POLICY BRIEF MAY 2021

USING POST-HARVEST TECHNOLOGIES TO MITIGATE CLIMATE RISKS IN FOOD SYSTEMS FOR IMPROVED FOOD SECURITY & LIVELIHOODS:

Hermetic Storage Technologies in Kenya and Uganda

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KEY MESSAGES

Climate change exerts a significant burden on food systems in Kenya and Uganda, firstly by increasing production volatility, and secondly by exacerbating post-harvest losses through increased pressure from pests and diseases. Considering the land, labour, water and agro-chemicals used to grow these harvests, the higher post-harvest losses imply the wasted use of these valuable resources.

Hermetic storage technologies (HSTs) are vital for reducing these post-harvest losses and mitigating climate risks and impact on livelihoods. Supporting the uptake of these products requires the following interventions in Kenya and Uganda:

- Adopting and enforcing HST standards through market surveillance protocols and building the inspection and testing capacity of regulatory bodies.
- Creating awareness of HSTs and their correct use among farmers, specifically equipping them to distinguish between genuine and counterfeit or sub-standard products. This will help to promote uptake of genuine HSTs and help to regulate the HST sub-sector.
- Removing taxes on HSTs to reduce their cost to farmers. Studies in Tanzania, a similar environment to Kenya and Uganda, found that removal of VAT can create a net gain to society of USD 38.9 million per agricultural season.
- Increasing awareness of the links between climate change and post-harvest management among all stakeholders, and in the process enhancing public awareness of post-harvest technologies that can support climate change adaptation.

Introduction

Climate change continues to adversely affect the agricultural sector across East Africa. Climate change affects grain productivity directly, by introducing changes in agro-ecological conditions – such as drought, variable precipitation, increased temperature trends and extreme weather events – and indirectly, by giving rise to new diseases and pests. Moreover, climate change reduces available arable land due to changes in land productivity caused by highly variable rainfall and high temperatures and their secondary effects (EAGC, 2019).

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Relationship between climate change and post-harvest losses

Like much of sub-Saharan Africa, Uganda and Kenya experience significant post-harvest losses in food value chains. For grains, these losses are typically estimated at between 15% and 30% of total production, which is much higher than the 6% post-harvest losses in Brazil (Goldsmith, Martins, & de Moura, 2015) and also higher than the global average for cereals, which is estimated at 19% (Kumar & Kalita, 2017).

In Uganda, this equates to approximately 493,000 metric tonnes (MT) of maize, 26,500MT of millet and 31,000MT of rice lost annually due to post-harvest-related challenges (FAO, 2019). Similarly, Kenya loses over 700,000MT of maize between harvesting and market. These losses result in wasted production resources such as farm inputs, land and labour, lost food that would otherwise improve food security, and lost income for smallholder farmers, traders and the wider economy.

For instance, if a country requires 3 millionMT of maize annually from farmers, with an average yield of 2MT per acre, it means 1.5 million acres of land are required, assuming no losses. However, with 25% post-harvest losses, it means the country would require 2 million acres of land to provide a net production of maize. This would require the expansion of farmland by deforestation and place a greater strain on water resources along with higher requirements for agro-chemicals, all of which combine to exacerbate climate change. It is thus apparent that reducing post-harvest losses is crucial to improve the efficient utilisation of environmental resources for agricultural production. In turn, the increases in efficiency will place less pressure on these natural systems and help build climate resilience.

Climate change is a significant contributor to post-harvest losses in Kenya and Uganda. Climate change increases pest and disease pressure, which not only affects crop production on farms – such as the Fall Armyworm plague in recent years – but also encourages the spread of pests that destroy food commodities after their harvest (Olayemi, 2016; APHLIS, 2019). This predominantly happens during storage where pest-related post-harvest losses, such as weevil infestation, account for up to 11% of food losses in Kenya (FAO, 2014) and up to 27% of food losses in the maize value chain in Uganda (FAO, IFAD, WFP, 2019).

Pest pressure caused by climate change also degrades food quality. More worryingly, higher temperatures increase the risk of mycotoxin prevalence, which is already a problem in tropical and subtropical countries such as Kenya and Uganda (APHLIS, 2019). The most common mycotoxin is aflatoxins, which are known carcinogens and are among the biggest food safety risks in maize value chains.

In international trade, Uganda's total agricultural exports are estimated to fall by USD 16.34 million due to deterioration in the quality of grain and aflatoxin contamination. Of this amount, grain exports comprise almost half – valued at about USD 7.48 million. Meanwhile, in Kenya, the value of maize lost due to aflatoxin contamination is estimated to be worth approximately USD 3 million (Kaaya, 2018).

Assessment of post-harvest technologies to mitigate climate risks

The Eastern Africa Grain Council (EAGC), with support from the Climate and Development Knowledge Network (CDKN), recently conducted a User Needs Assessment on Post-Harvest Losses in Kenya and Uganda. Some of the preliminary findings show that the small-scale operations and subsistence nature of the smallholder farming systems increase their vulnerability to climate shocks. Thus, there is a need for innovations in technologies and practices to help increase their resilience.

AFLATOXINS

Aflatoxins are produced by fungi present in moulds on grain, which occur due to improper handling after harvest. Higher temperatures and erratic rainfall stimulate growth of the *Aspergillus flavus*, the fungi responsible for aflatoxins, in commodities such as maize and groundnuts – two of the most important grain commodities in Kenya and Uganda.

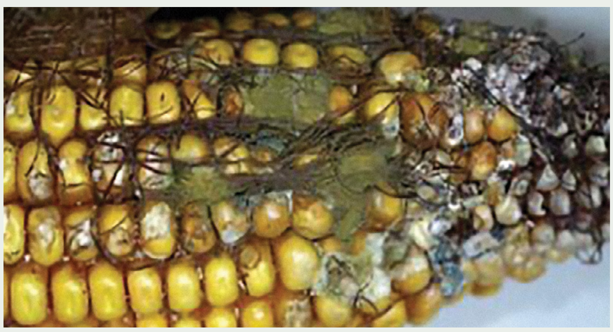


Image source: *Iowa State University*

The study also noted that there was low awareness among farmers regarding technologies to mitigate aflatoxin. Moreover, the survey established that farmers had incorrect information that hermetic technologies (which allow air-tight storage and preservation of dry agricultural commodities to stop pest infestation) prevent aflatoxins. Such misunderstanding among the farming community requires immediate attention due to the dangers of farmers storing wet grain in hermetic bags. This practice increases the rate of fungal multiplication and contamination, which is damaging to human and animal health. EAGC is sharing information to counter these misunderstandings and to inform farmers about the correct applications of hermetic technologies.

Hermetic storage technologies as a solution to reduce post-harvest losses

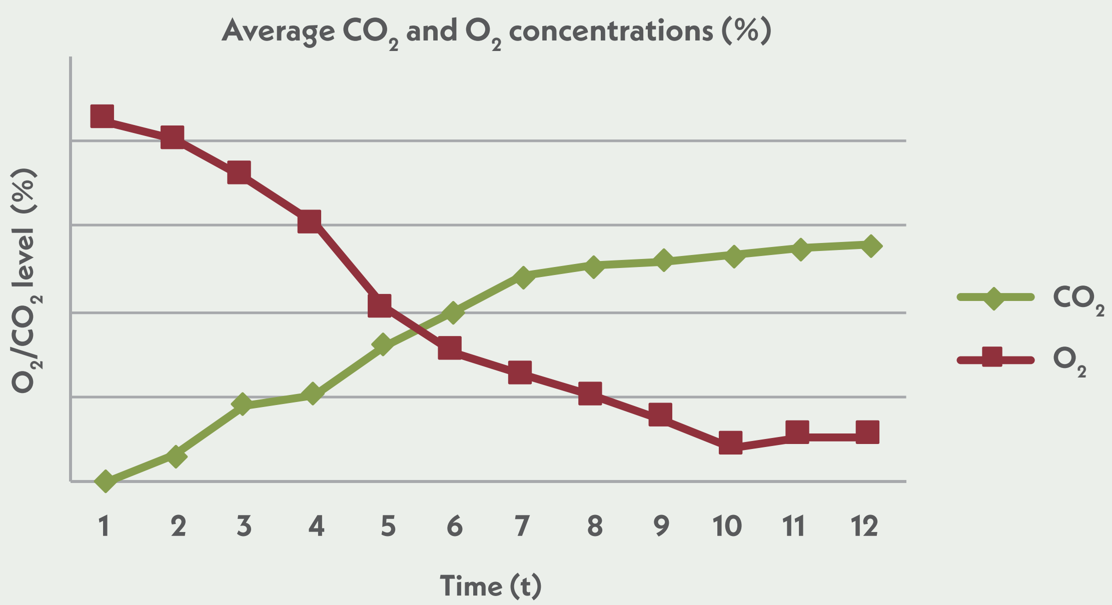
Hermetic storage technologies (HSTs) work by asphyxiating pests present in a consignment of commodities and preventing their multiplication, thus allowing for pest control without the use of pesticides (see Figure 1 below). Therefore, these products are generally a safer and potentially more affordable option to eliminate pest infestation compared to using chemical compounds and fumigants, which tend to pose a health risk if not applied correctly.

Common HSTs include hermetic bags (which consist of single or multiple inner hermetic liners enclosed by an outer woven bag), hermetic metal and plastic silos, and hermetic bulk storage solutions (such as silo bags and cocoons), to name a few.

HSTs are one of the most important tools for combating post-harvest losses and improving agricultural productivity, particularly in food grain value chains. These technologies offer the following benefits:

i. HSTs **reduce post-harvest losses from pest infestation** – itself a big problem caused by climate change – thus increasing the marketable surpluses for farmers to sell and increasing the availability of food. This helps to increase farmer incomes and improve food security by reducing price volatility in food markets and increasing the overall availability of food for consumption.

Figure 1: How hermetic storage works (for illustration purposes only). As time progresses, oxygen levels in a hermetic container decrease while carbon dioxide levels increase, thus asphyxiating any live insects and larvae. Thus the grain is preserved without the use of pesticides.



Hermetic bag

Metal hermetic silo

Plastic hermetic silo

ii. HSTs help to **preserve the quality of agricultural commodities**. Provided that the commodities have been dried and cleaned appropriately, HSTs will preserve their quality. As such, these products facilitate compliance with food quality and food safety standards, allowing farmers to sell higher quality commodities while significantly reducing food safety risks arising from aflatoxin contamination and pest infestation. The outcome is, again, higher incomes for farmers and improved food safety for consumers.

iii. HSTs enable the effective **storage of commodities over a long period of time**. Using HSTs allows farmers to store their grains for a longer time, which allows for prices to rise, thereby fetching better prices resulting in higher incomes.

iv. HSTs offer **cost-effective storage** of commodities, particularly since they eliminate the need for pesticides.

All of the above means that storage costs, quality and safety of stored agricultural commodities are improved. With support from development partners, HSTs – particularly hermetic storage bags and hermetic plastic silos – have become increasingly popular among smallholder farmers. HSTs are helping them to significantly reduce post-harvest losses and increase their incomes. For instance, maize stored in HSTs fetches approximately 75% higher prices than maize sold without storage, and 27% higher prices than maize stored in traditional means such as storage cribs or non-hermetic (sisal or woven polypropylene) bags (CITE, n.d.).

Challenges facing adoption of HSTs

Despite growth in uptake, the adoption rate of HSTs is still low (estimated at about 14% by an EAGC survey in 2018). Three major challenges are significantly undermining the wide-scale adoption of HSTs in both Uganda and Kenya:

i. Proliferation of sub-standard and counterfeit hermetic storage products on the market

Field observations by EAGC and stakeholders in both countries have identified the increasing prevalence of sub-standard and counterfeit HSTs, particularly plastic bags purporting to be hermetic bags. A survey by EAGC in Kenya in 2018 observed counterfeit hermetic bags that mimic the composition of a typical hermetic bag by having a clear plastic bag inside a woven polypropylene bag. In some cases, bags used for bulk packaging of sugar (which also has an inner plastic liner inside an outer woven bag) are being re-marketed as hermetic bags for storage of grains. Similar items have been observed in Uganda, particularly in Luwero and Masaka District where they are stocked and sold by some agro-dealers.

These counterfeit and sub-standard products severely undermine the adoption of genuine HSTs because farmers are generally unable to distinguish a genuine product from a sub-standard one. Sub-standard and counterfeit products also tend to be cheaper and are thus an attractive proposition to farmers. When they purchase these inferior products and end up incurring losses, their immediate and understandable conclusion is that hermetic storage does not work. In Uganda, promoters of HSTs have received hostile treatment from farmers who have been victims of these sub-standard goods.

Kenya has taken significant steps to weed out inferior HSTs by developing standards for hermetic bags and plastic silos. EAGC spearheaded the processes of developing these standards, the first of their kind globally, which were gazetted in August 2019. These official standards will go a long way to protect both manufacturers of genuine HSTs and the farmers who use them, by providing a basis for controlling the quality of HSTs in the market. Uganda does not yet have HST standards; however, East African standards for these products are currently under development based on the Kenya experience. Once gazetted, they will apply across the East African Community, including Uganda.

ii. Limited awareness of correct use of HSTs by farmers

Growth in adoption of HSTs is being undermined by limited awareness of their correct use among smallholder farmers. For instance, good storage of grains requires the commodities to be sufficiently dried and cleaned prior to bagging. While this applies to all forms of storage, it is particularly critical for hermetic storage. Farmers have been observed to store wet maize in hermetic bags, which leads to rapid deterioration in quality and high aflatoxin levels. These farmers then blame the bags for the losses they incur. Furthermore, due care in handling HSTs is required to reduce risk of perforation which would eliminate the hermetic properties. These considerations necessitate widespread education and sensitisation of farmers on the correct use of HSTs.

iii. Taxes on hermetic storage bags

HSTs are relatively expensive compared to traditional means of grain storage. For instance, a typical hermetic bag retails at KES 250 and UGX 8,000 a piece in Kenya and Uganda, respectively (approximately USD 2.50 in both countries), which is several times more expensive than conventional bags. The high price makes wide-scale adoption of HSTs harder to achieve. A significant part of this price is attributed to taxes, particularly Value Added Tax (VAT). VAT is 16% in Kenya and 18% in Uganda, meaning that while uptake has been growing, the tax significantly restricts farmer interest because farmers are highly price-sensitive. Conventional agricultural inputs, such as fertiliser, seeds and agro-chemicals, typically do not attract VAT given their importance to agricultural production.[2] HSTs deserve the same consideration because they complement agricultural production by reducing post-harvest losses.

Further compounding this problem is a recent development whereby the Uganda Revenue Authority has been charging 18% VAT on each component of the bag separately – that is, 18% for each inner liner and outer woven hermetic bag. For example, if a complete hermetic bag (outer bag and inner bag(s)) is declared at UGX 6,000, they charge 18% of the total value for the outer bag, and another 18% of the same amount for the inner bag. For bags with a single inner liner, this amounts to 36% VAT, while for those with two inner liners the total VAT charged is 54% of the product's value. This will increase the price of hermetic bags to between UGX 9,220 and 10,440 per piece.

Recommendations

HSTs are evidently an important tool that can be used to combat the highly intertwined problems of post-harvest losses and climate change. Addressing the above challenges impeding HST adoption requires not only policy, but also regulatory and programmatic interventions as recommended below:

1. Adopt and enforce HST standards

Kenya adopted standards for hermetic storage bags and hermetic plastic silos in August 2019. This provides an invaluable basis for weeding out counterfeit and sub-standard products to protect smallholder farmers. Uganda is also expected to adopt the East African standards for these products once gazetted by the East African Community in the coming months (subject to COVID-19 restrictions, which have undoubtedly slowed down policy processes at national and regional levels).

In both countries, however, these HST standards need to be rigorously enforced. This requires investment in market surveillance protocols and building the inspection and testing capacity of regulatory bodies, such as the respective bureaus of standards in Kenya and Uganda.

2. Build awareness of HSTs among farmers

As the end-users, farmers need to be trained and sensitised on various aspects of HSTs, including their importance in reducing post-harvest losses and their correct use. Considering (1) above, there is also a need to sensitise farmers on the HST standards and how they can distinguish between genuine and sub-standard products. This will help to promote uptake of genuine HSTs and help to regulate the HST sub-sector.

3. Removal of tax to reduce the cost of HSTs

HSTs are key products in the agricultural sector with a vital role in post-harvest management as well as in supporting climate-risk mitigation indirectly. They, therefore, need to be as affordable as possible to farmers. This requires removal of VAT on such products, which will reduce the retail price by at least 16%

2 Although agricultural inputs usually do not attract VAT, the Finance Act 2020 in Kenya introduced 14% VAT for fertiliser and inputs for pesticides, a move that was widely criticised by the agricultural sector. stakeholders.

and 18% in Kenya and Uganda, respectively. Considering that farmers are generally price-sensitive, such a price decline will significantly stimulate uptake of these products by farmers, and in doing so, help to reduce post-harvest losses and exert less pressure on the environment and natural resources used in agricultural production. The CIMMYT Effective Grain Storage Project (EGSP) II project (2012-2015) also recommended removal of taxes on post-harvest technologies in Kenya.

While waiving taxes will reduce government revenue, the reductions are unlikely to be significant given that current uptake of hermetic bags is still relatively low, and the value of grains saved is likely to far exceed the loss in government revenue. Evidence from Tanzania – a country with similar economic and agricultural sector profiles to Uganda and Kenya – reveals that removing VAT from hermetic bags can generate a total net benefit to the society of USD 38.9 million per season (Kweka, Chegere, & Michael, 2019).

4. Increase awareness of the links between climate change and post-harvest management among all stakeholders

Climate change has contributed to increased pest and disease pressure, which affects production of crops on farms. There is, therefore, a need to enhance public awareness of post-harvest technologies that can support climate change adaptation.

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