evaluator and project implementation team should work closely together from the beginning, so that the counterfactual, if possible random assignment, can be integrated into the project roll-out. The AgResults team successfully linked prize eligibility to an RCT design in Vietnam and thus successfully evaluated the program's impact on technology adoption.

3.3 Designing to increase market impact

Select enough competitors that can realise the desired market scale and structure.

The best industry actors to recruit as competitors in a PfR competition have the capacity to overcome key constraints inhibiting development of a market for the technology or its derivative products. The pool of competitors should be large enough to spur competition and bring the market to a sustainable scale, with individual competitors having adequate technical, managerial, and financial capacity to reach an efficient scale of operations. Operationally, this will vary significantly based on the technology and market environment. The required qualifications for competing in the PfR may spur competitors to adopt improved accounting and bookkeeping practices, or mean minimum sales/scale requirements in order to participate. In Kenya, for example, at project's end, six firms were engaged in the commercial market for improved on-farm storage, with this relatively small number still driving significant competition and continued investment in the market. In Nigeria, in contrast, there were 26 competitors in the market at the project's conclusion, with more than 40 active throughout the project. Selection criteria can aid in ensuring that competitors are sufficiently ready to provide information, data, and reporting to the Verifier. In Vietnam, 24 competitors initially applied to participate, 11 were selected to develop and test technologies, and of those 5 were invited to participation in the technology adoption competition.

Choose the prize type, prize payout frequency, and duration of the competition to promote the desired market structure.

Decisions about the type and timing of prizes and the duration of the competition should encourage industry participation that leads to the desired market structure as defined by the number of firms supplying the technology and the organisation of the value chains along which the technology and its derivative projects flow. For example, winner-take-all prizes can discourage participation of firms that are unlikely to be top performers; proportional prizes can encourage more participation but still enhance front-runner advantages, while a per-unit prize can increase participation by ensuring receipt of a prize to every competitor commensurate with its absolute (not relative) individual results. In Nigeria the per-unit prize ensured that any competitor that successfully procured Aflasafe-treated maize from smallholder

farmers would receive the prize incentive, promoting continued participation of relatively small-scale actors. This broad participation was conducive to developing an expansive market base. In Kenya, in contrast, six competitors made qualifying sales, but only three reached the minimum threshold required for prizes. In Vietnam, the prize advantaged the competitor that engaged the most farmers, so the incumbent firm with the largest engagement at baseline was the inevitable winner.

The timing of prizes—for example, a single end-of-project payout versus annual or milestone-based prizes—can also influence the market structure. Prizes tied to milestones can help competitors focus on meaningful market development milestones. Likewise, relatively frequent (seasonal or annual) prize payouts enable competitors to re-invest their prize earnings to make further gains in the market and have also been observed to align more closely with private sector business cycles than end-of-project payouts. The duration of the competition should reflect the number of years it takes to make the needed investments to overcome key constraints. Gradual reductions in prize incentives in later stages of the competition may help orient competitors to overarching market conditions without completely nullifying the incentive offered by the prize to invest in the nascent markets. The AgResults Nigeria project reduced its prize awards by 50 percent in the final year, and still new entrants joined that year and participation remained strong.

Finally, the timing of prizes can influence competitor trust. More frequent payouts can build trust between the program and potential competitors, especially in cases where donors do not have existing relationships or reputations among private sector actors. More frequent prizes also allow the competitor to invest their prize payment into expanding their business.

Explore ways to increase participation of under-represented firms, such as women-owned or women-managed firms.

Increasing the diversity of the competitor pool can help to increase the diversity of approaches, solutions, and beneficiaries that are reached. Potential means to increase inclusion can include proactively identifying under-represented groups; or linking such firms with resources, such as specialised technical assistance or lines of credit, that may enhance their competitiveness. Five of the six AgResults competitions discussed in this report did not have explicit objectives to include women or other underrepresented groups. During the design phase, Senegal included a gender analysis to see if the design could be adjusted to promote women farmers. The analysis recommended that the PfR project include a focus on crops where women were over-represented among potential competitors, but these were already included so the Secretariat made no adjustment to the design.

3.4 Designing to maximise smallholder farmer impact

The first four lessons below in this section focus on tailoring a PfR initiative to maximize its inclusion of smallholder farmers. While AgResults broadly seeks to develop inclusive markets for smallholder farmers, smallholder farmers themselves are not a homogeneous group. They vary considerably in how integrated they are into markets and their access to resources. This variation affects the ease and cost, and thereby profitability, of reaching them through commercial distribution channels. These lessons attempt to help prize sponsors consider the types of smallholders to target. To this end, it may be helpful to think of three market segments:

- Better-off, higher income smallholder farmers may be easiest to target and produce the largest impacts. They represent a small portion of the farmer population.
- 'Typical' smallholder farmers may require more effort and investment to develop as buyers or suppliers than the first group. They represent a larger portion of the farmer population.

- Low-income and remote smallholder farmers may be the most difficult to develop because they are less integrated with markets overall. These disadvantaged groups may benefit the most but yield modest impacts. It may be worth incentivising higher or middle-income primary smallholder farmers to include these farmers as indirect beneficiaries in a clearly defined way, such as training.

Tailor the competition rules to incentivise competitors to engage the intended beneficiary group.

The technologies that PfR prize competitions promote may be attractive to diverse types of farmers, not just smallholder farmers, which could lead competitors to maximise their gains by selling to wealthier or larger-volume buyers or producers. It is possible to define competition terms to reward only sales to (or procurement from) a specific beneficiary group. However, enforcement of the terms requires a clear definition of the beneficiary group (e.g., what specifically distinguishes a smallholder farmer). This can increase verification costs. An alternative option is to define other competition parameters that are consistent with maximizing sales to the intended beneficiary group.

The Kenya project, for example, rewarded only sales of improved on-farm storage technologies in regions where staple grain production predominated, and for sales of storage devices with capacity appropriate to the storage needs of smallholder farmers. This implicitly targeted the product to smallholder farmers who would use them to store the food staples they produced, rather than to larger-scale farmers or producers of cash crops. Similarly, in Nigeria, the project ensured that competitors would recruit smallholder farmers to produce Aflasafe-treated maize by limiting the areas cultivated from which competitors would be rewarding for procuring maize.

Verify that the technology under consideration can have a significant development impact on the target group if adopted at scale.

Prize designers should consider whether prize eligibility requires significant development impact or lays the groundwork for future efforts, hoping that a healthy market will grow ("scale") and lead to spillover effects that improve donor-prioritized development outcomes. AgResults demonstrated that one of the merits of the prize/PfR approach is the opportunity to catalyse the development of a smallholder-inclusive market that benefits from the adoption of new technologies. For example, in Kenya, AgResults successfully created a market for improved on-farm storage devices that were popularly enjoyed by smallholders and uniquely targeted to smallholders due to the size of the devices eligible for AgResults prizes.

AgResults also demonstrated that successful smallholder-inclusive efforts do not guarantee development impact. In Kenya, there was no significant effect on farmer income because farmers did not sell more grain or choose to sell grain at more advantageous times. In Nigeria, there was little health impact because farmers sold almost all their Aflasafe-treated maize, and most did not learn about the dangers of aflatoxins and the promise of Aflasafe to mitigate aflatoxins. In Senegal, during the one season in which the project managed to spur significant storage, the price of the main stored crop (cashews) actually went down, saddling the cooperatives and banks with losses.

Reward gains among better-off smallholder farmers—who will form the nucleus of the emerging market—to promote early success and increase a technology's visibility.

PfR prize competitions that aim to develop markets are likely to see their largest and quickest gains related to technology adoption among relatively better-off smallholder farmers who are the most active market participants. It might seem counter-intuitive to reward competitors for gains in sourcing from or marketing to these more accessible farmers in the market. However, doing so can help in early stages of market development when the technology may be little known, increasing the technology's visibility while also creating the nucleus of a self-sustaining market.

In Nigeria, where project rules ensured that competitors would source Aflasafe-treated maize from smallholder farmers, most competitors sought to recruit relatively more productive smallholder farmers. This made sense because yields needed to be higher than average for the application of Aflasafe to be economical. It also facilitated the production and management changes required for farmers to successfully produce and market Aflasafe-treated maize.

In Vietnam, competitors met the PfR requirements by working with cooperative leaders to create groups of neighbouring farmers who would coordinate their rice farming to meet competitors' technology requirements and PfR verification requirements. By working with cooperative leaders who strategically selected areas with the best water/drainage control and farmer groups who would be willing to coordinate with each other, competitors disseminated their AgResults technologies to the most influential figures in local agricultural production.

Systematically look for opportunities to include farmers who have lower rates of market integration, such as very poor farmers and women farmers, recognizing that including these groups may involve additional cost and complexity.

Disadvantaged, lower-income smallholder farmers and woman-headed households may have lower rates of market integration and less purchasing power, and consequently may be less likely to benefit from the development of markets for a technology in the short run. We discuss opportunities to increase inclusion of women and other under-represented beneficiary groups, without excluding other smallholder farmers who are more likely to be successful.

Gender outcomes can be improved through proactive design strategies. These include incorporating gender inquiries and household-level analysis during project scoping, which can help identify gendered patterns of behaviour to consider during project design. PfR approaches that promote low-cost technologies relevant to food security may ease uptake among and benefits to women. While prize criteria can be defined to encourage more inclusion of women, PfR projects' dependence on catalysing private sector investment and ingenuity requires balancing social and development goals with the motivations and business interest of the project's private sector competitors. Operationally, this may mean providing a bonus for achieving gender goals rather than predicating receipt of a prize on gender goals. The idea is to avoid undermining the development of a viable market by focusing too closely on integration of more costly and less profitable smallholder market segments.

Looking at the example of Kenya, very poor households had lower uptake of improved on-farm storage than less poor households. This is not inherently problematic; however, the scale and sustainability of impact comes from achieving rapid market growth, which implies targeting uptake among the most likely market participants first. This point does not argue that there is a trade-off between market impact and development impact, so much as that development impact is realised through market impact. The opportunity to leverage a large-scale impact through the market can increase pathways and resources available for targeting beneficiaries who are less integrated into markets through other types of initiatives.

Consider prize structures that will incentivise competitors to help farmers fully benefit from the technology, not just adopt it.

Farmers usually need to be trained or otherwise enabled to use new technologies correctly to obtain full benefits and for the development objectives of the project to be met. This is especially the case when the technology has potential not only for farmers to increase their incomes but also improve non-financial outcomes. Requirements for farmer training can be written into competition requirements. The imposition of such requirements can be appropriate if it is in the competitor's interest at some level to provide the needed training, and if the requirement is likely to stimulate the development of business models where such training becomes integral. If competitors are not already motivated to provide adequate training

(e.g., because they intend to buy back a derivative product and thus want to optimise production volumes or quality), the project must verify whether training was provided.

For example, in Kenya, it was in the competitors' long-term interest to teach farmers to use the products correctly, and therefore be effective, to attract repeat purchases. In some cases, however, the competitors have no commercial interest in certain aspects of training, and it may be preferable for the project to offer, or partner with another entity, to provide that. For example, in the Nigeria project, competitors had an interest in training farmers to use Aflasafe correctly because they usually intended to buy the product back to re-sell. They did not, however, have an interest in teaching farmers or household cooks about the health implications of aflatoxins, so they tended to emphasise these issues less. The result was relatively low farmer consumption of Aflasafe-treated maize even though one of the project's goals was to increase farm-level consumption.

In Senegal, the competition rules incentivised warehouse owners to increase their level of storage of crops from smallholders. However, there was no restriction that benefits from the sales of stored crops (either market profits or the AgResults incentive payments) needed to be shared with smallholders. While some warehouse owners had structures in place to share profits with smallholders, in most cases any profits from storage flowed directly to the owners themselves. Since the warehouse owners were typically farmer cooperatives, profits may have flowed back to their members through improved services, but these benefits would be diffuse and occur in the future. If the goal of a project is to increase smallholder incomes, the competition should be designed so that smallholders benefit directly.

3.5 Reflections on independent evaluation

Advantages of external evaluation

As mentioned in Section 1.3, AgResults had an uncommonly comprehensive evaluation approach. Besides conducting comprehensive evaluations on each project, the evaluation team also actively participated in project design discussions and Steering Committee meetings.

One value-add of independent evaluations was that they allowed measurement of impacts on smallholders, which the Project Manager or Secretariat did not generally track. This specifically allowed the stakeholders to identify scenarios in which the project was paying out prizes but smallholders were not benefitting. For instance, the Kenya On-Farm Storage project was a huge success in spurring the market for hermetic storage, as it spurred the sale of 413,265 MT of improved storage capacity, and in paying out US$6.25 million in incentives. However, the evaluation reported very small increased revenue of around US$2 per smallholder adopting the technology. Similarly, the Senegal Crop Storage Finance project raised interest from producer organisations, but never manage to attract smallholder farmers to directly store their own crops in licensed warehouses.

During the bi-annual Steering Committee meetings, evaluation teams presented results from the formal evaluation activities, as well as reflections on project implementation as an independent observer. In most cases, evaluation activities caused evaluation teams to spend extended periods in the regions where projects were being conducted, allowing them to independently observe implementation progress. At times, the narrative of project progress from the External Evaluator deviated significantly from that of the Project Managers. Having an independent voice that was intimately acquainted with the project provided the Steering Committee with valuable information that allowed its members to make informed decisions. For instance, insights from the External Evaluator played a key role in helping the Steering Committee decide to end three unsuccessful projects early. One Steering Committee member said, *The emphasis has always been on the learning. The different evaluation outputs affected the designs in a way I think was helpful, even if it…wasn't always welcomed.*

Evaluation challenges

The primary challenge of this comprehensive evaluation approach was its costs. Overall, the AgResults project plans to spend US$14 million (roughly US$3 million for IDinsight, and US$11 million for Abt[9]) on evaluation activities. This is $1.6 million per project, and 9 percent of the US$142 million that AgResults spent on implementation. While not large as a percentage of spending, donors may still find the total cost to be high.

The relatively high costs came due to the comprehensive approach taken to evaluations. All evaluations addressed at least six research questions using mixed methods. As shown in Exhibit 1-3, most evaluations had multi-year quantitative and qualitative approaches, with multiple rounds of data collection each. For each project, the evaluation team prepared many reports, including a design document, baseline report, midline report(s), endline report, and in some cases sustainability reports. The evaluation teams travelled to the bi-annual Steering Committee meetings, and prepared presentations for each one. They also prepared cross-cutting documents on evaluation approaches, lessons learnt, and cost-effectiveness. For most projects, delays in implementation meant that evaluation teams incurred some additional administrative costs.

Another challenge about evaluation is that there can be tension between the implementation goals and evaluation goals, especially when the evaluators advocate for approaches that interfere with implementation goals. For example, evaluators may value a scientifically rigorous RCT where some geographic regions are randomly assigned to be prize-eligible, as happened in the Nigeria and Vietnam projects. This can create tension with private sector actors who may be variably advantaged or disadvantaged by the random assignment outcomes; PfR sponsors may also require reassurance that evaluation designs do not limit the potential scale of the PfR project's market impacts.

Reflections on evaluation

We present a few high-level take-aways from the evaluation approach for AgResults:

- The evaluations' unique contribution was carefully measuring effects of AgResults projects on smallholder incomes.
- In most cases, the evaluations brought important learnings that drove implementation decisions within the project lifecycle.
- A key component of the evaluation approach's success was that the evaluator was independent of the implementers while observing their day-to-day progress, and the Steering Committee took the evaluator's findings seriously.
- For projects that did not interact directly with smallholder farmers (namely the FMD and Brucellosis projects) and were multi-national in scope, the evaluations provided less value, as their findings were similar to those reported by the Project Manager. In these cases, a less rigorous evaluation approach would be more appropriate.

Overall, we believe that the comprehensive evaluation approach used in AgResults was appropriate, given that learning was an explicit component of AgResults' mission. For projects more focused on implementation, a strong evaluation component would still provide value to allow course corrections mid-project.

[9] AgResults committed £3.7 million in 2013 and another £3.7 million in 2015. These convert to US$5.8M and US$5.6M, respectively, totalling US$11.4M.

However, donors may want to consider focusing evaluation efforts on certain projects where success is less certain.

Appendix A. Bibliography of AgResults Evaluation Resources

The evaluation designs, baseline reports, final evaluations, and evaluation briefs for each project are listed below.

General AgResults evaluation resources

Geyer, Judy, Adi Greif, Betsy Ness-Edelstein, and Denise Mainville (2021). Evaluation Methods. *Evaluator's Lessons Learned Series,* Issue 7. Rockville, Maryland: Abt Associates. https://agresults.org/wp-content/uploads/2024/02/Evaluator-Lessons-Learned-8_Impact-Evaluation-Methods.pdf

Mainville, Denise (2020). Incorporating a Gender Lens into Challenge Project Design. *Evaluator's Lessons Learned Series,* Issue 5. Rockville, MD: Abt Associates and Denise Mainville Consulting, October. https://agresults.org/learning/57-evaluator-lessons-learned-5-incorporating-a-gender-lens-into-challenge-projects/file

Mainville, Denise, and Tulika Narayan (2017). Pull Mechanisms for Overcoming Market Failures in the Agriculture Sector. *Evaluator's Lessons Learned Series,* Issue 2. Bethesda, MD: Abt Associates and Denise Mainville Consulting, November. https://agresults.org/learning/26-evaluator-lessons-learned-2-pull-mechanisms-for-overcoming-market-failures-in-the-agriculture-sector/file

Kenya On-Farm Storage Challenge Project

Abt Associates (2014). *Final AgResults Evaluation Design: Kenya On-Farm Storage Project.* Rockville MD: Abt Associates, June 27. https://agresults.org/learning/31-evaluation-design-kenya-on-farm-storage-challenge-project/file

Abt Associates (2015). *AgResults Baseline Report: Kenya On-Farm Storage Project.* https://agresults.org/learning/34-evaluation-baseline-report-kenya-on-farm-storage-challenge-project/file

Ness-Edelstein, Betsy, Denise Mainville, Tulika Narayan, Judy Geyer, and David Cooley (2019). *AgResults Impact Evaluation Report: Kenya On-Farm Storage Challenge Project.* Rockville, Maryland: Abt Associates. https://agresults.org/learning/48-evaluation-final-report-kenya-on-farm-storage-challenge-project/file

Ness-Edelstein, Betsy, Denise Mainville, Judy Geyer, and David Cooley (2020). *Evaluation Findings: Kenya On-Farm Storage Challenge Project.* Rockville, MD: Abt Associates and Denise Mainville Consulting. *Evaluator's Lessons Learned Series,* Issue 4, July. https://agresults.org/learning/52-evaluator-lessons-learned-4-kenya-on-farm-storage-challenge-project-evaluation-findings/file

Mainville, Denise, and Betsy Ness-Edelstein (2021). *AgResults Evaluation: Kenya On-Farm Storage Challenge Project. Sustainability Assessment.* Rockville, Maryland: Abt Associates. https://agresults.org/learning/65-sustainability-assessment-kenya-on-farm-storage-challenge-project/file

Nigeria Aflasafe Challenge Project

Abt Associates (2014). *AgResults Evaluation Design: Nigeria Aflasafe™ Pilot.* Abt Associates in association with Denise Mainville Consulting, December 30. https://agresults.org/learning/30-evaluation-design-nigeria-aflasafe-challenge-project/file

Narayan, Tulika, Denise Mainville, Judy Geyer, Kate Hausdorff, and David Cooley (2020). *AgResults Impact Evaluation Report: Nigeria Aflasafe™ Challenge Project.* Rockville, Maryland: Abt Associates. https://agresults.org/learning/37-evaluation-final-report-nigeria-aflasafe-challenge-project/file

Narayan, Tulika, Denise Mainville, Judy Geyer, Kate Hausdorff, and David Cooley (2020). Nigeria Aflasafe™ Challenge Project Evaluation Findings. *Evaluator's Lessons Learned Series,* Issue 3, August. Rockville, MD: Abt Associates and Denise Mainville Consulting. https://agresults.org/learning/27-evaluator-lessons-learned-3-nigeria-aflasafe-project-evaluation-findings/file

Uganda Legume Seed Challenge Project

Abt Associates (2017). *Final AgResults Evaluation Design: Uganda Legume Seed Project.* Rockville MD: Abt Associates, February 7. https://agresults.org/learning/33-evaluation-design-uganda-legume-seed-challenge-project/file

Abt Associates (2018). *AgResults Evaluation Baseline Report: Uganda Legume Seed Project.* Rockville MD: Abt Associates, August. https://agresults.org/learning/36-evaluation-baseline-report-uganda-legume-seed-challenge-project/file

Zambia Biofortified Maize Challenge Project

Abt Associates (2014). *AgResults Evaluation Design: Zambia Biofortified Maize Pilot.* Bethesda, MD: Abt Associates. https://agresults.org/learning/32-evaluation-design-zambia-biofortified-maize-challenge-project/file

Abt Associates (2016). *AgResults Baseline Report: Zambia Biofortified Maize Pilot.* Bethesda, MD: Abt Associates, April 5. https://agresults.org/learning/35-evaluation-baseline-report-zambia-biofortified-maize-challenge-project/file

Mainville, Denise, and Tulika Narayan (2020). *AgResults Zambia Biofortified Maize Challenge Project – Close-out Assessment.* Rockville, Maryland: Abt Associates, May, updated December. https://agresults.org/learning/50-evaluation-close-out-assessment-zambia-biofortified-maize-challenge-project/file

Mainville, Denise, and Tulika Narayan (2020). Evaluation Findings: Zambia Biofortified Maize Challenge Project. *Evaluator's Lessons Learned Series,* Issue 6, December. Rockville Maryland: Abt Associates and Denise Mainville Consulting. https://agresults.org/learning/62-evaluator-lessons-learned-6-zambia-biofortified-maize-evaluation-findings/file

Vietnam Emissions Reduction Challenge Project

Geyer, Judy, Adi Greif, and Denise Mainville (2022). *Final Evaluation Report: Vietnam Emissions Reduction Challenge Project.* Rockville, Maryland: Abt Associates. https://agresults.org/wp-content/uploads/2024/02/AgResults-Final-Evaluation-Report_Vietnam-GHG-Challenge-Project.pdf

Geyer, Judy, Adi Greif, and Denise Mainville (2022). Evaluation Findings: AgResults Vietnam Emissions Reduction Challenge Project, *Evaluator Brief* 7, January. Rockville, MD: Abt Associates and Denise Mainville Consulting. https://agresults.org/wp-content/uploads/2024/02/Evaluator-Lessons-Learned-7_Vietnam-GHG-Emissions-Evaluation-Findings.pdf

Mainville, Denise, Hai Ninh Nguyen Thi, and Judy Geyer (2023). *AgResults Sustainability Assessment Report: Vietnam GHG Emissions Reduction Challenge Project.* Rockville, Maryland: Abt Associates and Denise Mainville Consulting. https://agresults.org/learning/evaluators-sustainability-assessment-vietnam-ghg-emissions-reduction-challenge-project/agresults-vietnam-sustainability-assessment-report-final/

Senegal Crop Storage Finance Challenge Project

Stein, Daniel, Lorraine d'Anglejan, Julius Houehou, Julian Martin, and Ewoud Nijhof. 2023. *AgResults Senegal Crop Storage Finance Challenge Project Impact Evaluation- Baseline.* https://agresults.org/wp-content/uploads/2023/02/IDinsight_Impact-Evaluation_Baseline_AgResults-Senegal_2023_vf_publically-shared-180923.pdf

Stein, Daniel, Lorraine d'Anglejan, and Julian Martin (2022). *AgResults Senegal Crop Storage Finance Process Tracing Evaluation- Baseline.* https://agresults.org/wp-content/uploads/2024/02/AgResults-Process-Tracing-Baseline-Evaluation-Senegal.pdf

Appendix B. AgResults Projects Pending Evaluation

Projects where evaluation is not yet complete
Tanzania Over a four-year period, AgResults offered cash prizes to competitors for selling inputs directly to smallholder dairy farmers that are known to improve dairy productivity. Sellers could win prizes for selling dairy-cow vaccines, parasite control, artificial insemination, and nutrition packages. Twenty-four competitors participated and roughly 85,000 smallholder dairy farmers purchased AgResults-approved inputs. The project completed in 2024 and the external evaluation will be published in 2025.
Indonesia AgResults offers cash prize to tech startups and SMEs for each unit of technology rented or sold to encourage smallholder farmers adoption of on-farm aerators and feeders technologies to boost productivity and strengthen the aquaculture sector (including a "grand prize" for competitors which achieve a certain threshold of sales). Additionally, AgResults offers "technical assistance" cash prize to freshwater fish and monodon hatcheries which receive the IndoGAP certification. The project is now in its fourth year and has spurred interest from many micro and small-scale aquaculture farmers across Indonesia.
International: Brucellosis vaccine AgResults is sponsoring a prize competition for the development of a vaccine against Brucella melitensis that affects goats, sheep, and other small ruminants. Eligible companies can receive three milestone payments at different stages that could add up to a total of US$26 million for one entrant over the span of up to ten years.
International: Foot and Mouth Disease Vaccine AgResults is sponsoring a prize competition for the development of high-quality FMD vaccines tailored to meet the needs of Eastern Africa. After development, AgResults has a cost-share offer that reduces the cost-per-dose for buyers, enabling public and private sector actors to better combat FMD through more consistent purchases of these vaccines. The level of cost-share support gradually decreases each sales period, with the expectation that the FMD vaccine market becomes independently sustainable.