

## AgResults Kenya On-Farm Storage Challenge Project: Summary Report

# AIRTIGHT (HERMETIC) DEVICES

SAVE MONEY,  
SAFER FOOD

**No fresh air**

**Insects die**

**No aflatoxin growth**

Normal storage

HERMETIC BAGS

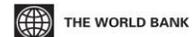
PLASTIC SILOS

METAL SILOS

TYPES OF DEVICES AVAILABLE

BENEFITS

- No insecticide needed**
- Reduced moisture loss**
- No insect damage**
- Grain tastes fresh**
- Fetches premium price**



**Report prepared by Tanager  
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## 1. Background to the Kenya Challenge Project

The AgResults Initiative ([www.agresults.org](http://www.agresults.org)) seeks to increase private sector investment in food security and agriculture, using Pay-for-Results (PfR) prize competitions or “pull mechanisms” — economic incentives or grants that are provided to organizations who achieve specific development outcomes, where private sector investment is typically absent or hindered due to market uncertainties. In doing so, AgResults goes beyond traditional “push mechanisms” that provide funding, technical assistance, or other inputs to create development impact.

AgResults harnesses the power of the market to promote the adoption of innovative technologies with high-yield development impacts. Strategically, AgResults uses “pull” financing to incentivize private sector investment in high-impact agricultural innovations that help achieve the following goals: reduce food insecurity, improve household nutrition and health, and raise livestock productivity.

The objectives of the AgResults performance-based prize competitions are to:

- 1) Overcome agricultural market failures by offering results-based grants (“pull” financing) to private actors for the development and/or scaling up of new agricultural technologies;
- 2) Test the effectiveness and efficiency of pull financing in comparison with traditional approaches for the promotion and use of innovative agricultural technologies.

The Kenya On-Farm Storage Challenge Project, managed by Tanager (formerly Agribusiness Systems International, ASI), is a part of the larger US\$147 million AgResults Initiative and aims to stimulate improved food security in Kenya through widespread adoption of improved, on-farm grain storage devices that reduce smallholder post-harvest crop losses, conversely increasing the amount of clean, pesticide-free grain available for household consumption; in addition, give farmers the ability to store grain for longer periods, obviate the pressure of selling at low prices during times of glut, and instead leverage higher market prices for increased revenue.

The Kenya Challenge Project was administered through performance-based grants awarded for sales of grain storage devices, adjusted by device capacity and useful life, to create new, improved storage space (measured in metric tons, MT) for smallholder farmers in Kenya’s Rift Valley and Eastern regions. The Rift Valley region produces approximately 60% (two million metric tons) of Kenya’s maize, presenting an attractive market for grain storage devices. The Eastern region is the third largest maize-producing region in the country and is known to experience losses from larger grain borer (LGB) outbreaks.

A total of US\$7.75 million in performance-based grants was offered by AgResults:

- In the Rift Valley Region, US\$4.75 million, comprising US\$3.75 million at the mid-point of the project and US\$1.0 million proportional prize at the end for participating private sector companies that created at least 21,000MT of improved storage space through sales
- In the Eastern Region, a US\$3.0 million proportional prize at the end of the project for participating private sector companies that created at least 21,000 MT of improved storage through sales of Larger Grain Borer-proof (LGB) storage devices

The Kenya Challenge Project expected to achieve the following by the end of the project:

- Reach approximately 480,000 smallholder farmers with quality storage devices and create at least 172,000 MT of new storage capacity for grain in the Rift Valley and Eastern regions.
- Generate US\$14 million in smallholder benefits from the storage of grain, sale of crops in higher price market periods, and the reduced need to buy grain for household consumption.
- Enable private sector companies to test products and marketing strategies that can be used for distribution of storage solutions.

## 2. Project Implementation

The Kenya Challenge Project was technology, marketing, and distribution agnostic. Instead, companies were encouraged to consider cost and storage effectiveness for smallholder farmers and the economic benefit to smallholder farmers and beyond, as they worked to meet prize thresholds for device sales.

### Participating Companies and Hermetic Devices

The project ran from 2014 to 2018, with the competitive Project Sales Term running from 1 May 2015 through 1 May 2018. Nine private sector companies participated in the project, with different sized hermetic, grain storage devices in the following four following storage types, each expected to serve the farmer for a specific duration (useful economic life):

- (i) Storage-enhancing bags: 3 years
- (ii) Storage-enhancing flexible bulk bags: 10 years
- (iii) Plastic containers: 15 years
- (iv) Metal containers: 20 years

**Table 1: AgResults Kenya Competitors and Devices**

Implementing Company	Hermetic device
African Farms and Markets Ltd/ GrainPro	<b>GrainPro SuperGrainBag Farm™</b> 90 Kgs <b>GrainPro SuperGrainBag IV-R™</b> 90 Kgs <b>Grain Pro GrainSafe Mini™</b> 250 Kgs
A to Z Textile Mills Ltd	<b>AgroZ Bag</b> 100 Kgs <b>AgroZ Bag</b> 50 Kgs
Bell Industries Ltd	<b>PICS Bag</b> 100 Kgs <b>PICS Bag</b> 50 Kgs
Corporate Business Forms Ltd/ Vestergaard	<b>ZeroFly® Hermetic Storage Bag</b> 100 Kgs
ELITE Innovations (K) Ltd	<b>Elite Bag Heavy Duty</b> 100 Kgs <b>Elite Bag Light Duty</b> 90 Kgs <b>Elite Bag Light Duty Double Layer</b> 90 Kgs
Ekima Engineering Works	<b>Metal Silo</b> – Nine (9) sizes, 50 – 540 Kgs
Kenya Promotions and Marketing Company Ltd	<b>KPMC GSBL</b> 90 Kgs <b>KPMC GSBL</b> 60 Kgs
Kentainers Ltd	<b>GranSilo</b> 380 Kgs – plastic silo
Post Harvest Africa	<b>grainz bag</b> 100 Kgs

## Storage Device Technology Requirements

The Project Manager and the Advisory Council used the following technology requirements to assess potential Competitors' devices for technical proficiency, prior to acceptance into the project:

- ✓ be able to increase the length of time grain crops can be stored compared to traditional storage methods;
- ✓ maximum 540 kg storage capacity;
- ✓ be reasonably easy for smallholders to use and suitable for storing crops for individual consumption;
- ✓ prevent insects and other storage pests from damaging the stored grain within two to three weeks of the crop being placed in the device, i.e., the pests will die before they can multiply and cause significant crop losses;
- ✓ prevent increased infestation of pests from outside the container during a reasonable storage life of the crop (estimated to be 4-6 months);
- ✓ do not cause any adverse effects on the quality of the stored crop;
- ✓ In the Eastern Region, device prevents LGB penetration and eliminates LGB infestation as determined by AgResults LGB-Proof Testing.

In addition, storage devices had to meet the following criteria: be approved by the competent Kenya government authorities, including the Kenya Bureau of Standards (KEBS) and as applicable, the Pest Control Products Board (PCPB).

## Implementation Areas

The Kenya Challenge Project promoted adoption of hermetic devices in 14 counties across the country: 9 counties in the Rift Valley region: Baringo, Bomet, Kericho, Laikipia, Nakuru, Nandi, Narok, Trans Nzoia, and Uasin Gishu; 5 counties in the Eastern region: Embu, Kitui, Machakos, Makueni, and Meru.

## Project Oversight and Implementation Structure

Several bodies were involved in implementing the AgResults Kenya project:

- The AgResults **Steering Committee**, comprising donor organization representatives and the Financial Trustee (The World Bank), is the apex body that provides strategic decision making for all AgResults projects.
- The AgResults **Secretariat**, Deloitte Consulting, was responsible for the project design and management for the Kenya Project and all other AgResults projects, and reports to the Steering Committee.
- A **Project Manager**, Tanager (formerly Agribusiness Systems International, ASI), coordinated and oversaw implementation of the project's activities in Kenya, reporting to the Secretariat. (Note: The Project Manager contract with the Secretariat ended in December 2018, at the close of the Kenya Challenge Project).
- A **Project Technical Advisory Council**, comprised of representatives from key stakeholders, industry associations and chambers, technical bodies, and relevant Government of Kenya entities, advised the Project Manager on technical aspects of the on-farm storage technologies and, as necessary, advised on pertinent implementation parameters.
- **Competitor** companies were contracted by the Secretariat to develop, manufacture, and sell improved grain storage devices, thereby creating enhanced grain storage capacity at the

smallholder farmer level, a prerequisite for receiving the performance-based grants outlined by the AgResults donor consortium.

- The Project **Sales Verifiers** were responsible for determining whether grain storage device sales reported by the Competitors conformed to the rules of the project: Ernst and Young conducted sales audits and confirmed the commercial authenticity of sales made by competitors; Infotrak Research Consulting conducted a household and market survey, which determined the proportion of sales that went to smallholder farmers.
- The Steering Committee contracted an **Independent Evaluator**, Abt Associates, to measure impacts created by all AgResults Projects (including the Kenya Project) through the ‘pull’ mechanism, juxtaposing it with traditional ‘push’ development approaches.

## Key Activities

### COMPETITOR COMPANIES IDENTIFICATION AND CONTRACTING

AgResults conducted a lengthy process of scanning the grain storage devices landscape to determine which companies were operating in the market, both in Kenya and elsewhere, and assess their interest in a results-based project for Kenya. This informal market research showed that the storage devices market had very few players, and even fewer that focused on smallholder farmers. In April 2015, AgResults issued a Competitor Request for Applications (RFA), inviting interested companies to join the Kenya Project with their respective storage devices. Applications were received and accepted, at different time points over the course of the project, from the nine Competitor companies. It was, however, noted (both in the pre- and post-RFA period) that the ‘pull’ strategy proposed by AgResults was not easily understood by companies, resulting in prolonged communications processes before there was sufficient buy-in, not only by the companies, but also other stakeholders.

### LGB TESTING

For the Eastern region portion of the Kenya Project, only Competitors with Larger Grain Borer (LGB, *Prostephanus truncatus*) proof grain storage devices were eligible to compete for the ‘market-pull’ incentive; the companies were required to sell sufficient LGB-proof grain storage devices to smallholder farmers to store in total at least 21,000 MT of grain. As there was no known standard in Kenya for assessing LGB proofness, AgResults commissioned independent trials of those grain storage devices wishing to be part of the Eastern Kenya project to determine their efficacy in protecting stored grain from insect damage particularly that caused by the LGB insect pest.

The standardized testing procedures to assess the efficacy of the different storage devices were developed in November 2014. Testing started in July 2015, implemented by the post-harvest team at the International Center for Insect Physiology and Ecology (icipe). In total, 13 storage devices were tested from companies that elected to participate in the test. The storage expert at the Natural Resources Institute (NRI)/University of Greenwich, Dr. Tanya Stathers, who had been involved in the design of the trials, acted as the scientific advisor and monitor. Three sets of trials were conducted:

- **Insect Damage trial** – Testing the efficacy of 13 storage devices in protecting grain seeded with LGB and *Sitophilus* weevils from further damage during a 24-week storage period;
- **Penetration 1 test** – testing whether LGB or *Sitophilus* can penetrate the materials that the storage device is constructed from within a 2-4-week period, using discs of the storage device placed in small arenas into which the test insects are added

- **Penetration 2 test** – testing whether insects released outside a life-size storage device full of maize grain will penetrate the device within a 4-week period. The devices were housed inside test boxes into which the insects were released.

The LGB test was successfully concluded in April 2016. The companies whose storage devices were tested were confidentially provided with the test results. Only companies selling LGB-proof storage devices (as determined through the AgResults LGB test) were registered for the ‘market-pull’ incentive for Eastern Region. For Rift Valley, however, no ‘LGB-proof’ criteria were stipulated by AgResults, and therefore, all storage devices were eligible for the ‘market-pull’ incentive in that region.

### **MAUZO (SALES)**

Competitor companies reported sales of grain storage devices to the Project Manager monthly, from 1 May 2015 through 1 May 2018. The Project Manager logged the sales in a tracking system, code-named *Mauzo* (Swahili for “sales”). The system enabled continuous performance assessment and monitoring through sundry sales analytics, dashboard, and other reporting routines.

### **SALES VERIFICATION**

Competitor sales reported through *Mauzo* were subjected to regular forensic audits by Ernst and Young (EY). The Sales Verification exercise was to assure AgResults that Competitor self-reported sales conformed to the rules of the Kenya Project—accurate, commercially consummated, devoid of subsidies—and that the ensuing incentive payments to the Competitors were correctly determined. The verification exercise was meant to mitigate against the following anticipated risks:

- Risk of misstated sales: the risk that reported sales are inflated to reach the incentive targets set under the agreement;
- Risk of fictitious sales: the risk that reported sales to reach the incentive targets set under the agreement never occurred;
- Risk of subsidized sales: the risk that reported sales were transacted outside the normal commercial terms to reach the incentive targets set under the agreement; and
- Risk of price dumping: the risk that reported sales were sold below cost to reach the incentive targets set under the agreement.

To achieve the verification objectives, EY carried out a range of forensic audit procedures including, but not limited to: conducted 100% examination of sales data and the underlying documentation, tested business control processes, visited distributors/agro-dealers in the supply chain, visited farmers who had purchased and were using the storage devices, conducted mystery shopper procedures, and considered all pertinent circumstances under which a sale was deemed to have been made. A total of eight sales verification exercises were conducted, covering the 36-months Project Sales Term.

### **Key Result from the Sales Forensic Audits:**

- ✓ All the sales reported by the Competitors were found to be genuine commercial transactions, and very importantly, there were no cases of fraudulent activity detected.

### **RANDOMIZED RURAL HOUSEHOLD SURVEY**

As the goal of the Kenya Challenge Project is to improve the economic welfare of smallholder farmers (defined by the project as persons cultivating less than 5ha/12.5 acres), AgResults had to not only

determine commercial validity of a Competitor's storage device sales, but also the proportion of such sales made specifically to smallholder farmers. Accordingly, AgResults engaged a survey/research firm, Infotrak Research Consulting, to conduct a randomized rural household survey (RRHS), which had the following objectives:

- a) To establish the proportion of smallholder farmers in the 14 project counties; and
- b) To estimate the number of project-eligible grain storage devices purchased by smallholder farmers as at the time of the survey.

For added quality assurance, the work of the primary data collection firm was monitored at two levels: by the Project Manager's own survey team and by a third-party firm, Precise Research Trends, specifically contracted by the Project Manager to provide independent monitoring. Data collection was carried out from 2 October 2017 to 24 October 2017, during which period a total of 5,647 households were visited across the 14 project counties, translating to a response rate of 99.7%.

#### **Key Learnings from the RRHS**

- ✓ Proportion of smallholder farmer households in the project counties is 89%.
- ✓ Penetration of hermetic devices among smallholder farmers was found to be 14.3%. This suggests there is need to enhance awareness creation of hermetic devices across the project counties.
- ✓ 60% of the households were aware of the hermetic devices; more people were aware of hermetic bags compared to metal silos and plastic silos.
- ✓ 91.2% of all devices sold were purchased by smallholder farmers, on normal commercial terms.

#### **FIELD VISITS**

During the tenure of the project, the Project Manager conducted field visits, principally to farmers, agrodealers, and the 14 project counties' Departments of Agriculture. The field visits served a dual purpose: verifying activities on the ground and sensitizing about post-harvest losses, plus the technological solutions available through improved storage devices promoted under the AgResults results-based 'pull' mechanism. Additionally, the Project Manager held farmer focus group discussions with those using hermetic storage devices (HSD), as well as non-users in seven counties, namely Baringo, Nakuru, Trans Nzoia, Uasin Gishu, Nandi, Kitui, and Embu. The purpose of the discussions was to better understand key aspects including: factors leading to technology adoption, economic, nutritional, and other benefits experienced, and challenges or constraints perceived by users.

#### **Key Learnings from Field Visits: Farmers**

- ✓ Farmers recognized that HSD's have multiple benefits: grain loss is abated, no expenditure incurred on insecticides, grain remains clean, food tastes better, food is not harmful, maladies associated with inhaling chemicals are avoided, cuts down otherwise expensive and laborious work in managing grain, price differential between clean and infested maize.
- ✓ The overriding motivation for adopting HSD seemed to be because the devices are pesticide-free. Whereas prior wisdom suggested that farmers are motivated to buy HSD to store grain for profitable selling during lean seasons, that may just be a secondary driver for HSD adoption.
- ✓ Farmer triangulation of HSD information is common. Most farmers learned about HSD from several sources, therefore a multi-stakeholder approach, with concerted, continuous correct messaging from various sources, is necessary to drive HSD adoption. As is common in the adoption of new

technologies, the typical farmer heard the HSD message more than once before finally deciding to buy a test device, and later adopting the technology fully.

- ✓ Among the non-HSD group, some participants said they felt that the price of HSD was too high compared with ordinary storage. But when such farmers were taken through a reflective cost-benefit analysis of HSD storage versus ordinary storage (entails buying an insecticide and PP bag, hiring outside labor), it often resulted in an ‘aha’ moment as their economic perspective changed. Farmer education, including dispelling myths about HSD, proper assessment of value implicit in HSD is important.
- ✓ Availability of HSD close to where the farmer lives helps adoption. Most farmers noted that they are unlikely to make a journey to a distant shopping center merely to buy a HSD. But if the device is taken to the farmer, or is readily available, the farmer is more likely to buy it.

### **Key Learnings from Field Visits: Agrodealers**

- ✓ The agrodealers rarely displayed preference for HSD brands; they stock the devices that offer the highest commissions, or those where the supplier had cultivated a good business relationship with the agrodealer.
- ✓ Sales of HSD by agrodealers have gone up, and correspondingly, sales of pesticides have declined.
- ✓ Supply weaknesses exist - some agrodealers fail to get HSD replenishments in time from the suppliers.
- ✓ Most agrodealers have still not heard of or seen plastic silos or metal silos. They concentrate on hermetic bags but said that they would be willing to try out the silos.
- ✓ According to agrodealers, most farmers are oblivious of HSD brand names—they are more interested in the value that the product offers; thus, when shopping for an HSD, the farmer normally asks the agrodealer for ‘ile ngunia ya kuhifadhi mahindi’ (the hermetic bag used for protecting maize from infestation).
- ✓ Most agrodealers see it as their role to educate farmers on the usage of HSD. The agrodealers are motivated to play this role because when the customer (the farmer) is happy with the product, the customer is more likely to provide a good referral to their family, friends, and neighbors, all potential clients.

## **3. Project Results**

The AgResults brief to the Kenya Project Competitors was simple and clear—the companies needed to create improved grain storage capacity at the farmer level through sales of technically proficient and affordable grain storage devices. To achieve this objective, the Competitor companies were challenged to draw entirely on their own technical, production, marketing, financial, and other business competencies; they carried and managed all the attendant business risks, but with a firm promise from AgResults of a *post facto* financial incentive, subject to the rules of the incentive challenge.

Over the three-year project sales window (1 May 2015-1 May 2018), the participating private sector companies sold 1,390,777 improved storage devices, creating 413,265 metric tons (MT) of improved storage capacity at the farmer household level.

**Table 2: AgResults Kenya Hermetic Device Sales, May 2015-May 2018**

<b>AgResults Kenya On-Farm Storage Pilot project: Hermetic devices uptake by Farmers</b>			
<b>Hermetic devices sold to farmers, May 2015 through May 2018</b>			
<b>Region &amp; County</b>	<b>Total hermetic devices sold</b>	<b>Total MT of Improved Storage created</b>	<b>% of Region Sales</b>
<b>Eastern</b>	<b>662,118</b>	<b>196,236</b>	
Embu	115,749	34,687	18%
Kitui	77,259	22,988	12%
Machakos	303,721	89,901	46%
Makueni	67,374	19,592	10%
Meru	98,015	29,068	15%
<b>Rift Valley</b>	<b>728,659</b>	<b>217,029</b>	
Baringo	24,681	7,502	3%
Bomet	11,328	3,370	2%
Kericho	87,286	25,846	12%
Laikipia	13,639	4,020	2%
Nakuru	145,916	43,703	20%
Nandi	101,644	30,398	14%
Narok	5,746	1,674	1%
Trans Nzoia	125,060	37,256	17%
Uasin Gishu	213,359	63,262	29%
<b>Grand Totals</b>	<b>1,390,777</b>	<b>413,265</b>	

The Competitor companies that helped create 413,265 MT improved storage capacity were awarded a total of US\$6.25 million incentive prizes by the AgResults Steering Committee through Award ceremonies held in March and October 2018 in Nairobi.

#### 4. Impact

- ✓ 413,265 MT of improved storage created translates to approximately 4.6 million 90-kg bags of maize safely stored from marauding grain pests which would ordinarily perpetrate losses of 12-20%. Using the 12-20% loss range, and assuming a modest market price of KES 2,500 per bag, the post-harvest loss averted is KES 1.38 billion – KES 2.3 billion.
- ✓ Last-mile challenge tackled effectively: The competitors created business linkages with agrodealers in the project counties, ensuring that hermetic storage devices are available nearest to the farmer. With time, a farmer anywhere in Kenya should be able to walk to the nearest agrodealer and purchase a hermetic device for their use, just like happens with other day-to-day products like milk, bread, or mobile phone airtime, which are always within easy reach!
- ✓ The AgResults Secretariat has commissioned Abt Associates Inc., to carry out a more comprehensive impact evaluation of the Kenya Challenge Project.

#### 5. Select Project Take-Aways

##### TA1: There is a significant unmet demand market for hermetic devices.

The AgResults RRHS findings showed that the uptake of the hermetic technologies is still low, at only 14.3%, implying that an unexploited market opportunity exists for private sector companies in the grain

storage business; but there is also scope for future programming around sensitization efforts, training farmers on the proper use of the products, and other post-harvest handling practices.

**TA2: It's not only how much you've got, but also how much you get it!**

It was almost a truism that Competitors with a strong financial resource base performed relatively better than those with fewer resources. But whereas resource endowment is a strong success factor, it was noted to be insufficient for competitive advantage; resources need to be combined with the dynamic capabilities for orchestrating all-round corporate competences—in resourcing, production, strategic partnerships, implementing and reconfiguring market strategies, etc.—that give the Competitor an edge over its rivals. To paraphrase the late Steve Jobs, captured in Teece (2014)<sup>1</sup>, “It’s not only how much you’ve got, but also how much you get it!”

**TA3: A results-based, market-driven programming approach enhances sustainability prospects.**

It was noted that even after the competitive phase of the project ended, the Competitor companies continued to post impressively high sales, an indicator that the private sector companies had locked into the business opportunity orchestrated through the AgResults Challenge Project.

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<sup>1</sup> Teece, D. J. (2014). The foundations of enterprise performance: Dynamic and ordinary capabilities in an (economic) theory of firms. *The Academy of Management Perspectives*, 28(4), 328-352