International Maize and Wheat Improvement Center

Effective Grain Storage for Better Livelihoods of African Farmers Project

Completion Report
June 2008 to February 2011

Submitted to:

The Swiss Agency for Development and Cooperation (SDC)

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

May 2011

Contact:

Dr. Maria Luz C. George
Head, Program Management Unit
Km. 45, Carretera, Mexico-Veracruz, El Batán,Texcoco, Edo. de Mexico, C.P. 56130 Mexico
Telephone: +52 (595) 9521900; Fax: +52 (595) 9521983
Email: cimmyt-pmu@cgiar.org

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1. Executive Summary

The International Maize and Wheat Improvement Center (CIMMYT) has implemented the project entitled “Effective Grain Storage for Sustainable Livelihood of African Farmers”, with a funding from the Swiss Agency for Development and Cooperation (SDC), June 2008 to February 2011. The project successfully introduced the development and deployment of metal silo technology in Kenya (Embu and Homa Bay districts) and Malawi (Dowa and Mchinij districts), in collaboration with Catholic diocese of Embu and Homa Bay in Kenya and World Vision International in Malawi. The project targeted training of farmers, trainers, and artisans in metal silo construction in order to provide farmers with better alternative storage solutions. In collaboration with the SDC, training of trainers was performed through the South-South Cooperation in 2009. The trainers came from El Salvador, travelled to pilot areas in Kenya and Malawi and trained trainers, artisans on how to fabricate and handle the metal silo.

A total of 4 trainers and 41 artisans were trained so far in Kenya and Malawi; and a total of 45 and 105 metal silos of various capacities were produced and distributed to farmers in Malawi and Kenya, respectively. Though the metal silo technology was primarily targeted for the benefit of smallholder farmers, schools and urban communities in the two countries are also using the metal silos. This helped them to buy grains at peak harvest time when prices are low, and to use it throughout the year. As a result, several countries and organizations in Africa have shown interest or engaged in metal silo production and dissemination. The metal silo was promoted through demonstrations and the media, which directly and indirectly created a critical mass among the stakeholders, including

farmers, technicians, artisans, NGOs, government line ministries and consumers in general.

2. Background

World population has been predicted to reach 9·1 billion by 2050 and this will require a 70% increase in food production. Almost all of this growth will occur in less developed countries including Africa. However, Africa is suffering from 20-30% postharvest losses valued at 4 billion dollars annually. Traditional storage practices in developing countries cannot guarantee protection against major storage pests of staple food crops like maize. The lack of suitable storage structures for grain storage and absence of storage management technologies often force the smallholders to sell their produce immediately after harvest. Consequently, farmers receive low market prices for any surplus grain they may produce. Safe storage of maize at the farm level is crucial, as it directly impacts on poverty alleviation, food and income security and prosperity for the smallholder farmers. Without appropriate grain storage technologies, farmers are forced to sell maize when prices are low to avoid post-harvest losses from storage pests and pathogens, cannot use their harvest as collateral to access credit, and ultimately their food security is undermined. Therefore, food security and safe storage at the farmer level go hand-in-hand. As well as providing food security for times of scarcity, effective grain storage is an inflation-proof savings bank; grain can be cashed as needed or used directly as a medium of exchange (i.e. in payment for work such as field clearing and weeding).

Low agricultural yields have been blamed for world food problems, but can we continue to emphasize only agricultural production when an average of 20-30 per cent of the crops harvested never reaches the consumer?. Significant amounts of the food produced in Africa are lost after harvest, thereby aggravating hunger. Postharvest losses contribute to high food prices by removing part of the supply from the market; as a consequence of high food prices public uprising now days are rampant across the world. It is, therefore, timely to consider how to minimizing postharvest food losses, can help conserve resources and improve human well-being.

The SDC-supported "Regional Programme POSTCOSECHA" achieved significant impact to reduce post harvest losses among > 300,000 families in Central and South America and the Caribbean. The POSTCOSECHA technology is based on decentralized fabrication of family-size, affordable metal silos that are used for safe on-farm storage of harvested grain. Multiplication of impact is achieved through participation (also committing their own financial means) of a great number of international and local NGOs and the government in each country. Today the production and dissemination of POSTCOSECHA silos are institutionalized and sustainable in several Latin American countries. The question is whether a similar approach would be successful in establishing affordable and efficient on-farm storage practices in Africa.

3. Goal

Increased and more secure incomes and reduced vulnerability of resource-poor rural maize producers in Sub-Saharan Africa through the implementation of a sustainable long-term program which provides affordable and effective on-farm storage technologies to an increasing number of African smallholders.

4. General objectives

Successful development of well-functioning (e.g. competitiveness, productivity, employment, value addition, linkage coordination, efficiency, quality) and sustainable input chains that provide small-scale maize producers with effective storage technologies in areas in eastern and southern Africa affected by significant grain storage losses.

5. Specific objectives

1. Select pilot areas for the implementation of metal silo manufacturing to assess acceptability and scale-out potential of the technology (2 countries with 2 target areas each)
2. Identify in-country lead organizations (NGO, private sector) to implement training of instructors/manufacturers and manufacturing of silos in pilot areas
3. In collaboration with SDC[1], support South-South knowledge transfer from Central America to pilot areas
4. Assess the economics of maize storage and storage pest control measures in pilot areas
5. Assess acceptability, micro-economics of metal silo production (among manufacturers) and purchase (among farmers) in pilot areas
6. Advise on scale-out potential of technology to other areas and countries in ESA

6. Expected impacts

1. Decreased maize storage losses
2. Postponed sales of surplus maize realizing higher grain prices
3. Farmers avoid having to purchase expensive grain before the next harvest due to selling their own grain for fear of storage losses
4. Increased use of maize grain for value addition (feed)
5. Availability of grain as collateral increases credit rating of farmers
6. Increased household food security and incomes with positive effects on poverty reduction, resilience, education and health
7. Increased and more stable maize grain production meeting in-country and regional demands for maize
8. Greater stability of maize prices and more reliable maize grain supply
9. Employment and business opportunities for manufacturers, traders and processors
10. Increased income generation among farmers, manufactures and processors stimulating rural development

7. Partners and alliances

7.1. South-south partnership and knowledge transfer

Two project scientists (Fred Kanampiu and Jonathan Hellin) visited El Salvador to assess activities on the ground and to familiarize themselves with the Swiss supported production and promotion of metal silos amongst farmers in El Salvador. During the visit, various information materials for use in Africa were collected. These materials have been adapted for use in Africa. It was clear that the training modules developed by *Postcosecha* are very applicable to Eastern and Southern Africa (ESA). During the visit the two scientists met with Director of Dirreción General de Sanidad Vegetal y Animal - DGSVA (Adolfo Ruiz) and Luis Enrique Parada Rodezno who affirmed that they were ready to help in any way needed in validating *postcosecha* technology from Central America to Africa. Jose Contreras (Regional Coordinator and artisan instructor) was identified and a preliminary agreement reached for him to conduct artisan training in Africa (Fig 1).

Figure 1 Training session facilitated by El Salvadorian Artisan expert

7.2. Local/Regional partners

Contact was made with two selected nongovernmental organizations (NGOs) working in Kenya and Malawi. These were the World Vision International (WVI) - Malawi and Catholic Relief services (CRS)-Kenya. However, in Kenya, CRS works through the Catholic dioceses, therefore, the Catholic Dioceses of Embu and Homa Bay were identified as a collaborator in Kenya. Whereas the dioceses have worked with metal silos before, WVI-Malawi had not. Both NGOs confirmed their interest in partnering with CIMMYT. Given WVI-Malawi vast experience, wide coverage and involvement in food security issues it was identified as the project partner in Malawi. They work in 26 of the 28 districts in Malawi and about 70% of their area of operation is under maize and farmers experience at least 30% postharvest losses. WVI is presently working on post harvest losses in cowpeas in West Africa, where the technology focuses on storing grains in double polythene bags which are sealed and air-tight. WVI Malawi has trained artisans in making watering cans and believes that these same artisans could easily learn how to make metal silos. In Malawi, there is also evidence that some artisan have been trained by FAO. In Kenya, CIMMYT learnt of the restricted use of phostoxin in the region, it became aware of previous work by CRS-Catholic Diocese of Embu, where metal silos were promoted without the use of any insecticides and where farmers have reported no problems with either the LGB and/or weevils.

CIMMYT visited the farmers in Mbeere (South of Embu in Eastern Kenya) in mid-October 2008 and the same farmers confirmed that since adopting the metal silo technology (and without using any insecticides) they have managed to store maize grain successfully. In early February 2009, CIMMYT visited Homa Bay on the shores of Lake Victoria in the West of Kenya. In 2000, the Catholic Diocese in Homa Bay, together with CRS, began a project that promoted the use of metal silos, a technology that was previously unknown in Kenya. Based on this previous experience, Catholic Dioceses of Embu and Homa Bay were identified as the lead country organizations for Kenya. Kenya is the first country in Africa to experiment with metal silos (CRS and the Catholic Diocese started promoting metal silos in the Homa Bay area in 2000), it also has metal workers who have been to trained to construct the metal silos based on the design used by SDC in Central America. Furthermore, in Kenya there are (as is the case in Malawi) different actors interested in post harvest issues who can play an important role in the promotion of metal silos. These include NGOs such as Catholic Relief Services and CARE; churches; farmer organizations; and the National Cereals and Produce Board. CIMMYT has an office in the country and has a very good relationship with its national counterpart, the Kenya Agricultural Research Institute (KARI). Together, CIMMYT and KARI are well placed to validate the effectiveness of the metal silos across a range of agro-ecological zones representative of those found in ESA. Both World Vision-Malawi and the Catholic Dioceses of Embu and Homa Bay confirmed that they have on-going food security projects and also work on postharvest and market access issues. Memoranda of understanding were drawn up with WVI-Malawi and the Catholic Dioceses of Embu and Homabay detailing the ctivities to be conducted under the project.

8. Information and awareness creation

Training and information material available from Central America were adjusted and translated for use with potential partner organizations, manufacturers and farmers, and translated into local languages as appropriate. On occasion of the first metal silo production (resulting from the training courses), a highly visible launch of POSTCOSECHA silos was conducted in each country to increase awareness about opportunities, costs, and quality characteristics of metal silos. A video was produced for training and awareness purposes and information distributed through TV, radio and posters (Figures 2, 3, 4, 5, 6).

Information and awareness material for metal silos and other appropriate post harvest technologies were conducted as follows:

a) Written and web-based information targeted at partner organizations (NGOs & GOs) and policy makers; (http://www.cimmyt.org/english/wpp/afr_livelih/metalSilo.htm)

b) Posters, pamphlets and radio messages targeted at farmers and farmer support groups (English and vernacular spoken in target areas)

c) Written information targeted at instructors and manufacturers (English and Swahili)

d) Video for use for instruction of metal silo fabrication

e) TV-based awareness creation for wider audiences

f) Highly visible launch of post-harvest programs in pilot countries: Farmers in pilot areas made aware about availability of silos and their costs

g) Facilitated visits of members of future partner organizations (NGOs & GOs) and decision makers to manufactures and farmers in pilot areas

Figure 2 Pamphlets for farmers.

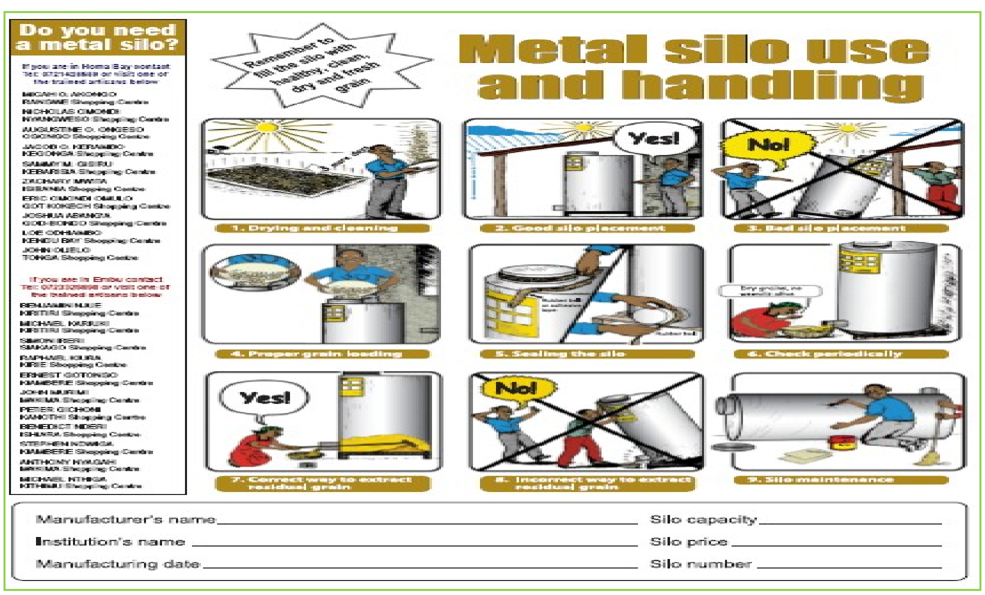

Figure 3 Pictorial description on the use of the metal silo.

Figure 4 Procedures in putting grains into the metal silo.

SUNDAY TIMES / MARCH 28 2010

EnviroTalk

WITH CHARLES MKOKA EMAIL: cmkoka@gmail.com

Can metal silos wrestle grain pests?

WHEN the issue of climate change started making headlines a few years ago, many thought it was one of the usual fiction stories humans create and build stitches of laughter amongst the majority.

That man activities could create a quagmire – for fellow humans on this very land – was a remote idea that everybody thought about.

Climate change remains a threat to food security and the livelihoods of many, few people believed this fact.

It was until recently that we started seeing the real effects of this new phenomenon.

The United Nations Environment Programme (UNEP) well detailed and documented Africa's atlas for changing environment cites , for example, the disappearances of Lake Chad and melting glaciers on Mount Kenya as some glaring examples of climate effects on the African continent.

Contrast this to yester – years when little impact was done by human activities and how the ecosystem responded to man's actions during those days.

The old people talk about abundant rains, presence of thick forests, availability of wild fruits, a stable interaction of living organisms. This was sustainable and long term in nature.

We have in recent times paid dearly for our actions. In return, what we have received include floods in areas that never received floods, droughts, erratic rains, emerging of new diseases and natural calamities among others.

New threats are emerging from radiation as a result of use of substances that are harmful to ozone layer, which filters ultra violet radiation from the sun rays.

In Malawi for instance, some districts experienced dry spell at the on set of the rains. This reduced the water levels in the soil, a situation that resulted in crops wilting. This has an effect on food security and the general nutrition of the people.

These are the same people who play an important role in social economic development in the country.

In order to safe guard harvests in the face of climate change effects and realizing that maize is the core to food security and poverty reduction. Experts realised that inappropriate grain storage technologies results in significant losses due to post harvest pests, which undermines food security.

In the wake of such developments, the Consultative Group on International Agricultural Research is supporting the International Maize and Wheat Improvement Centre by implementing a 10 year programme which provides affordable and effective farm storage technologies to an increasing number of Africa farmers as part of mitigation on climate related effects.

The programme intends to access the potential for the implementation of the metal silo approach within eastern and southern Africa among farmers. The idea is to ensure that those farmers with surplus production and experience the most significant losses of grain storage can be assisted.

This is being done with hope that decreased maize storage losses, will lead to increased food availability and income and that availability of grain as collateral in critical times will increase credit rating of farmers.

Finally, it is hoped that household food security and incomes with positive effects on poverty reduction will ensure good health and education for most families. This is in line with the UN Millennium Development Goals for poverty reduction.

In Malawi, the programme identified the non-governmental organisation World Vision International as an in country lead organization for implementation of use of metal silos in areas with high potential.

Experts expect to benefit from experience of partners with complementary activities to arrive at conclusion about the scale out and impact potential of metal silo in this part of Africa.

It is believed that that this could reduce loss of post harvest grain storage and mitigate climate related challenges, while ensuring storage of little harvest even in the face of challenges among farmers.

Figure 5 News paper about metal silo.

Figure 6 TV broad casting of the metal silo.

CIMMYT informa

No. 1656 – May 22 - 29, 2009

Unpuddled rice transplanting trials yield well in Bangladesh

More than 110 farmers attended a field day in Alipur village, Durgapur, Rajshahi district, Bangladesh on 16 May 2009. Enamul Haque, cropping systems agronomist, Conservation Agricultural Program, CIMMYT-Bangladesh, organized the field day along with CIMMYT partners Ilias Hossain, senior scientific officer, Bangladesh Regional Wheat Research Center (WRC); and Mohammad Abdur Rahman, principal scientific officer, Bangladesh Rice Research Institute (BRRI).

The farmers' day was set up to assess the first field trial for transplanted boro rice in unpuddled soil using strip-tillage, a minimal form of land preparation, and raised beds. Boro rice is high-yielding irrigated rice that is grown during the winter season and covers more than five million hectares in Bangladesh, where rice is grown year-round and is vital to food security. Almost all boro rice farmers in Bangladesh have been transplanting boro rice to puddled fields despite the fact that puddling destroys soil structure, is more costly, and requires more water and labor, according to Haque.

"I'm very grateful that a few skeptical farmers stepped forward before transplanting this year's crop, and ►

Metal silo artisans trained in Malawi and Kenya

CIMMYT is taking a creative approach toward reducing post-harvest grain losses in sub-Saharan Africa. The Effective Grain Storage Project, funded by the Swiss Agency for Development and Cooperation (SDC), targets and trains artisans in metal silo construction in order to provide farmers with better alternative storage solutions.

This 10-year project is in its 2-year pilot phase and currently focused in Malawi and Kenya. World Vision International, a project collaborator, trained artisans from the Dowa and Mchinji regions in Malawi 4-14 May 2009 at Lilongwe Technical College with assistance from Jose Contreras, an expert in silo construction. Covered topics included making metal silos of different sizes, cutting of metal sheets, and soldering and handling. "If anybody asks me if we have a solution to the enormous post-harvest losses experienced by the farmer, I now have an answer," said Mulugetta Abebe, director of World Vision International-Malawi.

Similar training courses held 18-29 May 2009 in Kenya targeted 10 artisans from the Homa Bay and Embu areas. Contreras and the Catholic Dioceses ran the courses at St. Bernard's Youth Polytechnic (Homa Bay) and Embu Agricultural Staff Training College with assistance from metal silo artists Micah Okongo in Homa Bay and Benjamin Njue in Embu.

Metal silos for grain storage were successful in reducing post-harvest grain losses in Central America and provided inspiration for this project. By using the metal silos to store surplus grain, especially maize, African farmers will be able to better control post-harvest losses, stabilize supplies and prices of maize while increasing their food and income security.
The technology will also increase employment and business opportunities for manufactures, traders, and processors. "The focus of the [Effective Grain Storage] project is to ensure that farmers use only well fabricated, high quality metal silos; that is why we are training the artisans who will make and sell these silos. We are promoting the technology while improving the artisans' skills," said Fred Kanampiu, CIMMYT agronomist and project leader who coordinated the training sessions. For more information visit http://www.cimmyt.org/english/wpp/afr_livelih/metalSilo.htm. ■

Figure 7 INFORMA, a CIMMYT magazine, describing on the metal silo.

9. On-station evaluation of storage technologies

On station testing was carried out to determine effectiveness of selected storage facilities for six months before disseminating them to farmers. Six storage facilities were evaluated: Farmer's traditional bag, farmer's traditional bag treated with actellic super, super grain bags, metal silo treated with actellic super, metal silo treated with phostoxin and metal silo alone (without insecticide). Phostoxin and actellic super were applied only once during the onset of the trials. The treatments were arranged in completely randomized design with three replications in three sites in Kenya, viz.; Embu, Kiboko and Homa Bay.

The result shows (Fig 8) grain stored in farmers' bag incured about 25% weight loss; however, grain stored in farmer's bag treated with actellic, and super grain bag kept the grain relatively safe for 3 and 5 months, respectively. Grain kept in metal silo alone, metal silo treated with actellic and phostoxin, invariably kept the grain safe for six months without any loss; leading to the conclusion that there is no additional benefit to treate grains with either actellic or phostoxin if metal silo alone is properly used. Therefore, promotion of metal silo alone is recommended without combining with dust or fumigant insecticides. The fact that grain stored in farmer's bag treated with actellic kept the grain for 3 months indicate the need for repeated application of the actellic dust every three months. The super grain bag kept the grain safe for 5 months, before it gets perforated by the LGB; however, super grain bags may be used in control of the maize weevils or in areas where the LGB is not prevalent.

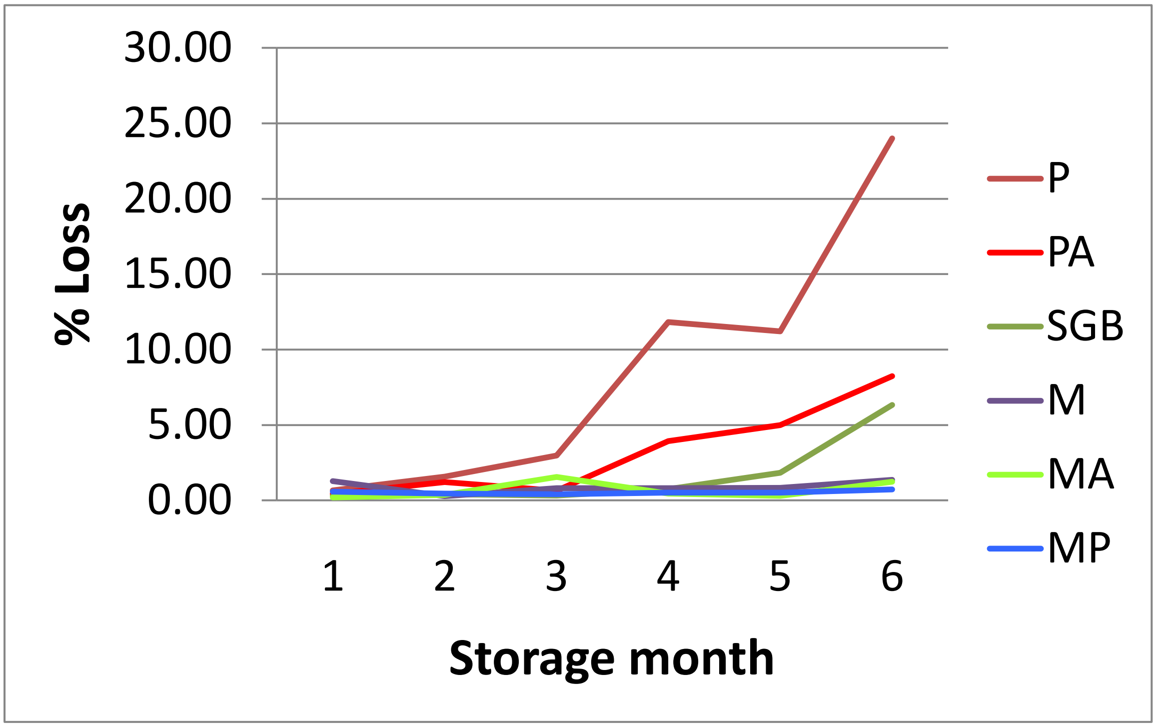

Figure 8 Effectiveness of different storage facilities in reducing grain weight losses across time.

The storage facilities tested were:

P = Farmers' (traditional) bag

PA = Farmers' bag + Actellic

SGB = Super grain bag

M = Metal silo alone

MA = Metal silo + Actellic

MP = Metal silo + phostoxin

The on-station result shows metal silos are effective in bringing the losses to zero if properly used. The proper usage includes testing grain moisture content and depletion of oxygen by burning candle inside the silo. Therefore, the most important prerequisite for effectively storing the grains in the metal silo is checking the moisture content of the grain. After the grains are harvested, they are usually laid out in the sun to dry before the actual storage begins. The grains should be properly dried to less than 13% moisture content in case of maize. The farmer needs to ascertain that the grains are completely dry before storing them in the metal silo. In the project sites, a simple method of checking the grain moisture content using a glass bottle is recommended and farmers are trained to practice the same. A few grains are put in a dry glass bottle together with a fair amount of salt (2-3 spoons). The content would be mixed thoroughly for a few minutes and left for a while (15-20 min). If the salt particles are left sticking on the glass walls, it shows that they have absorbed some moisture from the grains. This is an indication that the grains are not yet dry; therefore, further drying is required. If the salt particles do not stick to the glass walls, it is an indication that the grains are now ready for storage in the metal silo.

As farmers are opening the silo frequently to take the grain for consumption/market, it should be sealed properly and the oxygen inside the silo must be depleted, especially if the silo is not entirely filled in with the grain. As part of the proper usage of the metal silo technology, farmers were trained on how oxygen in the metal silo could be depleted by burning a candle inside the silo, while the in-let and out-let lids are sealed with a rubber band.

10. Training

In collaboration with in-country partner organizations training sessions were held in the two countries. One instructor and ten artisans were identified for training in each of the four target regions, namely, Dowa and Mchinji, in Malawi; and in Embu and Homabay, in Kenya. Selected artisans had an operational workshop and/or had indicated interest in tinsmith work. Fabrication work help to diversify their product range. Well fabrication of high quality metal silos is critical to proper grain storage and sustained supply.

During the month of May 2009, 4 instructors and 41 artisans trained in Kenya and Malawi. This training in Africa was facilitated by Jose Contreras, an El Salvadorean artisan expert from Central America. Jose Contreras conducted 4 training sessions (2 in Malawi and 2 in Kenya). This collaboration, with support from SDC, helped in South-South knowledge transfer from Central America to pilot areas in Kenya and Malawi. During the same time, 2 staff from World Vision-Malawi (Madalito Socela and Innocent Kamtedza), one from Catholic Diocese of Embu (Mary Mate) and one Catholic of Homabay (Charles Obiero) attended one 1 week artisan training. A total of 41 artisans underwent the one week training in fabricating and handling metal silos in Kenya and Malawi. During the training period, 10 metal silos were fabricated in Malawi, 10 in Embu and 7 in Homa Bay. World Vision Malawi-Malawi is assisting the trained artisans to fabricate these silos. In Homa Bay, the Artisans have formed a network is called Hodmesan Self Help Group. Its membership includes all the artisans within southern Nyanza so far trained through the Homa Bay Diocese. World Neighbors and World Vision – Kenya intends to order silos for the farmers through the network.

11. Economic Analysis Metal Silos

11.1 Economic analysis

Introduction

Maize grain is an important staple in many parts of the world. This is particularity so in Eastern and Southern African (ESA) countries where consumption per capita is 94 kg in Kenya, 122 kg in Zimbabwe and 148 kg in Malawi (Smale and Jayne, 2003). In these countries, most small scale farmers grow maize. However, most cereals are produced on a seasonal basis, often with only one harvest a year, which itself may be subject to failure (Proctor, 1994) . This leads to fluctuating supply at the international, regional, national or at household levels.

The fluctuating supply is in sharp contrast to a stable demand throughout time and space. Therefore, the main function of storage is to even out fluctuations in market supply, both from one season to the next and from one year to the next, by taking produce off the market in surplus seasons, and releasing it back onto the market in lean seasons. This in turn smoothens out fluctuations in market prices. The desire to stabilize prices of basic foods is at the heart of policy makers and it is one of the major reasons governments try to influence the amount of storage occurring, and often undertake storage themselves. Often, farmers in need of cash sell their maize right after the harvest, at the lowest price.

Farmers in many parts of Africa traditionally dry and store their maize on the cob with the husk in open maize storage facilities (Meikle et al., 2002). These traditional cribs are mostly made of bamboo, reeds or rafters and are usually constructed outside the house but within the household’s compound. This also facilitates drying of the maize into the required moisture levels. With reduced production and an increase in theft cases, the tradition of storing maize this way has been changing in some countries like Kenya, with many households preferring to shell and store in bags in their houses (Hellin et al., 2009). In other countries such as Malawi, traditional granaries are still common.

The change in storage traditions has also been caused by the emergence of new storage pests. The accidental introduction of the LGB to Tanzania during the late 1970s, probably with grain imported for food relief, rapidly increased the storage pest losses (Farrell and Schulten, 2002). LGB generally causes more losses in cobs than in shelled grain (McFarlane, 1988). The realization that traditional methods do not protect well against emerging pest such as the LGB has contributed to the improvement of storage technologies.

In ESA countries, the metal silo, a cylindrical container made of metal sheets, is one of the technologies being promoted against the LGB. It is based on the principle of airtight sealing and the depletion of oxygen which destroys insect pests and their eggs. This technology was implemented in Central and South America countries successfully (Hellin and Kanampiu, 2008).

Rates of adoption of new storage technologies at the farm level have often been disappointing (Proctor, 1994), often because technologies were promoted based on faulty assumptions on cost-effectiveness and farmers' priority of storage problems. Before storage projects are implemented, the economic and social factors involved need to be analyz first.

Several studies on cost-effectiveness of storage technologies have been conducted in ESA. A study comparing seven different storage technologies in Ghana found that traditional systems with lower capital costs and little or no operating costs achieve lower break-even prices in spite of higher losses (Boxall and Bickersteth, 1991). The improved storage crib was promoted by several projects, but economic analysis ranked it lowest among alternatives. Because of its high capital costs, it can only be financially viable in areas with particularly high losses. The mud bin was the most cost-effective structure because of its durability, cheap construction cost and low losses. An economic evaluation of the popular *rhumbu* storage structures in Nigeria, made of mud, cylindrical structure from grass, mud or mixtures with a dome-shaped thatch cover, found them economically viable (Umeh, 1994), with a benefit-cost ratio (BC) of1.97 and and internal rate of return (IRR) of 96.78%.

The metal silo technology has been successfully implemented in Central and Southern America (Tefera et al., 2011), but the economic analysis is limited.The project estimates the annual cost of the silo at US$ 4.5 (investment of a 900 kg silo of $60 over 15 years, plus fumigation cost), and the benefits at $20 (avoidance of 10% storage loss), or a net average profit of US$15.5 USD per year per silo. The metal silos have been promoted by in ESA by NGOs from such as the Catholic Relief Services and World Vision (Tefera et al., 2011), but the cost-effectiveness of the technology and their alternatives is not known. Here, a preliminary economic analysis based on the data from the on-station trials from Kenya is presented.

Methodology

Common indicators for methods the economic analysis of agricultural technologies are net present value (NPV), internal rate of return (IRR) and benefit-cost ratio (BC) (Gittinger, 1982) . The NPV represents the present worth of the income stream generated by an investment, in this case the storage technology to the farmer. The IRR represents the discount rate that makes the present worth of net incremental benefits equal to zero, or the maximum interest the investor could pay for the resources used and break even. The BC ratio represents the present worth of the benefit stream divided by the present worth of the cost stream. In this analysis, we use two other criteria: the number of years needed to recover the investment cost, and the number of years after which the investment in silo starts to return higher discounted net benefits than the control. The analysis assumed a time period of 10 years and no price fluctuation during the year.

A sensitivity analysis was also conducted to determine effect of changes in assumptions on loss abatement, prices, and stored volume.

During on-station trials three types of containers, polypropylene bags, super grain bags, and metal silos, were tested in combination with two pesticides, actellic super and phostoxin. The different combinations were tested in 90 kg units, with artificial infestation of LGB and maize weevil. Loss was estimated using the count and weigh method.

Supplementary data were collected from participatory rural appraisals (PRAs). PRAs were undertaken in five places in 2009: the Homabay-Kisii and Embu-Mbeere transects in Kenya, and the districts of Dowa, Mchingi and Zomba in Malawi. In all places discussion were held with farmers, artisans and project partners (the Catholic Diocese in Kenya and World Vision in Malawi).

In the analysis, we compare the costs and benefits of metal silos (treatment) to the common farmer practice (control). In Kenya, most farmers store maize in bags, stacked in the house, while in Malawi, farmers store maize in husks in traditional granaries for about four months before shelling and storing in bags in the residential house (Hellin et al., 2009).

Results

1. Results of the on-station trials

The results show that metal silos are highly effective, and do not need pesticides to control the insect pests (Fig 9). The super grain bags were also effective, but all were perforated by the second visit, after one month. Since these bags work on the principle of oxygen depletion, they cannot be reused, hence this technology is not interesting. Treating the maize grain with super actellic and keeping them in standard propylene bags controls the insects well for about three months, but after that, losses increase fast to 8% after six months. The results were extrapolated using regression analysis, leading to an estimated storage loss after 12 months of 33.6% in the control, 12% using actellic super, 6% for super bags and none for metal silos.

2. Costs of the different technologies

The standard polypropylene bags that farmers use typically contain 90 kg of maize and cost US$ 0.6, or $6.3/ton of maize stored (Fig 10). The insecticide actellic super costs $3.3/90 kg bag, bringing the total cost of the combination to $36.3/ton. A super grain bag, cost $5.3/90 kg bag, and is used as a liner within the PP bag, bringing the total cost of this method to $58.5/ton.

The cost of metal silos, as obtained from the artisans who construct them, depends on the size. About half of the cost comes from the metal sheet used, so the price per ton decreases with the volume, from $322 for a small container, $195 for a one ton container, to $178 for a 1.8 ton silo (20 bags). The cost does not reduce much after that, while the container becomes hard to operate so this is the largest practical size.

The different methods have handling and maintenance costs that need to be included. For the metal silos, this includes paint, labor, and replacing the rubber bands. For PP bags and super bags, there is the labor costs and cost of fasterners, while the actellic super treatments need to be repeated every three months.

3. Benefit cost analysis

The annual benefit of the different methods was calculated from the estimated abated storage loss at 12 months, valued at $230/ton (the price in Kenya at the time of the study). The benefits were calculated over a period of 15 years, and discounted at 10% (Fig 11).

Similarly, the investment and maintenance costs were calculated at an annual basis and discounted at 10%. The supergrain bags normally last three years, but when perforated they cannot be reused. Costs were calculated for both options. For a technology to be profitable, the benefits have to exceed the cost, so the ratios have to be larger than one. Moreover, for a technology to be adopted, a ratio of at least 1.5, preferably 2 is recommended {CIMMYT, 1988 #899}.

The results indicate that PP bags with superactellic are economically very interesting, with a BC ratio of 2.43 (Fig 11). Super grain bags are only interesting if they are not perforated and can be used for three years, leading to a very good BC ratio of 2.63. If they need to be replaced annually, however, they are not interesting (BC ratio of 1.08).

The profitability of the metal silos depends largely on its size. Small silos of 90 kg, as were used in the trials, are not interesting (BC of less than one), but they become interesting from about 0.5 tons. The silo of 0.7 ton already has a B/C ratio of 2.3, while the 1.8 ton silo has the best ratio, 3.25. Again, that ratio does not improve much with increasing the size.

4. Sensitivity analysis

To study the profitability of the new storage technologies under different circumstances, a sensitivity analysis was conducted under different scenarios of price and storage loss. Increased prices and higher losses make more profitable, but it does not change their rank in order of profitability.

When maize prices decrease by half, however, different technologies still keep their rank, but the B/Cc ratios of actellic super, the unperforated super grain bags, and the metal silo of 0.7 ton and 1 ton decline to almost 1.5 (yellow bars in Fig 12). Only the large metal silo of 1.8 ton still has a B/C ratio of more than 2.

When the storage losses due to insects reduce by half, down to 17%, but at the initial price of $240/ton, the B/C ratios decrease more than with a reduction in maize price (green bars in Fig 12). Super actellic and super grain bags, with a B/C ratio of 0.5 and 1 respectively, are no longer interesting, leaving only the large metal silo of 1.8 as profitable technology, with a B/C ratio of 1.6.

Finally, If both the maize price and the storage loss are reduced by half, only the large metal silo breaks even, but at an uninteresting B/C ratio of 1.1.

Conclusion

Metal silos are technically very efficient storage methods that protect the maize from LGB and maize weevil. They do, however, require a substantial investment that might be out of the means of many small scale farmers in Kenya. Easing access to the technology through credit should be considered.

Under current circumstances, metal silos from 0.72 tons (8 bags) on are profitable. To be profitable under less favorable circumstances, larger silos, up to 1.8 tons, should be recommended, For small quantities, treatment with actellic super are usually profitable and should be considered.

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Figure 9 Storage losses in different storage methods, on-station trials Kenya

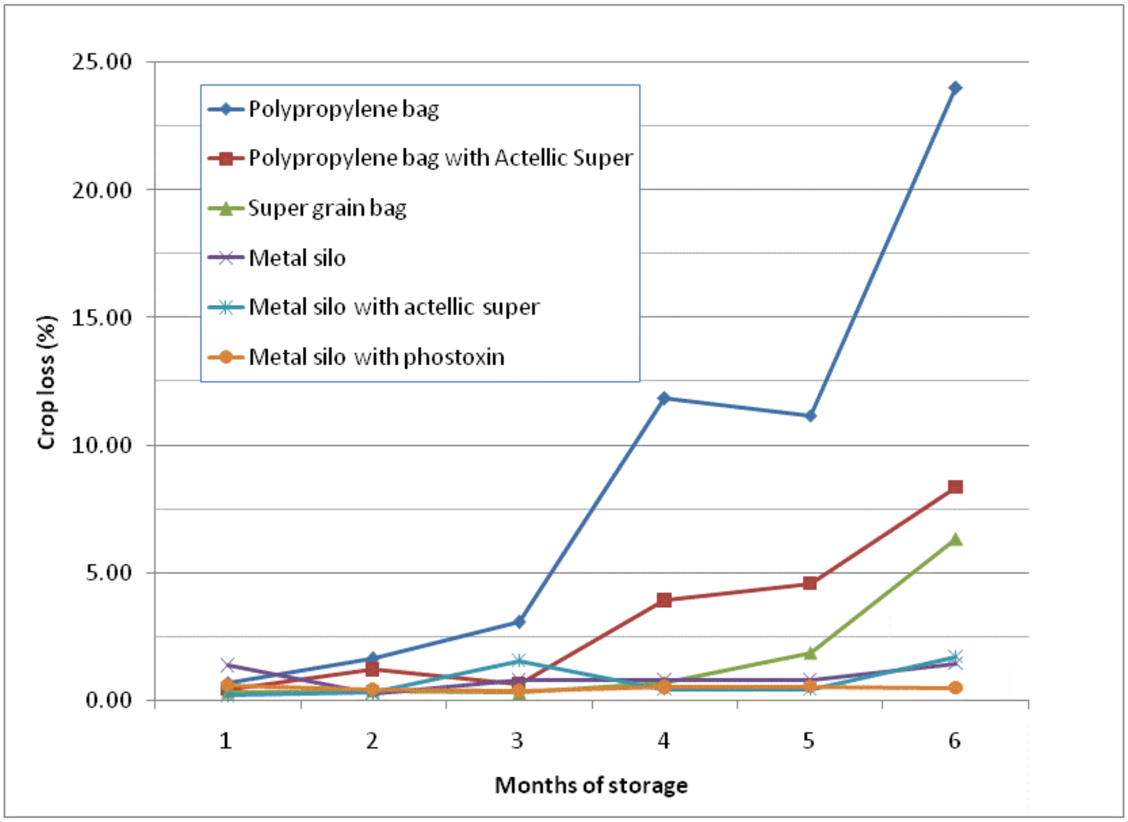


Figure 10 Cost of the different storage technologies

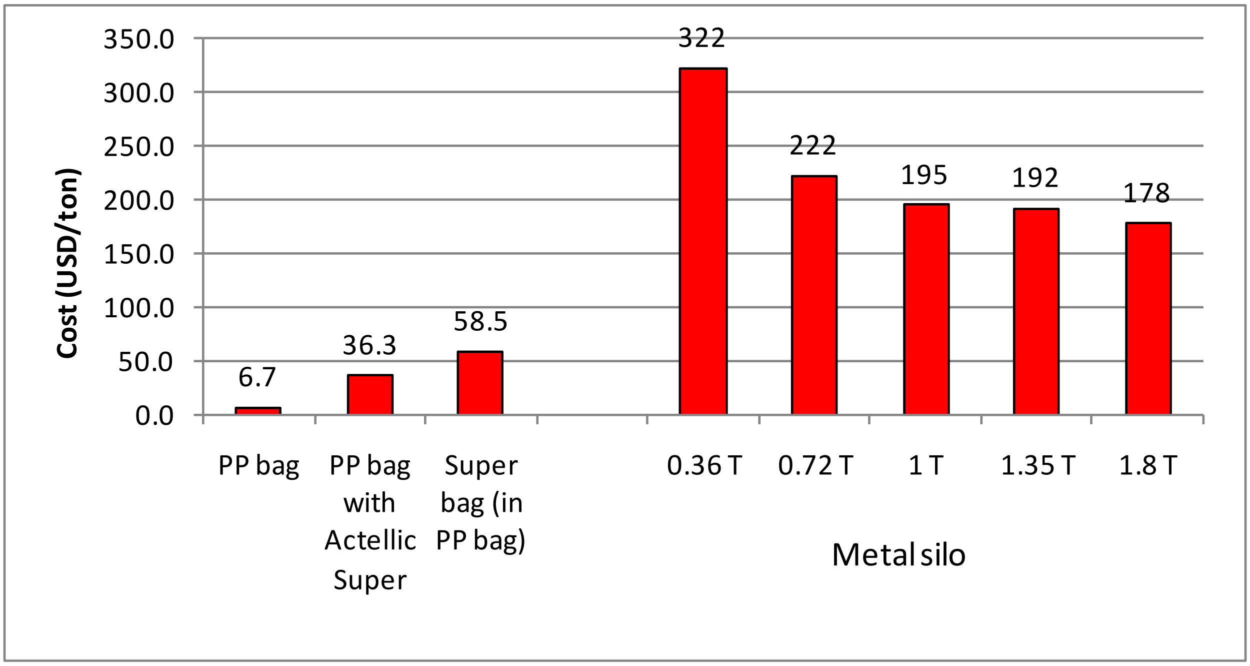


Figure 11 Profitability of alternative storage methods: benefit cost ratios (over 15 years, r=10%, price = USD 230/ton)

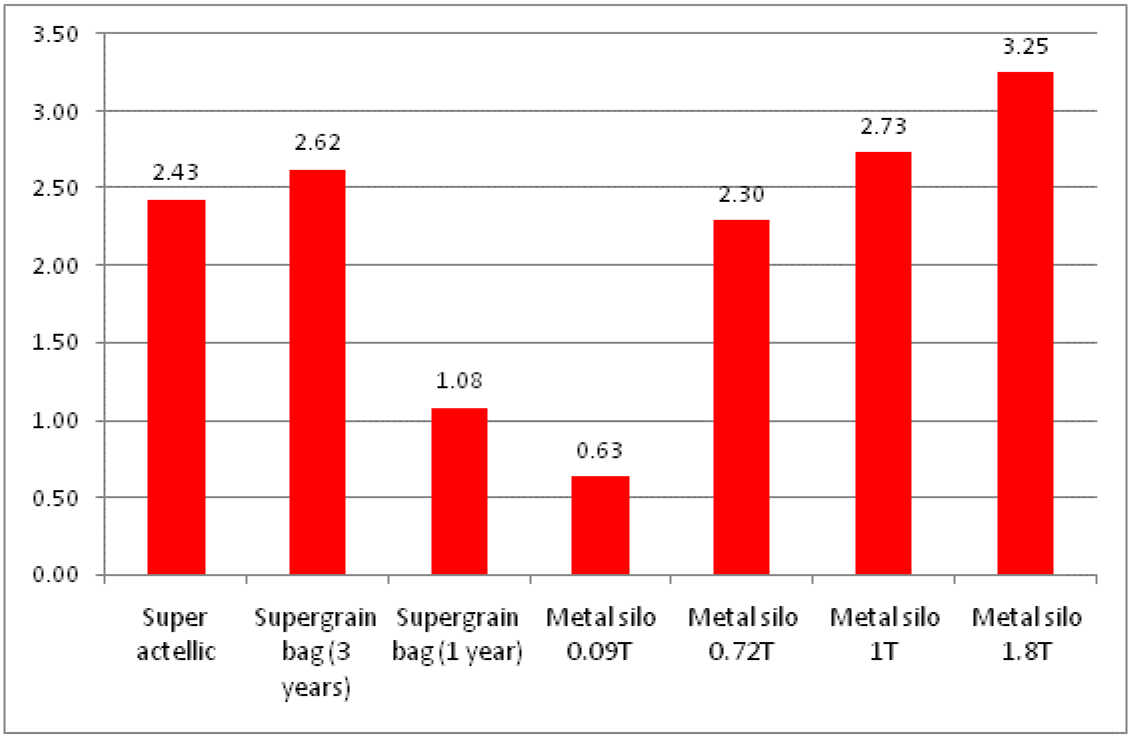
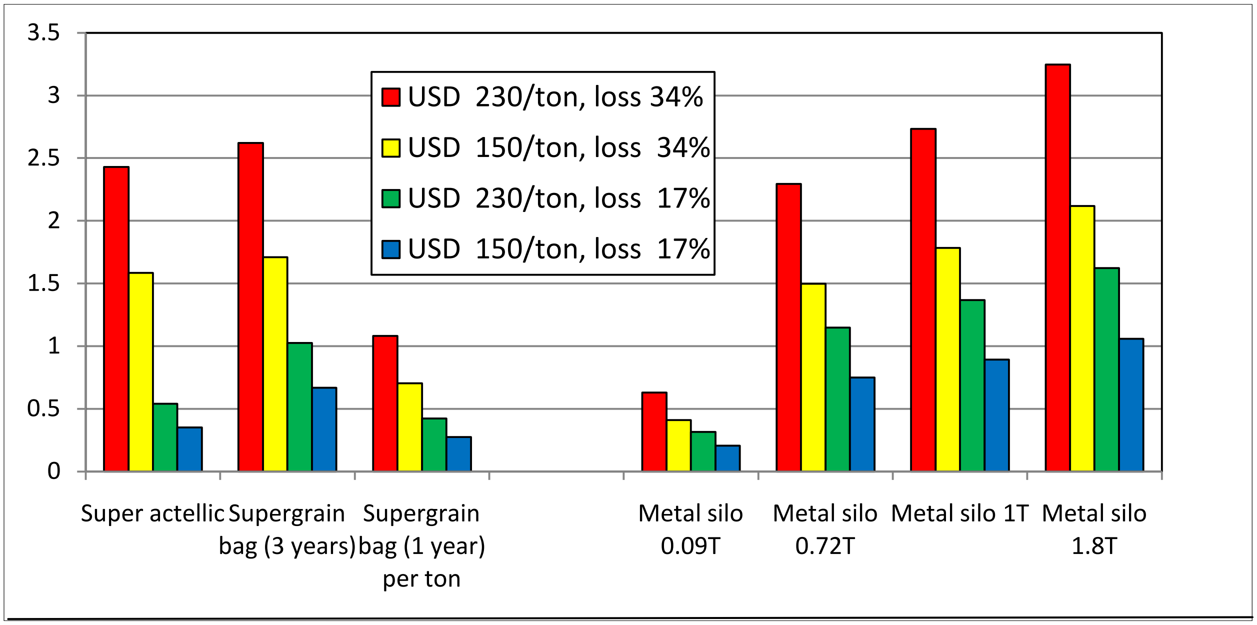


Figure 12 Sensitivity analysis of the B/C ratios of different maize storage technologies



11. 2 Impact assessment

Introduction and Methodology

To estimate the impact of metal silos, a survey was conducted among 134 owners of metal silos. Their characteristics and storage practices were compared to those of a nationally representative survey of 1340 maize farmers in Kenya, further called the baseline survey. To avoid selection bias, metal silo users (110 of the owners) were matched with non-users using propensity scores, such that both groups are similar in characteristics, other than the use of metal silos and the outcome variables. Thee matching algorithms were used: nearest neighbor, radius and kernel matching.

As outcome variables, or variables on which the use of metal silos was expected to have an impact, following variables were selected: i) storage loss expressed in % of grain stored, ii) storage loss expressed in kg of maize, iii) length of maize storage over the last year in months, and iv) food insecurity expressed as months of the last year the household did not have enough maize for home consumption.

2.2. Results

The survey of the 124 owners, of which 105 used it for maize, another 13 used it to store other grains, but 6 did not use them. In our analysis, we only took into account those using it for maize.

Moreover, of the 1340 farmers in the baseline survey, also 4 had adopted the metal silo, leading to 109 users, compared to 1336 non-users. After matching the users with the non-users with propensity scores, 576 non-users were maintained for the analysis.

In the baseline surveys, farmers reported that insect storage pests are a problem for households that do not use metal silos, especially the maize weevil (64% of respondents consider it a medium to very serious problem) and, to a lesser extent, the larger grain borer (29%). Households who have metal silos, however, rarely consider the pests a problem (Fig 13).

Comparing users of metal silos with the control using propensity score matching shows that length of postharvest maize storage, loss suffered due to insect damage and food security indicators are significant, for all three algorithms used. After matching, users and non-users of metal silos were similar in individual characteristics of their heads, except that users tend to have more schooling.

Comparing users and non-users with the three matching algorithms showed that metal silos reduced the cost of storing maize by USD 5-8 (Fig 14). The losses due to insect pests, according to farmers' estimate, were reduced by …. (from a to b), increasing the amount of maize by about 100 kg/household, at a value of $ 55-60 per household.

As a result of the improved storage, metal silo users also postpone the sale of their surplus maize. While non-users sell their surplus mostly in the first month after harvest, the maize sales of non-users peak in the sixth month after harvest. Further, the overall storage period is increased by more one month to one and a half months (depending on the algorithm used), and therefore also the average period that households are food secure (Fig 15).

These findings imply that adoption of metal silo storage technology could significantly improve food security situation through reduced losses due to storage insect pests and delayed selling of harvest. This not only helps them get better prices but also improves their economic access to food through higher farm incomes.

Conclusions

Farmers' perception indicate that insect These results suggest that the metal silo technology is effective against both the LGB and maize weevil.

Figure 13 Farmer's assessment of the storage insect pest problem

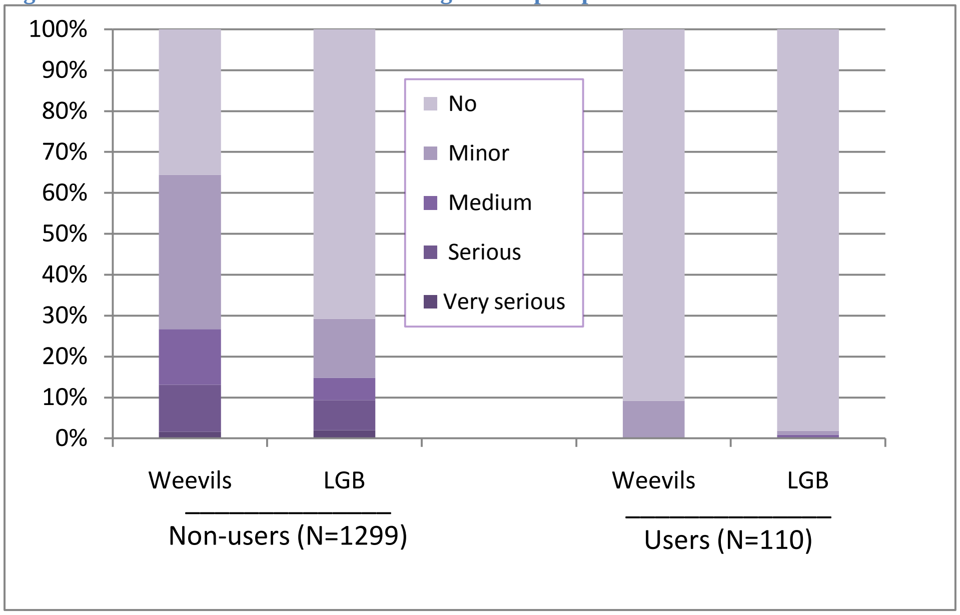


Figure 14 Effect of metal silos on reduction of storage costs and value of maize stored.

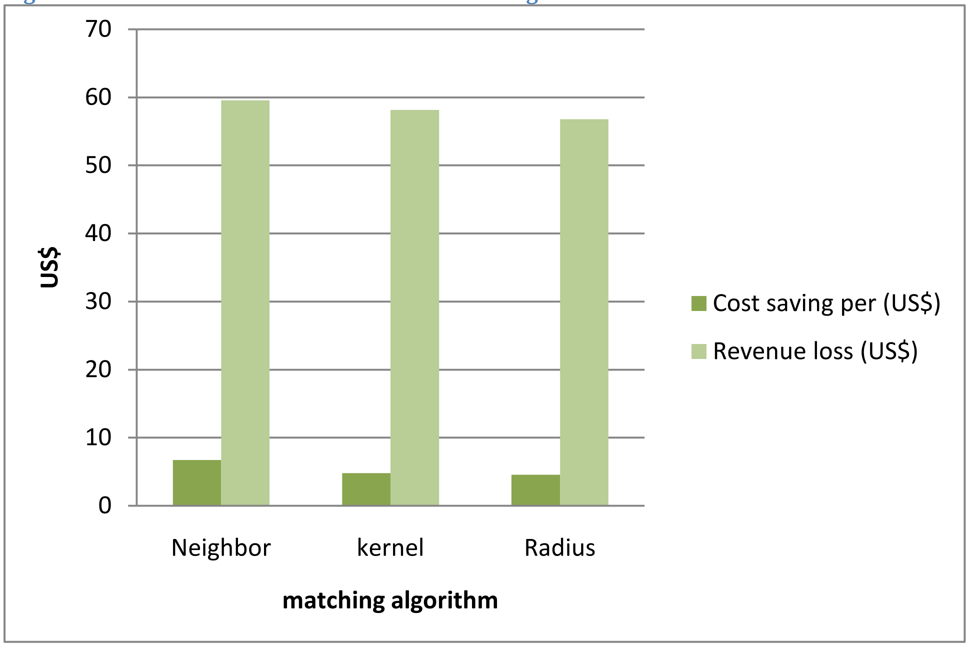
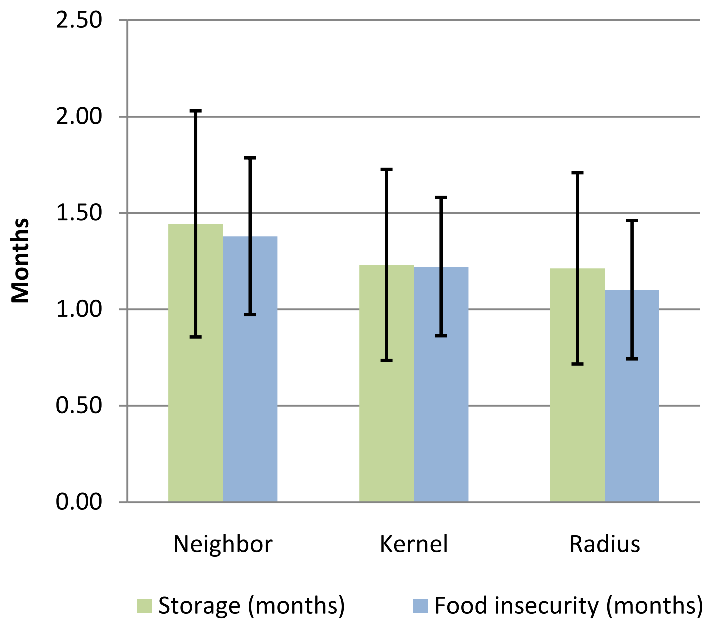


Figure 15 Impact of metal silos on length of storage and household food security (in months)



11. 3. Extrapolation of the results to East and Southern Africa

To estimate the storage losses under natural conditions and to test the metal silo technology under farmer conditions a set of on-farm experiments was conducted in both Kenya and Malawi. In each country, two transects through different agroecological zones were used to select the farmers. Unfortunately, the results are inconclusive, likely due to small sample size and high variability of storage losses.

At the same time, georeferenced households surveys were conducted in both countries. In Kenya, 1360 households were interviewed, representative of the different agroecological zones. In Malawi, 120 households were interviewed along the two transects, both intersecting the three major agroecological zones. The data for both countries have been entered and cleaning is under way (July 2011). Storage loss assessment by farmers will be used and extrapolated over the different zones in the target countries.

12. Impact of the metal silo technology and lessons drawn

12.1. Enhancing food security and empowering smallholder farmers

The metal silo is a useful food security element in the grain storage and distribution chain. Smallholder farmers with a metal silo could feed their family year round and free to decide when to bring surplus harvest to market. Grains can be stored in the metal silo for at least three or more years without any problem. This helps schools, urban dwellers and smallholder farmers to set aside the reserves needed when changing climate conditions or natural disasters lead to crop failure.

Secure postharvest storage empowers smallholder farmers. Postharvest storage facilities not only offer the opportunity to smooth hunger between staple crop harvests but also farmers are able to improve farm incomes by storing crops and selling it at premium prices when demand outstrips supply later in the post-harvest period. As quality is an important determination of crop retail prices, effective storage is crucial to improve agricultural incomes and food security for smallholder farmers. Farmer learnt to monitor the market and time their sales accordingly with the introduction of the metal silo. In many cases, metal silo owners were able to increase their annual income by simply holding onto their stocks until market conditions were right for them. The additional income improved the standard of living of rural inhabitants and gives farmer families the possibility of investing in their farms and developing new products. Metal silo has improved the status and self-esteem of women farmers; this is because women farmer are the ones who manage metal silo content.

12.2. Enhancing income opportunities and job creation

Engaging in metal silo fabrication and marketing can create jobs and rural enterprise development. The metal silo manufacturing activity is, therefore, an additional source of income for artisans; when they are not working in the fields, they spend their time producing metal silo. The proximity to farmers enabled artisans to immediately respond to their needs. Most farmer artisans had the extra seasonal income that they are able to earn by manufacturing metal silo when they are not working in the field. In some cases, however, artisans are jobless rural youth engaged in manufacturing the metal silo.

13. Deployment of the metal silo technology: successes and challenges

A total of 105 metal silos of various capacities were produced and distributed to farmers in Kenya (Table 1). In Malawi, 41 metal silos were distributed to farmers in Mchinji and Dowa districts. Though the metal silo technology was primarily targeted for the benefit of smallholder farmers, schools and urban communities in the two countries are also interested in using the metal silos. This helped them to buy grains at peak harvest time when prices are low, and to use it throughout the year. As a result, several countries and organizations in Africa have shown interest or engaged in metal silo production and dissemination. The metal silo was promoted through demonstrations and the media, which directly and indirectly created a critical mass among the stakeholders, including farmers, technicians, artisans, NGOs, government line ministries and consumers in general.

Strategies used by the CIMMYT for the successful dissemination of the metal silo were focus on food security, partnership with NGOs (World Vision International and Catholic Church development wing) and training of artisans in fabrication and marketing metal silo. The project focused exclusively on food security, which is a major problem faced by the poor in rural areas of Kenya and Malawi. The smallholder farmers were offered a technology that matched their needs and was easy to handle. The metal silo manufacturers were able to give advice and guidance to farmers because of their geographic proximity. With some exception, metal silo manufacturers are farmers themselves and have a clear understanding of the intrinsic benefits, want the metal silo technology to be successful. The fact that manufactures are the immediate vicinity of customers (farmers), particularly when road access is difficult, manufacturers build the metal silo directly on the purchaser's farm.

For most agricultural technologies, it is true that the rate of adoption is dependent on the cost-effectiveness of the new technology. While metal silo is a simple and effective grain storage technology, there are several challenges that require both innovation and creativity if poor farmers or consumers have to effectively benefit from the same. One of the biggest challenges is an initial high cost of the metal silo. In Kenya, the cost of metal silo varies according to capacity, from Kenyan Shilling (Ksh) 3000 for a 90 kg capacity metal silo to Ksh 25200 kg for a 1800 kg capacity (1 US Dollar = 78 Ksh) (Table 1). It appeared that metal silo is more expensive in Malawi than in Kenya, ranging from $320 (for 1000 kg holding capacity) to $480 (3000 kg holding capacity) (Table 2). The metal sheets constitute the largest proportion of metal silo cost averaging 60%. If the farmer retains the metal silo for 10 years, the present worth of future net benefits will be equivalent to Ksh 60,498.57, encouraging farmers to invest in the technology. However, considering that the metal silo can be used for over 10 years, with minimum or no maintenance costs, they are much cheaper than the conventional storage technologies. The metal silo can also protect the grain in storage for a much longer period of time than the three to four months under the conventional storage systems. Sensitizing the community on the effectiveness of the metal silo through trainings, participatory evaluations and demonstrations is important to speed up the rate of adoption. Subsidies should be considered to produce and sell metal silo at least at an initial stage.

Disseminating the metal silo to a large number of users across wider geographical coverage is another challenge. This calls for partnerships among different organizations including public-public and public-private working in the areas of agricultural development and food security. Achieving successful collaboration, however, is not easy. Although the potential for positive synergies is apparent, diverse institutional value and reward systems need to be negotiated. Organizations could differ in their perspectives on learning from alliances. A successful collaboration between the learning alliances requires a common language that acknowledges these differences and, at the same time, identifies common ground or purpose, complementary skills, or strengths, and invests in the creation of personal and organizational trust among participants.

A key feature of any work with metal silo is making them widely available to farmers on a sustainable basis. Though NGOs will play an important role in the short and medium term, increased involvement of private sector in metal silo production and farmer uptake is crucial in up-scaling the technology. Hence some public-private sector mixture may well be required. Therefore, government support and mainstreaming these activities within government extension service is probably the most sustainable way in the long-run.

Table 1 Production and distribution of the metal silos by CIMMYT in Kenya during 2008-2010.

Metal silo holding capacity (kg)	Farmers benefited	Unit Price (Kenyan shillings)	Unit Price (US Dollar)
90	1	3,000.00	40
270	19	5,500.00	74
450	4	6,8000	89
540	4	8,600.00	115
720	10	9,800.00	130
1800	67	25,200.00	336
Total	105		

Table 2 Price of the metal silo in Malawi in 2010.

Metal silo capacity (kg)	Unit Price (Malawian Kwacha)	Unit Price ($ Dollar)
1000	50,000	320
1500	55,000	350
2000	65,000	420
3000	75,000	480

14. Quality control and branding strategy for metal silo

To assure good quality, certain quality standards were stated agreed upon by discussing with the artisans and farmers. The metal silo should be of cylindrical structure made of gauge 24 galvanized sheet steel (0.5 mm thick) with the joints sealed by capillary soldering to ensure that they are airtight, using tin-lead (50/50) solder and a soldering iron. All actors were furnished with technical information regarding the quality standard. All instructors and artisans should have a manual with Instructions for Use and Handling. These instructions must be clearly understood and attached on all silos before delivery to farmers. Instructors (chief artisans) should regularly visit artisans in their workshops to monitor progress and quality. Artisans should be encouraged to offer after sales service to farmers, that is, offer transport service, provide guarantee of repairs free of charge for flaws in workmanship, teach customers about use and management, and visit their customers to solve any management problems.

The project team considered the creation of a unique brand identity and trade mark for the silos, but anecdotal evidence suggests that traditional Western style IP strategies to reduce infringing activities are almost impossible to enforce in developing countries, especially when the enforcer is an international organization without the funds or the specialized resources necessary for monitoring the marketplace and the "value" of the IP is more social than financial.

In response to the needs of the project, CIMMYT recruited a consultant from the Central advisory Service and Intellectual Property (CAS-IP) unit of the CGIAR. The CAS-IP assigned Peter Bloch, a market development and branding consultant, to develop a strategy for addressing the issue of quality control using IP-related tools (see annex 1 for details of the consultancy works). He has managed the IP strategies for CAS seed sector projects for ICRISAT in West Africa (WASA) and in Malawi (MASA) so has relevant experience. It was agreed with CIMMYYT that he would first meet with stakeholders in Kenya and Malawi to collect first-hand, on-the-ground feedback.

Although the logistics of this consultancy resulted in less than optimal stakeholder input, the available information that was received suggests the following strategy:

1. CIMMYT and its partners should support the formation of fabricator trade associations (FTAs) in both Kenya and Malawi;
2. Membership in each FTA would be determined by appropriate articles of association which would address the responsibilities of membership (farmer training, use of materials and construction techniques per the CIMMYT manual, etc.)[2].
3. The FTAs in each country should choose a brand name and logo design. CIMMYT should make input, but the FTAs should be empowered to make final decisions[3]; each FTA would then apply for a trademark which would be owned by the FTA.
4. The FTAs would execute simple license agreements with each member, authorizing them to use the brand to promote their services and to identify silos that have been fabricated according to the CIMMYT guidelines and consistent with the training.
5. The numbering scheme be adopted so that each silo has a unique serial number.

FTA formation is the first step. If indeed they are formed, one of their tasks will be to determine how to ensure that all members maintain the same high quality standards. This would normally be in the form of an association charter that each member would sign. "Self-policing" by trade associations is fairly standard in many sectors; the members recognize that their competitive advantage is recognition by the public - or by the

[2] CAS-IP is able to provide assistance for this if needed.

audience they serve - that the mark of the association is an indication of quality standards. In support of this, associations engage in outreach to promote an awareness of these standards.

15. Conclusions

Minimizing post-harvest losses is a very effective way of reducing the area needed for production and/or increasing food availability. By preventing post-harvest losses, the the metal silo becomes an important technology for food security, especially for small scale farmers in Africa. In Kenya and Malawi where it has been introduced, the metal silo has created a positive impact and a critical mass among players directly or indirectly associated with the grain production and storage. Solving the postharvest storage problems through the metal silo promotion will require cooperation and effective communication among government organizations, non-government organizations, artisans and farmers. The metal silo, therefore, represents an important element in food security and income generation.

Annex 1. Branding strategy for metal silo

Effective Grain Storage Project

Report to CIMMYT

Branding strategy for grain storage silos

August 23rd 2010

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Background

CIMMYT's Effective Grain Storage Project (EGSP) has been launched in Kenya and Malawi with the intention of helping farmers reduce post-harvest loss of grain to pests. Using traditional methods[4] losses of 10-20% are reported three months after storage, and this can often increase to more than 50% after six months[5].

Supported by the Swiss Agency for Development and Cooperation (SDC), EGSP aims to improve food security in sub-Saharan Africa through effective on-farm storage technologies, like metal silos. CIMMYT and its partners are promoting the silos and training artisans who build and sell them. "The focus of the project is to ensure that farmers use only well-fabricated, high-quality metal silos," says Fred Kanampiu, CIMMYT agronomist and former project head. "We are training artisans who will make and sell these silos."

EGSP has supported two artisan workshops in Homa Bay and Embu, with a total of 37 artisans attending these trainings. To date, the project is responsible for the construction of 146 silos across Kenya and Malawi. Two strong local partners, World Vision International in Malawi, and the Catholic Dioceses of Embu and Homa Bay in Kenya, host training sessions and promote metal silo use. In Malawi, metal silos have been used since 2007, initially supplied by a private company contracted by the government to distribute silos throughout the country. "Over the past few years,

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[4] sacks and/or *nkhokwe*, a structure built with mud, branches, and cow dung that allows free entry to the maize weevil and the larger grain borer, the two most damaging pests of stored maize in Africa.

[5] CIMMYT project documents

farmers have recorded high maize harvests, and now even request silos of a 7.5 ton capacity," says Essau Mwendo of World Vision-Malawi.

Challenge

CIMMYT contacted CAS-IP[6] to seek input on how best to ensure the integrity of EGSP products; concerns were focused on the possibility that as more silos were installed and their impact established, counterfeit silos might be produced. CIMMYT has invested donor funds to ensure that the EGSP silos are designed and fabricated for maximum effectiveness, but unscrupulous entrepreneurs could make silos with inferior materials and inadequate design. Such black market silos might appeal to farmers as they would likely be less expensive, but there would be a high risk of under performance resulting in high loss of grain.

If such a situation developed not only would farmers who bought the "counterfeit" silos suffer; CIMMYT's reputation could also suffer because of their association with the initiative. And because CIMMYT's brand image is critical to its continued effectiveness in providing technology for Kenya and Malawi, a solution needed to be developed.

Initial response

The EGSP project team considered the creation of a unique brand identity and trade mark for the silos, but anecdotal evidence suggests that traditional Western style IP strategies to reduce infringing activities are almost impossible to enforce in

[6] The Central Advisory Service on Intellectual Property is a system office Unit of the CGIAR.

developing countries, especially when the enforcer is an international organization without the funds or the specialized resources necessary for monitoring the marketplace and the “value” of the IP is more social than financial.

CAS-IP proposal

In response to the needs of the project, CAS-IP proposed assigning Peter Bloch, a market development and branding consultant, to develop a strategy for addressing the issue of quality control using IP-related tools. He has managed the IP strategies for CAS seed sector projects for ICRISAT in West Africa (WASA) and in Malawi (MASA) so has relevant experience. It was agreed with CIMMYYT that he would first meet with stakeholders in Kenya to collect first-hand, on-the-ground feedback.

What follows is a first person report on his visit to Embu in July 2010 with coverage of key input from farmers, NGOs and other stakeholder groups. In addition, he was able to meet the World Vision project manager and one of the artisans in Lilongwe and collect information on the status of the project in Malawi.

Lilongwe

I met with:

• Esau Mwendo (EM), responsible for food security at World Vision (WV) and manager of the Malawi silo project. He is also a member of the Government’s Post-Harvest Grain Storage Management Task Force.

• Douglas Kathakamba (DK), artisan metalworker from Mchinji. After training as a metal fabricator he took a business training course and then set up his own business.

The three of us discussed the entire process, and EM explained how WV proposes to address the IP issues, if approved by CIMMYT, as follows:

1. WV will submit the silo design and specifications to the Malawi Ministry of Agriculture (MoA).
2. MoA would then work with the Bureau of Standards and the IP Office to process a trademark for the silos that would effectively offer IP rights for the design and for a specific name (this still has to be determined).
3. The cost to WV of this would be minimal (see Footnote 7 below).

If government is involved in Malawi this might result in a fee waiver, in which case costs will be limited to the preparation of a specification for the trademark

4. An identification scheme was developed. Each silo would be stamped with a unique serial number along these lines:
    a. Letters #1 and #2 indicate region (e.g., MC for Mchinji)
    b. Letters #3 and #4 indicate artisan (e.g., DK for Douglas Kathakamba)
    c. Digits #5-#8 represent the unique ID of the particular silo
5. Such a numbering scheme would enable anyone who knew the system to identify the source of the silo, and it would be extremely hard for any unauthorized producer to generate a genuine ID#. Thus it would be easy to identify a counterfeit silo.
6. The ten artisans in the Mchinji district are planning to set up an association, and the WV plan is that WV would assign this association the rights to the trade mark.

We discussed enforcement. Both EM and DK were quite adamant that the agricultural communities are open and communicative, and that if any silos were produced outside the system, one of the trained artisans would hear about it. The proposed artisan association would then notify the MoA which would take appropriate enforcement actions against the infringer[7].

This needs to be clarified. Potential government involvement was described to me by EM. But the dialog between MoA and WV had not reached the point at which a detailed plan had evolved. The real issue is: who will own the trade mark?

This plan satisfies CIMMYT's need to protect farmers from being offered sub-standard product without involving CIMMYT in any enforcement activities.

The regulatory environment in Malawi is very supportive of small holder farmers and the government has made a substantial commitment to food security. I spoke directly with Mr. Ngauma, an official with the MoA, about the project. He told me that he was waiting for a proposal (I believe that WV will not pursue this plan until CIMMYT has approved) but that he and the MoA were ready to support the project. It is worth noting that, independently of CIMMYT and WV, the MoA is working with FAO on a similar project, using the same training program. This training program was approved by the MoA before being used by WV.

[7] It is important to know whether, if the government of Malawi does take on this role, it would own the rights to the mark.

Nairobi

The CIMMYT Project Manager, Tadele Tefera, was away and I met with:

• Fred Kanampiu (who had been the coordinator until May 2010) and

• Judie-Lynn Rabar, the communications specialist.

We discussed the IP strategy that has been proposed in Malawi, and determined that while government commitment and support for the project in Malawi could make this viable, conditions in Kenya are likely very different[8].

Fred expressed concern for quality control (QC). CIMMYT cannot take on the responsibility for QC and there is no assurance that funding will be available to enable the Archdioceses to manage this. It is not viable to consider inspecting each and every silo that is produced by the trained artisans and we need to consider engaging the artisans in this matter.

Embu

I met with:

• Fr. Alex Mati, Development & Social Services Coordinator, Archdiocese of Embu;

• Ben Njue, artisan metalworker (Kiritiri)

• Dr. Stephen Njoka, Center Director, KARI Embu

[8] The reality (as opposed to the policy) of government involvement in and support of ag sector development. The actions of the MoA in Malawi are indicative that food security is of the highest national priority. So, for example, the MoA in Malawi has been involved with FAO in a silo project, and has indicated a willingness to engage in the matter of IP protection. Because Kenya has other national priorities, we have not seen this high level of commitment **and** action.

• Nancy Njeru, farmer and Secretary of Kamarugu Farmers Assn., a PMG (Producer Marketing Group)

• Nicasio Njeru, farmer and Chairman of Kamarugu Farmers Assn.

• Pieriena Nyambura, farmer and Treasurer of Kamarugu Farmers Assn.

I did not receive any negative comments; everyone was very supportive of the plan to ensure that farmers and others are only offered high quality silos that "do the job".

Note:

I had planned to meet with other fabricators but none were available. Both Mati and his assistant, Sara (who reportedly has all the contact information) were in a workshop. This resulted in my meeting with fewer informants than we had anticipated.

Mati reported high demand for silos and a need to increase production capacity. He is concerned about counterfeited silos and was very supportive of the idea of an artisan association that would address quality control. He has only been in this job for three months and does not have much on-the-ground experience. He confirmed that if CIMMYT's support was discontinued they would not be able to continue to manage the project. His observations are that the project is having a real impact but he has not collected any data at this point.

In summary, these meetings revealed that:

• The Archdiocese, with funding from CIMMYT, had made significant contributions to silo purchases in the early stage of the project, covering 50% of the cost for some farmers and 75% of the cost of three large (1800 kg) silos for the Kamarugo PMG;
• Ben Njue, who has been employed by the Archdiocese to train other fabricators, is deeply committed to the project, to maintaining high quality and to training end users on how to use the silos for maximum protection against pests.

The issues of QC and "protection" were discussed and the informants I interviewed all seemed to like the idea of a farmer association that would eventually take ownership of the project and ensure that quality standards were maintained. Njue said that he would be happy to take on the role of advocate for such a development.

An IP, QC and business development strategy

Although the logistics of this consultancy resulted in less than optimal stakeholder input, the available information that was received suggests the following strategy:

6. CIMMYT and its partners should support the formation of fabricator trade associations (FTAs) in both Kenya and Malawi;
7. Membership in each FTA would be determined by appropriate articles of association which would address the responsibilities of membership (farmer training, use of materials and construction techniques per the CIMMYT manual, etc.)[9].

[9] CAS-IP is able to provide assistance for this if needed.

8. The FTAs in each country should choose a brand name and logo design. CIMMYT should make input[10], but the TAs should be empowered to make final decisions[11]; each FTA would then apply for a trademark[12] which would be owned by the FTA.

9. The FTAs would execute simple license agreements with each member, authorizing them to use the brand to promote their services and to identify silos[13] that have been fabricated according to the CIMMYT guidelines and consistent with the training.

10. The numbering scheme (or some version of it) that was proposed by WV would be adopted so that each silo has a unique serial number.

All indications suggest that demand for silos is increasing in both Malawi and Kenya; that more trained fabricators are or will be needed; and that the silo project is having a positive impact on both farmer storage and on the businesses of fabricators. This could be held up as an example of assisting entrepreneurs set up businesses.

From a larger development perspective, the project may soon reach the point at which CIMMYT and its partners can withdraw support, passing responsibility for brand

[10] There are several scenarios: CIMMYT might, for example, decide that a single identifier should be used as a component of each national TM. An IP strategy, even if implemented by the FTAs, would probably need and/or benefit from CIMMYT and/or CAS-IP input/guidance.
[11] The benefits of empowering each national FTA to choose a brand name and trademark probably outweigh any perceived need to develop a single identity. CIMMYT could, however, *advocate* for a single multi-country identity.
[12] Kenya and Malawi are both members of ARIPO, but the effectiveness of an ARIPO TM has been questioned (see Appendix). National applications cost approx. $120 in Kenya and $1100 in Malawi exclusive of legal fees.
[13] Probably using an embossed logo, brand name and unique serial number.

management, quality control and further training on to the FTAs[14]. CIMMYT could then focus available resources on promoting the silos in other target countries. In Kenya, the early stage partial funding of silo purchases has jump-started silo usage and the benefits are now sufficiently evident that word has spread within the farming community.

A transition phase, during which the FTAs are formed and trade marks applied for, could be planned and resources which have been budgeted for Kenya and Malawi might be repositioned to:

1. Provide a modest payment to the lead fabricator who would manage the formation of the FTA;
2. Cover the cost of preparing and applying for the trade marks;
3. Cover the cost of a national meeting of fabricators in both countries in support of FTA formation.
4. Organize a business training program (see below).

The issue of implementation is a matter for internal discussion. One scenario is for CIMMYT to design an exit strategy for their involvement in Malawi and Kenya. Integral to this would be a handing over of responsibilities to the FTAs over, say, a 6-12 month period. This would include support for items 1-4. The underlying objective would be to help build FTA capacity and stimulate the development of robust and

[14] If such a plan were implemented, care should be exercised in the design of marks so that there would be no association with CIMMYT as CIMMYT would have no control over the use of the marks.

self-reliant FTAs. The proposed business training would be integral to this, and would be offered and managed by CIMMYT. AGMARK in Kenya and RUMARK in Malawi could be contracted to deliver these trainings using modified versions of their successful agro dealer business training programs.

Support of these FTAs might continue for a year, by which time the increased demand should enable each fabricator to pay a modest association membership fee to support the ongoing operations of the FTA.

The benefits of this strategy are that CIMMYT will be able to focus on taking silos to other countries and that the fabricators – who have been presented with an exciting new business opportunity – will be empowered by CIMMYT and its partners to take responsibility for further market development.

Business Training

As part of the transition, CIMMYT could deliver a business training program which would help FTA members to build their businesses. Inventory control, group purchasing of raw materials and IP management could be central to such training. A well designed and executed business-centric training program could play an important role in helping the nascent FTAs to develop their articles of association and strategies for how to effectively manage the FTAs. The training could also stimulate a dialog between fabricators on entrepreneurship – how to grow a business, how to develop partnerships (for example, fabricators might work with other stakeholders such as agrodealers to expand their reach). CIMMYT has already provided essential materials (the training manual, the video, a brochure and a poster listing trained artisans), and the business training could also provide guidance on how to build on this solid base to ensure that potential buyers are aware of the benefits to them of purchasing from an FTA member.

Quality Control

FTA formation is the first step. If indeed they are formed, one of their tasks will be to determine how to ensure that all members maintain the same high quality standards. This would normally be in the form of an association charter that each member would sign. "Self-policing" by trade associations is fairly standard in many sectors; the members recognize that their competitive advantage is a recognition by the public - or by the audience they serve - that the mark of the association is an indication of quality standards. In support of this, associations engage in outreach to promote an awareness of these standards. As always, communication is an integral part of most branding initiatives.

Communications

Whether this proposed plan is adopted or modified, communications will play an important role in establishing the brand(s) and in communicating to farmers and institutional users the benefits of using storage silos, and of acquiring them from certified fabricators. In Malawi, both the NASFAM newsletter and the Zodiac radio network would be excellent means of reaching farmers, and the proposed business training might incorporate a module on this approach to establishing and building brand awareness. The introduction to the training video produced by CIMMYT could be more widely distributed as it provides a compelling introduction to the program and its rationale.

The great benefit of this proposed action plan is that each FTA becomes the guardian of the IP and that each member has a strong self-interest in maintaining the quality standards that CIMMYT and its partners have established. The stronger the FTA, the less likely it is that sub-standard silos will be produced by untrained artisans. Demand is growing and there are indications that more artisans need to be trained. If more metalworkers are trained, FTA membership will grow; and as it grows the likelihood of counterfeit silos will decrease. These farming communities are tight-knit and most farmers belong to a PMG; the PMGs in the Embu area (and, likely, in the Homa Bay area) are well aware of the program and its benefits.

If the proposed FTA-owned trade mark is abused, it seems highly likely that the FTA will find out and it can then take appropriate action.

In support of this approach, Carolina Roa, CIMMYT IP Manager, informed me in an email that:

I spoke with George Mahuku, a maize pathologist at El Batan who is working with the silos in Mexico in the Oaxaca region and who wants to introduce the silos in other regions. George told me that until now there have not been any experiences of counterfeited silos because the artisans who build them are part of the community, well-known among the farmers they serve. Thus, if the artisans cheat on the farmers, they will be basically "signing their death sentence". Here the regulatory tool is *basically trust that comes with acquaintance among the community and the artisans.*

Next steps

Should CIMMYT decide to adopt the proposed strategy, CAS-IP would be able to offer further input to support implementation, including the specifications for trade marks and the proposed business training. I am available by email to answer any questions that may arise.

APPENDIX

ARIPO

In 2009 CAS was asked by ICRISAT to develop a branding strategy for ESASA. We secured the pro bono services of Simon Bennett of Arnold and Porter, a prestigious law firm with whom we had worked before. In a meeting on the subject, Simon referenced a client with whom he had been working in 2008 to register a TM in Eastern and Southern Africa. Their research had led them to the conclusion that an ARIPO mark was insufficiently robust and that in practicality would not offer strong protection if challenged or infringed in one of the participating countries. Based on this, we (CAS) decided to recommend to ICRISAT that they apply in each country individually.

Innovation

Ben Njue indicated that he had developed an idea for producing a simple tool that would facilitate both the shaping of the sheet metal and the soldering of the main joint. He asked whether some funding might be available to cover his costs in developing a prototype. He has been a metalworker for 18 years and has fabricated a large number of silos including the 1800 kg units which were manufactured in situ. Support for grassroots innovation which might shorten/simplify silo construction would benefit end users by reducing costs, and CIMMYT may wish to follow up on this opportunity.

PMG training need

Nancy Njeru, Secretary of the Kamarugu Farmers Assn. told me that as the PMGs are expanding she has seen a real need for some training in record-keeping and accounting. While this does not fall within the scope of the project, it is worth noting in case there is some other project or organization that could fill this need.