Effective seed storage in Timor-Leste

Introduction

Timor-Leste is a small, impoverished country on the eastern end of the Indonesian archipelago. It ranks 134th out of 187 countries in the UNDP 2012 Human Development Index, where US$0.76 of every US$1 earned is spent on food and 60% of the 1.1 million population live below the official poverty line of US$1 per day. Maize is the most important cereal crop in Timor-Leste with an estimated production area of 120,000 hectares (ha), representing approximately 8% of total land area (14,916 km^2), and with yields approximating 1 metric ton (MT) per hectare. Cropping systems in Timor-Leste vary depending on topography, elevation, and long wet and dry seasons which are subject to wide variability and can have a major impact on agricultural productivity. Agricultural productivity in the mountainous target districts of Ainaro and Manufahi is characterized by high rates of erosion, low soil fertility, poor access to water, and low levels of livelihood diversification. Farmers grow maize followed by cassava or mixed cropping of maize with cassava, sweet potato and taro. Rice predominates in the lowlands. Because of the relatively long wet season, cropping systems are usually of longer duration and a more efficient post-harvest storage system for cereals could enhance resilience and food security (Da Silva and San Valentin 2004; UNDP 2013; FAOSTAT 2012).

Post-harvest losses for grain crops are estimated to be 30%. It is common practice for farmers to save and store seed amongst grain in storage for the next planting season, in particular for maize and rice. Limited knowledge and resources for effective seed selection, handling, and post-harvest storage have led to high post-harvest losses and contributed to poor yields. Post-harvest handling and storage programs have tended to focus solely on grain storage systems with much less emphasis on seed selection, handling, and storage. An earlier wave of community seed storage projects met with little success due to lack of ownership and accountability (Da Costa et al. 2013).

This paper is based on the Effective Seed Storage (ESS) pilot phase in two districts of Timor-Leste, from August 2011 to February 2013, working with two local manufacturers. The pilot's goal was to design and develop sustainable and scalable farmer seed storage models in Timor-Leste. MercyCorps, along with CRS and five local NGOs, is expanding the ESS program nationwide, targeting at least 10 (out of 13 districts) in the country and working with 17 local manufacturers.

Metal silos with a capacity of 35 kg and 75 kg were developed and selected as the preferred storage unit as they could be hermetically sealed (control for insects, without the need for pesticides) and protect against rodents.

This technology was already known by Timorese farmers. Drums were introduced by the Portuguese and promoted in earlier projects with the support of UN/FAO.

Materials & Methods

The project utilized a "design thinking" approach to design the seed storage system. In February 2012, the project commissioned a scoping study by an expert from the University of Illinois to assess existing storage practices as well as farmer attitudes and willingness to pay for storage in the two target districts. The study suggested that farmer seed management "based on long-standing traditions and methods passed along by their ancestors", was highly ineffective and recommended a focus on reducing post-harvest storage losses of farm-saved maize (seed and grain) and raising the quality of farmer saved seed through improved post-harvest handling and storage. The study noted that seed was not always stored in rodent-resistant or fire-resistant containers, that seed and grain were usually not separated, and that it was common for farm families to lose all of their grain and seed in storage (Elliott-Litchfield 2012).

The study recommended a variety of storage options for further market assessment, including: (i) 50-100 liter polymer drums (not to be confused with steel drums, some of which may have been used for oil/gasoline/chemicals), (ii) plastic water bottles or bags (i.e. GrainPro) inside large-opening silos or custom silos specifically for seed (smaller in size, no discharge spout, and airtight), (iii) polymer plastic rectangular totes, available in various sizes and with airtight lids; and (iv) wooden container boxes. The study also identified glass wine bottles, vegetable oil containers, biscuit tins, and other post-consumer containers that might be used as stand-alone containers, but these are only available on a limited basis (most likely at no cost). Following the study, ESS, in partnership with a local blacksmith, developed prototypes of improved quality silos (airtight and smaller, as required for seed storage) and wooden containers for testing. The project found that high quality wooden containers would be prohibitively expensive, and thus decided to drop it from the options for further exploration.

In light of poor economic and physical infrastructure conditions in the target areas, developing supply chains for multiple products would be very challenging, and for that reason the project needed to strategically select and focus efforts on the most in-demand storage solution. To ascertain which would be best, in April 2012 ESS conducted a series of consultation meetings with target communities to select the storage unit that would be the main focus of the project. Consultation meetings included a presentation of various polymer plastic drums, different sizes and models of totes, silos – both with small airtight openings and large openings – jerry cans, plastic bottles, etc. from which farmers were asked to select their preferred product. From a total of 149 participant farmers, 87% selected metal silos with airtight lids, 9% selected metal silos with large openings, while the rest selected other storage units. It is likely that custom manufactured silos were prioritized by farmers because they convey the desired attributes (airtight, rodent and fire resistant) and embrace the "drum culture" of Timorese farmers (identified by the study). Based on this, the project then decided to focus on market development of metal silos (MercyCorps 2012).

Storage structure and cost: The developed and promoted storage system was a cylinder-shaped metal silo. Following consultation meetings with farmers and after the second prototyping process, 35 kg and 75 kg metal silos were developed and selected as the preferred storage unit as they could be hermetically sealed (control for insects, notably weevils, without the need for pesticides) and protect against rodents. The metal silos were an improved design based on those earlier introduced by the UN FAO and could be made by trained local blacksmiths (Mejía Lorío and Njie 2012).

During the pilot phase, MercyCorps supported two local manufacturers, one in each district, to develop a market system, including linking with materials, assisting in promotion activities and distributing vouchers to selected farmers to create demand (details are presented in respective sections). Materials used for the silo include: galvanized steel sheets (0.5 mm, 26 gauge); PVC caps; solder (50% lead/50% tin); hydrochloric or muriatic acid (10% concentration); flux such as rosin or sal ammoniac (ammonium chloride); paint; soap powder and rags; and charcoal. Total production costs (excluding labor) range from US$15–25, depending on size. The manufacturers were allowed under contract to sell units for between US$20 and US$35 (for farmers who received vouchers and allowing fluctuations of material costs) but manufacturers then agreed to sell at US$23 for the 35 kg unit and US$26 for the 75 kg unit. Towards the end of the pilot phase the prices remained unchanged.

Training and technology promotion: Training was conducted for government extension workers and farmers on good seed selection practices and post-harvest handling. It is important to note that the training was not only to promote the use of metal drum/silos but also to encourage alternative storage systems identified during the scoping study (i.e. the use of used wine/water bottle, jerry can, etc.). Post-training monitoring and support was given to extension workers to improve their outreach. Promotion of the silos was conducted through manufacturers exhibiting them at local markets, and through the production of booklets and leaflets. Training on good seed selection practices and post-harvest handling was obligatory for all beneficiaries receiving a voucher. Comprehensive written instructions were also provided with each unit (including three steps on how to conduct seed selection, drying and storage).

Local manufacturers were trained in basic business management, supported at the start-up, and linked with suppliers for key materials. MercyCorps worked with suppliers to make materials locally available. Selected farmers were subsidized through vouchers, where they were required to pay part of the cost for the silo. Selection criteria for voucher recipients included high levels of vulnerability and/or food insecurity, and a willingness to participate in post-harvest training and project monitoring activities, as well as a willingness to share the information with other farmers. Feedback from early participant farmers was used in the further development of the containers.

Results & Discussion

During the pilot phase, metal silos were accessed by 3,378 rural farmers across 21 villages in Ainaro and Manufahi Districts. Vouchers enabled 2,337 farmers (34% of whom were women) to access drums from two local manufacturers and 1,041 farmers paid full price for the drums (Table 1). More than 2,200 farmers (31% women) received training on post-harvest techniques and, according to the final evaluation, the adoption of these techniques ranged from 70–100%. The evaluation also concluded that participating farmers increased their food self-sufficiency by nearly two months as a result of this project and storage losses among a group of pilot farmers reduced by 80%.

Storage design: Discussions during the final evaluation indicated that a greater range of silo capacity was required. Many poorer households did not store 35 kg of seed, sometimes storing as little as 5 kg (where plastic/glass bottles may have been more appropriate than silos); larger farmers could store more than 70 kg. Difficulty was also noted in separating varieties of seed in cases where farmers grew three of four varieties. For the expansion, the final evaluation encouraged the project to combine the large opening silo design with secondary inner containers holding different seed varieties (i.e., water/glass bottles, jerry can or GrainPro bags). According to the evaluation, 25% of farmers found the cap and opening of the silos to be too small. It was then recommended that the project ensure manufacturers only use large PVC caps. After one season of use, farmer feedback on the silo design was generally favorable as summarized in Figure 1 (Van Duijn 2013).

Table 1: Metal drums accessed in Ainaro and Manufahi Districts

District	# drums accessed	% metal drums accessed by category		
		Paying full price	Men*	Women*
Ainaro	1,643	32% (n=523)	66% (n=743)	34% (n=377)
Manufahi	1,735	30% (n=518)	66% (n=806)	34% (n=411)
Total (N)	3,378	1,041	1,549	788

**Based on voucher access only, no gender disaggregated data for full price purchases.*

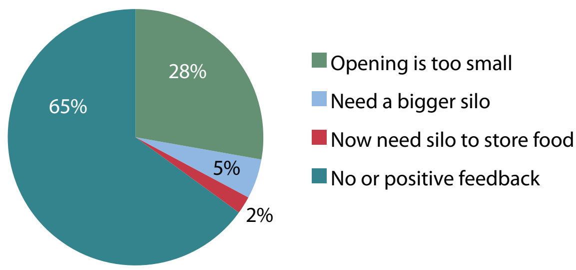

Figure 1: Farmer comments on silo design

Program staff carries out quality control at a local manufacturer production center.

An early adopter farmer shows how the new storage system retains seed quality after months of storage.

Targeting and vouchers: A voucher-based subsidy was used to promote early adoption of this technology among vulnerable farmers and to partially underwrite the production costs of the two local drum manufacturers. Individual beneficiaries were selected by a team comprised of suco (township) or aldea (village) chiefs, government extension workers, and project and partner staff. The evaluation stated that selection through local leaders may be a potential source of conflict. The original intention had been to distribute 30 silos in each local community to ensure geographic coverage and inclusion of the poorest and most vulnerable. In practice, numbers varied from two to 60 because, in many communities, conflict arose between proposed vulnerable farmers and farming households not selected. Ultimately fewer vulnerable farmers were selected than originally intended. Also, many of the poorest were unable to afford the US$3 contribution and thus vouchers were transferred to others. Beneficiary selection is a crucial step for project success, and to proceed smoothly the beneficiaries' circumstances must be fully understood, the selection criteria explained, and the process accepted by the community as a whole.

Vouchers were valued at US$20 which was US$3 below the retail price of the 35 kg drum and US$6 below the retail price of the 70 kg drum: US$23 for a 35 kg capacity container and US$26 for a 70 kg capacity container. A total of 3,378 silos were accessed by farmers as a result of this project, of which 2,337 were accessed with vouchers which subsidized approximately 80% of the retail price of the drums. Even with the significant subsidy, farmers accessing drums with the vouchers preferred the smaller 35 kg drums both in Ainaro (60%) and in Manufahi (51%). Eighty-five percent of farmers that paid full price for the drum in Manufahi (they received no voucher) purchased the 75 kg drum which reflects their financial status and seed storage needs. The vouchers were effective in creating demand as the project exceeded its target of beneficiaries by 50%. See Figure 2 for a breakdown on drum size accessed with and without vouchers in the two districts.

Based on interviews with drum manufacturers, the unit profitability of drum production ranged between US$2 (10%) and US$7 (25%) per silo according to the manufacturer and silo size. Drum producers made a substantial profit on the smaller units, but it is unclear whether they will continue to achieve enough volume to earn a profit if the subsidies to farmers are removed. Market saturation and fluctuating input prices, principally for metal sheets and labor, make drum production risky. Production diversification could be key for local manufacturers to sustain storage production.

Training and awareness: Manuals on improved seed production and storage practices were prepared for the training of government extension workers and 29 extension workers were trained on this, including two women. In Ainaro these materials were also used for training farmers in non-project areas. A sample of the early beneficiaries who had sufficient time to complete a full growing and storage cycle reported adoption of improved practices as shown in Table 2. Although only a small sample was used, the results show a very high rate of adoption, possibly reflecting the simplicity of the practices promoted and also the keen interest of farmers.

Storage efficacy: Farmers in Ainaro (N=14) reported an 82% reduction in losses and in Manufahi (N=18) a 79% reduction. A few farmers reported no reduction in losses which may be related to not having used improved seed production techniques since they only obtained the drums and training immediately before harvest. If this is the case, it emphasizes the importance of only storing quality product. A subsequent crop using the improved stored seed has not yet been harvested to note the impact on future production.

While the project focused on seed storage, a number of farmers reported being able to store maize longer, which, if used for grain storage, could result in a significant reduction of the hunger period. Farmer attributions for the improved storability are summarized in Table 3.

Figure 2: Drum size and access by district

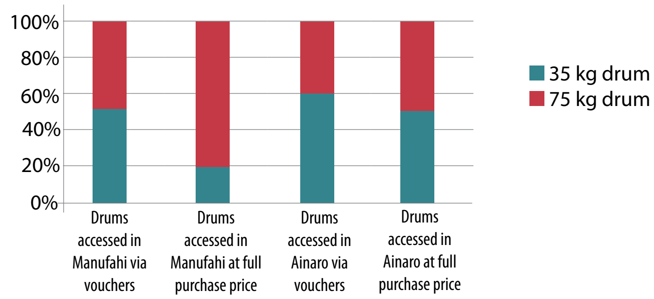

Table 2: Respondents attribution for increased duration of storage

		% respondents attributing increased duration of storage to				
District	# households interviewed	Improved seed spacing	Improved variety (cv. Sele)	Improved timing of harvest	Improved seed selection	Improved drying practices
Ainaro	10	100	90	70	90	100
Manufahi	20	75	85	85	85	80

Table 3: Respondents attribution for increased adoption of storage

		% respondents reporting adoption					
District	% households reporting longer grain storability	Improved cultivation practices	Improved seed	Favourable growing season	Increased availability of seed	Improved drying practices	Improved grain storage
Ainaro	43	90	95	95	70	95	80
Manufahi	29	93	93	86	86	93	93

Responsibility for seed production and storage:
A small survey following project implementation showed a change in perception amongst households concerning who is primarily responsible for seed production and who is responsible for seed storage. Prior to the project it was believed that men were responsible for seed production and women for seed storage. Results in the post-project sample were variable reflecting the differences between households, but there was a general consensus that responsibilities for both activities were now shared more equally. It would be interesting to relate this finding to initial targeting, gender of the trainees, and the design and approach to extension.

Conclusions & Recommendations

The program goal to design and develop sustainable and scalable farmer seed storage models in Timor-Leste was achieved by developing the market system of a metal-based seed storage solution that is customized, locally manufactured and has facilitated access for farmers to the solution that can be easily replicated/scaled-up nation-wide. Through the design thinking approach, the process has embraced local values (i.e. preference of Timorese farmers towards drums, as introduced by Portugese during the colonial era) for broader adoption. Rapid prototyping and consultative processes which promote regular iteration of program approach and storage design were used to gather and incorporate consumers' insights.

The program used a voucher system to facilitate demand creation rather than simply handing out units. Providing vouchers encouraged direct "transactional interaction" between producers and buyers. Rather than directly distributing the units or providing full-value vouchers, this enhanced the farmers' sense of ownership of the product; making an individual investment causes farmers to value the silo more highly, and further increases their awareness of the importance of high quality seeds. The fact that 1,041 farmers had paid full price for the units at the end of the pilot – with an average cost of US$27 – demonstrates not only the importance of this technology to their livelihood, but also highlights that farmers in rural areas do have cash and will make smart purchasing choices. It is also important to note that smaller units and perhaps other designs – such as plastic bottles – could be effective in helping vulnerable farmers to access inexpensive seed storage solutions.

The timeline for engaging with communities should be longer and there should be more emphasis on cost recovery by reducing the size and cost of the unit so that farmers can plan their cost contribution and subsidy rates can be reduced. Beneficiary selection is a crucial step for project success. The criteria and processes for beneficiary selection, with a strong involvement and support of communities, are more useful than relying on local government and extension workers.

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