Scaling Up Post-Harvest Losses Interventions in Uganda Through Market Forces

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This Policy Analysis Exercise (PAE) reflects the views of the author and should not be viewed as representing the views of the World Food Programme (WFP) or those of Harvard University or any of its faculty.

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1. Executive Summary

Context

According to the World Food Programme (WFP), despite the increase in the global food production, 800 million people around the world are still trapped in poverty and hunger. While the strategy to tackle this challenge has mainly directed its attention towards rising food production, addressing post-harvest food losses could also be an important pathway to increase food availability, alleviate poverty and improve nutrition.

Actually, the adoption of hermetic grain storage equipment (HGSE) has shown to reduce post-harvest food losses (PHL), improve nutrition and increase households' income. For this reason, the World Food Programme (WFP) has launched an intervention in Uganda to deliver these improved technologies.

Since 2014, WFP has succeeded in building a strong supply chain and delivering almost 100,000 storage solutions. Nevertheless, equipment is provided through substantial subsidies and the HGSE market is still highly dependent on WFP's coordination. To ensure the sustainability of the project beyond WFP's involvement, the project was planned with an exit strategy where the private sector would take over the provision of equipment as a profitable business.

Research questions

In building this exit strategy, two questions must be addressed: (1) At the micro level, what should be WFP's strategy to enhance and prove the profit potential of HGSE? And (2) at the macro level, what should be WFP's strategy to further develop the HGSE market in Uganda?

Key findings

Smallholders' profile:

At least 4.5 million smallholder farmers currently stockpile crops in their homes and could benefit from HGSE in Uganda. However, most of these farmers are below the poverty line, with a constrained ability to afford new equipment. Many also do not perceive HGSE as a business opportunity.

Many Ugandan farmers rely on friends and family as sources of agricultural information and advice. Thus both early adopters and word-of-mouth transmission of information have an important role. Taking into consideration the demand side of the HGSE market is key for the success of initiatives at the micro and macro level.

Micro level market considerations:

- **WFP approach:** WFP has developed a reliable supply chain, which relies on private players to deliver HGSE to smallholder farmers. However, even if the equipment offered presents high rates of return on investment – on average: 223% – and short repayment terms – 2.5 harvests on average –, farmers' willingness to pay is below WFP's costs. Bridging this gap is a priority.
- **Adoption factors:** The WFP's operations currently face the following challenges along these different dimensions: (1) Awareness: Universal targeting is failing to leverage natural dissemination dynamics such as the potential role of early adopters; (2) Advantage: Marketing efforts lack a clear and compelling case for farmers; (3) Affordability: Subsidy policy

distort farmers' perceptions and hide the lack of tailored financial products; and (4) Access: The supply change is strong, but at the expense of smallholders who find the products unaffordable.

Macro level:

- **Market analysis:** Three sets of players are critical to the delivery of HGSE to farmers: manufacturers, distributors and microfinance institutions (MFIs). Currently, Uganda's supply-chain is underdeveloped, based in part on several factors: (a) Manufacturers face high up-front investments in an unfamiliar market. The resulting low penetration rates hinders scale effects; (b) Distributors are not attracted to the market due to the prospect of low margins and intense, price-based competition; and (c) Finally, for MFIs, the small size of the loans and the vast distances between rural households and branches prevents MFIs from engaging easily and cost-effectively with these farmers..

- **Market inefficiencies:** Underdeveloped markets for beneficial technology, such as HGSE, tend to reflect distortions created by market inefficiencies along several dimensions, including: (a) Information: There are no incentives for private players in this market to invest in costly massive campaigns; (b) Credit: There is a lack of products tailored to farmers to purchase storage equipment; (c) Coordination: There is a lack of articulation between private players leading to a low level of investment; and (d) Input: There is little supply chain development due to firms being unwilling to take risks. These inefficiencies must be addressed to attract new players and further develop the market.

Recommendations

Based on the diagnosis above and insights from successful case studies around the world, a set of ten initiatives was identified. Each of initiative was assessed along four evaluation criteria: (1) Impact in scaling up; (2) Administrative feasibility; (3) Political feasibility; and (4) Time to impact.

This analysis identified six priority initiatives in three groups:

- **Quick wins:** Low-risk initiatives with low investment requirements and immediate results that will improve operations and sustain the momentum around PHL: (1) Target early adopters, over-invest in their satisfaction and leverage them as promoters; and (2) Develop a branding and marketing strategy focused a compelling business case for smallholders to adopt HGSE.

- **High priority:** Due to minimal access to appropriate financial needs products, farmers' perceptions and current distortions on the supply side, WFP is urged to: (3) Streamline the supply chain to bridge the gap between costs and farmers' willingness to pay, dismantling the subsidy schemes and proving HGSE profit potential.

- **Game changing**: Initiatives with the potential to radically transform the HGSE market but which require larger investments and are challenging to execute: (4) Implement pull mechanisms to attract new players; and (5) Invest in massive awareness campaigns to expand the demand.

Irrespective of the prioritization of these initiatives, WFP needs to consider that while initiatives can technically be implemented as stand-alone policies, no initiative will be sufficient by itself. One cannot target a single challenge while ignoring the others. Thus, the number of initiatives implemented should be sequenced according to a manageable scope for the organization.

The path ahead for WFP Uganda will be challenging but the goal of a functioning market for HGSE products is worth the effort.

2. Introduction

2.1. Post-harvest food losses

According to the World Food Programme (WFP), despite the increase in the global food production, 800 million people around the world are still trapped in poverty and hunger[1]. Looking ahead, the main challenge for global agriculture will be how to feed an increasing population of 9 billion people by 2050[2]. While the strategy to meet this target has mainly directed its attention towards rising food production by 50-70%, addressing post-harvest food losses could also be an important pathway to increase food availability, alleviate poverty and improve nutrition[3].

As explained by WFP, post-harvest food losses (PHL) refer to "*crop losses –in quality and quantity– that occurs between harvest and the moment of human consumption*"[4]. Directly impacting the lives of millions of poor smallholder farmers and leading up to 40% of crop losses within the first three months after harvest, PHL is currently one of the main "*contributing factors to food insecurity, under-nutrition and hunger across developing countries*"[5].

As poor storage practices at the household level highly contributes to high rates of post-harvest losses[6], WFP has defined reducing PHL as a top priority for its mission of achieving zero hunger[7].

2.2. Technology adoption

There is an assumption throughout the literature that technology and development are closely interconnected and that technology improvements in the world's poor rural areas can have large transformative effects[8]. Regarding the pervasive cycle of poverty brought on by PHL, adopting improved storage technologies and practices for grains has demonstrated to be an innovative and cost-effective method to avoid preventable losses and to overcome the pressure to sell the crops at lower price after the harvest[9].

As explained by the Agricultural Technology Adoption Institute (ATAI), historical evidence suggests that the adoption of beneficial technology does occur, largely driven by market forces, when the conditions are right[10].

[1] Costa, S. (2015$_1$). Reducing Food Losses in Sub-Saharan Africa. Improving post-Harvest Management and Storage Technologies of Smallholder Farmers. *World Food Programme Report*, p. 2.
[2] Parfitt, J., Barthel, M., & Macnaughton, S. (2010). Food waste within food supply chains: quantification and potential for change to 2050. Philosophical Transactions of the Royal Society B, 365, 3065–3081.
[3] Hodges, R. J., Buzby, J. C., & Bennett, B. (2011). Postharvest losses and waste in developed and less developed countries: Opportunities to improve resource use. *Journal of Agricultural Science*, 149, 37–45.
[4] WPF Uganda (2015). Special Operation. Logistics Capacity Development: Post-Harvest Food Loss Reduction in Uganda Through improved Storage and Handling at the start of the Supply Chain. *World Food Programme Internal Document*, p. 1.
[5] Costa, S. (2015$_1$), p. 1.
[6] Rockefeller Foundation (2014). Reducing Global Food Waste and Spoilage. Assessing resources needed and available to reduce post harvest food loss in Africa. *Global Knowledge Initiative*.
[7] WPF Uganda (2015), p. 1.
[8] Brand, M., Fowler, C. & Campbell, R. (2015). Appling a market system lens to technology scale up. A brief literature review. *USAID Leveraging Economic Opportunities*, 13, p. 1.
[9] WPF Uganda (2015), p. 1.
[10] Jack. K. (2013). Market inefficiencies and the adoption of agricultural technologies in developing countries. *Agricultural Technology Adoption Initiative J-PAL (MIT) - CEGA (Berkeley)*, p. 2-7

In other words, when: (1) There is an attractive and easily understood business case for the smallholders to adopt the technology; and (2) There are no market failures or adoption constraints.

In a perfect world, adoption rates and organic spread perfectly reveals whether a technology is beneficial for a farmer or not, creating greater benefits than costs. In most developing markets, though, the individual adoption decisions tend to reflect the distortions created by market inefficiencies[11].

2.3. World Food Programme Intervention

In 2014, WFP launched the Zero Food Loss Initiative to reduce post-harvest food losses, developing an intervention that promotes technology adoption. Heavily influenced by WFP's expertise in logistics and supply chain management[12], the intervention sought to train farmers and deliver hermetic grain storage equipment (HGSE).

Initially implemented in Uganda, the impact at the household level has been positive: (1) Reduction of post-harvest food losses by 90-100% with improved technology and practices; (2) Improvement in family nutrition and health by increasing food availability; and (3) Increase in household income by preventing losses and selling at more convenient times[13].

Since its initial pilot delivering storage solutions to 16,000 farmers in 28 Ugandan districts in 2015, WFP was planning to reach more than 90,000 solutions before the end of 2016.

2.4. Leveraging market forces

The challenges to overcome in PHL interventions are: (1) Achieving adequate adoption; (2) Attracting sufficient long-term financial support; (3) Achieving sustainability; and (4) Impacting at scale. After past failures and successes addressing PHL, there is an increasing consensus by practitioners that market-led systemic approaches are needed[14].

Consequently, since its design phase, WFP envisioned an exit strategy where the private sector, playing an active role from the onset, would take over the provision of storage equipment on a full recovery basis. This strategy would ensure the sustainability and impact of the project far beyond the period of WPF's involvement.

So far, however, WFP Uganda has been facing several challenges regarding full cost recovery and market development:

(I) Financial: From the beginning, storage equipment was subsidized to generate awareness. Therefore, farmers became used to paying a portion of its value without being aware of the real cost. As a result, every harvest that WFP decides to decrease the subsidy and increase the price, smallholders tend to feel scammed and become more reluctant to pay a higher price. In addition, WPF is exposed to incremental fundraising needs as the number of solutions delivered by harvest increase.

(II) Behavioral: WFP's initial approach aimed to prove the existence of a customer need, the market potential and the social impact of adopting storage equipment. With this purpose, WFP absorbed most of the risks in the supply chain: faulty or unsold equipment, ineffective marketing and defaulting buyers. This approach allowed the private sector, mainly manufacturers and distributors, to enjoy high returns with low uncertainty. Therefore, they are currently unwilling to dismantle this confortable *status quo* and take the lead

[11] Jack. K. (2013), p. 4.
[12] Costa. S. (2015_2). Taking it to scale: Post-Harvest Loss Eradication in Uganda 2014-2015. *UN World Food Programme*, p. 2.
[13] Costa. S. (2015_2), p. 3.
[14] Deloitte (2015). Reducing Food Loos Along African Agricultural Value Chains. *Deloitte Publications*, p. 18.

to adopt a prominent and more profitable but also riskier role.

(III) Operational: WPF relies on local non-profit organizations to identify smallholders, market the equipment, train the customers and provide after sales support. As the intervention achieves scale, the potential for growth becomes constrained by the ability of WFP to partner with professional non-profits across the country and manage the increasing complexity of coordination.

Due to these limitations, WFP needs to assess its current strategy to ensure that the provision of storage equipment could be profitable and that private players could take over the market.

2.5. Scaling up

Given the increasing attention on PHL, WFP created in 2016 the Global Post-Harvest Knowledge and Operation Center (KNOC). The mission of the KNOC is to serve as the focal unit responsible to engage country offices worldwide, the broader community and the private sector to scale up PHL interventions at a household level[15].

In this paper, scaling up is defined according to a widely adopted concept proposed by the International Institute of Rural Reconstruction (IIRR): "*more quality benefits to more people over a wide geographical area, more quickly, more equitably and more lastingly*"[16]. This definition is relevant as it explicitly emphasizes four features that will be taking into account while evaluating alternatives: (1) Quality; (2) Reach; (3) Sustainability; and (4) Speed.

In 2016, the National Government of Uganda offered WFP its support to deliver more than 2.5 million storage solutions in 2017. Simultaneously, several WFP offices, mainly in Africa, started implementing their own PHL interventions with different levels of development (*Exhibit 1*).

2.6. Research questions

In this context, in order to get the private sector to take over the equipment provision, the KNOC needs to address two key questions:

(1) Micro level: What should be WPF's strategy to enhance and prove the profit potential of the HGSE supply chain?

(2) Macro level: What should be WFP's strategy to further develop the HGSE market in Uganda?

Certainly, Ugandan lessons will be valuable for other country offices addressing similar challenges.

2.7. Methodology

The paper is organized as follows:

Section I: Smallholder farmers' profile: Based on a survey conducted by the Consultative Group to Assist the Poor, Section I characterizes smallholder farmers and estimates the potential market size of GSE in Uganda.

Section II: World Food Programme approach: Section II introduces the theory of change behind WFP intervention, assesses the alternative solutions, maps WFP's operational model and compares total costs with farmers' willingness to pay. Information is based on interviews conducted with WFP executives, official documents from WFP operations and literature review about PHL interventions.

Section III: Micro level: Adoption factors: Based on literature review and a conceptual

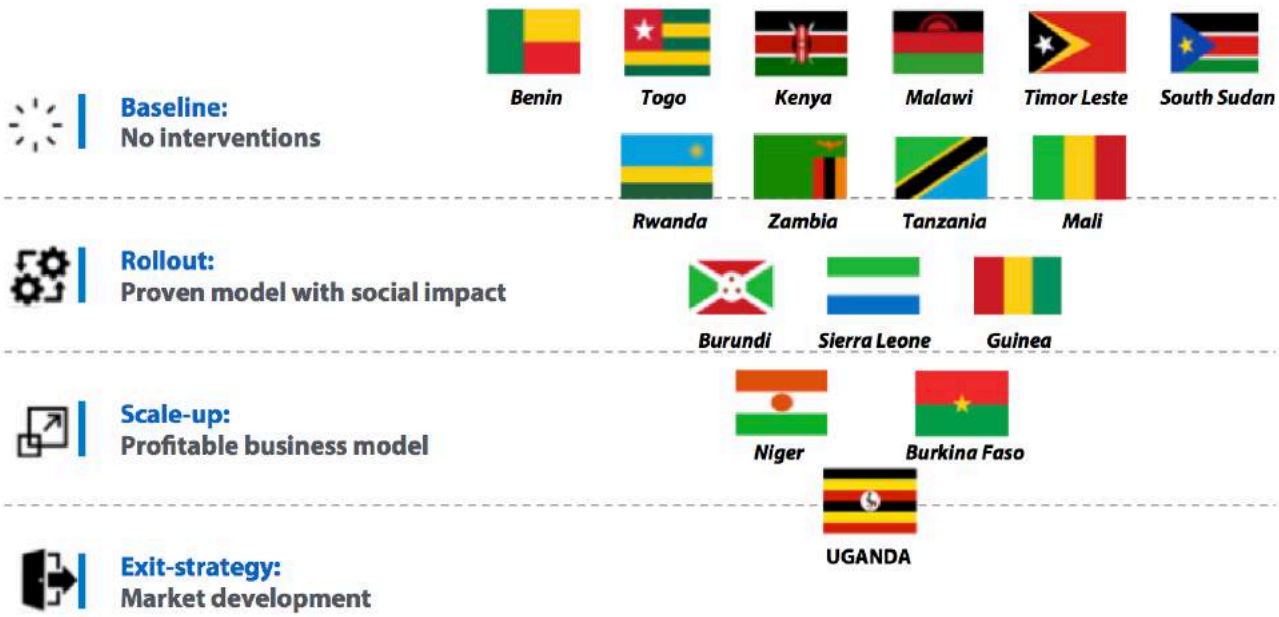
[15] WPF Uganda (2015), p. 11-12.
[16] IIRR. (2000). The CGIAR-NGO Committee & The Global Forum for Agricultural Research. Going to scale: Can we bring more benefits to more people more quickly? Silang, Cavite, Philippines, International Institute of Rural Reconstruction. YC James Yen Centre, 2000.

framework from Acumen & Bain[17], Section III assesses four key adoption factors at a micro level to explore opportunities for improving the profitability of the operational model.

Section IV: Market analysis: Section IV identifies current and potential players at each stage of the supply chain and assesses barriers and disincentives to enter into the market. Information was gathered through interviews with WFP local partners, manufacturers and distributors and complemented by public information.

Section V: Macro level: Market inefficiencies: Based on a literature review and a conceptual framework from the Agricultural Technology Adoption Institute (ATAI), Section V assesses structural barriers affecting the development of the GSE market in Uganda.

Section VI: Policy options: Finally, following the diagnoses of adoption and market constraints, Section VI outlines and assesses a list of ten micro and macro initiatives for WFP Uganda. In addition, Section VI provides recommendations regarding initiatives to prioritize and general considerations for the implementation plan.



Source: WFP executives' interviews.

Exhibit 1: **PHL interventions by stage of development and country (2017)**

[17] Tam, V. et al. (2014). Growing prosperity: Developing Repeatable Models to Scale the Adoption of Agricultural Innovations. *Bain & Company & Acumen Publications*.

3. SECTION I:

Smallholder Farmers' Profile

Key Takeaways

- Six million smallholder farmers' households dominate the production structure in Uganda.
- Most farmers live below the poverty line, constraining their ability to afford technology.
- Three-quarters of smallholders store crops after the harvest, normally stockpiling at home.
- Smallholders still do not perceive grain storage as a business opportunity.
- Adopters express a high level of satisfaction and would recommend storage technologies.
- Smallholders rely on friends and family as sources of agricultural information and advice.
- At least 4.5 million farmers could benefit from improved technology in Uganda.

3.1. Agriculture in Uganda

Despite its low growth rate[18], the agricultural sector still remains the most important economic activity for Uganda[19] and a key driver for growth, food security and income enhancement[20]. According to the 2014 census, 84% of citizens live in rural areas and agriculture accounts for 22.5% of GDP, 54% of exports and 66% of all workers[21].

The country offers both ideal growing conditions and institutional and financial constraints. On one hand, Uganda has fertile soil, consistent median temperatures, plentiful sunshine and bimodal rainfall enabling a wide variety of crops and multiple harvests every year[22]. On the other, however, informal land rights, meager infrastructure, poor extension services and limited access to quality inputs lead to low rates of technology adoption and low productivity levels. In addition, smallholders face limited access to markets, lack of effective regulation and limited finance options[23].

Currently, the production structure is dominated by approximately six million smallholder farmers' households, representing 70% of national production[24].

3.2. Data portrait of smallholder farmers

Projects supporting agricultural inputs need to start by understanding the demand side[25], to respond with goods that fulfill the need of the customers at an affordable price and in an accessible way.

[18] In recent years, agriculture in Uganda suffered from weather hazards, economic downturns, limited availability of inputs, diversion of investments into the industrial sector and insurgencies in neighboring countries.
[19] P4ARM (2015). Agricultural Risk Assessment Study: Uganda. *Platform for Agricultural Risk Management.*
[20] WPF Uganda (2015), p. 3.
[21] Uganda Bureau of Statistics (2014). National Population and Housing Census. *Provisional Results*.
[22] Costa. S. (2015$_2$). p. 5.
[23] Lama, M., McEvoy, A., Parker, S. & Robbins, k. (2014). An Analysis of Market Systems Approaches to Agricultural Development in Uganda and Tanzania. *BRAC, GWU Capstone Report*, p. 1.
[24] MIT CITE (2017), p. 6 & 45.
[25] Belt, J et al. (2015). Market-based solutions for input supply: making inputs accesible for smallholder farmers in Africa. *KIT Working Papers*, 2015-5.

The *National Survey and Segmentation of Smallholder Households* conducted in 2016 by CGAP[26] offers valuable data for mapping and understanding the farmers. Key findings are summarized below:

• **Household economics: Most smallholders live below the poverty line of USD 2.50 a day, only having money for food and clothes or only food.** One quarter of smallholder households live with less than USD 1.25 a day and almost half with less than USD 2.50, totaling 70% of farmers living below the poverty line. When self-assessed, 37% answer that they do not have enough money for food and 41% percent only for food and clothes[27] (*Appendix 1.1*).

• **Land ownership: Farmers individually own, on average, 2.7 acres mainly under a customary law or through a lease or certificate.** Most farmers do not face property rights risks, having the opportunity to grow their crops and owning enough land to produce surplus and store grains after the harvests[28] (*Appendix 1.2*).

• **Storage practices: (I) Most smallholders store crops after the harvests and the storage location is normally their home.** Three-quarters of the farmers are currently storing crops, the majority of them at home[29]. According to Costa, traditional storage practice consists in stockpiling the crops either on the floor, in baskets or in polypropylene sacks, due to fear of theft[30].

(II) Smallholders store almost exclusively food or staple crops and not cash crops. Farmers tend to store the crops that are most commonly grown and perceived as most important: maize, beans, groundnuts, cassava and millets. In general, farmers both grow and store more than one crop[31].

(III) The main reason for storing crops is family consumption after the harvest and not for businesses purposes. Three quarters of farmers store crops to consume them later, while less than half of them mention getting better prices in the future as the rationale[32].

(IV) Failure to store crops after the harvest is primarily due to a lack of leftover crops. Out of those farmers who do not store, most of them sell, trade or consume the crops after the harvests, while only a small portion argue that there are not available storage places nearby or that storage is too expensive[33] (*Appendix 1.3*).

• **Storage preferences: Farmers choose between different alternatives of storage equipment mainly based on perceived effectiveness and price.** According to WFP, the reason for selecting a technology was the perceived effectiveness for storage (46%) and price (34%), followed by perceived strength and size[34].

• **Customer satisfaction: Farmers express a high level of satisfaction with new storage technologies and would recommend buying new equipment to their neighbors.** Most farmers are highly satisfied with improved technologies and would recommend them to their neighbors. Smallholders express that they have experienced economic gain from storing crops, that they are more comfortable leaving home without fear of losing food and report that they have more control over family consumption[35].

• **Sources of information: Smallholders rely on family and friends, the radio and**

[26] Anderson, J. et al. (2016). National Survey and Segmentation of Smallholder Households in Uganda. *Consulting Group to Assist the Poor (CGAP)*
[27] Anderson, J. et al. (2016), p. 11.
[28] Anderson, J. et al. (2016), p. 12-13.
[29] Anderson, J. et al. (2016), p. 31.
[30] Costa. S. (2015_2). p. 18.
[31] Anderson, J. et al. (2016), p. 13.
[32] Anderson, J. et al. (2016), p. 13.
[33] Anderson, J. et al. (2016), p. 32.
[34] Costa. S. (2015_2). p. 30-31.
[35] Costa. S. (2015_2). p. 3 & 30-31.

community leaders as sources of information on agricultural activities. While there are limited sources of information with high penetration rates[36], the CGAP survey reinforces the literature consensus that word-of-mouth is the most powerful communication channel (*Appendix 1.4*).

- **Purchase decision: Both partners – male and female– decide over agricultural purchases with the financial advice of family and friends.** Even if men head over three-quarters of households, men and women jointly make decision to purchase farm inputs or borrow money to support agricultural production. In the majority of the cases, friends and family are the first sources for financial advice, with no other source reaching above 10%[37] (*Appendix 1.5*).

- **Relationship with suppliers: Most smallholders purchase agricultural inputs largely from retailers, paying in cash immediately.** The majority of the farmers purchase from retailers (64%), wholesalers (14%) and middlemen (9%) while one quarter declares that they do not buy any agricultural inputs. Transactions, in most cases, tend to be in cash and paid at the point of purchase with few options to pay later[38] (*Appendix 1.6*).

- **Financial inclusion: Smallholders have limited exposure to and use of financial services, with low levels of financial inclusion.** Given the limited availability of banks in rural areas, only 30% of the farmers have ever been inside a bank, only 10% have a bank account registered and only 26% currently have a full-service and formal financial product in their own name[39] (*Appendix 1.7)*.

- **Trust of financial institutions: Smallholders show relatively high trust in banks and mobile money providers and low trust in microfinance institutions.** While this presents an opportunity for certain entities to develop services that respond to farmers' needs, it also raises the challenge for microfinance institutions to modify current perception[40] (*Appendix 1.8*).

3.3. Potential market size

Regarding the potential of the HGSE market in Uganda, data from 2014 Census states that there are six million smallholder households. Given CGAP's statistics regarding the percentage of farmers storing crops, there are approximately 4.5 million farmers that could benefit from adopting storage technology in Uganda.

3.4. Implications for WFP's strategy

Looking ahead, the smallholders' portrait provides key information that should be considered in WFP's strategy: (1) Most farmers live below the poverty line, constraining their ability to afford technology; (2) The majority store crops, normally stockpiling at home on the floor, demonstrating the need of at least 4.5 million for improved equipment; (3) They perceive storage mainly as a tool to increase food security; therefore, the challenge involves changing the perception to also perceive it as a business opportunity; (4) Adopters express a high level of satisfaction and would recommend grain storage technologies to their neighbors; and (5) Farmers rely on friends and family as the main source of agricultural information and financial advice, generating an opportunity to leverage early adopters as promoter.

[36] Anderson, J. et al. (2016), p. 16.
[37] Anderson, J. et al. (2016), p. 16.
[38] Anderson, J. et al. (2016), p. 35.
[39] Anderson, J. et al. (2016), p. 43-44.
[40] Anderson, J. et al. (2016), p. 52.


WORLD FOOD PROGRAMME
WFP

4. SECTION II:
World Food Programme approach

Key Takeaways

- Improved storage has the potential to increase food security and improve livelihoods.
- Different technologies have proven to be highly effective reducing post harvest losses.
- WFP developed a strong and reliable supply chain articulating different private players.
- Equipment offered by WFP presents outstanding ROI and short repayment periods.
- Even so, a significant gap between costs and farmers' willingness to pay needs to be bridged.

4.1. Theory of Change

With current storage practices, after a harvest, farmers have to decide either to: (a) sell their crops, often at a lower price due to excess of supply, and buy food again later at a higher price in the lean season; or (b) store grains at home with the risk of experiencing losses of quantity and quality due to insects, pests, mould or moisture[41].

With WFP's improved technologies, farmers are able to "*realize two advantages: (1) Increased food security: By losing less grain to quality degradation and therefore having more to consume (also by decreasing the need to purchase food on the market); and (2) Improved livelihoods: By waiting longer after the harvest season to sell grains, when diminishing supplies translate to higher unit sales prices*"[42].

4.2. Technology options

Numerous product solutions can be used in place of traditional storage techniques to preserve the quality and quantity of grain[43]. In 2014, WFP tested six different technologies: (1) Super grain bags; (2) Zero fly bags; (3) Plastic silos; (4) Metal silos; (5) Grain safes; and (6) Traditional granaries[44] *(Exhibit 2)*. Even if most of them proved to be highly effective, the range of solutions offered by WFP was narrowed to three options to simplify the intervention[45] (*Exhibit 3 & Table 1*).

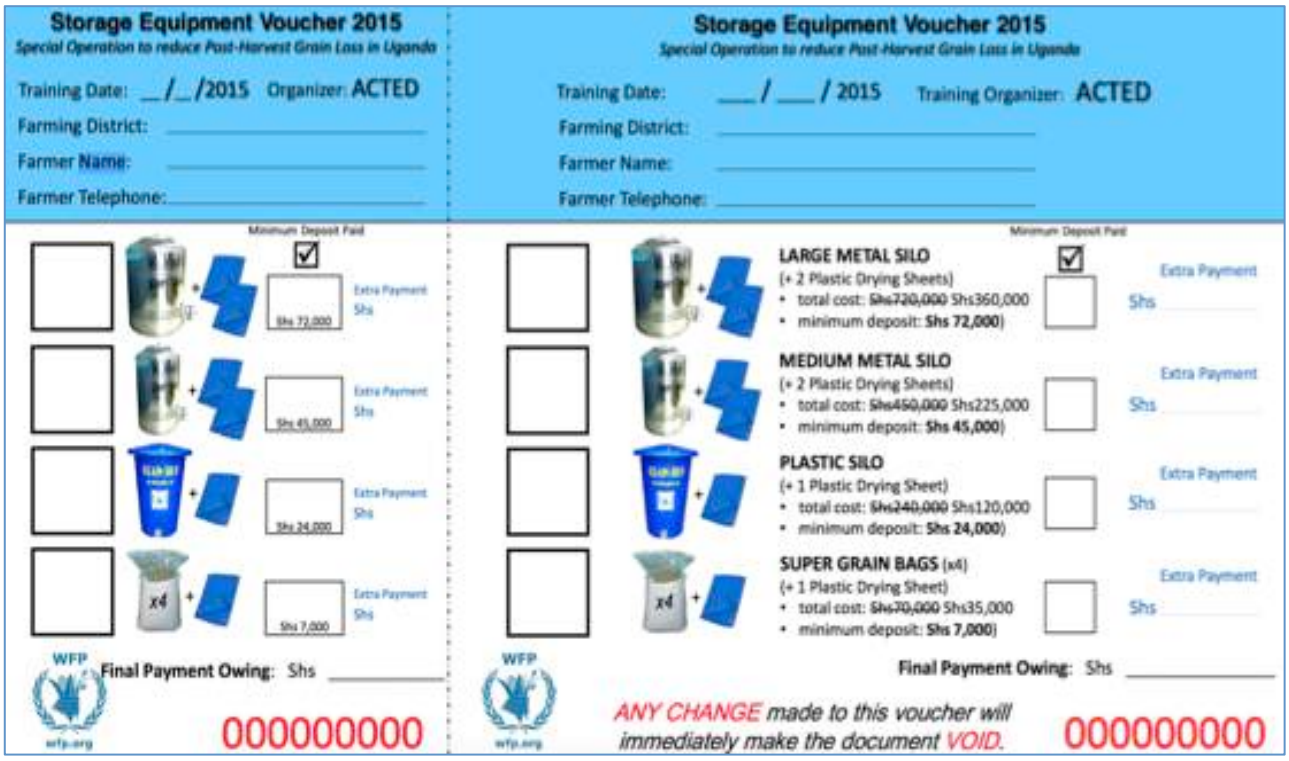
1. Super grain bags: Super grain bags are multi-layer polyethylene bags, usually placed inside ordinary storage bags for additional protection, creating an effective, hermetic and water-resistant unit. The key advantages of these bags are that they are easy to handle and transport, perform very well, do not require pesticides and are the most affordable solution. The disadvantages are that they have limited capacity, a shorter life span and do not provide rodent protection. Different types of hermetic bags have been marketed in

[41] WPF Uganda (2015), p. 1-2.
[42] Goentzel, J. et al. (2016). Supply Chain Scalability for Hermetic Post-Harvest Storage Technologies in Uganda. *Comprehensive Initiative on Technology Evaluation, Massachusetts Institute of Technology*, Draft Report, p. 5.
[43] Deloitte (2015), p. 9.
[44] Costa. S. (2015_1), p. 7.
[45] Costa. S. (2015_2). p. 12.



Source: Own analysis based on Costa, S. (2015[1])

Exhibit 2: **Grain storage options assessed by WFP (2015)**



Source: WFP official documents

Exhibit 3: **WFP storage equipment voucher (2015)**

20 different African countries[46] from 2007 onwards.

2. Plastic silos: Plastic silos are plastic polyvinyl chloride (PVC) storage units –similar to locally produced water containers– that provide effective rodent and pest protection. They are durable, present a strong performance, have a larger capacity and are less expensive than metal silos. Their disadvantages are that they present some challenges with maintaining hermiticity around seals and are difficult to deoxygenate when filling. Even though they are available in Kenya, Tanzania, and Bangladesh, in most countries, though, plastic silos have not been widely promoted or marketed.

3. Metal silos: Metal silos are robust, hermetic and water resistant units constructed by local artisans or industrial manufacturers from either galvanized iron or stainless steel. Metal silos provide a long-term solution for all crops, they are highly durable and more than double plastic silos capacity. They perform very well, do not require use of pesticides, are rodent and pest proof and are easy to recycle. Their disadvantages are that they have a high initial cost compared to other technologies, are difficult to transport and often require structural adjustments in farmer's houses prior to installation. In addition, sometimes, it is challenging to keep them airtight. Metal silos were the focus of numerous programs across Central America in the 1990s and more recently in Africa, mainly in Malawi, Zimbabwe, Kenya Tanzania and Zambia[47].

Based on data from deliveries in 2015, smallholder farmers have mainly chosen super grain bags (59%) and plastic silos (31%). However, preferences significantly vary across regions in Uganda. WFP executives explained that those differences correspond to the income level of the smallholder household, the amount of the subsidy and the focus of the marketing strategy.

4.3. WFP operational model

Delivering almost 100,000 storage solutions since 2014, the WFP intervention has shaped the market in Uganda. Therefore, understanding how the model actually works is key to assessing strengths and improvement opportunities at each stage of the supply-chain (*Exhibit 4*):

1. Diagnosis: WFP maps key post harvest losses challenges for the region or country of intervention and designs a range of possible actions. In its diagnosis, WFP takes into account the number and profile of smallholder farmers, the most suitable storage technologies, timeframes and the donor landscape. WFP relies on a needs assessment with field visits and interviews with local experts, country office staff and potential customers to gather information.

2. Project design: Before each harvest, WFP plans every aspect of the PHL intervention, ranging from location and targets to the availability of funds and partnership agreements with manufacturers, distributors and local NGOs. Furthermore, WFP develops supporting documents both for consumers –e.g. training manuals– and internal tracking –e.g. delivery schedules. WFP is in charge of planning and integrating each stage of the project.

3. Engineering: WFP develops specifications for each type of equipment under general premises: hermetic, maintenance free, female farmer friendly, affordable, local manu-

[46] Countries: Senegal, Mali, Burkina Faso, Ghana, Togo, Benin, Nigeria, Niger, Chad, Cameroon, Rwanda, Kenya, Nepal, Burundi, Congo, Tanzania, Ethiopia, Malawi, Zambia, and Sierra Leone

[47] Hodges, R. J., Buzby, J. C., & Bennett, B. (2011). Postharvest losses and waste in developed and less developed countries: Opportunities to improve resource use. *Journal of Agricultural Science*, 149, 37–45.

factured and easy to handle and transport. Leveraging the feedback from manufacturers and farmers, WFP iterates the product design with focus on decreasing costs and increasing quality. In addition, WFP verifies the conformity of equipment delivered to specifications and guarantees proper handling of equipment by random inspections on the factories and along the supply chain.

4. Equipment procurement: Based on the type and quantity of solutions planned in previous stages, WFP ensures that appropriate equipment is available for customers in a cost-effective manner. Procurement is driven through a competitive bidding process with qualified suppliers, guaranteeing transparency and the best possible prices. During the process, WFP holds meetings with potential entrants, assesses the manufacturing reliability of participants[48] and allocates purchase orders. WFP procurement decisions aim to balance an adequate quality of equipment and the development of the new manufacturers in the market.

5. Design of Trainings: The adoption of new practices is key to enable the purchase and adequate use of storage equipment. As a result, WPF identifies relevant content for the farmers and develops quality training modules and materials, adapted to the context and language of the participants.

6. Marketing and mobilization: To market the technologies, WFP partners with local non-profit organizations. The partners are responsible for creating awareness and for identifying and mobilizing smallholder willing to buy storage units. Each partner organization is allocated a number of farmers to be reached during each harvest and they are free to design their own strategies to accomplish the goals. Generally, NGOs conduct district-based entry meetings with local leadership to build awareness about the potential impact of the project. Then, they organize demonstrations at local venues to show how equipment works and to inform farmers about timelines and payment modalities. After the harvest, NGOs also provide after-sales support, assisting the smallholders on setting up their storage units at home and ensuring that all the procedures are followed when placing grain into the storage unit.

7. Smallholder training: NGO partners are also in charge of delivering general trainings for farmers. First, WFP organizes Training of Trainers (ToT) workshops to develop facilitators who are knowledgeable on PHL content and who also have adequate teaching skills and proficiency in local languages. After that, each partner organization agrees to a training schedule with WFP and delivers a series of training sessions to around 40 farmers per session. Trainings are delivered in churches, rural schools or community halls through a participatory approach. Farmers' experiences, storytelling, relevant examples and energizer exercises are techniques employed during the trainings. At the end, farmers answer a short survey giving feedback about the importance and effectiveness of the training. Close to the harvest period, the NGOs also deliver refresher talks for smallholders who bought equipment. The refresher talks are shorter versions of the general trainings.

8. Equipment distribution: WFP's country office centralizes all the purchase orders coming from farmers from different regions to ensure that the right equipment is delivered in a timely manner. At a national level, WFP agrees with manufacturers on a production and delivery schedule. At the local level, WFP partners with Private Sector Distributors (PSDs),

[48] Key factors include raw materials sourcing strategy, plant capacity, quality systems in place, ability to comply with specifications and logistical strength.

who are responsible for the last-mile distribution from the regional points to the collection points.

9. Financing and payment schemes: After the first training and before the harvest, smallholders submit a purchase order choosing one type of equipment and making a deposit of 10% of the subsidized price. The remaining 90% is paid to the PSD at the collection point at the moment of delivery.

10. Field operations management: As the project is heavily concentrated on the harvest periods, the coordination of all the activities is crucial. Thus, WFP ensures that every aspect of the intervention is delivered according to the project design. To keep track of orders and equipment, WFP has designed managerial tools that are shared with manufacturers, PSDs and NGOs, including inventory sheets, distribution plans and weekly receipts and dispatch reports.

11. Monitoring and evaluation: WFP has developed a framework to track progress and impact of PHL interventions combining large scale, nationwide impact assessment with deep dive qualitative studies. Currently, WFP gathers information on four key indicators: food availability, household income, health and nutrition and private sector participation. Finally, WFP provides evidence-based information to inform decision-making and improve project performance.

As reflected above, WFP has developed a strong and reliable model, heavily influenced by its expertise in logistics and supply chain management. In this operational model, WFP plays an indispensable role articulating different private stakeholders across the supply-chain and ensuring that the equipment is properly delivered.

4.4. Cost of intervention

According to the most recent available data, WFP's direct costs have four components [49]

(I) Hermetic unit: Price paid by WFP varies depending on the type of equipment and the agreement with manufacturers, ranging from USD 2.7 to USD 158.

(II) Tarpaulins: Price paid by WFP for one or two tarpaulins to ensure that farmers dry the grains before storing them (USD 9 per tarpaulin).

(III) PSD last-mile distribution: WFP agreed with PSD to pay 20% of the value to the equipment for the distribution between the regional point and the collection point.

(IV) NGO marketing, training and after-sales support: The cost per farmer ranges from USD 16 to USD 26 depending on the efficiency of the organization[50], the number and density of farmers and the organization type. While it seems high, representing up to 58% of the cost of a super grain bag, it also reveals the importance assigned by WFP to the quality of training.

Therefore, the total cost of grain storage units in Uganda ranges from USD 34 for a super grain bag to USD 232 for a large metal silo (*Table 2*).

4.5. Farmers' willingness to pay

The profit potential depends not only on the cost structure but also on the smallholder farmers' willingness to pay (WTP). In 2016, MIT researchers conducted a survey asking

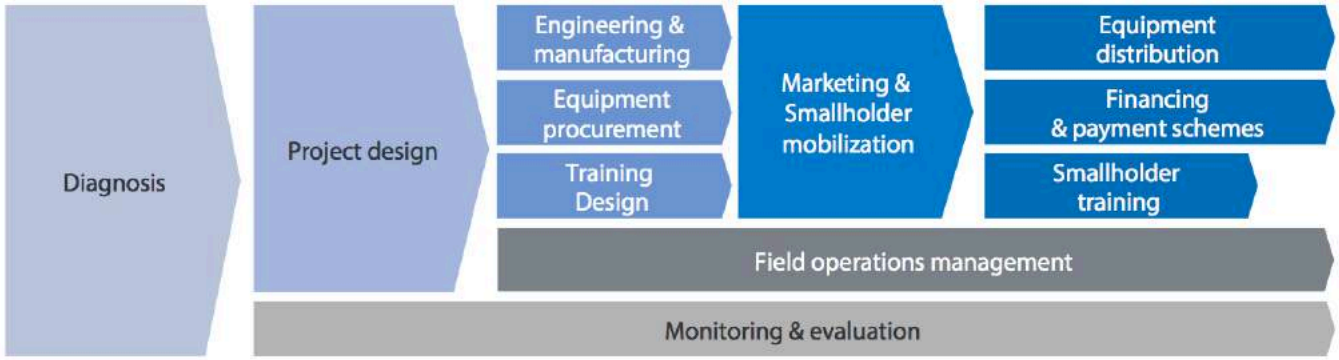
[49] Direct costs are separate from overhead costs, which include salaries of WFP staff responsible for quality assurance, training design, training for trainers, fields operation management and monitoring and evaluation (M&E).

[50] MIT CITE (2017). Scaling adoption of hermetic post-harvest storage technologies in Uganda. *Comprehensive Initiative on Technology Evaluation, Massachusetts Institute of Technology*, Full Report, p. 30.

Description	Super Grain Bag	Plastic Silo	Metal Silo
Capacity (liters)	110 liters	500 liters	750-1250 liters
Average food losses (%)	0.44 %	1.87 %	0.59%
Life-span (harvest or years)	2-3 harvests	7-15 years	20-25 years

Source: Own analysis based on Costa, S. (2015[1])

Table 1: **Key characteristics of WFP grain storage equipment (2015)**



Source: Own analysis based on WFP executives interviews.

Exhibit 4: **WFP operational model (2017)**

Description	Super Grain Bag	Plastic Silo	Medium Metal Silo	Large Metal Silo
Hermetic Unit (Price to Wholesalers)	USD 2.7	USD 78.0	USD 124.7	USD 158.7
Tarpaulin (Price to Wholesalers)	USD 9.0	USD 9.0	USD 18.0	USD 18.0
PSD Last-mile distribution (20%)	USD 2.3	USD 17.4	USD 28.5	USD 35.3
NGO Marketing, Training & Support	USD 20.0	USD 20.0	USD 20.0	USD 20.0
TOTAL COST	**USD 34.1**	**USD 124.4**	**USD191.2**	**USD 232.1**

Source: Own analysis based on interviews with WFP executives

Table 2: **Cost of Intervention by type of equipment – excluding overhead costs (2016)**

adopters and non-adopters an open-ended question about their WTP[51]. This study used a contingent valuation methodology for estimating stallholders' WTP *(Exhibit 5)*.

Despite the limited sample[52] and potential biases[53] of the study, the results present an estimate of the percentage of farmers willing to purchase storage technology at different prices. While around 70-80% of the farmers are willing to buy at subsidized prices for every type of equipment, less than 5% would purchase at non-subsidized price, even at an optimized cost[54].

Although estimated demand curves look similar, suggesting the potential impact of methodological inaccuracies, the WTP results reveal a substantial difference between farmers' WTP and WFP's ability to serve at the lowest cost. This presents a substantial challenge for full cost recovery.

4.6. Economic case for smallholders

In a perfect world, willingness to pay for a technology should be highly correlated with the economic returns of adoption. Therefore, this sub-section aims to assess the economic cases for the adoption of different types of improved technologies.

Six scenarios were simulated to compare traditional storage practices and non-storage with the benefits of adopting super grain bags, plastic silos and medium metal silos (*Appendix 2*). Simulations estimated return on investment (ROI), time to recover the investment and net present value (NPV) under two prices –current full price and expected optimized price– for three different crops: beans, maize and sorghum.

Key findings of the simulations were:

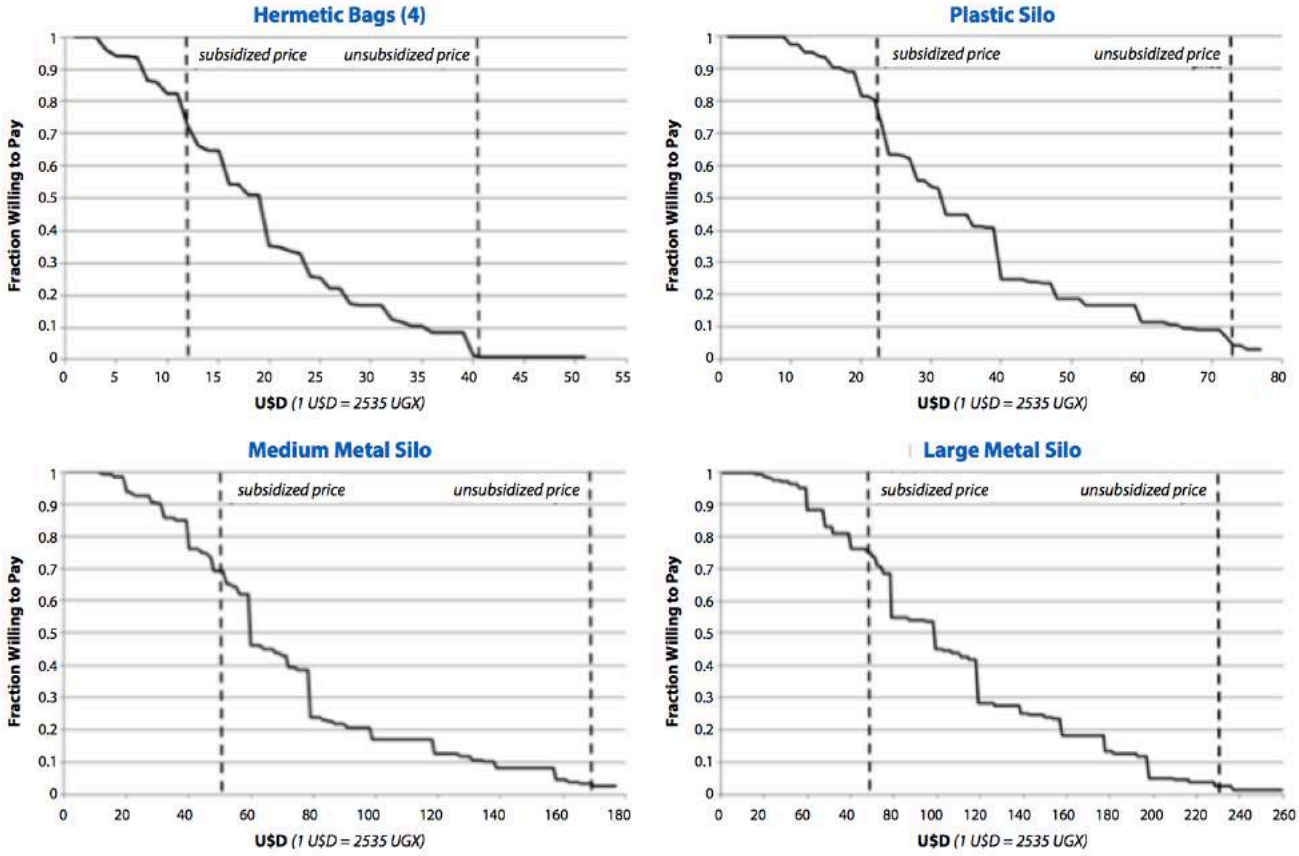
- **Super grain bags, plastic and metal silos are highly attractive investments**: Under current full prices, all of the technologies present outstanding ROI –average: 223%– and short repayment periods –average: 2.5 harvests–.
- **The economic case for adoption becomes even more compelling under optimized price:** Farmers expect average ROI of 508% and repayment periods of only 2 harvests, equivalent to one year.
- **Adopting a medium metal silo consistently presents higher net present value**: Under current full prices, it leads to an average profit of USD 424 compared to super grain bags –average USD 208– and plastic silos –USD 174–. Under optimized prices, metal silos remain the best option –average NPV USD 556– but super grain bags and plastic silos tend to converge around USD 268.
- **Beans are the most profitable crops to store; sorghum are the least profitable:** Given initial higher price and variation between the price at the peak of supply and the price three months later (+51%), beans are the most profitable crops to store. On the contrary, sorghum, with low initial prices, is the least attractive.
- **Almost every scenario led smallholders to be better off by adopting improved technology**: Out of the eighteen cases analyzed, only one lead to worse results compared to traditional practices: purchasing plastic silos to store sorghum under current prices –ROI -22% and NPV USD -23–.

[51] MIT CITE (2017), p. 41-42.
[52] Sample: 202 total farmers, 153 adopters and 49 non-adopters.
[53] Survey risks of biases: (1) starting-point bias: participants influenced by anchoring the question on reference prices –subsidized and non-subsidized optimized price–; (2) hypothetical bias: participants failing to take the question seriously; and (3) "Yea saying" bias: participants aiming to please the interviewer.
[54] Researchers projected an optimized "*retail price based on existing supplier costs and margins that would be reasonable for actors in the supply chain*". MIT CITE (2017), p. 35.

Even if the analysis could internalize additional factors[55] to better simulate reality, results are robust enough to prove the economic attractiveness of technology adoption.

4.7. Implications for WFP's strategy

Looking ahead, WFP's priority should be to bridge the gap between full cost and farmers' WTP, either by optimizing the cost structure or increasing the attractiveness of HGSE for farmers. Based on the outstanding rate of returns of investments and short repayment terms, even at current costs, low WTP may be explained by different factors: the lack of awareness about the product and its advantages or the lack of access to credit. By addressing these challenges, WFP will demonstrate the profit potential of HGSE market in Uganda.



Source: MIT CITE (2017).

Exhibit 5: **Willingness to pay by storage technology (2016)**

[55] Additional factors: performance for other crops; different price variation considering the bimodal seasonal calendar; no quality penalization for farmers with no access to markets outside their villages; or negative impact of weather hazards, among others.

5. SECTION III:
Micro level: Adoption Factors

Key Takeaways

- At a micro level, farmers tend to adopt a technology if they know about it, they will benefit from it, they have the money at the right time and they can get it when they need it.
- To bridge the gap between farmers' willingness to pay and the actual cost to deliver storage devices, four key factors should be addressed:
  - Awareness: Universal targeting failing to leverage natural dissemination dynamics.
  - Advantage: Marketing efforts lacking a clear and compelling case for farmers.
  - Affordability: Subsidy policy distorting perception and hiding real challenges.
  - Access: Reliable and user-friendly supply chain substantially increasing costs.
- A diagnosis of these adoption factors provides improvement opportunities for WFP's model.

5.1. Introduction

According to Acumen & Bain, the adoption of innovative agriculture technology among farmers is usually driven by four factors: (1) Awareness; (2) Advantage; (3) Affordability; and (4) Access[56]. In other words, farmers tend to adopt a technology if they know about it, they will benefit from it, they have the money at the right time and they can get it when they need it.

This section assesses each of the adoption factors in the WFP intervention in Uganda and identifies constraints and opportunities for WFP to improve its economics, both by increasing farmers' WTP and decreasing the costs of delivery.

5.2. Awareness: *Do farmers know about and believe in the new technology?*

Description: Awareness is the knowledge a farmer possesses about a new technology. After experiencing broken promises regarding products purchased from governments, companies and NGOs, farmers have developed high levels of skepticism and distrust. Consequently, marketing new products to this segment has become time intensive and costly. In these contexts, awareness requires face-to-face interactions, local demonstrations and repeated visits. To illustrate the challenge, some farmers declare that they do not take a company seriously until its salespeople visit their village at least three times. However, once «early adopters» have a positive experience and spread the word, these local influencers become the most important source of information and promotion[57].

Diagnosis in the Ugandan setting: WFP advertises its product through NGOs partners at an average cost of USD 25 per farmer, including training and after-sales support. Based on interviews with local partners, there is no evidence that they have developed a profile of early adopters, defined by income or mind-

[56] Tam, V. et al. (2014), p. 31-39.

[57] Tam, V. et al. (2014), p. 31-34.

set, to clearly target their marketing efforts. Instead, it seems that local partners deploy broad campaigns to the whole community, which may make them less cost-effective.

Regarding bridging the gap of distrust, after several harvests, WFP has built a strong reputation among community leaders and farmers. So far, WFP has delivered almost one hundred thousands storage solutions with high levels of customer satisfaction across different regions. This constitutes an outstanding starting point to spread the word-of-mouth. However, WFP has not recruited satisfied «early adopters» as promoters. In contexts where farmers heavily rely on friends and family for advice on agricultural decisions, there is an opportunity to give them incentives to contact other community members and diffuse their knowledge and experience about HGSE.

5.3. Advantage: *How will farmers benefit from this technology relative to others?*

Description: According to Everett Rogers's theory of innovation diffusion, the more a new technology is perceived as better than other alternatives, the quicker the adoption rate will be[58]. Among different potential advantages, researches indicate that wealth increase is the most powerful for boosting adoption[59]. If this is the case, a successful marketing strategy needs a clear and compelling economic case for farmers[60]. Although wealth increase is the most important, adoption could be constrained or encouraged by other dimensions: compatibility with existing values and practices, ease of use, proven and observable results, reversibility and trialability[61].

Diagnosis in the Ugandan setting: Local partners mainly sensitize farmers' groups about the efficacy of storage equipment to reduce PHL, instructions for use, price for each option and payment modalities. In contrast to other organizations, such as One Acre Fund Uganda, WFP's marketing strategy does not address the economic returns of adopting the technology. Given that wealth increase is the main factor for adoption, advertising the payoffs of technology at a household level could be more effective than providing general information[62&63]. In addition, the CGAP survey demonstrated that storing grains is still not perceived as a business opportunity. Therefore, WFP has the opportunity to redesign its marketing strategy to communicate the economic potential for farmers, which is likely to increase their WTP.

Regarding other dimensions, units were designed to be easily used and to be fairly compatible with current practices. Furthermore, field demonstrations have been effective at showing the performance of new technology. In terms of reversibility, however, while adopting super grain bags represents an incremental and temporary change, plastic and metal silos do not offer the opportunity to try the technology on a limited basis. As with other innovations, this level of commitment increases farmers' fears of adoption.

5.4. Affordability: *Do farmers have the money at the right time to buy it?*

[58] Brand, M., Fowler, C. & Campbell, R. (2015), p. 8.
[59] Tam, V. et al. (2014), p. 34-35.
[60] Graf, J., Kayser, O. & Klarsfeld, L. (2013). Marketing Innovative Devices for the Base of the Pyramid. Lessons from 15 global pioneers that challenge conventional sales and marketing approaches to successfully serve the poorest. *Hystra Strategic Consulting*, p. 21.
[61] Brand, M., Fowler, C. & Campbell, R. (2015), p. 8.
[62] Jensen, R. (2010). The (perceived) returns to education and the demand for schooling. Quarterly Journal of Economics 125(2): 515-548.
[63] Jalan, J. and E. Somanathan (2008). The importance of being informed: Experimental evidence on demand for environmental quality. Journal of Development Economics 87(1): 14-28.

Description: Farmers usually have low purchasing power and irregular cash flows aligned with harvesting cycles. As a result, the timing of the purchase is critical. Immediately after the harvest, for example, farmers tend to have more money at hand and they also have the feeling that products and services are more affordable. To reduce the burden of making large lump-sum payments to have access to technology, several strategies are generally used: incremental product sizes, deferred payments schemes and access to finance[64].

Diagnosis in the Ugandan setting: Farmers have to overcome two challenges to afford storage units: (1) ability to pay the non-subsidized price; and (2) smallholders need to pay the equipment during the training day and at the delivery point, which is usually before the harvest.

Unaffordable prices were addressed by WFP via a decreasing subsidy scheme, starting at 70% in 2014, with plans to phase out to no discount in 2019[65]. This approach was successful at facilitating early adoption and generating learning externalities within the communities. However, it also led to farmers becoming attached to the subsidized price. Unaware of the real full price, as subsidy decreases, farmers tend to feel that price increases are unfair and become unwilling to pay higher prices. This «anchoring effect» has negatively impacted farmers' WTP, as observed in Section II.

Regarding timing, subsidies have also relaxed cash flow constraints, hiding a difficult reality. While WFP Uganda approached several banks to assist farmers with credit to purchase storage units. , few of them saw a profitable opportunity in this segment. Consequently, the absence of financial products for this segment will become a binding constraint as soon as subsidies start to decrease.

5.5. Access: *Can farmers get the technology when they need it?*

Description: Access is defined as "*the ease, distance and timing of the procurement and sale of an agricultural innovation*"[66]. In rural areas, smallholders travel long distances to the nearest store or local distribution point to get their equipment. However, the perception of closeness does not merely depend on the real distance, usually shortened by the scope of the distribution network. Instead, farmers' mobility, the access to motorized transport and the ease of carrying the products are also highly relevant. Finally, availability at the adequate timing is also important[67].

Diagnosis in the Ugandan setting: WPF has built a strong last-mile distribution network reaching several districts of the country[68]. Highly convenient to their customers, the location of delivery points, the timing of delivery and the equipment design are carefully planned to make it easier to the farmers to transport the units to their homes. Although it is highly successful in the access dimension, the current model raises concerns in terms of costs. Last-mile distribution costs represent 15-20% of the value of the equipment, which is relatively expensive compared to traditional rates in Uganda.

[64] Tam, V. et al. (2014), p. 12 & 36-37.

[65] In 2014, WFP designed the following subsidy phase-out strategy: 70% (2014), 50% (2015), 30% (2016), 20% (2017), 10% (2018) and no subsidy (from 2019 onwards). In practice, though, phasing out happened at a lower rate.

[66] Tam, V. et al. (2014), p. 12.

[67] Tam, V. et al. (2014), p. 38-39.

[68] Districts covered: Soroti, Pader, Agago, Kasese, Kawenge, Jinja, Gulu, Masindi and Nakapiripirit, among others.


wfp.org
GRAIN SILO
900 Litre Capacity

6. SECTION IV:
Market Analysis

Key Takeaways

- Several players are critical at different stages of the supply-chain for grain storage equipment: (a) manufacturers, (b) distributors and (c) microfinance institutions (MFIs).
- Currently, Uganda presents a underdeveloped supply-chain explained by different factors:
    - Manufacturers: Unfamiliar market to potential entrants, high up-front investments required, low penetration rates hindering scale effects and a challenging context due to evolving specifications, a short window for sales and poor logistics.
    - Distributors: Low attractiveness for potential entrants due to prospects of low margins, intense-price based competition and highly price-sensitive consumers.
    - Microfinance institutions: The small amounts of the loans and the vast distances between rural households and MFI branches prevent the MFIs from investing time and resources to develop product tailored to smallholders.
- Most of the barriers hindering further development of current and new players can be addressed by assessing the root causes at a structural level.

6.1. Supply chain

Several players along the supply-chain are critical to ensuring that smallholders have access to HGSE and financial services. This section assesses the level of market development at each stage, identifies key players and potential entrants and diagnoses main barriers to entry.

6.2. Manufacturers

While the supply of hermetic storage bags is relatively distributed throughout the marketplace, Uganda presents an underdeveloped supply market for silos, specially plastic silos, with a lack of players producing these goods.

There are several reasons for this phenomenon: (1) Storage equipment is relatively new in the market and thus unfamiliar to potential suppliers; (2) Manufacturing infrastructure requires substantial up-front investments for risk-averse companies considering entering the market; (3) Low market penetration of storage products prevent manufacturers from leveraging scale effects and increasing profitability; (4) Evolving specifications as a result of learning effects add additional costs and pressures for manufacturers; (5) Firms face a short window of time for the delivery of equipment, which increases operational challenges; and (6) Poor logistical infrastructure prevents companies in neighboring countries from being competitive in Uganda, as indicated by their performance in WFP's bidding processes.

As manufacturers vary depending on the type of equipment they produce, it is worthwhile to analyze each segment separately (*Exhibit 6*).

6.2.1. Super grain bags: Uganda has a prevalent non-hermetic polypropylene bags

sector and an emerging hermetic bags sector, both of which are capable of responding to current demand and potential increases.

About ten to fifteen companies, mainly based in Kampala and Jinja, compose the non-hermetic bags sector. Local manufacturers, such as PopyPro, source polypropylene from Saudi Arabia and South Africa, produce the bags using local infrastructure and sell them locally or export them to neighboring countries.

Regarding hermetic storage, there was no local supplier when WFP initiated its intervention. As a result, super grain bags were procured from HermTech, an Asian firm that imported high quality polyethylene bags through the port of Mombasa, Kenya. The first hermetic crop bag manufacturer within Uganda was HermPro in 2015 and, after that, several players that specialize in producing packaging materials entered into the market[69]. Examples of these firms are GrainPro Inc., Luuka Plastics and PolyBags Ltd., among others.

6.2.2. Plastic silos: Currently, only two players, Crestanks Ltd. and Smile Plast Ltd., are manufacturing high quality plastic silos in Uganda. In 2014, when WFP launched the PHL intervention, there was no local supplier. The strategy, therefore, was to attract companies whose core business was the production of water tanks, so that they could leverage their infrastructure and know-how to produce silos.

Crestanks Ltd., a market leader in water and sanitation solutions in East Africa, was the first company to manufacture plastic silos. In 2016, another water tank company, Smile Plast Ltd., emerged as a successful bidder by developing an optimized design with modern technology. Smile Plast is supplying silos locally and is planning to begin exports to Tanzania, Kenya and Burundi.

In Uganda, even if there are about half a dozen large firms providing water solutions (such as Poly Tanks or Victoria Nile), most of them have no interest on entering into the market. The main reasons are the significant up-front investments and a lack of long-term contracts with WFP or other large buyers to ensure demand[70].

6.2.3. Medium and large metal silos: At the onset of WFP's intervention in 2014, local artisans across Uganda were trained to manufacture silos using galvanized iron sheeting. Due to quality concerns and production capacity constraints, WFP decided to replace iron with stainless steel and to centralize the production in Kampala with a large-scale industrial partner.

Since 2015, Steel and Tube Ltd., one of the leading manufacturers of steel products in the region, emerged as the market leader providing medium and large metal silos[71]. Since 2016, other local industrial manufacturers have shown interest in entering into the market[72]. However, they have declared that they need additional time to prepare their machinery and overcome sourcing challenges.

6.3. Distributors

In most African countries, agro-input dealers tend to concentrate in cities and towns that are far away from smallholder households. As a result, the network penetration is low and farmers are over 20 km. away from the closest shop[73]. In Uganda, however, the

[69] Goentzel, J. et al. (2016), p. 9-10.

[70] Goentzel, J. et al. (2016), p. 10-11 & 23-24.

[71] Goentzel, J. et al. (2016), p. 11..

[72] Examples: BrazAfric Enterprises Ltd., Genesis Metal Works, Tonnet and Alam Group, among others.

[73] African Development Bank (2016). Agricultural Input Supply. *An Action Plan for Agricultural Transformation*, Background Paper, p. 11.

number of agro-input dealers has significantly increased from 100 in 2002 to around 2500 in 2012, expanding the reach of distribution channels[74].

Currently, the distribution network is made up of different players, who follow a set mark-up pattern: (1) National suppliers or distributors (10% on high volume and high value and 15% on low volume and/or low value); (2) Regional distributors: based in regional towns or major arterial roads (10% wholesale and 15% retail); and (3) Rural agro-input dealers: located in remote trading points selling inputs in small quantities to small-scale farmers, commercial farmers and groups (7-15% depending on volume, value and affordability)[75 & 76].

According to UNADA[77], two thirds of agro-input dealers are located in rural areas (trading centers and shops in the villages) and one-third in urban zones (district town areas or municipalities). Most of the businesses are engaged in retail trade only, 20% in both wholesaling and retailing and 2% in importation. Regarding suppliers, the majority get their inputs from Kampala, 18% from regional suppliers and 5% from international manufacturers[78]. Suppliers' location and payment terms are key to building agreements between suppliers and dealers. Inputs are delivered to dealers' shops, on credit, with promotional support and with price discounts on supplies purchased.

Each agro-input dealer serves on average 11-50 households, promoting products and offering complementary services, such as advice to farmers, problem identification or after-sale support. The typical promotional techniques used in Uganda are word-of-mouth, advertising, training and in-field demonstrations[79].

The HGSE market has many similarities with rainwater harvesting products[80]. As a result, if HGSE follows the same path as this market, re-sellers will not be particularly attracted to entering into the market. Several factors can explain this reluctance: (1) Manufacturers, focused on increasing sales, would partner with multiple dealers; (2) Low barriers to entry and ease of access to affordable transportation flood the market with dealers; (3) Storage units, commodities with no value-addition by re-sellers, do not allow differentiation; (4) Smallholders, highly sensitive, would resist price increases; and (5) These dynamics lead to intense-price based competition and low margins. This prospect presents critical challenges to develop the interest of distributors in the HGSE market.

6.4. Financial Institutions

The formal microfinance sector emerged in Uganda in 1980s, primarily driven by foreign-funded non-governmental organizations. Despite increasing public support for improving access to credit for the rural poor, financial inclusion still remains low[81].

[74] ASCH (2015). Uganda Country Profile 2015. Report 2015, p. 4.
[75] Uganda National Agro Dealer Association (2009). National Agro Input Dealer Census and Needs Assessment. *Agro Dealer Network Strengthening for Uganda*, p. 24.
[76] Danert, K. & Motts, N. (2009) Uganda Water Sector and Domestic Rainwater Harvesting. Sub-Sector Analysis. *United States Agency for International Development (USAID),* p. 44-45.
[77] Uganda National Agro-Input Dealer Association (UNADA).
[78] Countries of origin: India, China, Taiwan and Singapore, among others.
[79] Uganda National Agro Dealer Association (2009).
[80] Both markets started with non-profit organizations offering beneficial facilities to highly price sensitive consumers, initially promoting them with high subsidies and discouraging purchase at full cost from private players. Both offer similar products; high cost goods that are largely commodities, with initial low sales potential and generally ignored by targeted consumers. Danert, K. & Motts, N. (2009)
[81] Budget Monitoring and Accountability Unit, Government of Uganda (2016). Improving access

Ugandan microfinance players operate under a "tiered regulation" that affects their mode of operation, source of funding and target clients[82 & 83] (*Exhibit 9*):

• **Tier I**: Tier I consists of commercial banks that developed strategies aimed to reach low-income households and rural areas with microfinance programs. Out of the 25 commercial banks currently operating in the country, only two banks are targeting low income populations: the Centenary Rural Development Bank, an Ugandan-owned Catholic affiliated institution that has 90% of its clients in the microfinance portfolio; and the Equity Bank, a Kenya-owned bank that purchased Uganda Microfinance Limited in 2008.

• **Tier II**: Tier II consists of credit institutions that are permitted to take deposits in the form of savings accounts and which may offer collateralized and non-collateralized loans to savings and non-savings clients. Currently, two out of the three credit institutions in Uganda are offering microfinance in their lending portfolio: Post Bank and Opportunity Bank.

• **Tier III**: Tier II consists of institutions known as Microfinance Deposit-Taking Institutions (MDIs). MDIs offer a broad range of lending and saving products to their clients. Currently, FINCA Uganda, Pride Microfinance and Uganda Agency for Development (UGAFODE) are the only institutions in this tier.

• **Tier IV**: Tier IV is the largest component of the microfinance sector. This tier is mainly made up by non-profits, often established by donor-driven international organizations. This group includes different types of organizations: Savings and Credit Co-operatives (SACCOs); non-deposit taking microfinance institutions; self-help groups or savings groups; and community-based microfinance institutions. Not regulated by the Bank of Uganda, they target the rural poor with collateralized or non-collateralized loans. According to a census of Tier IV institutions conducted in 2015, 45% of these were either dormant or closed. These institutions faced human resources constraints, which were intensified by high staff turnover[84].

Currently, products offered to smallholders are highly dissimilar both in terms of design (*Exhibit 7*) and requirements to access (*Exhibit 8*). Due to the small amounts of the micro loans and the vast distances between rural households and the branches, farmers are required to organize into groups and interest rates remains high—between 17% and 30%. Despite WFP's interest in working with microfinance institutions in the context of the HGSE market, only 1,000 farmers have received a loan to purchase equipment, less than 2% of total customers.

6.5. Implications for WFP's strategy

So far, most of the players participating in the HGSE supply-chain are involved due to WFP's efforts. Consequently, Uganda presents an under-developed market that is highly dependent on WFP. As analyzed above, each stage –manufacturers, distributors and MFIs– has private companies the know-how necessary to succeed in the market. However, they face a diverse set of structural challenges that prevents them from entering. Therefore, to further develop the market, WFP should assess and address the root causes of those structural challenges.

to rural microfinance: What must be done? *BMAU Briefing Paper [15/16]*, p. 1.

[82] Darko, F. (2016). Is there a mission drift in microfinance? Some new empirical evidence from Uganda. *School of Economics Discussion Papers, University of Kent*, p. 7-10.

[83] FSU Uganda (2014). Uganda Microfinance Sector Effectiveness Review 2014. *Annual Report*.

[84] Budget Monitoring and Accountability Unit, Government of Uganda (2016), p. 1.



Source: Own analysis based on interviews with WFP executives and local manufacturers.

Exhibit 6: **Manufacturers in Uganda – Market overview (2016)**

	Regulator	Number of institutions	Key Microfinance Players	Number of Branches
Tier 1: Commercial Banks	Bank of Uganda	25	• Centenary Bank • Equity Bank	146
Tier 2: Credit Institutions	Bank of Uganda	3	• Post Bank Uganda • Opportunity Bank	62
Tier 3: MDIs	Bank of Uganda	3	• FINCA • Pride Microfinance • UGAFODE	70
Tier 4: MFIs and Others	None	Several hundreds	• Vision Fund • BRAC Uganda • WAZALENDO	N/A

Source: FSDU Uganda (2014)

Table 3: **Financial Institutions in Uganda – Market overview (2016)**

	BANK OF AFRICA	dfcu	PRIDE	UGAFODE	Opportunity Bank	FINANCE trust BANK
Minimum Amount Borrowed	2,000,000 UGX	Depends on how much saved: 150% of savings	200,000 UGX	100,000 UGX	100,000 UGX	100,000 UGX
Maximum Credit Limit	60,000,000 UGX	Depends on how much saved: 150% of savings	10,000,000 UGX	5,000,000 UGX	5,000,000 UGX	4,000,000 UGX but 1st loan is 100,000-500,000 UGX
Repayment Period	3 years (pay monthly, weekly or quarterly)	4 years (pay monthly)	3 years (pay weekly)	4 months (negotiable, pay weekly)	4 -12 months (with grace period of 21 days, pay weekly)	4 months – 1 year
Interest Rate (%)	17-21% p.a.	21% p.a.	22-30% p.a.	30% p.a.	30% p.a.	30% p.a., paid bi-weekly; in addition, each individual pays 5,000 each time of savings

Source: Grameen Foundation (Based on bank websites, in-branch interviews, documents provided).

Exhibit 7: **Group loans – Market overview (2016)**

	BANK OF AFRICA	dfcu	PRIDE	UGAFODE	Opportunity Bank	FINANCE trust BANK
Save Specified Amount	X	X	X	X	X	X
Valid ID and Signatures	X	X		X	X	
Source Income / Business			X	X		X
Financial Card	X			X		X
Certification from District	X				X	
Group knows each other well			X			X
People on the group			X			X
Attend weekly meetings			X			
Guarantors				X		
Training and Certificate					X	

Source: Grameen Foundation (Based on bank websites, in-branch interviews, documents provided).

Exhibit 8: **Group loans – Requirements to access (2016)**

7. SECTION V:

Macro level: Market Inefficiencies

Key Takeaways

- Slow adoption rates of beneficial technology, such as grain storage equipment in Uganda, tend to reflect distortions created by market inefficiencies:
  - Information: No incentives to invest in costly massive awareness campaigns.
  - Credit: Lack of products tailored to smallholders' purchases of storage equipment.
  - Coordination: Lack of articulation, leading to low level of investments.
  - Input: No supply chain development due to players' unwillingness to take risks.
- At a structural level, inefficiencies should be addressed to attract new players and further develop the Ugandan market.

7.1. Introduction

At a structural level, market development can be constrained by a set of inefficiencies: (1) Informational; (2) Credit; (3) Coordination; and (4) Input. As addressing none of them is sufficient by itself to boost adoption, targeting a single market inefficiency while ignoring others is likely to be unsuccessful[85].

This section presents, from a macro perspective, different challenges impacting the development of the GSE market in Uganda.

7.2. Informational inefficiencies:

Description: In rural contexts, poor local infrastructure, limited access to mass media[86] and low mobile phone penetration makes information distribution more costly. As a result, the majority of farmers tend not to be aware of the benefits of new technologies.

Like the distribution of any other good, information relies on the incentives of the distributor[87]. As the investment required in education and demand creation is highly expensive and competitors could free-ride on the benefits, suppliers choose not to engage in large-scale awareness campaigns. As a result, markets tend to get trapped in a «low equilibrium state», with low volumes and high prices. Few consumers are aware of the technology and willing to pay relatively high prices and few manufacturers are supplying small number of devices, due to not being able to leverage economies of scale.

Diagnosis in the Ugandan setting: With the exception of national and local radio programs that reach almost half of smallholders weekly, access to mass media on a regular basis is below 3%. Moreover, even though three quarters of smallholder farmers have used a mobile phone in their lives, they mainly use them to text family and friends[88]. Lastly, manufacturers have not leveraged information and communications technology (ICT) to promote their products or deliver agricultural information.

[85] Jack. K. (2013), p. 7.
[86] Television, newspaper and radio.
[87] Jack. K. (2013), p. 7.
[88] Anderson, J. et al. (2016), p. 33 & 39.

Similarly, neither the government nor WFP have engaged in a massive campaign creating awareness of the benefits of hermetic storage. In 2016, WFP started assessing the potential of radio advertising, short-message-services (SMS) and interactive-voice-responses (IVR) to lower the cost of information distribution. Trials, though, have been done at a very small scale, and without conclusive results.

7.3. Credit inefficiencies:

Description: Imperfect financial markets in rural areas lead to limited access to credit and high interest rates, preventing farmers from investing in new innovations[89]. In those cases, several strategies are usually deployed: customizing loans to seasonality of farmers' cash flow cycle; accepting assets and stored crops as collateral; developing mechanisms to reduce costs of gathering information about borrowers; implementing nudges for repayment; or designing pre-approved credit lines.

Diagnosis in the Ugandan setting: Currently, there are not financial products tailored to smallholders. As a result, financial institutions are currently offering individual or group loans with high interest rates, high operational charges and unfavorable repayment terms. There are several reasons for this low level of engagement: (1) information asymmetries about borrower type and behavior; (2) limited liability; (3) geographically dispersed demand; (4) lack of commercial appeal; (5) vast distance between rural villages and branches; and (6) high monitoring costs. Furthermore, on the demand side, farmers fear that, if they fail to pay in time, banks wil attack their land or houses. As a result, overcoming credit inefficiencies requires understanding and addressing the needs and concerns of both the financial institutions and the farmers.

[89] Jack. K. (2013), p. 37.

7.4. Coordination inefficiencies:

Description: According to Rodriguez, "*a firm's productivity depends not only on its own efforts and abilities, and on general economic conditions, but also on the actions of other firms, infrastructure, regulation and other public goods*"[90]. Coordination, then, is the "*effort or measures designed to make players within a market system to act in a common or complementary way towards a common goal*"[91]. Therefore, coordination inefficiency is "*the market failure to make an investment due to a possible absence of a complementary investment by other players at different stages of the supply chain*"[92].

When the economy fails to coordinate, the most common strategies are vertical integration, efforts by industry groups to share costs in feasibility studies for new markets and a set of actions led by a larger player –e.g. the national government–, with incentives and capacity to absorb the costs.

Diagnosis in the Ugandan setting: In the HGSE market, coordination failures exist at two levels:

(a) Vertical: manufacturers are reluctant to invest in storage units because they cannot rely on farmers' access to finance to expand the demand. In turn, financial institutions see no reason to invest in understanding smallholders and developing tailored financial products to buy storage units when there is not enough scale to make it profitable; and

[90] Rodríguez-Clare, A. (2005). Coordination Failures, Clusters and Microeconomic Interventions. *IDB Working Paper*, 452. p. 5.

[91] Poulton, C. et al (2004). Competition and coordination in liberalized African cotton market systems. *World Development 32*, 3, p 519-536.

[92] Dorward, A. and Kydd, J. (2013). Implications of market and coordination failures for rural development in least developed countries. *Development Studies Association Annual Conference, Strathclyde University, Glasgow*, 10-12 September 2003 .

(b) Horizontal: among players in the same stage of the supply-chain, there has been a lack of coordination, such as a consortium of manufacturers collaborating on co-financing a massive awareness campaign or financial institutions working together to understand farmers' financial behavior and adjust the services to their needs.

7.5. Input inefficiencies:

Description: Input inefficiencies occur when smallholders that would benefit from a technology are unable to access to or pay for it. Generally, poor infrastructure increases the cost of distribution, and the lack of competition weakens farmers' market power, leading to high prices. As explained by Jack (2013), "*low-take up [results] in few players with market power, which lowers profits for farmers and further depresses take-up*"[93].

To overcome these constraints, public sector involvement through subsidies can generate the volume required to set up a competitive supply network and lower the prices. On another dimension, farmers' coordination can improve their bargaining power, increase aggregate demand and decrease suppliers' transactional cost associated with marketing and credit[94].

Diagnosis in the Ugandan setting: So far, WFP has been the only player to develop an integrated supply-chain to deliver storage units at scale. Because their goal was to prove the existence of a customer need, WFP integrated different actors and absorbed all of the risks. Private sector manufacturers and distributors have now become used to enjoying high returns with low levels of risk and uncertainty. As a result, they are now unwilling to dismantle this confortable status quo by taking the risk of developing their own supply-chains. If it were not for the WFP's ongoing activities, there would probably be no supply-chain at all.



[93] Jack. K. (2013), p. 16.

[94] Jack. K. (2013), p. 20-21.



8. SECTION VI:
Policy Options

Key Takeaways

- A broad set of initiatives at a micro and macro level was identified to improve the profit potential of the supply-chain and further develop the market for grain storage equipment.
- Initiatives were evaluated along four criteria: (1) Impact on scaling up; (2) Administrative feasibility; (3) Political feasibility; and (4) Time to impact.
- Our recommendation is for WFP to prioritize three key groups of initiatives:
    - Quick-wins: target smallholder farmers and leverage them as promoters and develop a branding and marketing strategy focused on economic benefits.
    - High-priority: streamline WFP supply-chain to reduce marginal costs and bridge the gap between costs and farmers' willingness to pay.
    - Game-changing: invest substantially in massive awareness campaigns and implement pull-mechanisms to attract new players to the market.

8.1. Menu of initiatives

Following the diagnostic analysis above and a literature review on successful case studies, a broad set of key initiatives was identified to improve the profit potential of the supply-chain and further develop the market for HGSE in Uganda (*Table 4*).

8.1.1. Micro-initiatives

The micro-initiatives are a set of policy options that can be implemented by WFP to optimize its current operational model and to improve the economics of the intervention, bridging the gap between costs and willingness to pay.

(1) Target «*early adopters*», invest in their satisfaction and leverage them as «promoters» to drive technology adoption: «Early adopters» tend to be wealthier and more educated than average smallholders. Therefore, they are in a better position to understand the potential advantages of a new technology, take greater risks to make a purchase and overcome obstacles to access the products[95]. As further explained by Hystra[96], they have an entrepreneurial mindset, are resilient enough to invest in new technologies but not prosperous enough to be satisfied with the status quo. Finally, they are typically respected individuals with good reputations and strong communal ties.

Persuading early adopters to purchase a new technology is easier and thus more cost-effective than widespread campaigns with broader targets. In addition, in the absence of traditional media and low levels of awareness and trust, most farmers rely on the experiences of their friends and family.

[95] Tam, V. et al. (2014), p. 34.
[96] Graf, J., Kayser, O., Klarsfeld, L. Bonsey, R. & Brossard, S. (2015). Smallholder Farmers and Business. 15 pioneering collaborations for improved productivity and sustainability. *Hystra Strategic Consulting*, p. 27.

	Micro level *How to enhance the profit potential of the supply chain while promoting adoption?* **Adoption Factors**				**Macro level** *How to further develop the grain storage equipment market in Uganda?* **Market Inefficiencies**			
	Awareness	**Advantage**	**Affordability**	**Access**	**Information**	**Credit**	**Coordination**	**Input**
(1) Target early adopters and leverage them as promoters to drive technology adoption	☑							
(2) Test cost-effectiveness of ICT-based extension programs to increase awareness	☑							
(3) Develop a branding and marketing strategy focused on economic benefits		☑						
(4) Implement interventions to de-risk farmers' investments		☑	✓					
(5) Streamline WFP's supply chain to reduce unit marginal cost		✓	☑	☑				
(6) Invest in massive awareness campaigns to expand demand	✓	✓			☑		✓	✓
(7) Develop a local MFI network focused on designing customized products to farmers			✓			☑	✓	
(8) Implement pull-mechanisms to attract players to the market			✓	✓		✓	☑	✓
(9) Benchmark successful BOP market developments in Uganda							☑	
(10) Implement push-mechanisms to reduce marginal costs and barriers to entry			✓	✓			✓	☑

☑ Dimension targeted
✓ Dimension impacted

Source: Own analysis.

Table 4: **Menu of micro and macro initiatives (2017)**

In this context, WFP has the opportunity to focus its marketing efforts on identifying early adopters, by providing them with intensive and tailored support and investing in their satisfaction and positive experience. After that investment, WFP can recruit them as promoters to amplify the communication of the benefits of PHL technologies among their fellow community members. This initiative has the potential to optimize marketing efforts and increase the pace of adoption (*Case Studies 1*).

(2) Test cost-effectiveness of ICT-based extension programs to increase awareness: ICT-based programs delivering information about new technologies can be categorized in four groups[97]: radio dial-up and broadcasts; SMS-based; voice-based; and e-learning[98]. The potential of ICT to lower the costs of disseminating information –both for marketing but also for after-sales support– appears clear and several different mechanisms and programs have been implemented in African countries. However, evidence of success is scarce. So far, WFP has launched pilots of radio ads with *On Farm Radio* and SMS/IVR experiments reaching farmers that already bought storage equipment. Yet, as the samples were small, it has not gathered concluding evidence regarding the most cost-effective mechanism to increase awareness.

Therefore, WFP has the opportunity to further pilot and test ICT-based extension mechanisms that are designed to disseminate information about the importance and benefits of HGSE. This initiative would complement WFP efforts to optimize marketing efforts (*Case Studies 2*).

(3) Develop a branding and marketing strategy focused on economic benefits: As wealth increase is the selling point for technology adoption, many technologies that provide tangible economic benefits to smallholder farmers, focus their branding and marketing on economic advantages[99].

WFP faces the urgency of bridging the gap between farmers' willingness to pay and costs. Leveraging the attractive economic returns of HGSE, WFP has the opportunity to redesign its brand and slogan to focus on the wealth increasing potential of HGSE. This initiative has the potential to increase farmers' willingness to pay and can help to optimize marketing efforts (*Case Studies 3*).

(4) Implement interventions to de-risk farmers' investments: Affordability plays a key role in base of the pyramid (BOP) customers. Evidence suggests, however, that farmers are sometimes willing to pay more for a risk-free, good quality and comprehensive solution[100]. Despite the high returns of storage equipment, the fear of purchasing an ineffective device at a high cost relative to household income levels deters household from investing.

As a result, WFP has the opportunity to assess the potential impact of a range of policies to de-risk purchases, including money back guarantees, product trials, warrantees or redesign of devices in smaller sizes. This type of initiative has the potential to increase the value proposition by lowering the risks and therefore increasing the willingness to pay and the pace of adoption (*Case Studies 4*).

[97] Acker, J. (2011). Dial "A" for Agriculture: A Review of Information and Communication Technologies for Agricultural Extension in Developing Countries. *Tufts University*.

[98] ICT based-program categories: (a) radio dial-up and broadcasts: live or pre-recorded agricultural content disseminated by radio, sometimes allowing farmers to ask questions via SMS; (b) SMS-based: message-based platforms collecting and disseminating information; (c) voice-based: mainly telephone-based, ranging from simple –a community fixed or mobile phone– to more complex mechanisms –interactive voice responses, call-in centers or hotlines–; and (d) E-learning: telecenters and internet kiosks located in rural areas that allow that allow smallholders to access to agricultural-related information

[99] Graf, J., Kayser, O. & Klarsfeld, L. (2013), p. 5.

[100] Graf, J., Kayser, O. & Klarsfeld, L. (2013), p. 6.

(5) Streamline WFP's supply chain to reduce unit marginal cost: In order to deliver grain storage devices, WFP has built a strong, but costly supply chain. With the current cost structure, farmers cannot afford to purchase the equipment at full price. Therefore, WFP is urged to reduce marginal costs to move towards full cost recovery. Understanding key cost drivers, learning from other industries, increasing the leanness of the supply-chain and leveraging scale effects in each segment will be critical to optimize current manufacturing, marketing and logistics costs.

WFP has the opportunity to explore alternative strategies to optimize its model: negotiating of VAT exemption with the government, leveraging scale effects, integrating activities to reduce the number of intermediaries and renegotiating profit margins with partners, among others. This initiative has the potential to reduce costs more than 45%, dramatically transforming the economics of the WFP model (*Case Studies 5*).

8.1.2. Macro-initiatives

The macro-initiatives are a set of structural policy options that require the WFP to cooperate with other stakeholders and which aim to further develop the market of HGSE in Uganda.

(6) Invest in massive awareness campaigns to expand demand: As it is highly unlikely that a private player will invest in overcoming informational barriers at scale, the HGSE market is expected to remain at the «low equilibrium state» of low volumes, high prices.

In this context, WFP has the opportunity to leverage Ugandan government support to take the lead on building massive awareness. This investment in consumer education can be done through radio advertising, mobile phone messages or fieldwork by community facilitators. If successful, this initiative has the potential to expand the demand, generate mass widespread adoption and attract new suppliers to the market, leading to a «high equilibrium state: high volumes, low prices (*Case Studies 6*).

(7) Develop a network of local microfinance institutions focused on designing customized products for farmers and to further developing the sector: As explained by CGAP, microfinance institutions need to become more customer-focused [101]. This means providing well-tailored products and services based on a profound understanding of customers needs, preferences and behaviors. This shift requires investing significant time and resources profiling a new market segment and rethinking the business and operations models and the organization's mindset. As a result, institutions are reluctant to adopt this approach.

However, coordination and cost-sharing initiatives have the potential to reduce the costs of developing the market. WFP has the opportunity to engage microfinance institutions in a network with the mission of: (a) designing a customized product to help smallholders make HGSE purchases; (b) catalyze innovation to reduce costs of serving this segment; (c) promote data collection and transparency; and (d) build capacity in the sector. Leveraging current relationship with several financial players[102] and access to international donors, WFP could mobilize them to overcome credit inefficiencies in Uganda and enhance farmers' financial capacity to access storage equipment (*Case Studies 7*).

(8) Implement pull-mechanisms to attract players to the market: Pull mechanisms involve the "*ex post provision of economic in-*

[101] CGAP (2014). Customer Centricity for Financial Inclusion. CGAP Briefs.
[102] Grameen, Post-Bank, Opportunity Bank, Centenary Bank and UGAFODE, among others.

centives for innovation where the aim is to solve a specific, well defined problem"[103]. According to AgResults, "*the rewards for desired results are extensively specified in advance, without preference as to the market participants, strategies and technologies that might involve in achieving them*"[104].

Leveraging similar experiences in Kenya, WFP has the opportunity to replicate pull-mechanisms in Uganda to overcome market inefficiencies and attract new players to the industry. These mechanisms are expected to generate three key positive effects: (1) crowdsourcing of solutions: engagement of several players competing for reaching the best solution; (2) platform for innovation: emergence of the most effective solution as no single approach is preferred ex-ante; and (3) attractiveness of the market: on one side, ex post rewards making the industry more attractive for new entrants; on the other, once the competition is finished, organizations developing internal capabilities and a proven supply chain to thrive in the market[105] *(Case Studies 8)*.

(9) Benchmark successful base of the pyramid (BOP) market developments in Uganda: As explained by Prahalad & Hammond[106], most companies target consumers at the upper tier of the economic pyramid, and lack the capabilities necessary to address the challenges of serving the rural poor. In Uganda, though, some industries have succeeded in providing goods to this segment, providing opportunity to learn about how to develop a market from scratch.

WFP has the opportunity to further study and systematically learn from companies that succeeded in serving smallholder farmers in Uganda. By sharing those lessons, the initiative has the potential to attract manufacturers, distributors and financial institutions aiming to enter into the market *(Case Studies 9)*.

(10) Implement push-mechanisms to reduce marginal costs and barriers to entry: Push-mechanisms consist of the ex-ante provision of direct incentives in the inputs and processes for private sector actors that are likely to be required to achieve desired results but are not conditional on their achievement[107].

WFP has the opportunity to leverage Ugandan government support to implement different mechanisms to push the supply: (a) driven by the government: tax concessions or smart subsidies on initial investments, high up-front costs to introduce new technologies; and (b) driven by WFP: funding of development partnerships or partial subsidies at different stages of the supply chain (e.g. marketing). Understanding the context and level of development of the industry in Uganda and replacing current push-mechanisms for others that are less distortionary may help to accelerate the scaling up process *(Case Studies 10)*.

8.2. Evaluation criteria

To determine the most convenient course of action for WFP, the initiatives described above were each assessed along four evaluation criteria: (1) Impact in scaling up; (2) Administrative feasibility; (3) Political feasibility; and (4) Time to impact.

- **Impact in scaling-up** evaluates whether the initiative would be technically sufficient to address WFP's key priorities for scaling up PHL interventions: (a) enhancing and proving the profit potential of the HGSE supply-chain; and

[103] AgResults (2012). Innovation in Research and Delivery. *Australian Agency for International Development on behalf of the AgResults Steering Committee Draft Note*, p. 3.
[104] AgResults (2012), p. 3.
[105] Ortiz, R. (2016). AgResults Kenya On-farm Storage. *Presentation to the Crawford Conference.*, p. 3.
[106] Prahalad, C.K. & Hammond, A. (2002). Serving the World's Poor, Profitably. Harvard Business School Review, September 2002.
[107] AgResults (2012), p. 3.

(b) further developing the market in Uganda. This criterion weights not only the scope of the outcomes –incremental vs. *game-changing* initiatives–, but also the efficient use of human and economic resources.

- **Administrative feasibility** assesses the ease of implementation, the availability of required capabilities and the financial implications. For the complexity of execution, each potential initiative is evaluated by taking into account the complexity of the tasks, the number of players involved, the level of control that WFP has over the outcome and the likelihood of success. In terms of capabilities, each initiative is evaluated by assessing WFP internal capability to implement the policy. In some initiatives, it may be the case that WFP does not possess the skills in-house and may need to procure them through external consultants or strategic partnerships. In those instances, the likelihood of securing the expertise and the additional costs are considered. Finally, in the financial dimension, although most initiatives are in a pre-feasibility stage where detailed budgetary information is not available, they are classified in low, medium and high, based on similar cases studied.

- **Political feasibility** evaluates whether WFP and key stakeholders required to successfully execute the initiative would be willing to engage with each other over the duration of the implementation. For this to happen, stakeholders' leaders need to understand the value of the initiative for their organizations, agree with the time and resources to be invested and have to be eager to absorb potential risks. As an evaluation criterion, political feasibility involves identifying key players with power to influence the outcome and designing a strategy to ensure their buy-in.

- **Time to impact** assesses both the time it will take a given initiative to show an effect as well as the durability of the impact. Following our initial definition of scale-up, the "*more quickly and more lastingly*"[108] effects are, the better.

8.3. Recommendations

Based on the diagnosis and the evaluation of the set of initiatives described above (*Exhibit 9 & Appendix 3*), the recommendation is to focus on three key groups:

1. **Quick wins:** WFP has the opportunity to implement low-risk initiatives with immediate and observable benefits and low or no investments. Being successful at this level will allow WFP not only to improve its current operations but also to sustain the momentum around PHL interventions. Keeping the attention of the Ugandan government and international donors and strengthening their support will be key to facilitating the implementation of *game-changing* initiatives.

In particular, as first steps, WFP should: (1) Target early adopters, invest in their satisfaction and leverage them as promoters; and (2) Develop a branding and marketing strategy focused on the economic benefits of adopting HGSE. While redesigning the targeting processes can be implemented by WFP leveraging in-house capabilities and the knowledge of local partners, the recommendation is to outsource the marketing strategy to an agency specialized on BOP markets. Once the WFP decides to pursue these initiatives, they can be executed in six months, with immediate results.

2. **High-priority:** In the short-term, due to the incremental financial needs and the negative distortions on the perceptions of market players and farmers, WFP should review its subsidy schemes. In addition, from a long-term perspective, bridging the gap between actual marginal costs and farmers' WTP is also critical to prove the profit potential of the

[108] IIRR. (2000).

business and attract additional players to the market. As a result, streamlining WFP's supply chain to reduce marginal costs should be a high-priority.

In this regard, preliminary studies for plastic silos have indicated a promising potential for reducicing costs by more than 45% through VAT exemption, scale effects and elimination of the number of intermediaries. Similar approaches could applied to plastic bags and metal silos with significant impacts on the economics of the model.

As WFP's success on PHL interventions is built around a reliable supply chain, streamlining may represent a threat to quality, an aspect on which WFP is not willing to compromise. Thus, cost improvement proposals will need to assess the tradeoff between efficiency and additional risks in order to be politically feasible.

3. Game-changing initiatives: Finally, WFP also has the opportunity to lead initiatives with the potential to radically transform the market for HGSE. Although challenging, requiring significant investments and with impact in the medium-long term, similar approaches have proven to work in other countries.

Two initiatives are included in this group: (1) Invest in massive awareness campaigns to expand demand; and (2) Implement pull-mechanisms to attract players to the market. While both present high-impact potential, the second one is more attractive: it can be executed by WFP with support from partners with experience in this field –e.g. AgResults– and payments occur only if there are proven results. On the contrary, massive awareness campaigns require a sustained participation from the national government, large investments up-front and risk WFP's reputation with a very high-profile initiative.

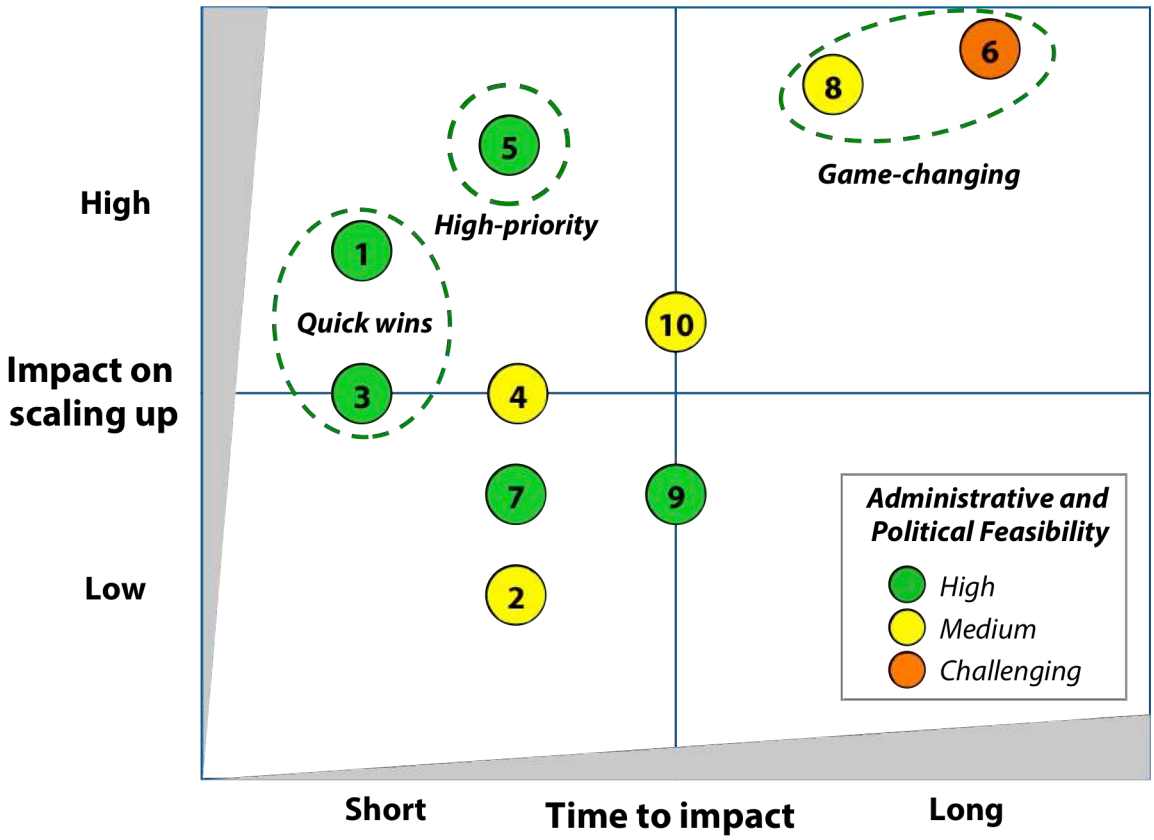
Despite the challenges, WFP should focus in advance on improving the feasibility of these initiatives. In this regard, the recommendation is to: (a) Invest in developing political skills in-house to strengthen the relationship with the Ugandan government; (b) Investigate the interest and economic capacity of the government to support massive awareness campaigns; (c) Engage international donors in assessing cost and benefits of pull-mechanisms for the HGSE market in Uganda to persuade them to finance the initiative; and (d) Monitor the evolution of *Ag-Results On-Farm Pilot* in Kenya to learn from their successes and failures stimulating private sector participation (*Case Study 8*).

8.4. Final considerations

At a higher level, irrespective of the recommendation regarding the prioritization of initiatives, it is important to consider:

- **Initiatives are independent and valuable stand-alone:** While the impact of one initiative can be enhanced by the implementation of another, all of them can be executed stand-alone and their success is not conditioned by other initiatives. Therefore, WFP is not constrained to follow a specific path.
- **However, none of the initiatives will be sufficient by itself:** As WFP's operations and the Ugandan market are constrained by multiple factors, targeting a single challenge while ignoring others will have positive effects but will be limited. Consequently, WFP should take into account the different constraints and attempt to address as many as is feasible.
- **The number of initiatives implemented should be narrowed and sequenced according to a manageable scope:** Since the KNOC and the WFP Uganda office are still

running daily PHL operations with a reduced team, their capacity to execute actions simultaneously is limited. As a result, it will be critical to assess internal capacity and prioritize initiatives based on available staff before defining the action plan.



(1) *Target early adopters and leverage them as promoters to drive technology adoption*

(2) *Test cost-effectiveness of ICT-based extension programs to increase awareness*

(3) *Develop a branding and marketing strategy focused on economic benefits*

(4) *Implement interventions to de-risk farmers' investments*

(5) *Streamline WFP's supply chain to reduce unit marginal cost*

(6) *Invest in massive awareness campaigns to expand demand*

(7) *Develop a local MFI network focused on designing customized products to farmers*

(8) *Implement pull-mechanisms to attract players to the market*

(9) *Benchmark successful BOP market development in Uganda*

(10) *Implement push-mechanisms to reduce marginal costs and barriers to entry*

Source: Own analysis (Appendix 3)

Exhibit 9: **Evaluation of Initiatives (2017)**

9. Conclusion

WFP is facing an extraordinary opportunity to radically transform the lives of smallholder farmers, starting in Uganda. In only three years, it has succeeded in delivering almost one hundred thousand grain storage solutions and has reduced post-harvest losses, improved nutrition and increased farmers' income. In addition, WFP enjoys the sustained support from international donors and the increasing attention from the Ugandan national government.

Looking ahead, WFP needs to address a broad set of challenges threatening the scalability and sustainability of its intervention. Proving the profit potential of HGSE and further developing the market should be WFP's priority in the coming years. At least 4.5 million smallholders in Uganda could benefit from the success of this endeavor.

In this regard, this paper provides a detailed description of smallholders' behavior, an operational and economic assessment of WFP's model and a market analysis considering the level of development at each stage of the supply chain. In addition, it offers a micro and a macro framework to identify improvement opportunities and proposes ten different initiatives to address each dimension of WFP's model and the market. Finally, this study evaluates the initiatives and recommends focusing the efforts on a limited set of actions.

So far, WFP Uganda has demonstrated to be a dynamic organization willing to experiment, learn, adapt and iterate. Being at the forefront of efforts to reduce post-harvest losses, this culture will be critical to its long-term success. WFP is entering into two new stages: (a) Scaling up by building a profitable business model and (b) Developing an exit strategy that lets the private sector take over the provision of storage equipment. Both stages will require new approaches and capabilities that WFP will need to find in-house or develop.

Simultaneously, at least other fifteen WFP offices, mainly in Sub-Saharan Africa, are working on designing and rolling-out their own PHL interventions. Those offices are dealing with similar challenges to the ones faced in the Uganda project. Therefore, they can absorb the lessons from WFP Uganda's successes and challenges.

The path ahead for WFP Uganda will be complex and challenging but it is clear that it is one that is worth the effort.

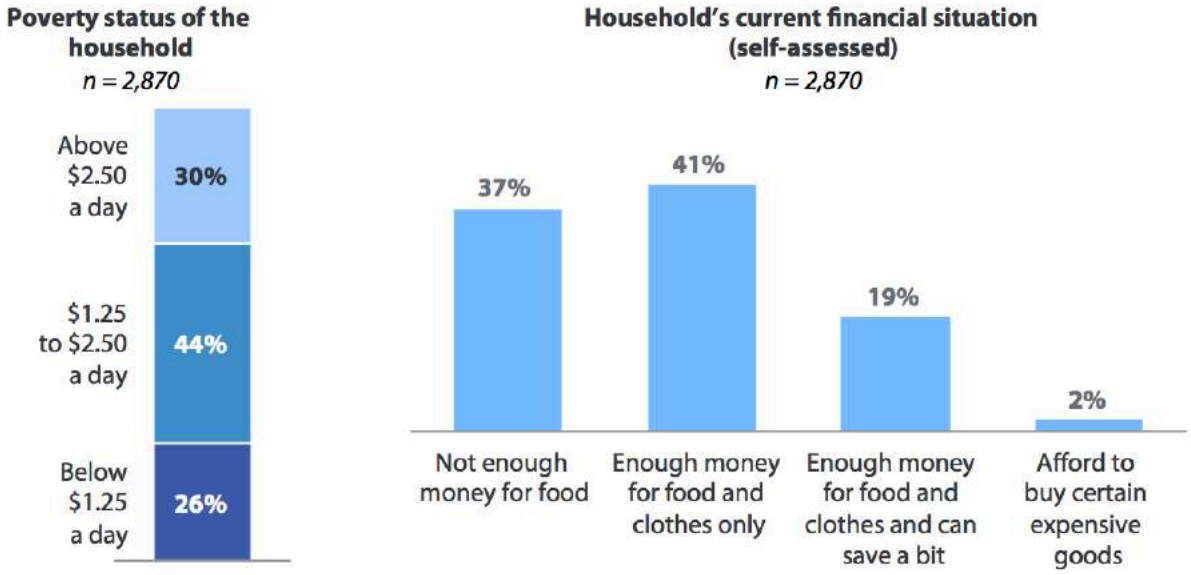



WFP
GRAIN SILO
500 Litre Capacity

10. Appendices

Appendix 1: Smallholder farmers' profile

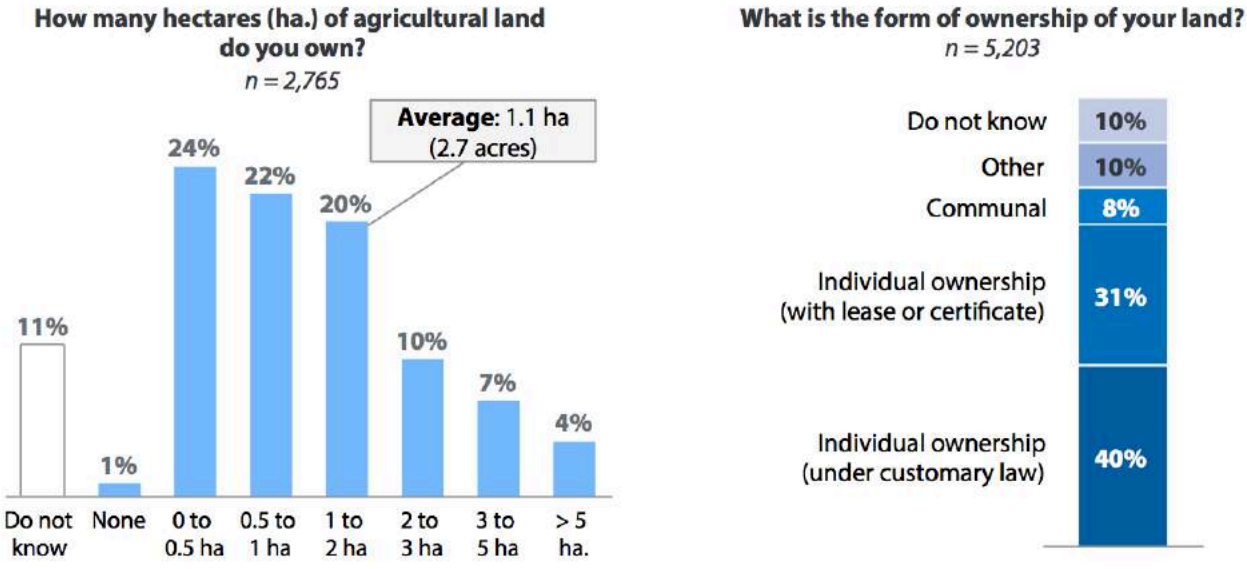
Appendix 1.1. Household economics



Source: Anderson, J., Learch, C. & Gardner, S. (2016).

Exhibit 10: **Smallholders' profile – Household economics (2016)**

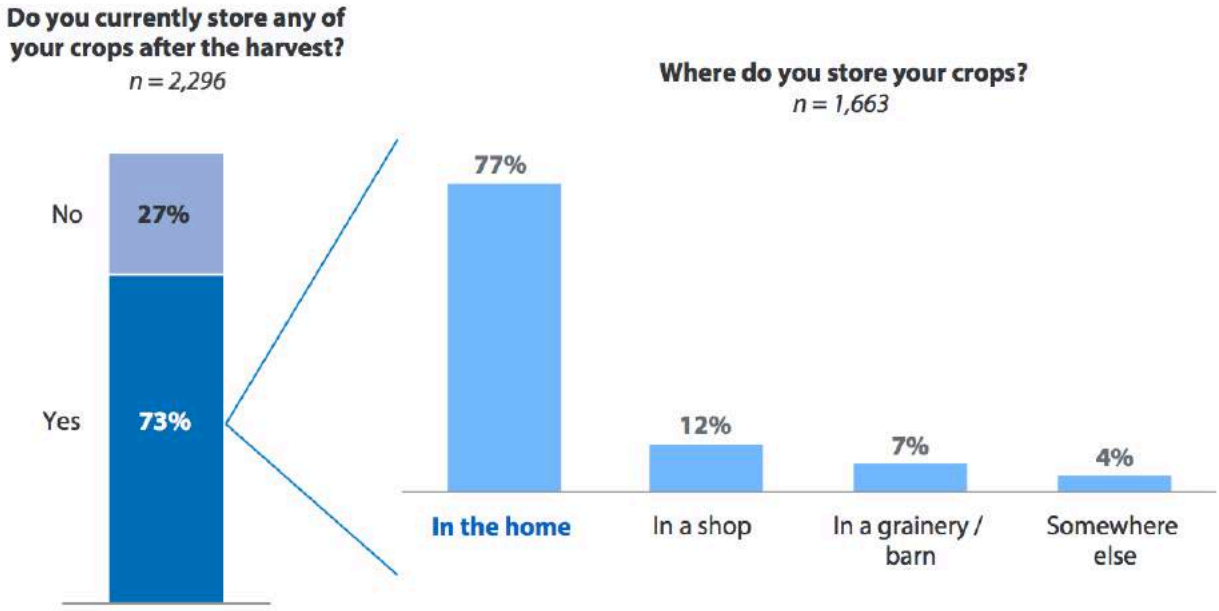
Appendix 1.2. Land ownership



Source: Anderson, J., Learch, C. & Gardner, S. (2016).

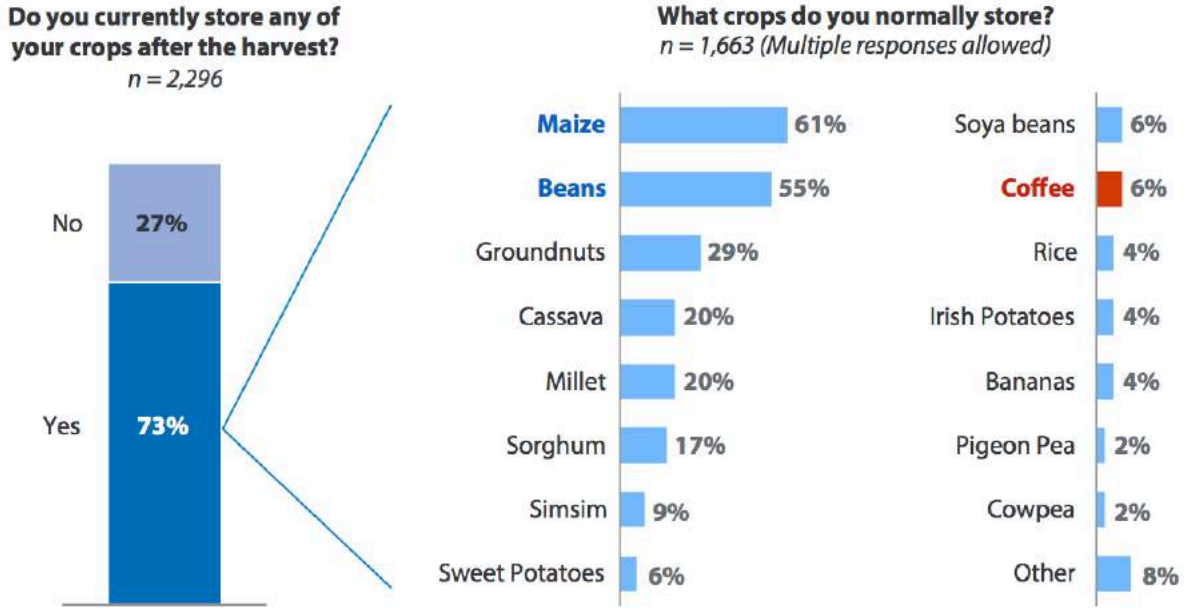
Exhibit 11: **Smallholders' profile – Land ownership (2016)**

Appendix 1.3. Storage practices



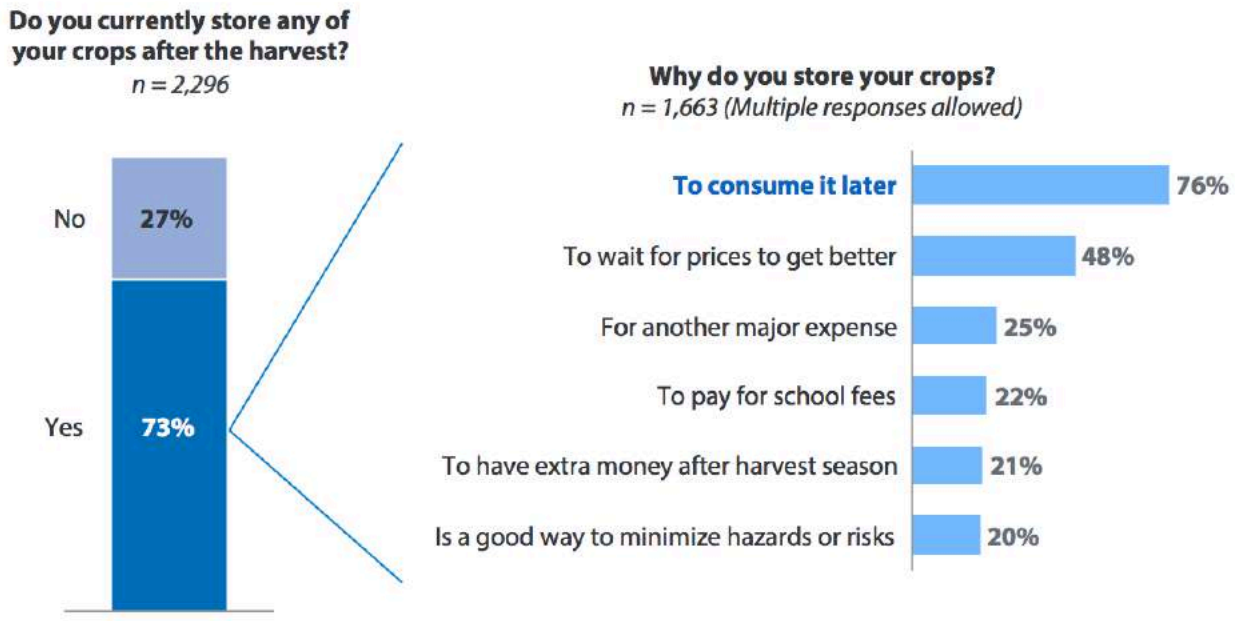
Source: Anderson, J., Learch, C. & Gardner, S. (2016).

Exhibit 12: **Smallholders' profile – Storage behavior (2016)**



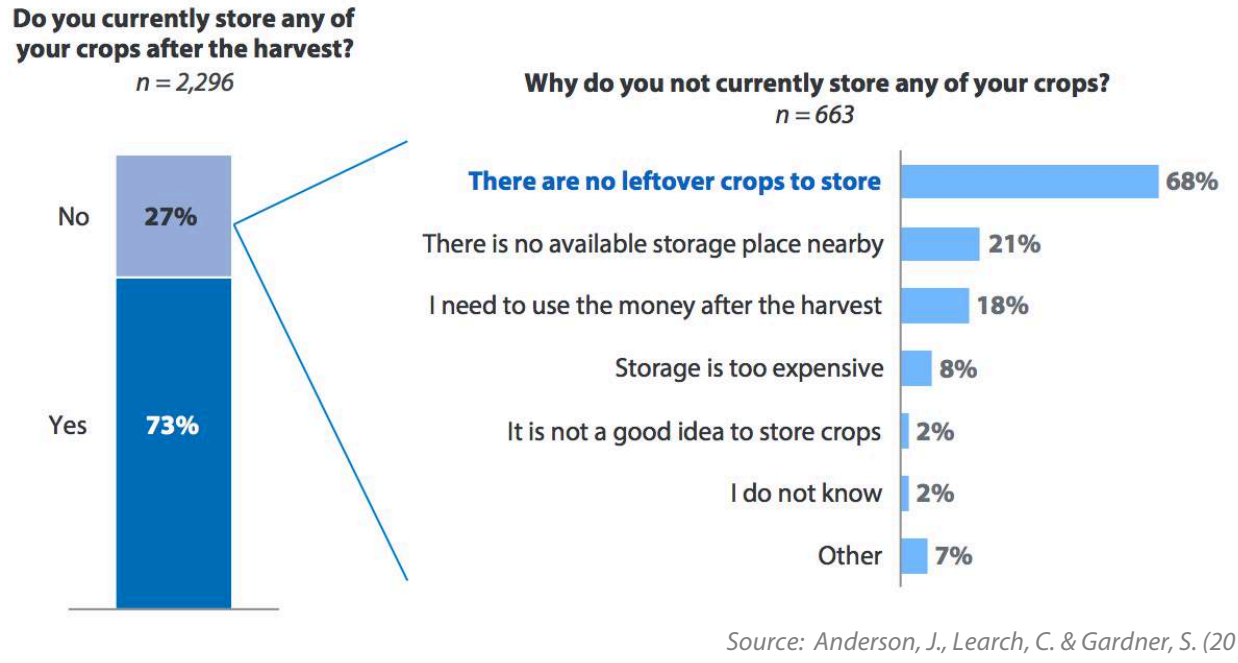
Source: Anderson, J., Learch, C. & Gardner, S. (2016).

Exhibit 13: **Smallholders' profile – Crops stored (2016)**



Source: Anderson, J., Learch, C. & Gardner, S. (2016).

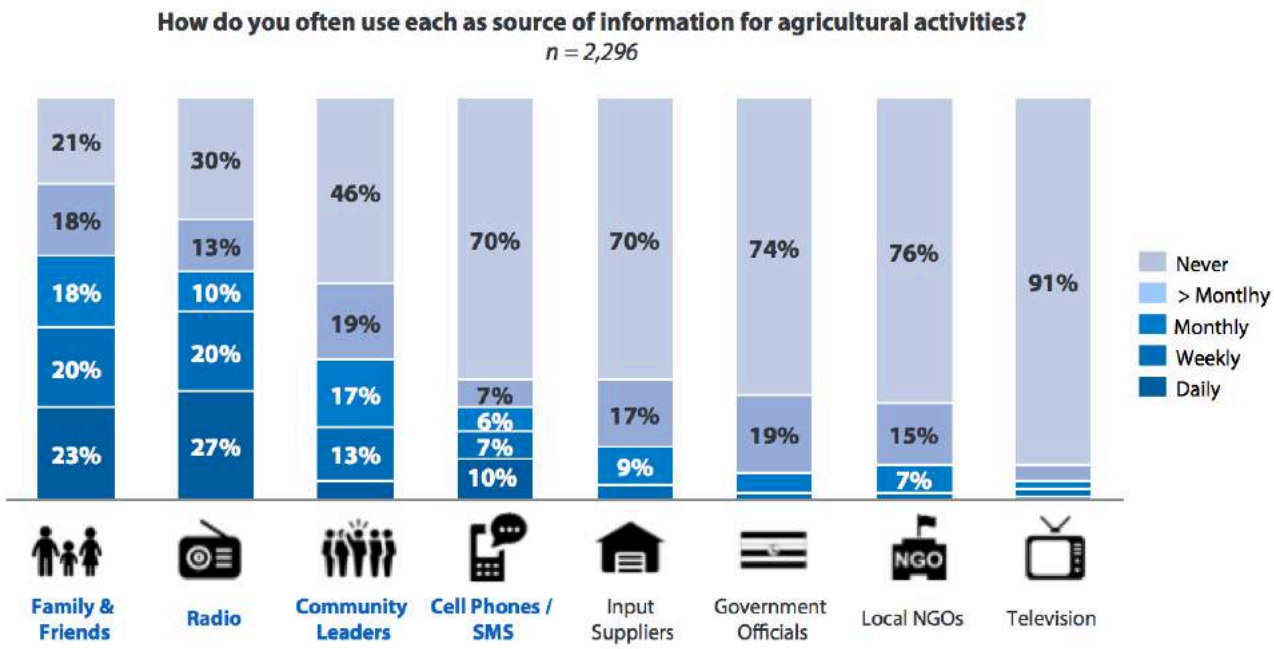
Exhibit 14: **Smallholders' profile – Reasons for storing crops (2016)**



Source: Anderson, J., Learch, C. & Gardner, S. (2016).

Exhibit 15: **Smallholders' profile – Reasons for not storing crops (2016)**

Appendix 1.4. Sources of agricultural information



Source: Anderson, J., Learch, C. & Gardner, S. (2016).

Exhibit 16: **Smallholders' profile – Sources of information (2016)**

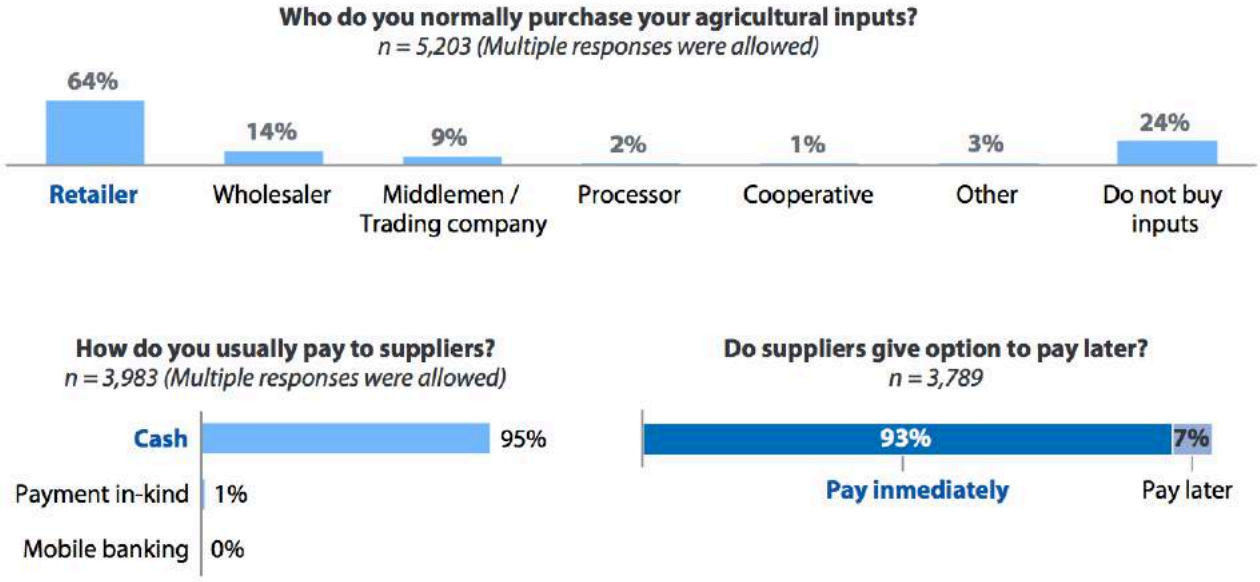
Appendix 1.5. Purchase decision



Source: Anderson, J., Learch, C. & Gardner, S. (2016).

Exhibit 17: **Smallholders' profile – Decision-making and advice (2016)**

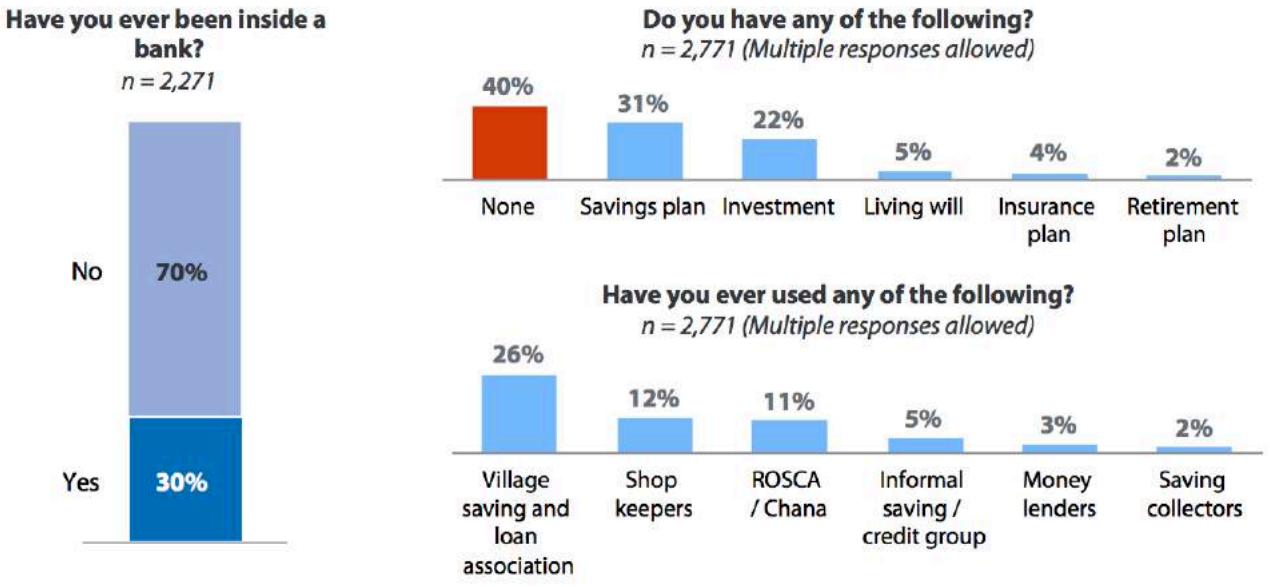
Appendix 1.6. Relationship with suppliers



Source: Anderson, J., Learch, C. & Gardner, S. (2016).

Exhibit 18: **Smallholders' profile – Relationship with suppliers (2016)**

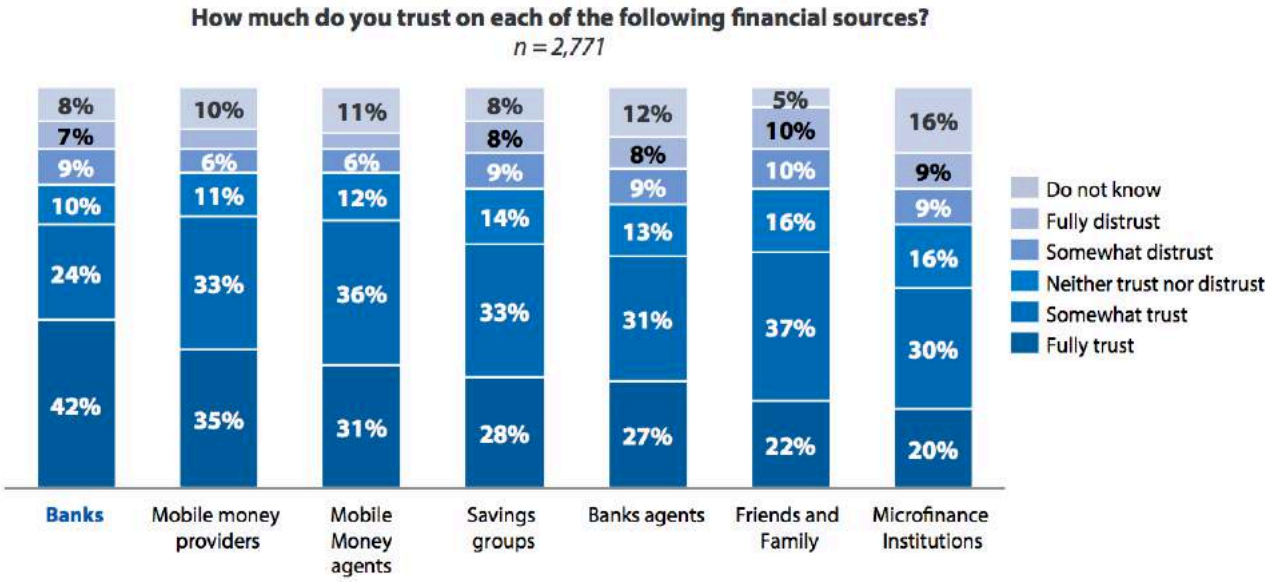
Appendix 1.7. Finance inclusion



Source: Anderson, J., Learch, C. & Gardner, S. (2016).

Exhibit 19: **Smallholders' profile – Financial inclusion (2016)**

Appendix 1.8. Trust in financial institutions



Source: Anderson, J., Learch, C. & Gardner, S. (2016).

Exhibit 20: **Smallholders' profile – Trust in financial institutions (2015)**

Appendix 2: Economic case for smallholder farmers

Table 5: Economic case for smallholder farmers – Scenarios simulated

	BEANS (+47% Price increase) 	MAIZE (+64% Price increase) 	SORGHUM (+51% Price increase) 
Current full price of equipment	Business Case 1	Business Case 2	Business Case 3
Optimized price of equipment	Business Case 4	Business Case 5	Business Case 6

Assumptions: In each business case scenario, the assumptions were:

(1) Smallholders harvest at least 650 kg. of grains to store. This quantity is below the yield expected for an average land of 2.7 acres but high enough to compare technologies with different storage capacity; (2) Smallholders face the option to sell immediately after the harvest, when the prices are low, or store and wait and sell three months later, when prices are higher; (3) Price variation corresponds to 2015 and is maintained throughout the entire analysis; (4) The price of low quality grain stored in the floor or in gunny bags in traditional practices is penalized (78% of high quality grain price); (5) Average post-harvest losses, lifespan of equipment and capacity are defined according to practitioners' expertise; (6) Farmers store 400 kg under current practices and as much as they can with new technologies (Note: capacity to store varies depending the equipment and crop); (7) Traditional practices and no storage have no additional cost for the farmers while adopting new technologies implies an investment before the first harvest and paying the interests of a loan; (8) Business cases are run under two scenarios: (I) Current full price; and (II) Optimized prices; (9) The annual interest rate for smallholder farmers in Uganda is 30%; and (10) The exchange rate is 3,360 UGX/USD (June 2016).

Table 6 - Business Case 1: Beans (+47% increase in grain price) – Current full price

Beans (+47%)	Traditional	No storage	Super Grain Bags	Plastic Silos	Medium Metal Silo
Crops stored (Kg.) (Maximum capacity)	400 (Gunny Bags)	- (No storage)	368 (4 grain bags)	420 (Silo: 500 ltr.)	630 (Silo: 750 ltr.)
Equipment cost (USD) (Current full price)	-	-	34.1	124.4	191.2
Crops stored (Kg.) (After 3 months)	280 (30% loss)	- (No storage)	366 (0.44% loss)	412 (1.78% loss)	626 (0.59% loss)
Selling price (USD/Kg) (After the harvest)	0.48	0.48	0.48	0.48	0.48
Selling price (USD/Kg.) (After 3 months)	0.55 (Low quality)	-	0.70 (High quality)	0.70 (High quality)	0.70 (High quality)
Revenues (USD) (Vs. Traditional)	0	48	112	117	219
Harvests to Repay (#) (vs. Lifespan)	**n/a**	**n/a**	**1** (2–3)	**2** (15-30)	**1** (40-50)
Net Present Value (USD) (Vs. Traditional, 10 years)	**0**	**303**	**534**	**513**	**1.040**
ROI (USD) (10 years)	**n/a**	**n/a**	**651%**	**474%**	**625%**

Table 7 - Business Case 2: Maize (+64% increase in grain price) – Current full price

Maize (+64%)	Traditional	No storage	Super Grain Bags	Plastic Silos	Medium Metal Silo
Crops stored (Kg.) (Maximum capacity)	400 (Gunny Bags)	- (No storage)	376 (4 grain bags)	425 (Silo: 500 ltr.)	638 (Silo: 750 ltr.)
Equipment cost (USD) (Current full price)	-	-	34.1	124.4	191.2
Crops stored (Kg.) (After 3 months)	280 (30% loss)	- (No storage)	374 (0.44% loss)	417 (1.78% loss)	634 (0.59% loss)
Selling price (USD/Kg) (After the harvest)	0.14	0.14	0.14	0.14	0.14
Selling price (USD/Kg.) (After 3 months)	0.18 (Low quality)	-	0.24 (High quality)	0.24 (High quality)	0.24 (High quality)
Revenues (USD) (Vs. Traditional)	0	9	38	40	79
Harvests to Repay (#) (vs. Lifespan)	**n/a**	**n/a**	**1** (2–3)	**4** (15-30)	**3** (40-50)
Net Present Value (USD) (Vs. Traditional, 10 years)	**0**	**59**	**71**	**33**	**175**
ROI (USD) (10 years)	**n/a**	**n/a**	**87%**	**31%**	**105%**

Table 8 - Business Case 3: Sorghum (+51% increase in grain price) – Current full price

Sorghum (+51%)	Traditional	No storage	Super Grain Bags	Plastic Silos	Medium Metal Silo
Crops stored (Kg.) (Maximum capacity)	400 (Gunny Bags)	- (No storage)	368 (4 grain bags)	420 (Silo: 500 ltr.)	630 (Silo: 750 ltr.)
Equipment cost (USD) (Current full price)	-	-	34,1	124.4	191.2
Crops stored (Kg.) (After 3 months)	280 (30% loss)	- (No storage)	366 (0.44% loss)	412 (1.78% loss)	626 (0.59% loss)
Selling price (USD/Kg) (After the harvest)	0.12	0.12	0.12	0.12	0.12
Selling price (USD/Kg.) (After 3 months)	0.14 (Low quality)	-	0.18 (High quality)	0.18 (High quality)	0.18 (High quality)
Revenues (USD) (Vs. Traditional)	0	11	29	31	59
Harvests to Repay (#) (vs. Lifespan)	**n/a**	**n/a**	**2** (2–3)	**4** (15-30)	**4** (40-50)
Net Present Value (USD) (Vs. Traditional, 10 years)	**0**	**71**	**19**	**-23**	**58**
ROI (USD) (10 years)	**n/a**	**n/a**	**24%**	**-22%**	**35%**

Table 9 - Business Case 4: Beans (+47% increase in grain price) – Optimized full price

Beans (+47%)	Traditional	No storage	Super Grain Bags	Plastic Silos	Medium Metal Silo
Crops stored (Kg.) (Maximum capacity)	400 (Gunny Bags)	- (No storage)	368 (4 grain bags)	420 (Silo: 500 ltr.)	630 (Silo: 750 ltr.)
Equipment cost (USD) (Optimized price)	-	-	22.0	70.3	110.0
Crops stored (Kg.) (After 3 months)	280 (30% loss)	- (No storage)	366 (0.44% loss)	412 (1.78% loss)	626 (0.59% loss)
Selling price (USD/Kg) (After the harvest)	0.48	0.48	0.48	0.48	0.48
Selling price (USD/Kg.) (After 3 months)	0.55 (Low quality)	-	0.70 (High quality)	0.70 (High quality)	0.70 (High quality)
Revenues (USD) (Vs. Traditional)	0	48	112	117	219
Harvests to Repay (#) (vs. Lifespan)	**n/a**	**n/a**	**1** (2–3)	**1** (15-30)	**1** (40-50)
Net Present Value (USD) (Vs. Traditional, 10 years)	**0**	**303**	**592**	**607**	**1.181**
ROI (USD) (10 years)	**n/a**	**n/a**	**1120%**	**993%**	**1235%**

Table 10 - Business Case 5: Maize (+64% increase in grain price) – Optimized price

Maize (+64%)	Traditional	No storage	Super Grain Bags	Plastic Silos	Medium Metal Silo
Crops stored (Kg.) (Maximum capacity)	400 (Gunny Bags)	- (No storage)	376 (4 grain bags)	425 (Silo: 500 ltr.)	638 (Silo: 750 ltr.)
Equipment cost (USD) (Optimized price)	-	-	22.0	70.3	110.0
Crops stored (Kg.) (After 3 months)	280 (30% loss)	- (No storage)	374 (0.44% loss)	417 (1.78% loss)	634 (0.59% loss)
Selling price (USD/Kg) (After the harvest)	0.14	0.14	0.14	0.14	0.14
Selling price (USD/Kg.) (After 3 months)	0.18 (Low quality)	-	0.24 (High quality)	0.24 (High quality)	0.24 (High quality)
Revenues (USD) (Vs. Traditional)	0	9	38	40	79
Harvests to Repay (#) (vs. Lifespan)	**n/a**	**n/a**	**1** (2–3)	**2** (15-30)	**2** (40-50)
Net Present Value (USD) (Vs. Traditional, 10 years)	**0**	**59**	**129**	**127**	**304**
ROI (USD) (10 years)	**n/a**	**n/a**	**244%**	**208%**	**318%**

Table 11 - Business Case 6: Sorghum (+51% increase in grain price) – Optimized price

Sorghum (+51%)	Traditional	No storage	Super Grain Bags	Plastic Silos	Medium Metal Silo
Crops stored (Kg.) (Maximum capacity)	400 (Gunny Bags)	- (No storage)	368 (4 grain bags)	420 (Silo: 500 ltr.)	630 (Silo: 750 ltr.)
Equipment cost (USD) (Optimized price)	-	-	22.0	70.3	110.0
Crops stored (Kg.) (After 3 months)	280 (30% loss)	- (No storage)	366 (0.44% loss)	412 (1.78% loss)	626 (0.59% loss)
Selling price (USD/Kg) (After the harvest)	0.12	0.12	0.12	0.12	0.12
Selling price (USD/Kg.) (After 3 months)	0.14 (Low quality)	-	0.18 (High quality)	0.18 (High quality)	0.18 (High quality)
Revenues (USD) (Vs. Traditional)	0	11	29	31	59
Harvests to Repay (#) (vs. Lifespan)	**n/a**	**n/a**	**2** (2–3)	**4** (15-30)	**4** (40-50)
Net Present Value (USD) (Vs. Traditional, 10 years)	**0**	**71**	**78**	**71**	**182**
ROI (USD) (10 years)	**n/a**	**n/a**	**147%**	**116%**	**190%**

Appendix 3: Initiatives Evaluation

The initiatives evaluation is based on: (a) Information gathered through interviews and meetings with WFP Uganda executives, manufacturers, private sector distributors (PSD), local NGO partners and microfinance institutions; (b) Case studies of similar initiatives in comparable contexts, i.e. developing countries, Sub-Saharan Africa, BOP markets and/or agricultural settings (Case studies); (c) Analysis of initiatives implemented by WFP Uganda in the past (e.g. radio and SMS/IVR experiment in May-July 2016); and (d) a focus-group with private sector distributors (PSD) and local NGO partners conducted in June 2016 to assess preliminary reactions towards potential initiatives.

MICRO-INITIATIVES

(1) Target *early adopters*, over invest In their satisfaction and leverage them as *promoters*

Impact on scaling up: *MEDIUM/HIGH*

- *Expected impact*: moderate impact on optimizing marketing efforts and increasing pace of adoption
- *Likelihood of success*: high given the relevance of family and friends advice to agricultural decisions
- *Cost-effectiveness*: very good with no investments required and moderate returns

Administrative feasibility: *HIGH*

- *Complexity*: medium/low as local partners have developed strong relationships with early adopters
- *Capabilities*: in-house capabilities sufficient to effectively redesign marketing efforts
- *Financial implications*: low as no additional investments or operational budget are required

Political feasibility: *HIGH*

- *Stakeholders*: driven by WFP with new strategy imposed by contract to local NGOs partners
- *WFP risk assessment*: no additional risks for WFP

Time to impact: *SHORT-TERM*

- *Timeframe*: could be implemented immediately during the next harvest
- *Lasting impact*: if successful, new marketing strategy could be replicated every harvest

(2) Test cost-effectiveness of ICT-based extension programs to increase awareness

Impact on scaling up: *MEDIUM/LOW*

- *Expected impact*: moderate impact on reducing marketing costs by identifying cost-effective methods
- *Likelihood of success*: moderate as evidence of success of ICT-based extension programs is scarce
- *Cost-effectiveness*: good with small investments and moderate returns

Administrative feasibility: *MEDIUM*

- *Complexity*: medium as experiments require rigorous design to obtain conclusive evidence
- *Capabilities*: in-house experience complemented with external technical support
- *Financial implications*: small investment required to deploy experiments at a small scale

Political feasibility: *MEDIUM*

- *Stakeholders*: WFP driven with support from government and local partners (NGOs and radios)
- *WFP risk assessment*: medium as some adaptations may compromise the reliability of the supply-chain

Time to impact: *MEDIUM/SHORT-TERM*

- *Timeframe*: at least two harvests are required to design and test ICT-based extension programs
- *Lasting impact*: if successful, new marketing strategy could be replicated every harvest

(3) Develop a branding and marketing strategy focused on economic benefits

Impact on scaling up: *MEDIUM*

- *Expected impact*: moderate impact on increasing farmers' willingness to pay and optimizing marketing efforts
- *Likelihood of success*: uncertain given skepticism of local NGOs on the potential of the initiative
- *Cost-effectiveness*: good with small investments required and moderate returns

Administrative feasibility: *HIGH*

- *Complexity*: low as external support would easily execute required tasks
- *Capabilities*: outsourcing of the branding design to a specialized BOP marketing firm is required
- *Financial implications*: small investment required to develop new brand and print new materials

Political feasibility: *HIGH*

- *Stakeholders*: mainly driven by WFP with inputs from local NGOs partners
- *WFP risk assessment*: no additional risks for WFP

Time to impact: *SHORT-TERM*

- *Timeframe*: could be implemented immediately during the next harvest
- *Lasting impact*: if successful, new branding could be leveraged every harvest

(4) Implement interventions to de-risk farmers' investments

Impact on scaling up: *MEDIUM*

- *Expected impact*: high impact on increasing farmers' willingness to pay by improving value proposition
- *Likelihood of success*: uncertain given skepticism of local NGOs on the potential of the initiative
- *Cost-effectiveness*: uncertain depending on the efficacy of the de-risks policies designed

Administrative feasibility: *MEDIUM*

- *Complexity*: medium as the design of de-risking policies requires both on-field and technical knowledge
- *Capabilities*: in-house experience complemented with external technical support
- *Financial implications*: small investment required to hire external support to design de-risking policies

Political feasibility: *MEDIUM/LOW*

- *Stakeholders*: participation of manufacturers, currently reluctant to take additional risks, is required
- *WFP risk assessment*: high as faulty design may lead to increasing costs or customers' dissatisfaction

Time to impact: *SHORT/MEDIUM TERM*

- *Timeframe*: at least two harvest are required to design and implement effective de-risking policies
- *Lasting impact*: if successful, de-risking policies could be replicated every harvest

(5) Streamline WFP supply chain to reduce unit marginal cost

Impact on scaling up: *HIGH*

- *Expected impact*: high impact on optimizing costs more than 45%, radically changing the model economics
- *Likelihood of success*: medium/high as some improvements opportunities were already identified
- *Cost-effectiveness*: excellent with no investments and high returns

Administrative feasibility: *HIGH*

- *Complexity*: medium/low as WFP has experience on optimizing supply chains
- *Capabilities*: in-house capabilities sufficient but could be complemented with external support
- *Financial implications*: low as no additional investments or operational budget are required

Political feasibility: *MEDIUM*

- *Stakeholders*: driven by WFP with increasing potential with governmental and partners' support
- *WFP risk assessment*: medium as some adaptations may compromise the reliability of the supply-chain

Time to impact: *MEDIUM/SHORT-TERM*

- *Timeframe*: could be implemented gradually beginning the next harvest
- *Lasting impact*: if successful, improvement initiatives could become an on-going process

MACRO-INITIATIVES

(6) Invest in massive campaigns to expand demand

Impact on scaling up: *HIGH*

- *Expected impact*: high impact on spreading adoption and attracting new players to the market
- *Likelihood of success*: uncertain depending on the efficacy of the campaigns
- *Cost-effectiveness*: uncertain as it requires large investments but is expected to deliver high returns

Administrative feasibility: *CHALLENGING*

- *Complexity*: high as it demands a wide range of activities at scale during a sustained period of time
- *Capabilities*: need to hire staff with political skills and ensure Ugandan government capabilities
- *Financial implications*: large investments funded by Ugandan government or international donors

Political feasibility: *CHALLENGING*

- *Stakeholders*: buy-in and sustained participation of Ugandan national government is required
- *WFP risk assessment*: high as it would be a high-profile initiative exposing the WFP's reputation

Time to impact: *LONG-TERM*

- *Timeframe*: based on similar cases (e.g. Indonesia Sanitation), it would take five to ten years
- *Lasting impact*: if successful, it has the potential to be a game-changing initiative

(7) Develop a local MFI network focused on designing customized products

Impact on scaling up: *MEDIUM/LOW*

- *Expected impact*: moderate impact helping to overcome credit inefficiencies but not sufficient alone
- *Likelihood of success*: medium depending on the ability to actually deliver new products for farmers
- *Cost-effectiveness*: very good with no investments and moderate returns

Administrative feasibility: *MEDIUM/HIGH*

- *Complexity*: medium as it should be designed to attract MFIs to collaborate and work together
- *Capabilities*: in-house capabilities and current networks with banks and MFIs sufficient
- *Financial implications*: no investments required

Administrative feasibility: *MEDIUM*

- *Stakeholders*: buy-in and sustained participation of MFIs will be challenging
- *WPF risk assessment*: no additional risks for WFP

Time to impact: *MEDIUM/SHORT-TERM*

- *Timeframe*: at least two harvests are required to design and implement effective de-risking policies
- *Lasting impact*: if successful, customized products could be offered every harvest

(8) Implement pull-mechanisms to attract new players to the market

Impact on scaling up: *HIGH*

- *Expected impact*: high impact on making the market more attractive and developing new supply chains
- *Likelihood of success*: high as similar initiatives worked in similar context (*On-Farm* pilot in Kenya)
- *Cost-effectiveness*: very good as payments occur only if there are proven results

Administrative feasibility: *MEDIUM/HIGH*

- *Complexity*: medium as it requires careful design of the incentive schemes
- *Capabilities*: WPF has the potential to partner with organizations with solid experience in this field
- *Financial implications*: high investments used as economic incentives

Administrative feasibility: *MEDIUM/HIGH*

- *Stakeholders*: WFP-driven but requiring funds from the Ugandan government or international donors
- *Risk assessment*: medium as it would be an innovative approach within WFP

Time to impact: *MEDIUM/LONG-TERM*

- *Timeframe*: at least six months to be designed and three years to be implemented
- *Lasting impact*: if successful, it has the potential to be a game-changing initiative

(9) Benchmark successful BOP market developments in Uganda

Impact on scaling up: *MEDIUM/LOW*

- *Expected impact*: moderate/low impact on systematizing the learning of successful BOP markets
- *Likelihood of success*: high as similar markets can provide insightful lessons to WFP
- *Cost-effectiveness*: very good with no additional investments and moderate/low returns

Administrative feasibility: *HIGH*

- *Complexity*: low as it only requires research and systematization of insights from other markets
- *Capabilities*: in-house capabilities sufficient to implement the initiative
- *Financial implications*: no investments required

Administrative feasibility: *HIGH*

- *Stakeholders*: WFP driven
- *Risk assessment*: no additional risks for WFP

Time to impact: *MEDIUM-TERM*

- *Timeframe*: could be implemented immediately but with visible impact in the medium term
- *Lasting impact*: if successful, it may lead to changes that will change the market forever

(10) Implement push-mechanisms to reduce marginal costs and barriers to entry

Impact on scaling up: *MEDIUM/HIGH*

- *Expected impact*: high impact on accelerating the pace of adoption
- *Likelihood of success*: uncertain depending on the push-mechanisms selected
- *Cost-effectiveness*: uncertain depending on the push-mechanisms selected

Administrative feasibility: *MEDIUM*

- *Complexity*: medium as it requires careful design of the incentive schemes
- *Capabilities*: in-house capabilities complemented with external support
- *Financial implications*: high as push-mechanisms require large investments

Administrative feasibility: *MEDIUM*

- *Stakeholders*: buy-in and sustained participation of Ugandan national government is critical
- *Risk assessment*: medium as it has the potential to create harmful distortions in the market

Time to impact: *MEDIUM-TERM*

- *Timeframe*: could be implemented during the next harvest depending on external support
- *Lasting impact*: it tends to be unsustainable in the medium-term due to the level of investments required

11. Case Studies

MICRO-INITIATIVES

Case Studies (1): Target *early adopters*, invest in their satisfaction and leverage them as «promoters» to drive technology adoption: Businesses targeting the base of the pyramid have recognized the importance of investing in customer satisfaction to encourage a positive word-of-mouth.

Patrimonio Hoy, a program targeting the housing needs of a low-income population in Mexico by providing affordable cement, tracks the monthly net Promoter Score (nPS): the number of clients that will recommend the product minus those who say they never will. By identifying and following-up with dissatisfied customers, *Patrimonio Hoy* is able to prevent negative word-of-mouth[109].

In terms of knowledge dissemination, several projects in different contexts –HIV prevention in Zambia[110] or introduction of cotton among rural women in Uganda[111] – have demonstrated the high potential for peer-based promotion. In this regard, *Toyola*, a Ghanaian enterprise improving access to energy efficient cook stoves to unserved households, recruits "evangelists" among their first clients to inform agents about demand in their local villages and to persuade friends to purchase the product[112].

As "*convincing others to adopt may require costly efforts with external benefits while the benefits are external, performance-based incentives can help to internalize that learning externalities*"[113]. In the dissemination of new agricultural technologies –pit planting and "Chinese composting– in rural villages of Malawi, for example, providing incentives to communication have shown to positively affect the flow of information between farmers.

Case Studies (2): Test cost effectiveness of ICT-based extension programs to increase awareness: Recent initiatives in Burkina Faso, Kenya and Uganda provide examples of a variety of successful ICT-based programs to increase awareness in rural contexts.

In Burkina Faso, the adoption of improved rice varieties has been significantly higher for farmers that have listened radio programs on rice than those who have not. This suggests that leveraging "*rural radio could be an effective strategy to speed up the adoption of improved agricultural technologies*"[114]. Similarly, in Kenya, farmers who regularly listen agricultural programs are assumed to be more likely adopters of maize production technology[115].

Regarding mixed and more complex programs, the *Question and Answer Service Vouch-*

[109] Graf, J., Kayser, O. & Klarsfeld, L. (2013), p. 8.
[110] Ashraf, N., Bandiera, O. & Jack, K. (2014). No margin, no mission? A field experiment on incentives for public service delivery. Harvard Business School.
[111] Vasilaki, K. & Leonard, K. (2014). As Good as the Networks They Keep?: Improving Farmers'Social Networks via Randomized Information Exchange in Rural Uganda. Columbia University.
[112] Graf, J., Kayser, O. & Klarsfeld, L. (2013), p. 8.
[113] BenYishav, A. & Mobarak, M. (2015). Social Learnings and Incentives for Experimentation and Communication. College of William and Mary & Yale University.
[114] Alia, D., Nakelse, T. & Diagne, A.(2013). Rural media, agricultural technology adoption and productivity: evidence from small rice farmers in Burkina Faso. International Conference for the African Association of Agricultural Economists.
[115] Wekesa, E. et. Al. (2003). Adoption of Maize Production Technologies in the Coastal Lowlands of Kenya. Kenya Agricultural Research Institute.

er System (QAS VS) in Uganda has increased engagement of farmers in post-harvest activities. In this program, farmers receive vouchers that entitle them to submit an information request that addresses their agricultural problem and, in return, they receive a response from an expert via a field agent. All the questions and answers are compiled in an online platform and community centers that can be easily accessed by farmers. Also, the most frequently asked questions are incorporated into radio scripts and are broadcasted[116].

Case Studies (3): Develop a branding and marketing strategy focused on economic benefits: Three successful examples are *KickStart*, *Toyola* and *One Acre Fund*.

KickStart International, a non-profit social enterprise focused on lifting farmers out of poverty, has developed low-cost, high quality irrigation technologies. These products, designed for smallholder farmers in Africa, pay for themselves in a season due to increased agricultural production. To highlight this economic argument, the pump was branded as the «*Money Maker*».

Toyola has not focused its sale pitch on the major health benefits of the device –i.e. the elimination of toxic fumes–. Instead, it has focused on the 50% reduction in energy cost to cook the food with a compelling slogan: «*Don't burn your money*»[117].

Finally, in the agricultural domain, *One Acre Fund* is a non-profit organization that supplies smallholders with asset-based financing and agriculture training services. Currently active in providing grain storage services in Uganda, One Acre Fund markets storage equipment through a simplified business case for farmers, adjusted for the size of the plot and the affordability of each customer.

Case Studies (4): Implement interventions to de-risk farmers' investments: *Toyola* and *Patrimonio Hoy* provide evidence on the willingness of BOP consumers to de-risk their investments, even if it is at expense of paying more.

Toyola has developed a one-month trial period offered to its cook stoves customers. Sales agents provides families with a "*Toyola Box*", a can where they deposit the savings from reduced charcoal usage. The box is then opened after thirty days to prove that the product is delivering the promised savings. With the new «trial-period» policy, half of the customers prefer to forego an 11% discount on a USD 10 cook stove to have the opportunity to test the stove's effectiveness.

Similarly, in Mexico, customers of *Patrimonio Hoy*, a program targeting the housing needs of low-income population by providing affordable cement, are willing to pay a 26% premium for complementary services –e.g. architectural advice– that increase the likelihood of satisfying their needs –building a room–[118].

Case Studies (5): Streamline WFP's supply chain to reduce unit marginal cost: In a preliminary assessment of cost reduction initiatives in the supply chain of plastic silos, three initiatives were identified leading to potential savings of 43% (USD 54) per unit, from USD 124 to USD 70.

First, in Tanzania, PICS bags have been exempt from VAT and, in Kenya, GrainPro products are not subject to import duty. In Uganda, however, grain storage devices targeted to smallholders are still subject to taxes. Leveraging national government support, WFP can request VAT exemption (18%) leading to a USD 11.9 reduction.

Second, if scale were guaranteed, Smile-Plast Ltd., key manufacturer in Uganda and

[116] Kasangaki, P. & Oguya, V. (2011). Contributing to Extension – The Question and Answer Service Voucher System. Rural Empowerment Network.
[117] Graf, J., Kayser, O. & Klarsfeld, L. (2013), p. 5.
[118] Graf, J., Kayser, O. & Klarsfeld, L. (2013), p. 13.

currently expanding to other countries, declared that it could reduce costs at least 25% by investing in new and more cost-effective production technology (USD 16.5).

Finally, WFP has split outreach activities, training and last-mile distribution in two different players: private sector distributors with a 20% guarantee margin and local non-profit organizations charging on average USD 22.5 per farmer. Some agro-input dealers have expressed their interest in integrating these activities for a total 20% margin, leading to a USD 25.7 cost reduction.

MACRO-INITIATIVES

Case Studies (6): Invest in massive awareness campaigns to expand demand: The sanitation sector in Indonesia is an illustrative example of the transformative potential of investing in educating consumers.

In 2000, half of Indonesian population and more than 60% of rural population had no access to improved sanitation services –i.e. latrines and septic tanks–. This was a major challenge with serious health, economic and welfare consequences. Over the course of 30 years, policies focused on public investment in infrastructure. Despite an average capital spending of $27 million per year, no significant progress was achieved.

In 2002, the *Government of Indonesia* (GOI) realized that it needed to change its approach to overcome the trap of a low-state equilibrium, increase private investment in sanitation and develop new mechanisms to deliver services at scale. As a result, the GOI decided to engage in a systematic process of proving from the bottom-up that behavior change produce benefits to the households.

The GOI implemented a community-led total sanitation (CLTS) program that consisted of a participatory process aimed at analyzing the community's practices and stimulating a collective sense of disgust and shame. After some time, CLTS triggered change in sanitation habits and behaviors. In addition, the government invested in marketing to reinforce demand generation by reaching customers and persuading them to buy and use sanitation products and services. Once the demand increased, suppliers were willing to enter into the market and GOI shifted to technical support to ensure availability of products in the rural areas.

As a result of this intervention, in one decade, Indonesia provided 25 million rural people with access to improved sanitation[119].

Case Studies (7): Develop a local microfinance institutions network focused on designing customized products to farmers and further developing the sector: Similar initiatives at a larger scale are: the *Microfinance African Institution Network (MAIN)* and the *Association of Microfinance in Uganda (AMFIU)*.

At a continental level, the *Microfinance African Institutions Network (MAIN)* was established in 1995 through the engagement of several institutions with long experience in microfinance in Africa. Its mission was to strengthen internal capacities, to facilitate and promote the exchange of information and to provide documentation of existing know how and practices.

At a national level, the *Association of Microfinance Institutions in Uganda* (AMFIU) was created with the purpose of sharing information and experience and network with both local and international MFI actors.

[119] Glavey, S. & Haas, O. (2015). How to Scale Up Rural Sanitation Service Delivery in Indonesia. *Global Delivery Initiative Case Study*.

Case Studies (8): Implement pull-mechanisms to attract players to the market: *AgResults*, a multi-donor, multi-lateral initiative incentivizing and rewarding high-impact agricultural innovations, launched the *Kenya On-Farm Storage Pilot*. This project consists of a performance grant based on verified sales to address post harvest losses of maize and grain by creating a market for on-farm storage solutions for farmers.

By offering a USD 7.75 million in prize to solvers that meet different sales thresholds, the initiative aimed to: (a) Overcome market barriers: low supply of technologically effective storage solutions, lack of awareness, limited access to affordable solutions and high marketing costs; and (b) Catalyze a sustainable market for storage devices in Kenya.

So far, the pilot has increased market participation of storage providers with six local and international companies and two joining soon from Uganda. This led to an increase in demand and sales to farmers. The expected outcome at the end of the pilot is a developed private sector with machinery in place to provide storage devices with a profitable business model, established distribution channels with agro dealers highly incentivized to sell storage equipment and higher demand driven by smallholder after realizing the benefits[120].

Case Studies (9): Benchmark successful BOP market developments in Uganda: The *Domestic Rain Water Harvesting* (DRWH) industry is particularly interesting due to its similarities with the HGSE industry.

In Uganda, both markets started with non-profit organizations offering beneficial facilities to highly price sensitive smallholders, initially promoting them with high subsidies and discouraging purchase at full cost. Both offer similar products; goods that are largely commodities, with initial low sales potential and high cost. Both were generally ignored by targeted consumers and not attractive for rural retailers to stock, as they are not faster selling products[121].

While HGSE emerged in 2014 in Uganda, DRWH has been promoted since early 1990s, providing a valuable opportunity to learn from its successes and failures.

Case Studies (10): Implement push-mechanisms to reduce marginal costs and barriers to entry: From the private perspective, MEDA, an international economic development organization, implemented a discount promotion strategy via vouchers to accelerate the market development for water technologies. This generated volume to start setting up distribution networks reaching rural areas and, once the targets were achieved, the subsidy was dismantled.

From a public perspective, in Brazil, the government has implemented rural finance, tax import and interest rates policies to promote the access to agricultural technology. As a result, smallholder farmers have adopted mechanized farming equipment –tractors and combine harvesters– leading to increasing productivity[122].

[120] Ortiz, R. (2016).

[121] Danert, K. & Motts, N. (2009)

[122] Brand, M., Fowler, C. & Campbell, R. (2015), p. 14.

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