Can pull mechanisms achieve agriculture development objectives?
Evidence from AgResults external evaluation

UK Department for International Development (DFID)
Chief Economist’s Seminar Series
February 24, 2020
Abt Associates
Presentation outline

• What are pull mechanisms?
• AgResults – created to test pull mechanisms
• How well has AgResults worked?
• What have we learnt – how can we make the most of pull mechanisms?
Pull mechanisms

- Pull mechanisms are among results-based approaches:

<table>
<thead>
<tr>
<th>With or without milestone prize</th>
<th>Grand challenge</th>
<th>Advance market commitments</th>
<th>Proportional prize</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Winner takes all for developing the innovation</td>
<td>• Typically a single winner who gets advance commitment of purchase of innovation at a pre-specified price</td>
<td>• Multiple winners based on their performance</td>
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<tr>
<td></td>
<td>• Allows monopoly pricing</td>
<td>• Ensures marginal cost pricing</td>
<td>• Expects competitive pricing because of multiple suppliers</td>
</tr>
</tbody>
</table>
• AgResults is a $145 million multilateral initiative, managed by a dedicated Secretariat and overseen by a Steering Committee comprised of the five donor agencies and the World Bank as financial trustee.

• AgResults provides prizes to temporarily offset underlying market conditions that limit private sector investment in agriculture technology development or technology adoption. Its technology adoption projects aim to create a market for the technology.

• AgResults’ learning agenda is to understand the effectiveness of pull mechanisms and other related questions - Abt Associates’ role as external evaluator.
Key elements of pull mechanisms

Development Problem
- A specific development problem that the pull mechanism can address

A Solution
- A specific technology – proven, or needs tailoring – that can address the problem

Competitors
- Private sector actors who have an underlying interest in the market for the solution and who will respond to incentives

Incentive structure
- A well-defined outcome that solvers are incentivized to achieve
- A prize structure – winner-takes-all, proportional prize

Theory of change
- A series of causal relationships that tie together all the preceding elements linking them to final impact

Verification protocol
- An independent, transparent cost-effective and tamper-proof system to verify that the outcomes were achieved

See brief “Pull mechanisms for overcoming market failure in agriculture sector.”
AgResults Projects

**Completed**

**Vietnam GHG Emissions Reduction Project**
Testing and scaling up improved, low emissions rice farming technologies

**Nigeria Aflasafe™ Project**
Promoting adoption of biocontrol technology to combat aflatoxin (fungal mold) in maize

**Kenya On-Farm Storage Project**
Expanding improved on-farm storage for smallholder farmers

**Uganda Legume Seeds Project**
Strengthening the production and distribution value chain for improved legume seeds

**Zambia Biofortified Maize Project**
Incentivizing uptake of pro-Vitamin A orange maize

**Stopped early**

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**Brucellosis Vaccine Development Project (Global)**
Creating a low-cost and effective Brucellosis vaccine

**Completed**

**Brucellosis Vaccine Development Project (Global)**
Creating a low-cost and effective Brucellosis vaccine
Pull mechanisms in the context of market failure in provision of agricultural technologies for poor consumers

- Lack of awareness
- Poor infrastructure
- Credit market constraints
- Risk of loss

Missing market for technology

- Low demand for technology and derived products
  - Lack of awareness
  - Credit, land, labor market constraints
  - Risk of loss
  - Externalities

- Low supply of technology

- Weak institutions and policy environment
AgResults: Addressing market failure

- Low demand for technology and derived products
- Weak institutions and policy environment
- Low supply of technology
- Missing market for technology

AgResults Incentive: prize proportional to sale of technology to smallholders

Investment (or transfer of incentives) that increase expected return from adoption

Increase in expected revenue from sale of technology
### Missing market because...

<table>
<thead>
<tr>
<th>Country</th>
<th>Farmers' Issues</th>
<th>Suppliers' Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>Farmers are not aware of aflatoxins or Aflasafe as a solution, or of premium markets for aflatoxin-free maize</td>
<td>Suppliers face poor infrastructure and lack of financing to source aflatoxin-free maize from smallholders</td>
</tr>
<tr>
<td>Kenya</td>
<td>Farmers are not aware of improved on-farm storage</td>
<td>Suppliers face distributional constraints in reaching smallholders</td>
</tr>
<tr>
<td>Zambia</td>
<td>Farmers and value chain actors are not aware of PVA maize and its benefits</td>
<td>Policies that favor white rice, higher cost in sourcing maize from smallholders</td>
</tr>
<tr>
<td>Uganda</td>
<td>Farmers cannot distinguish improved quality seeds</td>
<td>No quality certification of seeds</td>
</tr>
<tr>
<td>Vietnam</td>
<td>Farmers are not aware of GHG emissions from rice or of technologies that reduce emissions and increase returns</td>
<td>Externalities, lack of a business case to have farmers adopt low emissions technology</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>Farmers do not see the value of brucellosis vaccine either because of they are not aware of it or because they think it is not efficacious</td>
<td>Externalities, low ability to pay by final consumers</td>
</tr>
</tbody>
</table>
**How AgResults pull mechanisms work:**

<table>
<thead>
<tr>
<th>Country</th>
<th>Project incentivizes …</th>
<th>and awards prizes for …</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>Maize aggregators</td>
<td><em>Per unit prize</em> for every ton of maize aggregated that is treated with an aflatoxin biocontrol agent – Aflasafe – from smallholders</td>
</tr>
<tr>
<td>Kenya</td>
<td>On-farm storage device suppliers</td>
<td><em>Proportional prize</em> based on on-farm storage capacity sold to smallholders</td>
</tr>
<tr>
<td>Uganda</td>
<td>Seed companies</td>
<td><em>Per unit prize</em> based on amount of certified legume seeds sold above 8% annual growth</td>
</tr>
<tr>
<td>Zambia</td>
<td>a) Maize millers and b) Seed companies</td>
<td><em>Threshold prize and per unit prize</em> for selling a) Pro Vitamin-A milled maize and b) Pro Vitamin A maize seeds</td>
</tr>
</tbody>
</table>
Evaluation questions

- **Market impact.** Did the private sector invest to create a smallholder-inclusive market for the technology?

- **Development impact.** Did the smallholders benefit?

- **Cost effectiveness.** What was the cost per adopting farmer?
How did the AgResults Nigeria Aflasafe project perform compared to expectations in the business plan by the end of four years?

**Expectation on Market and Production Impact**

- **Pilot expected to created a niche market for Aflasafe-treated maize** with around 3% market penetration

- **Smallholder impact.**
  - Smallholders will increase income from maize
  - Smallholders will consume more Aflasafe-treated maize by virtue of own consumption, and because of awareness of the adverse effects of aflatoxins

**Project performance**

- **A niche market was created** with multiple and diverse private sector actors investing in supplying Alfasafe-treated maize. Market penetration was 1% of total maize harvested. Farmer adoption increased by 56 percentage points in AgResults villages.

- **Smallholders** increased maize income by $318 or 16 percent, and consumption of Aflasafe-treated maize increased by 0.02 kg per day or 13 percent. Smallholder awareness about aflatoxins increased by only 22 percentage points.

See [evaluation brief](#) and [report](#).
Evaluation approach

The evaluation conducted:

• **Qualitative analysis** of 223 interviews with maize value chain actors to assess the development of the market using a structure-conduct-performance framework.

• **Quasi-experimental evaluation** using data from structured surveys of 1823 smallholders in Kano, Kaduna, and Katsina to assess the pilot’s impact on:
  - smallholders in villages reached by AgResults.
  - smallholders in villages not reached by AgResults (after balancing on baseline characteristics).

• **Cost-effectiveness analysis** using project monitoring data, pilot costs, and publicly-available data.
How did the AgResults Kenya OFS project perform compared to expectations in the business plan?

Expectation of market and smallholder impact

- **Market impact**: Project was expected to create a market for OFS with market penetration of 6% in Eastern region and 18% in Rift Valley.

- **Smallholder impact**: reduced post-harvest loss, reduction in expenditure on maize for consumption, possibly increased maize income and reduced use of pesticide dust. Estimated benefit from post-harvest savings for marketing or consumption was projected at $6-$34 per OFS

Project performance

- **An emerging market was created** with multiple firms competing to provide OFS. There was a 23 percentage point increase in adoption in Eastern and 6 percentage point increase in Rift Valley.

- **Smallholder impact**: Increase in Maize revenue net of costs for container, pesticide, and purchased maize for consumption from OFS adoption was $3 but it was not statistically significant. Smallholders reduced the use of pesticide dust.
Evaluation approach

• **Qualitative method:** Semi-structured interviews with 80 stakeholders to assess market impact using structure-conduct performance approach.

• **Quantitative method:**
  – Estimated impacts of project on adoption using interrupted time series design
  – Estimated impacts of adoption on other farmer returns including food security, by matching adopters with similar non-adopters
Adoption of OFS

Eastern


Rift Valley

2011: 1%  2012: 1%  2013: 2%  2014: 2%  2015: 2%  2016: 3%  2017: 4%

Regression-adjusted pre-intervention trend time series
Regression-adjusted post-intervention trend time series
Projected using pre-intervention trend
Comparing cost-effectiveness in Nigeria and Kenya

<table>
<thead>
<tr>
<th></th>
<th>Nigeria</th>
<th>Kenya</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project cost per smallholder household adopting technology</td>
<td>$135</td>
<td>$39</td>
</tr>
<tr>
<td>Smallholder return for adopting technology (excluding health benefits)</td>
<td>$318**</td>
<td>$3</td>
</tr>
</tbody>
</table>

Cost per smallholder adopting:
- Nigeria costs are higher because Aflasafe is a more complex technology to adopt with field level intervention needed.
- The scale of adoption was higher in Kenya, and therefore the cost per smallholder adopting was lower.

Smallholder returns:
- Smallholder returns were greater from adoption Aflasafe than from purchase of OFS.
Zambia learning

• If enabling environment is a main cause for market failure, a pull mechanism will not succeed.
  – The policy environment was always a challenge – preferential treatment of white maize and periodic export bans that disrupted the market. This was the reason the project closed early.

• Theory of change should link incentive structure to development impact.
  – Initial design had a weak theory of change to achieve development impact – incentivizing maize millers for selling milled maize would have benefited farmers only if they sourced Pro Vitamin A maize from farmers, which was questionable.
  – Updated design to include seed company sales of Pro Vitamin A maize to farmers improved the link to development impact.
Uganda learning

- If enabling environment is a main cause for market failure, a pull mechanism will not succeed.
  - Uganda’s seed sector is a market for lemons. Lack of a quality certification means that the bad seeds drive out the good. Without quality certification, the pull mechanism would also not work.
  - The project was redesigned to include a quality certification system—AgVerify— which did not launch, causing the project to close early.
Key findings

• **Pull mechanisms can create a market** for technologies beneficial to smallholders if competitors can address the key constraints or if the enabling environment is not an impediment.

• **Pull mechanisms attract multiple private sector** actors with more participation when the chances of winning are greater (per unit prize compared to proportional prize).

• **Smallholder impacts can vary** for many reasons – targeting by private sector actors, strategic behavior by competitors, and technology characteristics.
Key lessons

- **Type of technology matters.** Adoption is stronger when technology yields private benefits and/or when the benefits are clearly perceived by the users; additional resources may be needed to raise broader awareness for technology that has public goods attributes.

- **Private sector may not do all the work.** Strategic behavior by competitors could inhibit development impact.

- **Theory of change requires sound understanding of the market.** It should flesh out how private sector will respond to incentives, how that will result in development impact and results will sustain.

- **Do cost-benefit analysis, do it early.** Ex-ante cost-benefit analysis is key to assess expected development impact and the degree of sensitivity of the impacts on assumptions; it can also help set prize amount (see blog).

- **For evaluators: Private sector actors may not treat those interviewed at baseline.** Baselines are critical but may not always be useful in cases where multiple private sector actors implement with freedom to innovate as they go!
Appendix slides
<table>
<thead>
<tr>
<th>Outcome</th>
<th>Treatment mean (regression adjusted) (A)</th>
<th>Comparison mean (B)</th>
<th>Impact (C = A-B )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uptake. Percentage of smallholders who applied Aflasafe on at least one maize plot</td>
<td>57%</td>
<td>1%</td>
<td>56***</td>
</tr>
<tr>
<td>Farmer knew the health risks of aflatoxins</td>
<td>23%</td>
<td>1%</td>
<td>22 ***</td>
</tr>
<tr>
<td>Cook knew about the health risks of aflatoxins</td>
<td>6%</td>
<td>0%</td>
<td>6 ***</td>
</tr>
<tr>
<td>Income. Net maize income ($/annum)</td>
<td>2,305</td>
<td>1,987</td>
<td>318***</td>
</tr>
<tr>
<td>Consumption. Aflasafe-treated maize consumption yesterday per person (kg)</td>
<td>0.02</td>
<td>0.00</td>
<td>0.02 ***</td>
</tr>
<tr>
<td></td>
<td>Adopters (A)</td>
<td>Non-adopters (B)</td>
<td>Difference (C=B-A)</td>
</tr>
<tr>
<td>------------------------------</td>
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<tr>
<td><strong>Primary outcome:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household revenue from sales (in 2010 Ksh)</td>
<td>479</td>
<td>310</td>
<td>169***</td>
</tr>
<tr>
<td>Maize revenue net of costs for container, pesticide, and purchased maize for consumption (2010 Ksh)</td>
<td>-1,135</td>
<td>-1628</td>
<td>493**</td>
</tr>
<tr>
<td>Cost of pesticides used in stored grain (2010 Ksh)</td>
<td>104</td>
<td>304</td>
<td>-200***</td>
</tr>
<tr>
<td>Annualized cost of containers (2010 Ksh)</td>
<td>189</td>
<td>69</td>
<td>120***</td>
</tr>
<tr>
<td><strong>Primary outcome:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount spent on maize for consumption during the past 12 months (2010 Ksh)</td>
<td>1,353</td>
<td>1,646</td>
<td>-292</td>
</tr>
<tr>
<td>Household used any pesticides in grain stored for consumption</td>
<td>20.7</td>
<td>56.5</td>
<td>-35.8***</td>
</tr>
</tbody>
</table>