



# Pull Mechanisms for Overcoming Market Failures in the Agriculture Sector

## INITIAL LESSONS LEARNED WITH CASE ILLUSTRATIONS FROM AGRESULTS' KENYA ON-FARM STORAGE PILOT

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Through the AgResults initiative, donors are testing the use of pull mechanisms to engage the private sector in providing agriculture technology solutions to smallholder farmers. Drawing on early lessons from the AgResults experience to date and the AgResults Kenya On-Farm Storage pilot in particular, this Knowledge Note provides guidance for development practitioners interested in incorporating pull mechanisms in their own work. It presents the key elements of pull mechanisms, which include:

- A development problem to be addressed
- A technology solution (or a practice) to be marketed
- “Solvers” or private sector actors whom the pull mechanism incentivizes
- An incentive structure that includes the predefined outcomes and prizes
- A verification protocol
- A theory of change that ties together all the elements
- Ongoing monitoring and evaluation

The note suggests circumstances when pull mechanisms are most likely to be effective as a development tool for the practitioner wanting to develop a market for agricultural technologies that benefit smallholders. It also draws on AgResults' experience to date to suggest some initial lessons, several of which point to the value of incorporating what economic theory can tell us about the behavior of economic agents in agricultural markets and the underlying causes of market failure in the provision of the technology. For example:

- A starting premise is that pull mechanisms that aim to develop a sustainable market for a technology are best designed for development problems that can be resolved by large scale adoption of a technology that has already been proven in the field or requires only some tailoring.
- The solvers should have a clear business case to engage in the market for the technology. Also, the users of the technology – smallholders – should realize an economic benefit from adopting the technology.

- The outcomes that trigger payments should be easily measurable, cost-effectively verifiable and in the manageable interest of the solvers.
- Finally, and very critically, a robust value chain analysis should inform the theory of change. This theory of change must clearly articulate how the solvers, motivated by the incentive structure, will address the key constraints limiting the development of a market for the technology.

Results to date also lead us to endorse the argument that pull mechanisms are more likely to succeed when there is only a single binding constraint limiting market development, and not a multitude of constraints (unless other interventions are effectively and simultaneously addressing those other constraints). Avoiding a multitude of constraints makes it more likely that the nudge provided by the incentives will induce the private sector to engage and a functioning market to emerge. Synthesizing these lessons, the Knowledge Note presents the critical steps in designing the technical elements of a pull mechanism.

## INTRODUCTION

After the food crises of 2007-2008 and the growing realization that donor resources were not sufficient to meet global agricultural development challenges, the AgResults initiative was launched at the June 2012 G20 Summit in Los Cabos, Mexico as an innovation to boost private sector engagement in meeting these challenges. With funding and leadership of several donors – Australia, Canada, United Kingdom, United States, and the Gates Foundation – and the World Bank as its trustee, the AgResults initiative uses results-based incentives or “pull mechanisms” to harness the resources and creativity of the private sector to drive agricultural innovation, research, and delivery for smallholder farmers in developing countries. AgResults is now a \$118 million initiative comprised of seven pilot projects that incentivize the private sector to develop and deliver innovative products to smallholder farmers in settings where markets for these products are otherwise underdeveloped. Each pilot provides financial incentives to the private sector actors to encourage them to enter the market, but the incentives are paid only after they achieve predefined results. The ultimate objective is that private sector will invest in overcoming market failures impeding the establishment of sustainable markets for developmentally beneficial agricultural innovations serving smallholder farmers.

This Knowledge Note reflects the initial findings from the external evaluator’s ongoing research to evaluate the pilots. It draws on the evaluators’ initial qualitative assessments and baseline assessments in each pilot country, which involved interviews with diverse actors in the agricultural sector, key government representatives, and the pilot design and implementation teams. The Knowledge Note also draws from structured interviews conducted in June 2016 with key AgResults stakeholders, aimed at synthesizing their collective thoughts on lessons learned thus far. These 13 interviewees included the in-country pilot managers in Kenya and Zambia and representatives from the Secretariat and the Steering Committee.

The Knowledge Note uses the experience and lessons from AgResults to provide guidance to development practitioners on the use of pull mechanisms to develop markets for technologies that can benefit smallholder farmers or poor consumers. First, we begin by defining pull mechanisms, then explain how they can address market failures in agricultural value chains. We next discuss the key elements of a pull mechanism and discuss initial lessons learned relating to these key elements. We conclude by identifying the critical steps involved in design of a pull mechanism. Throughout, we draw on examples from the AgResults On-Farm Storage pilot in Kenya to illustrate our guidance.

## WHAT ARE PULL MECHANISMS?

**P**ull mechanisms are among the incentive-based development approaches, such as prizes and advance market commitments (AMC), that pay only after predefined results are achieved. Thus far, prize-based approaches have been used to encourage innovation, recognizing that socially beneficial technologies are by nature a public good and underprovided (Masters 2003 and Masters and Delbecq 2008). These prizes are usually structured as winner-take-all grand reward such as the X Prize, first awarded in 2004, which sponsors high-profile competitions to encourage technological breakthroughs “for the benefit of humanity.” While the focus of these prizes has been to develop technologies, more recently Michael Kremer has argued for using AMC that not only spur innovative technology, but also include a market test to ensure that the technology is adopted. For example, the AMC for developing a pneumococcal vaccine pays winners only after the vaccines are purchased by countries where targeted beneficiaries live. However, the AMC does not specifically focus on developing a market for the vaccine or engaging the private sector. In 2008, William Masters proposed a proportional prize to encourage private sector actors to develop technological innovations to address predefined agriculture development challenges such as increasing yields (Masters and Delbecq, 2008). This approach emphasizes innovation in breakthrough technologies and encourages private sector engagement with some focus on adoption, but includes nearly no focus on developing a market for the innovations. Overall, these approaches that combine innovation and adoption do not recognize that research and dissemination are typically domains of different types of organizations.

In contrast, AgResults technology adoption pilots have the explicit aim of not only encouraging adoption by smallholder farmers, but developing a functioning and sustainable market that will provide the technology to these farmers. Therefore, AgResults pull mechanisms focus on socially beneficial technologies that are usually further along in their development. AgResults provides payments (or incentives) to targeted market players (or “solvers”) only after they achieve pre-specified outcomes associated with development of a market for the agricultural products or services they promote. The payments

are designed to alter the risk-reward payoff to market players, motivating investments that address the underlying market failures that otherwise limit the development and provision of beneficial technologies.

As such, pull mechanisms, if successful, can leverage donor funds by engaging the private sector to substantially increase their investment in food security and agricultural development. Without relinquishing resources up front, the sponsor has a chance to engage more than one innovator at a time, thereby theoretically increasing the chances of success, while removing the risk of contracting with a sole innovator who may not succeed—yet who could use up all the donor’s resources in the attempt. By directly engaging with the private sector, this approach also avoids crowding out the private sector, which often happens with grants that use subsidies or provide technologies for free. Pull mechanisms also offer the appealing advantage of Pull mechanisms in this context are seen as a possible complement or even alternative to traditional donor-funded development approaches that seek to “push” promising technologies out to beneficiaries through grants or contracts that pay in advance for recipients’ efforts. In the next section, we discuss how pull mechanisms can work to address market failures in the agriculture sector, which is how they are used in AgResults.

*Pull mechanisms, if successful, can significantly leverage donor funds by engaging the private sector to substantially and sustainably increase their investment in food security and agricultural development.*



## HOW CAN PULL MECHANISMS ADDRESS MARKET FAILURES IN DEVELOPING COUNTRIES' AGRICULTURAL SECTOR?

Many underlying constraints can lead to low demand and low supply of development solutions, whether a technology or a practice, particularly to smallholders or poor consumers. Low demand for a technology may result from limited awareness about the technology, or difficulty in accessing, paying for, or implementing the technology, particularly by smallholder farmers who are likely the final intended beneficiaries. Perceived risk of using the technology can also limit demand. On the supply side, the costs and risks of investing in developing appropriate products or services for smallholder farmers may be too high. Even if the product is developed, low expressed demand, or high distribution costs to reach smallholders may limit the supply. These problems are often accentuated by a weak enabling environment. Overall, a reinforcing cycle of low demand and low supply can lead to a “chicken and egg” problem that inhibits the emergence of a viable and sustainable market for socially beneficial technology. These conditions lead to a missing or underdeveloped market for the technology or, in other words, a market failure in the provision of the technology (see Exhibit 1).

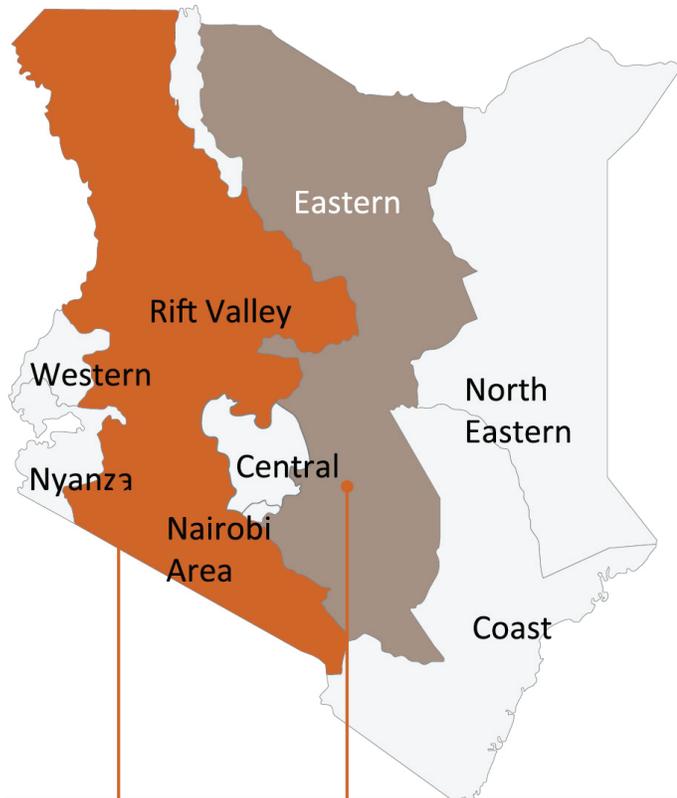
Pull mechanisms offer incentives to their solvers that temporarily offset these unfavorable demand and supply conditions. Through results-based prizes that reduce the risk of investment in these markets, pull mechanisms effectively increase the likelihood of the solver achieving a minimum return on investment. Consequently, these prizes create incentives for private sector actors to develop systems for procurement, value addition, distribution, and promotion of innovative technologies, thus creating a functioning (and eventually sustainable) market for the technology.

The AgResults Kenya On-Farm Storage pilot demonstrates how this looks in practice (see Exhibit 2). In Kenya, as in many developing countries, as much as a quarter of smallholder farmers' production of staple grains is lost after harvest to problems such as pests and mold. Improved storage devices that could reduce post-harvest losses, such as hermetically sealed bags and metal or plastic silos, had been developed (see Exhibit 3). However, smallholder farmers' low levels of awareness of these storage products and the large investment required to raise awareness and set up distribution systems were barriers that kept suppliers from refining these products for, and marketing them to, smallholders. Instead, suppliers often relied on development agencies as their primary buyers because these agencies could be counted on to make large orders, conduct farmer awareness creation and trainings on how to use the products, and then distribute them at reduced or no cost to the farmer. Even though some development partners had been working on promoting smallholder adoption of improved on-farm storage solutions for more than a decade, at the start of the AgResults pilot, fewer than 12 percent of Kenya's smallholder farmers in the main grain growing areas were aware of the existence of improved on-farm storage technologies, and less than 4 percent were actually using them.

**EXHIBIT 1. MISSING MARKETS FOR BENEFICIAL TECHNOLOGIES**



EXHIBIT 2. KENYA AgRESULTS PILOT AT A GLANCE



**Geography**

**14** Counties in the Rift Valley and Eastern regions of Kenya

**Pilot Timeframe**  
May 2015 - June 2019

**Technology**  
Improved on-farm storage devices

**Targeted Beneficiaries**  
Smallholder farmers

**Number of Implementers**

**2015** ● **4** original solvers joined

**2016** ● **4** new solvers joined

**2017** ● **1** new solver joined

● **2** more interested

**Prize Structure**

**Rift Valley Mid Point:**  
first 5 implementers to reach 21,000MT sales receive \$750,000 each

**Rift Valley End Point:**  
all implementers to reach 21,000MT sales receive \$1,000,000 proportionally to capacity sold

**Eastern Region End Point:**  
all implementers to reach 21,000MT sales receive \$3,000,000 proportionally to capacity sold

**Results to Date**  
146,436MT of improved storage space created for small holders

AgResults' Kenya On-Farm Storage pilot energized commercial suppliers of on-farm storage products to compete with each other to develop and distribute these products to smallholders. The suppliers were motivated by an attractive incentive structure with prizes proportional to their performance in achieving predefined sales goals. At the end of Year 3 of the four-year project, in response to the incentives, there are now nine suppliers selling storage products to farmers under AgResults with sales of 704,776 storage units providing 146,436 MT of improved storage capacity for smallholders. At least 70 percent of these storage products are estimated to be in the hands of smallholders (verification of the proportion of total sales going to smallholders was ongoing at the time this Knowledge Note was written). Although the final evaluation has not yet been conducted and there is more to be learned, monitoring data imply that the pilot appears to be addressing a key market failure. Companies are using several strategies to market to smallholders, such as using sales and marketing staff in the region to connect with the smallholders and understand their needs, and nurturing connections with local cooperatives and farmers groups to increase exposure to farmers (Deloitte, 2017). There is evidence of competition among companies that is giving agrodealers and farmers many options for purchasing improved storage for the first time. There is also evidence of efforts by companies that go beyond what is rewarded by the pilot. For example, the companies are coming together informally in a working group to discuss standards for hermetic storage.

In the next section, we delve further into the necessary elements of a pull mechanism that enable it to address market failures in agriculture value chains.



*In Kenya, there is emerging evidence that competition among companies is giving farmers many new options for on-farm storage.*

### EXHIBIT 3. STORAGE PRODUCTS



**Metal Storage Silo** – adapted for smaller capacity for use by smallholder farmer



**Hermetic Storage Bag** – Several companies are promoting different types of hermetic storage in Kenya, incentivized by the AgResults pilot incentives

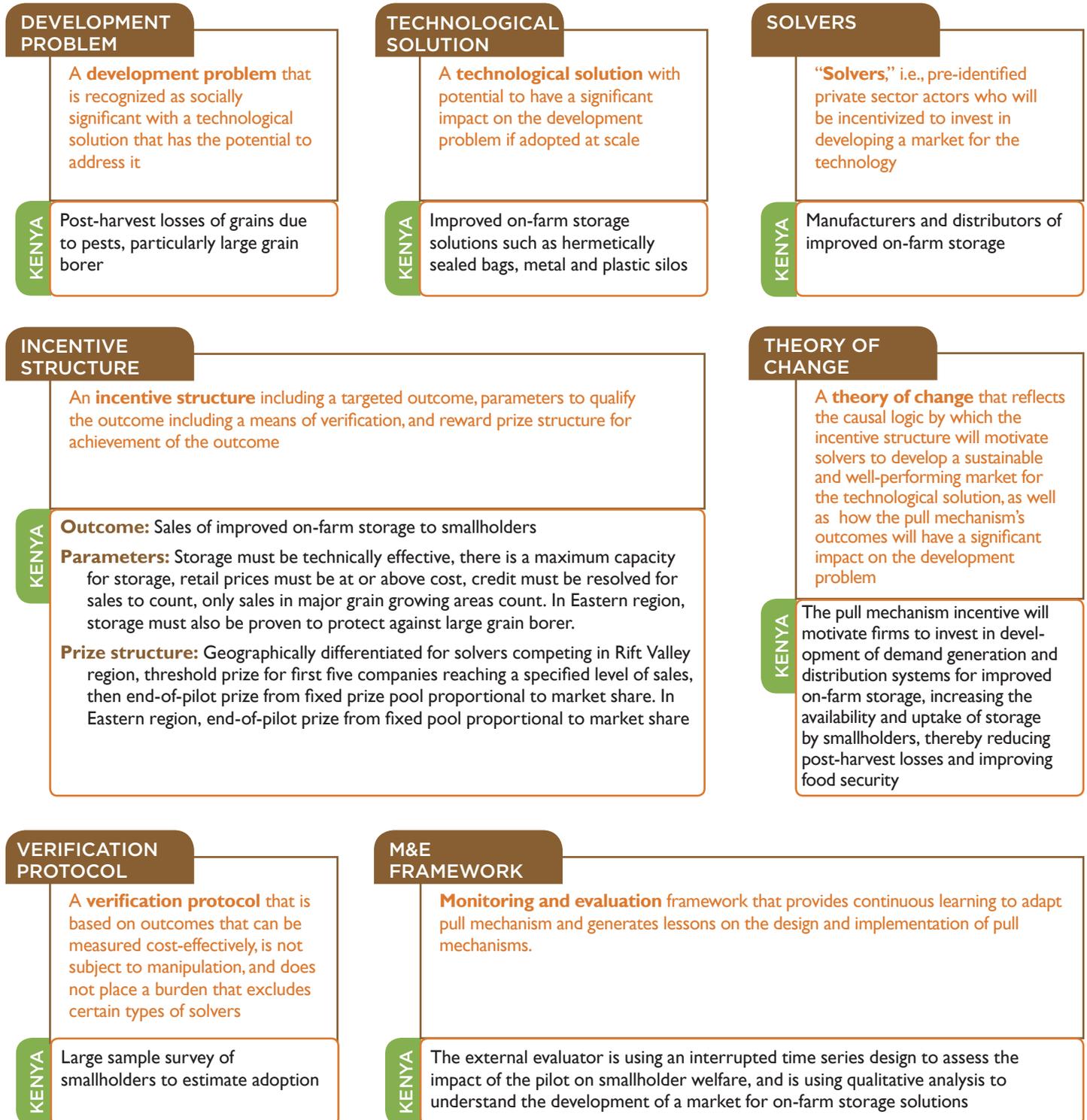


**Plastic Storage Silo** – adapted for smaller capacity for use by smallholder farmer

# WHAT ARE THE KEY ELEMENTS OF A PULL MECHANISM?

As we gain more experience with pull mechanisms through AgResults, we are seeing that these mechanisms have a number of essential technical elements (see Mitchell et al, 2014 on designing broader prizes). Many of these elements were

identified at the beginning of AgResults, but have come into sharper focus over time. Below we discuss each of the major technical elements in turn, illustrated with details from the Kenya pilot.



Pull mechanisms must be grounded in a clear **development problem**—a socially meaningful problem that the pull mechanism is intended to address and a **solution** that has the potential to address the problem if it is brought to scale. The pull mechanism can then be designed to address the key market failures that have limited the development of a market for this socially beneficial solution.<sup>1</sup> The solution can be a specific technology solution that is already tested and proven, or it can be a technology or practice that requires further tailoring to be adapted to smallholder needs and the specific development problem. In the latter case the pull mechanism can incentivize investment in the refinement of the technology itself. Development problems that do not yet have viable technological solutions are best addressed through innovation-oriented pull mechanisms or other non-pull approaches.

A key element of a pull mechanism is the **solvers** or private sector actors or a role in the value chain that can be filled by private sector actors—who are incentivized to achieve the predefined outcomes. Because the solvers are the main agents of change in a pull mechanism who invest with their creativity and capital to address the development problem, they must have an underlying interest in the market for the solution. Therefore, the choice of solvers is intrinsically tied to the choice of the development problem and its solution, which are underpinned by a clear theory of change that demonstrates the solvers' path to scale up the solution to address the problem and the underlying market failures (as discussed below). Furthermore, it is important to ensure that there is a sufficient pool of such solvers with the capacity to invest at the scale needed to develop a competitive market with adequate critical mass.

The **incentive structure** includes the predefined **outcomes** that will trigger payout, the **parameters** against which those outcomes are judged, and the **prize structure**. It is critical to the pull mechanism that the outcomes are clear, measurable, and verifiable without vulnerability to tampering by solvers, while also being in the manageable interest of the solvers. Furthermore, the outcomes need to be such that the solvers' efforts undertake to achieve those outcomes advance the resolution of the

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<sup>1</sup>Masters (2005) has argued for pull mechanisms that are more solution agnostic and focused on development problems with the specific intent to spur innovations that lead to new solutions. In contrast, the focus of this Knowledge Note is scaling up the adoption of socially beneficial solutions that exist by using pull mechanisms to remove the barriers to adoption.

development problem. One outcome that is commonly used in AgResults' pilots is the level of sales of the targeted technological solution by solvers.

**Parameters** against which outcomes are judged can help to ensure that the solvers' investments lead to development of a sustainable market whose structure and performance are in line with the resolution of the development problem and other objectives that sponsors may have. For example, the pull mechanism could specify technical parameters on the technology to ensure its suitability to smallholder farmers, and/or specify market terms under which sales would qualify for reward to promote investments that lead to sustainable market systems.

The **prize structure** includes the size, type, and frequency of payments that are triggered once the verified outcomes are achieved. Prize structures differ in the types of competition they induce between solvers, the degree of risk they place on solvers, and the types of market structure that they promote. Prize structures range from winner-takes-all to payment per unit of outcome achieved (see Exhibit 4). AgResults prize structures typically eschew winner-take-all awards that are not suitable for developing markets with multiple actors; instead they tend to rely on prize structures featuring multiple awards such as proportional prizes, milestone prizes, and per-unit prizes (similar to AMCs).

The next important element of the pull mechanism is a clear **theory of change** that articulates the expected causal linkages between the pull mechanism incentive structure and the realization of a meaningful impact. The theory of change should articulate how the solvers' expected investments and activities in response to the incentive structure are likely to lead to the development of a market for the target technological solution and how the development of this market will address the development problem. The theory of change should also recognize the external factors that might impact the causal linkages, positively or negatively, necessitating a clear understanding of the current enabling environment, such as policies and regulations, and any expected changes to it in the future.

Although technically part of the administrative structure, the **verification protocol** has important implications for technical aspects of the pilot and a verification protocol must be incorporated into the pull mechanism design process.

Verification typically involves a third-party verifier, to transparently and defensibly verify that the solvers achieved the outcomes as laid out in the initial requirements.

A final and important element of a pull mechanism is a robust **monitoring and evaluation framework** (see Conrad et al, 2017 for an evaluation framework for prizes). Engaging an

external evaluator from the start enabled the design of rigorous impact evaluations for the initiative. The evaluator’s initial qualitative assessments and the ongoing review of pilots’ progress have informed pilot adaptations and ongoing learning from implementation. The next section presents the initial lessons that draw on, in part, the external evaluator’s ongoing learning.

**EXHIBIT 4. PRIZE STRUCTURES USED IN PULL MECHANISMS**

Type of prize	Suitability	Advantages	Disadvantages
<b>Winner-takes-all:</b> End-of-contest award with just one winner	Suitable when solvers are willing and able to take risks and invest, as they are placed in intense competition to achieve outcomes, with high uncertainty about receiving payment, and when the focus is on developing an innovation rather than developing a market, as just one award can leave a single solver at the end.	Limits the total amount of prize payout.	May not be suitable if solvers do not have resources ahead of time to invest with returns much later or if solvers are risk-averse.
<b>Proportional:</b> Payments are shared proportional to the relative performance of solvers	Suitable when outcomes can be measured in units attributable to individual solvers and the intent is to place solvers in competition, but not as intense as winner-takes-all. Solvers face less uncertainty about receiving payments, which are less dependent on the efforts of other solvers.	Increases likelihood of engaging multiple solvers for a longer period of time; solvers may face less competition and reduced investment risk—as all successful solvers earn some prize—without eliminating incentives to “win” since more successful solvers earn larger prizes.	A large payment can be made even if total quantity of outcome is low (which can be mitigated by setting parameters that establish a minimum threshold before the proportional payouts are made).
<b>Milestone:</b> Payments are made as a pre-defined milestone is reached	Suitable when the steps to achieving the final outcome are known. The level of competition among solvers is low, as all solvers who reach the milestone can get an award (the competition can be intensified by requiring that only the first few to reach the milestone receive the prize), implying much less uncertainty about receiving payments.	Allows periodic payment to solvers if they have a cash flow problem, and therefore increases the likelihood of engaging more solvers in the process.	Results in payment even if the final outcome is not achieved.
<b>Prize per unit of outcome achieved:</b> Payment is made per unit of outcome achieved (e.g., AMC is a payment per unit of sales)	Suitable when the intent is to keep the level of competition for the prize among solvers low to encourage multiple solvers to achieve the outcomes and to reduce the degree of risk they face in receiving payment.	If the per-unit price can be crafted to mimic the final price of the technology or the price premiums, then it can create the exact conditions for value chain actors to move toward a sustainable market (e.g., AMCs can be set at marginal cost of production for the vaccine).	Results in payment even if the final outcome is not achieved at the desired scale (which can be mitigated to some extent by providing minimum thresholds before per-unit payments are made).

# INITIAL LESSONS ABOUT PULL MECHANISMS FROM AGRESULTS

In this section, we offer initial lessons that can guide development agencies in deciding whether pull mechanisms are an appropriate tool for their agriculture development programs. These lessons draw from our AgResults experience and are illustrated with examples from the AgResults Kenya pilot. The lessons are focused on the technical aspects and do not include lessons on the management structures and coordination required at the country level, which are the focus of the AgResults Secretariat's lessons learned series.

## Lessons about the choice of development problem, its technology solutions, and the solvers

**The development problem should have a clear binding constraint that the private sector or targeted solvers can address.**

The applicability of a pull mechanism to a development problem is heavily dependent on the reasons underlying the persistence of the problem over time. Specifically, there must be clearly identifiable causes of market failure that can be overcome if the private sector invests in the market. If the market failure results from multiple constraints, the pull mechanism may not be able to address all of them, at least not without making the pull mechanism difficult to understand and complex. AgResults experience indicates that pull mechanisms bring about a better early response when there is only one major binding constraint impeding development of a market. The emerging lesson is that there should be an overriding constraint that, if addressed, can unleash the market potential.

Related to this is the consideration of other “push” approaches that support the pull mechanism (or potentially interfere with it). The pull mechanisms may consider including push mechanisms to address other underlying constraints. If the level of push funding becomes substantial, the project would become a push-pull hybrid.

Early results from AgResults' Kenya pilot indicate that it tackles a development problem that is highly amenable to the influence of a pull mechanism. Although potential technology solutions exist, private sector actors have not made large-scale investments in developing smallholder markets for their on-farm storage solutions. The constraints that have inhibited greater investment by the private sector include that the technologies needed tailoring to smallholders' technical and economic realities, smallholders were not aware of the technology's benefit, and large-scale distribution networks were costly to develop. The private sector actors needed a nudge to propel their entry into the market and did not face a multitude of constraints that would have limited their engagement despite incentives proposed under the pull mechanism.



**Storage structures** for improved on-farm storage in Kenya

**The implementation context—including both the enabling environment and market environment—should be conducive to a pull mechanism. Other programs should not be targeting the same development problem and promoting the solution in a way that interferes with market development.**

The enabling environment—the government policies and rules—should be neutral or supportive. In particular, the enabling environment should not create distortions that undermine the development of the market. Such distortions include policies that favor competing or substitute products, and onerous regulations that inhibit private sector investment. It is also important that there not be other donor or government-funded activities addressing the same problem in way that can complicate the private sector’s efforts and present additional constraints. For example, subsidized distribution of the target technology can undermine smallholders’ willingness to pay for it, inhibiting development of a market.

In terms of market environment, there should be some existing market infrastructure that the solvers can leverage in developing their own markets. Such market infrastructure includes the presence of distribution networks for similar products that can be extended to include the technology and the availability of other complementary services such as credit to enable the solvers to invest productively.

In Kenya, the enabling environment has proven to be largely to supportive of the pull mechanism. Specifically, there is adequate rule of law coupled with a meaningful but not burdensome regulatory environment to support private sector investment. Likewise, the market environment is also conducive to private sector investment in the market for on-farm storage—for example, many of the pilot’s solvers are leveraging the distribution networks that they have developed for other products. Although there has been, and continues to be, a significant degree of donor and government-funded activity to promote storage solutions for smallholder farmers, these efforts have had limited success and are not considered to directly undermine

incentives to invest in developing smallholder markets for on-farm storage. This factor concerned some solvers, who felt that they were not playing on a level field, as other solvers had previously benefitted, or were currently benefitting, from donor funds to develop the storage solutions, or benefit from subsidized distribution. Such funding, for example, was behind the development of PICS bags and metal silos, and had supported subsidized distribution of some storage solutions giving solvers initial inroads in the market that other solvers lack. Furthermore, donor funding could be argued to alter solvers’ overhead costs allowing for implicit cross-subsidization of the storage solutions they sold under AgResults and a consequently unfair competitive advantage. Ultimately, however, the decision was made to not alter the design to address these concerns; indeed there was no clear way to do so without significantly complicating the incentive structure. In this case, the decision to maintain the original design does not appear to have hampered the entry of diverse solvers to the pilot.

**The technology solution for which the market is being developed must be economically beneficial to the key value chain actors. The private sector players that the pull mechanism incentivizes – the solvers – must see a long-term business case and the ultimate consumers of the technology should see an economic benefit.**

The private sector actors should have an underlying interest in the technology, with a clear solver who can be incentivized to participate to address the market failure. The business case for each value chain actor’s engagement in the technology should be clearly articulated, particularly the solver who is incentivized and the smallholder farmers who are expected to have an inherent interest in adoption. This is critical to ensuring that the market for the technology and any of its derivative products sustains after the pilot. Early results have shown that pilots that promote technologies that do not offer a clear economic benefit struggle to take off because solvers are reluctant to engage.



**Agriculture inputs distributors** who sell storage solutions in Kenya

In Kenya, an array of smallholder-suitable storage devices are available which have the potential, if used in combination with appropriate post-harvest practices to ensure adequate drying and cleanliness of grain, to significantly reduce post-harvest losses of food staples such as grains and pulses. These storage solutions present a clear economic benefit to smallholders for whom reduced post-harvest loss will offset their need to purchase grain for their own consumption during the lean season. These technologies include hermetically sealed metal or plastic silos and hermetically sealed plastic bags. The technology producers and distributors, many of whom became solvers, were enthusiastic about the market potential of on-farm storage solutions because of the large potential demand, and saw a clear business case to support their investment in the market.

**The solvers must be adequate in number and have capacity to address the constraints limiting market development.**

The choice of technology, the nature of market failures, and the intended final outcome of the pull mechanism all help the program sponsor identify the ideal private sector actor to incentivize as the solver. In choosing the solver, it is important to ensure that the solver's engagement in the value chain is central to achieving the development impact. In other words, the solver must be well-placed to address the key constraints in the value chain of the technology or its derivative products.

This might imply choosing solvers that have adequate financial standing and access to credit (particularly because pull mechanisms pay only after results are achieved). Furthermore, the pool of such solvers should be large enough to spur competition in the market and bring the market to a sustainable scale, with individual solvers having adequate technical, managerial, and financial capacity to successfully invest in the market and reach an efficient scale of operations.

The Kenya AgResults pilot encouraged participation from entities that could produce technically responsive storage solutions and articulate a plan to develop a market for them. The solver pool was relevant to the development impact as technology solutions needed tailoring, distribution networks needed to be developed, and adequate resources were needed to raise awareness among farmers. Manufacturers and distributors of the technologies could meet these needs directly or through partnerships with organizations that work with smallholders. The solver pool was also robust: A broad array of firms expressed interest in the pilot, including national and international firms active in markets for agricultural inputs, pesticide-treated mosquito nets, agricultural produce (grains and pulses), and storage solutions specifically. The number of firms showing interest in the pilot, as well as the number that eventually applied to participate (9 by 2017), demonstrated the potential to reach a scale of operations that could reach the pilot's objectives of 172,000 MT of storage solutions being distributed to 480,000 smallholders by the pilot's end.

**Lessons about defining the incentive structure - the outcomes, qualifying parameters, and prize**

**The outcome should be measurable and cost-effectively verifiable with adequate qualifying parameters to link the outcome to the development objective.**

In defining the parameters on a measurable and verifiable predefined outcome, it is critical to strike a balance between a highly prescriptive approach that can inhibit private

sector innovation and introduce burdensome costs, and an excessively laissez-faire approach that may lead solvers to develop the market in ways that undermine realization of the pull mechanism's development objectives. One way to do this is to set parameters on outcomes that mimic the characteristics of the market and product that the pull mechanism intends to promote. For example, the parameters can be set to reflect the geographic scope of the target market, the technical parameters of the technology, and the market conditions which are deemed to most likely to lead to establishment of sustainable production and distribution systems for the intended beneficiary. A related lesson is that the seemingly simple option of mandating the desired outcome (e.g. the technology must be sold to smallholders) can impose excessive monitoring and verification requirements on either the solver or pilot management. This also highlights the fact that a pull mechanism may not be an optimal means to reach stakeholders who are not well integrated into agricultural input and product markets—these typically include the poorest and most vulnerable smallholders including women. Nonetheless, it is worth considering the likelihood of whether this population would eventually benefit once the market is more fully developed, as well as the possibility of freeing up resources to target to these populations as more market-integrated smallholders gain access to them through the market.

The AgResults Kenya pilot used sales of on-farm storage technology to smallholder farmers as its predefined outcome. The pilot aimed to promote the development of a sustainable market for on-farm storage technologies for smallholder farm families to store staples for home consumption. Therefore, the parameters for storage and sales that counted towards the achievement of the predefined outcomes included the geography of the sales (grain producing areas were targeted so that storage wouldn't be sold to farmers to use for cash crops), the technical attributes of the storage (specifically a maximum capacity of 540 kg, which approximates the annual consumption requirements of a typical smallholder farming family), and the market conditions under which the storage was sold (storage must be sold at or above the

distributor's cost, and any credit under which the storage was provided had to be resolved before the sale could be counted). At the same time, the parameters also specified that the storage had to be sold to smallholders, which required costly verification involving large-sample surveys of households. Currently, there is discussion about whether this requirement is redundant given the afore-mentioned parameters on the sales which encouraged their sale to targeted smallholder populations, particularly considering that the storage distributors did not have the capacity to track or document the identity of the final buyer of the storage, nor did they consider it to be in their business interest to develop that capacity.

### **The prize structures should take into account solver constraints and encourage participation and investment by diverse solvers.**

The size of the payment should adequately reduce private sector risks and attract a large pool of solvers, while accounting for the trade-off with cost-effectiveness of the pull mechanism. Tepid interest among potential solvers in the early stages is an indication that the size of the prize is not adequate or that underlying assumptions in the theory of change must be revisited and redesign considered. At the same time, cost-effectiveness is a consideration, so the incentive has to balance the two elements. Phasing out of the incentives can address this issue, while also promoting sustainability and scale-up over the duration of the pull mechanism.

Solvers prefer and benefit from more frequent prize payments, as they have the option of re-investing those payments to enable more rapid growth (an important consideration given the prevalence of capital constraints in developing country economies), and also because they are more in line with private sector solvers' business cycles which typically operate on a seasonal or annual basis.

The duration of the prize—the number of years over which it is paid—should be as short as possible to offset the risk of solvers' becoming dependent on the prizes to enable ongoing participation in the market. Shorter duration prizes also have the benefit of leaving the pull mechanism

less vulnerable to changes in the implementation context (for example as a result of policy changes or market developments) that might affect the viability or effectiveness of the prize, and which are more likely to occur as prize duration extends. Phasing out of the incentives can address this issue, while also promoting sustainability and scale-up over the duration of the pull mechanism.

The Kenya pilot presents an example of a relatively complex prize. Two separate prize structures were defined based on the geographic location of sales, with the Eastern Region prize requiring that the storage technologies be proven to be large-grain-borer proof. The incentive structure also rewarded a limited number of solvers (five) for reaching an initial threshold of sales in the Rift Valley Region, with another large prize to be shared proportionally among solvers based on their volume of sales at the end of the pilot. In terms of timing of the payouts, there is an early lesson of allowing periodic payout after which the solvers start afresh in achieving their outcomes, rather than an end-of-pilot prize. This could have encouraged more entrants in the market, and reduced the first-mover advantage, in addition to addressing any cash-flow constraints. There is also some speculation that the Kenya pilot could have still achieved desired results with a smaller prize, although, the large prize may be the key reason that large private sector actors with the ability to solve the problem have entered the market. There may be an early lesson in conducting a prospective cost-effectiveness analysis to determine the size of the prize, and also the qualifying parameters in terms of the minimum sales to qualify for the prize.

## Lesson about the theory of change

**It is critical to carefully develop a theory of change based on a robust analysis of the value chain and implementation environment. This analysis must be updated as implementation nears.**

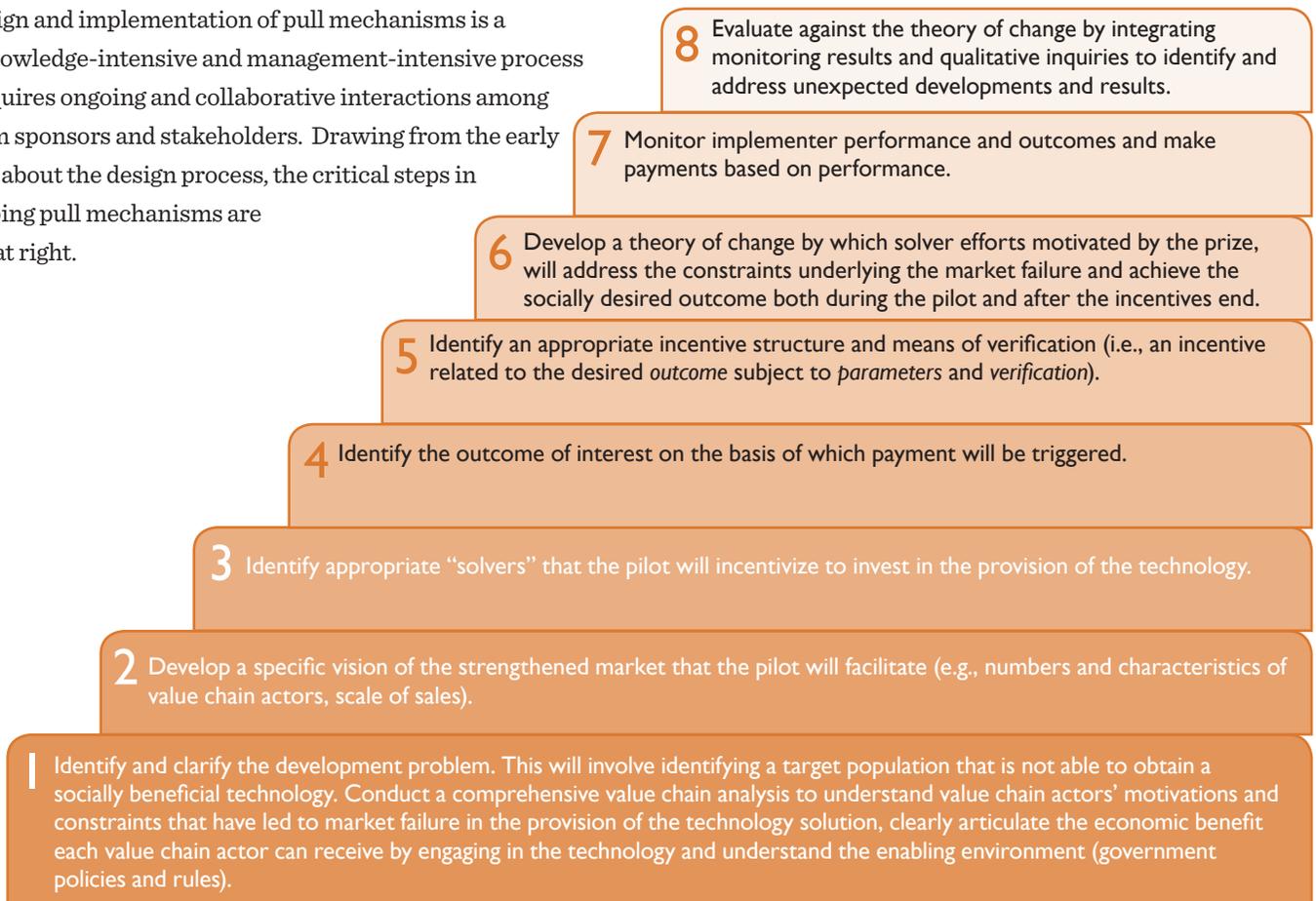
The theory of change needs to be mapped out on the basis of a detailed description of the current market condition and enabling environment. It should articulate how the solver's

technology solution will address market constraints and lead to the final intended outcome. A value chain analysis underpins the development of this theory of change and is essential for all aspects of the pull mechanism design process—the identification of the development problem, its technological solution, the solvers, and design of the incentive structure. The value chain analysis must identify the major players in the value chain and their activities, motivations, and constraints as they relate to the provision of the technology or its derivative products. It must also describe the related flow of inputs, services, and products along the value chain, and major features of value chain's organization and governance. The objective is to identify the key constraints to development of a market for the target technology (particularly as faced by the targeted solvers), to assess the potential profit (or “business case”) for solvers, and identify the potential economic returns from smallholders' engaging with the technology. The value chain analysis requires interviews with key informants along the entire value chain including the potential solvers, smallholder farmers, and policy makers and other government officials who can shed light on the enabling environment. An agricultural economist or agribusiness expert paired with a value chain expert from the country with keen knowledge about the implementation environment is essential to this process.

The Kenya pilot offers an example where a strong theory of change was based on a thorough value chain analysis, conducted in advance of the pilot and updated as pilot implementation approached and in response to emerging issues. The pilot's theory of change was based on a clear identification of the major factors contributing to post-harvest losses of grains, as well as those inhibiting the emergence of a market for improved post-harvest storage solutions. The analysis also examined the business case for the solvers to engage in the pilot, and the economic returns to smallholders. The critical junctures, or leverage points, where the pull mechanism could catalyze investments to resolve the critical market failures were identified based on that analysis.

# CRITICAL STEPS IN THE DEVELOPMENT OF PULL MECHANISMS

**D**esign and implementation of pull mechanisms is a knowledge-intensive and management-intensive process that requires ongoing and collaborative interactions among program sponsors and stakeholders. Drawing from the early lessons about the design process, the critical steps in developing pull mechanisms are shown at right.



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**AgResults** is a \$118 million multi-donor, multi-lateral initiative incentivizing and rewarding high-impact agricultural innovations that promote global food security, health, and nutrition through the design and implementation of pull mechanism pilots. The objectives of AgResults are to:

- Overcome market failures impeding agricultural innovations by offering results-based economic incentives (known as “pull” mechanisms) to competing private actors for the adoption of new agricultural technologies.
- Test the effectiveness and efficiency of pull financing in comparison with traditional approaches to the promotion and adoption of innovative agricultural technologies.

The external evaluator uses a framework grounded in economic theory regarding the behavior of economic agents in agricultural markets, coupled with rigorous quantitative and qualitative evaluation methods, to identify lessons learned and best practices based on evaluation of the pilot’s impact on:

- Private sector engagement and market development
- Smallholder income and adoption of the technology and its derivative product
- Scale, cost-effectiveness, and sustainability

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