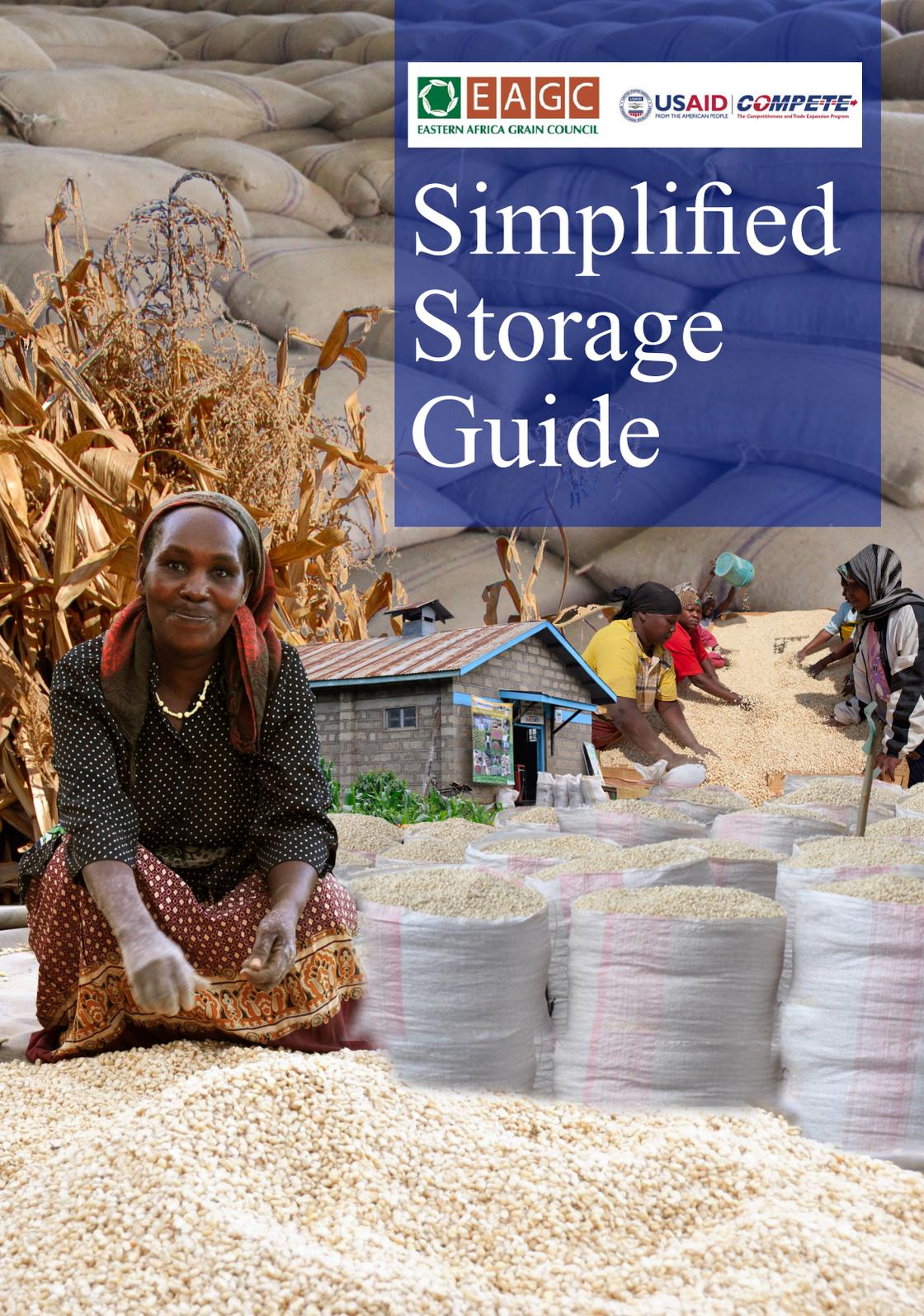




# Simplified Storage Guide



# ACKNOWLEDGEMENTS

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# SIMPLIFIED STORAGE GUIDE

## INTRODUCTION

The U.S. Agency for International Development (USAID)-funded Competitiveness and Trade Expansion (COMPETE) program works to build the capacity of smallholder farmers, support the establishment of viable storage facilities in East and Central Africa and address issues that limit smallholder access to the region's markets.

### The Farmer Challenge

Smallholder farmers face considerable challenges accessing commercial markets and earning the best possible prices for their commodities. This is due to the fact that smallholder production is characterized by low volumes and poor (inconsistent) quality that are the result of weak post-harvest handling practices and insufficient/inadequate storage. Proper storage and handling can significantly reduce crop losses that in some cases can be as high as 40 percent.



### The Storage Challenge

Storage facilities in the East African Community (EAC) often suffer from poor management and weak controls. Consequently, farmers are reluctant to trust storage operators and are skeptical of the value of these facilities, which often charge a lot while delivering very little. As a result, many farmers sell immediately after harvest when prices are at their lowest.

This is a missed opportunity for both farmers and small-scale storage operators. To truly benefit smallholders and improve market access, storage facilities must be cost-effective, well-managed operations that represent an attractive alternative to quick, easy sales.

### Improving Storage Practices

COMPETE and its partner, the Eastern Africa Grain Council (EAGC), developed this simple guide to provide storage operators with tips, techniques and cost-effective solutions that, if implemented, will improve operations, help gain the trust of farmers, and encourage farmers to make deposits.

**The best store is not necessarily the fanciest store; it is the best kept store.**

# WHAT IS IN THE GUIDE?

Good storage facility management does not have to be complicated and expensive. It does not require sophisticated technology. It does, however, require attention to detail, a rigorous maintenance schedule and careful recordkeeping.

The guide provides practical advice on how to improve quality, reduce losses and manage stocks that will help operators deliver valuable services to depositors and help them realize the benefits of storage such as higher prices.

The guide's four sections address some of the key misconceptions about storage management that have kept depositors from using facilities as they should.

## **Myth 1: Post-harvest handling has no impact on quality or pricing**

The section covers harvesting and post-harvest handling; best practice for grain drying; and inexpensive moisture tests that operators can share with farmers to help them maximize their surplus and adequately prepare their commodities for storage.

## **Myth 3: Store management is a complicated process**

The section provides step-by-step guides to the intake, storage and discharge processes, with templates for documents used in inventory control such as Goods Receipt Notes. It also highlights the importance of applying the EAC's harmonized quality standards.

## **Myth 2: Expensive equipment is necessary to operate a quality storage facility**

The section details basic store requirements and must-have equipment and materials; it also contains illustrated descriptions of the different types of storage facilities.

## **Myth 4: Fumigation is the best method of pest control**

The section provides an illustrated anthology of the common storage pests in the Eastern Africa region and outlines recommendations to manage and control each of them with an eye towards prevention and cost containment.

## **Why is it important?**

Utilizing the tools in this guide will help operators effectively manage aggregation centers and warehouses, adhere to the EAC's harmonized staple foods quality standards and enable farmers to address the quality issues that have limited their access to markets in the past and help them fetch higher prices for their products.

Over the long term, expanded access to quality storage will yield higher quality grains, encourage production (greater quantities for storage) and improve smallholder livelihoods.

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# SECTION ONE: POST-HARVEST HANDLING

## KEY MESSAGES:

- High moisture levels will result in lower prices
- Grain needs to be at stipulated moisture levels before storage

## INTRODUCTION

Farmers must prepare grain for storage. Warehouse operators should remind farmers to properly prepare their grain and train them if necessary.

This section of the guide outlines the various components of post-harvest handling, including tips on how to prepare grain for storage, moisture testing, and drying methods.

## Harvesting

### When to Harvest

Harvesting is best done on a warm, sunny day when the growing process is finished. Harvesting too early or too late can result in poor-quality grain, which leads to losses.

Two key indicators of when a plant is ready to be harvested are:

1. It changes color from green to light brown or yellowish. Moisture content at this point is 20-30%.
2. Cereals like maize, sorghum and millet have a black layer just below the tip of the grain.



Photo credit: CIMMYT

### How to Harvest

Harvested cobs, seedheads and pods should be kept off the ground and put in sacks or clean containers to avoid contamination. Next, those products need to be dried. Dry, clean grain provides the best quality product to buyers, which translates to higher prices.

# SUN-DRYING: BEST PRACTICE FOR GRAIN DRYING

Here is the most common method for small-holder farmers to dry grain.

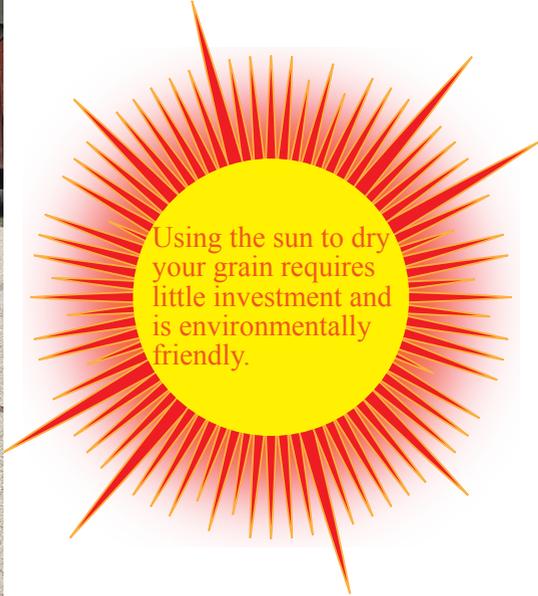
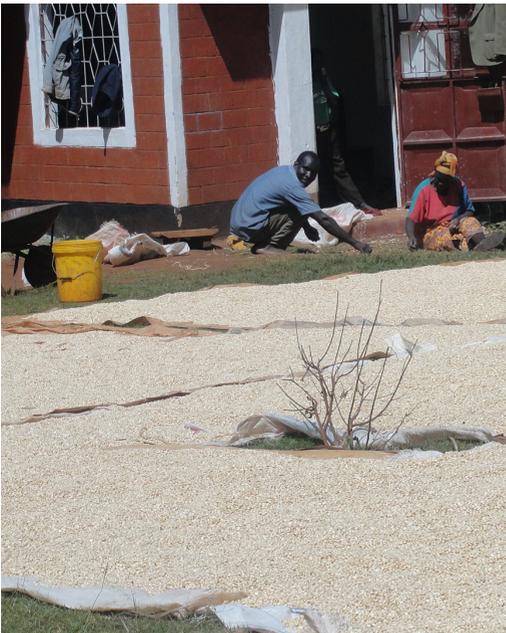
1. Spread the grain out on a plastic sheet or tarpaulin, in a layer no more than 3 cm deep.
2. Leave it exposed to the sun, turning it with a rake every hour.
3. Every two hours, move all the grain to one side of the sheet to allow any moisture on the sheet to evaporate. Wait five minutes, then spread the grain out again across the whole sheet.
4. Keep chickens and other animals away so that they will not eat the grain or make it dirty.
5. If it is going to rain, cover the grain with a spare sheet or move it to one half of the sheet and cover it with the other half.
6. At night, cover the grain with a sheet, weighted down at the edges to stop it from blowing off.
7. Sort grain to remove unwanted materials from the good quality product.

## TIP

The loss of moisture during drying leads to a loss in weight which is calculated using the following formula:

$$\text{Weight loss} = M \frac{(mw - md)}{(100 - md)}$$

M = mass of the wet maize  
mw = moisture of wet grain  
md = moisture of dry grain



Using the sun to dry your grain requires little investment and is environmentally friendly.

# STEPS IN POST-HARVEST HANDLING

## Harvesting

- Collect the crop at the right time
- Avoid bad weather
- Avoid contamination with soil and other foreign matter



## Transporting

- Haul the crop from farm to homestead in clean, dry containers
- Avoid spillage on the way
- Store harvested product in a clean, dry place

## Shelling / Threshing

- Remove maize husks to check for damage
- Shell or thresh grain from cob, seedhead or pod, taking care to avoid breakage
- Avoid breakage of grain to reduce risk of pests



## Drying

- Dry grain to EAC standards or better to increase value and ensure best quality
- Keep dry grain clean and free from contamination

## Cleaning / Winnowing

- Remove foreign matter from grain
- Use a machine or clean by hand to achieve best results



## Storage

- Keep different types of grain in separate containers and separate areas of the store
- Time grain sales with harvest calendar to ensure best market access and highest prices

## MOISTURE TESTING

There are three easy ways to test whether grain is dry enough to store:

1. Bite the grain to check how hard it is. If it has a chalky taste, it is not dry enough.
2. Let grains drop onto a hard surface. Dry grains bounce; wet grains do not.
3. The salt test. Dry salt will absorb moisture from grain. This test can help determine moisture content of above or below 15%.



Moisture meters are a more expensive (about \$750) but still simple and accurate way to test moisture in grains. They must be calibrated before use to make sure they are accurate. Generally speaking, meters are accurate to within  $\pm 0.5\%$  in the middle of the moisture range (12% to 17%) moisture content for grains.

The EAC standard moisture content for stored maize is 13.5%

## THE SALT TEST

You will need:

- A clean dry glass bottle with an airtight cap
- A cup of salt
- Enough grain to fill the bottle 1/3 of the way up

How to do it:

- Dry the salt on plastic sheeting in the hot sun for 3-4 hours
- When it is hard, seal the salt in a tight container
- Fill the bottle 1/3 of the way with grain
- Add 2-3 soup spoons of dry salt
- Close bottle tightly
- Shake it and leave to rest for 15 minutes

How to tell if it worked:

- If the salt sticks to the bottle, moisture content is above 15% and is not yet safe for storage
- If the salt does not stick, moisture is below 15% and is safe for storage

Time to Store!



Photo credit: CIMMYT

# SECTION TWO: BASIC STORAGE REQUIREMENTS

## KEY MESSAGES:

- Stores do not have to be costly or sophisticated, just clean and well-managed
- Production cost calculations must include costs of preparing grain and storing it for market

## INTRODUCTION

A successful store operator provides clients with a safe, clean and well-managed place to keep their commodities until they are ready to sell. The best store is not necessarily the fanciest store; it is the best-kept store. Storage operators should make sure their facilities are clean, well-lighted and well-managed. This will ensure a quality product at the highest price.

This section details the best types of storage structures for small operators. Mid-range stores are defined as those between 10 tonnes and 100 tonnes.

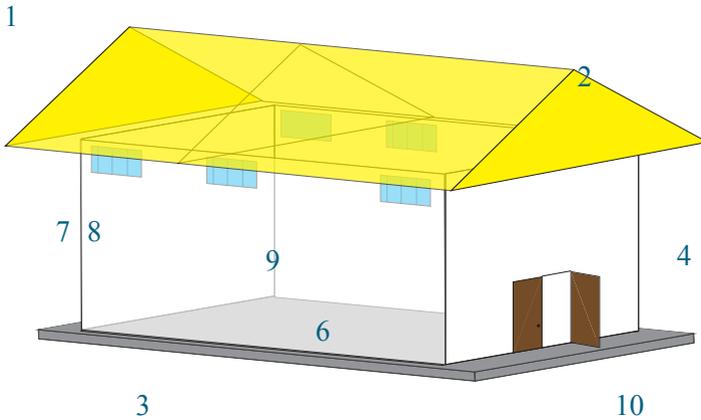


## TIP

Consider these costs when determining storage needs:

- Fixed assets - storage facility construction, handling equipment
- Maintenance and depreciation - repair and maintenance of capital goods, insurance
- Grain management - storage losses, post-harvest handling, pest control, labor, utilities

This diagram illustrates basic store requirements.



## BASIC STORE REQUIREMENTS

1. Well-maintained and clean site that is easily accessible but not too close to livestock pens and living quarters
2. Well-drained site preferably away from the flood plain, with leak-proof roof that is well-guttered
3. Enough room for vehicles (either motorized or man-powered) to turn around in a loading zone
4. Raised foundation to avoid flooding or runoff seeping through the floor
5. Floors should be concrete and reinforced to bear heavy weight
6. Good, natural light and well-ventilated walls below eaves
7. Plastered surface to seal cracks and make it more difficult for pests to find hiding spots
8. Ample room to cover stacks properly during fumigation
9. Clean area outside the store and make sure that it is clear of any rubbish and grass to remove possible hiding places for rodents and other pests
10. Easily available accurate weighing, logging and inventory verification processes
11. Well-organized to allow for multiple commodities being stored in same facility

# BASIC STORAGE MATERIALS AND EQUIPMENT

No matter their size, the best-run storage facilities provide the right materials and equipment.

## Bags

Bags are the most important product in a store because they keep grain free from contamination.

- Bags should be stitched so that their hems are touching. Do not overfill bags. Overfilled bags that are sewed tightly may burst once they are stacked together.
- Before storing, store operators should inspect their bags for wear and tear, as well as for signs of insects and mold. Bags used in previous seasons should be washed and disinfected, then thoroughly dried.
- There are two common types of bags: natural fiber bags normally woven from sisal and polypropylene/plastic bags, known as PP bags.

Below is a table comparing the two kinds of bags.

Natural Fiber/Sisal	Polypropylene/PP
+ Allows aeration	- Limited aeration
+ Allows fumigants to penetrate	- Limited fumigants can penetrate
+ No damage from sampling spikes	- Can be damaged by sampling spikes
- More expensive	+ Less expensive
+ Reusable	+ Reusable
+ Good for long- and short-term storage	-/+ Good for short-term storage



## Pallets



Grain is better stored on pallets than on the floor. By lifting bags off the floor, it allows better fumigation and has also been shown to reduce the risk of

afatoxin. Pallet storage also allows for easier cleaning and sweeping around the stacks, and allows air to circulate through the stack. Pallets should be checked for nails and splinters to make sure there is nothing that can tear bags. All pallets should be the same height so that stacks can be secure. Round poles like eucalyptus laid side-by-side can serve as a makeshift pallet. Make sure the poles are roughly the same diameter!

## Sampling equipment



Every trader or processor or warehouse operator must have a device to take samples of bagged grains and to be able to assess quality.

Samplers do not necessarily need to be fancy; they can be as simple as a clean tin that can hold up to 100g of grain and a mesh strainer that the grain can be poured into and looked at piece by piece. Storage facilities should also have a selection of sampling spikes to maintain quality controls within stored, bagged grains. These are inexpensive spikes that can easily penetrate sisal bags to take small samples to ensure there has been no rot, mold or insect damage to stored grains.

The EAC is moving towards the International Labor Organization's (ILO) recommended 50kg bags because the commonly used 90kg bags are dangerous for workers.

## Sieving Platform



Sieve platforms are made from coffee wiremesh with square holes of 5mm. The wiremesh is mounted on a wooden or metal frame, supported by a wooden stand. Grain is poured onto the platform and spread slowly towards a tapering end or spout where the clean grain is bagged. Dust, broken grain and other foreign matter will drop down through the holes. Larger pieces, stones, metal, broken cobs and other foreign objects can be picked from the sieve as the grain is being spread out.

## Scales



Every storage facility must have a weighing platform scale; a 250 kg size is ideal. Many roadside brokers have spring-type scales, but these can be easily manipulated. Weighing scales should be inspected and calibrated annually by the department of weights and measures or a registered company dealing with scales. Those annual inspections come with a certificate, which should be posted prominently on the wall of the storage facility. This helps build the trust of depositors.

## TYPES OF STORAGE STRUCTURES

Storage facilities can be made from modern or traditional materials, depending on their size and expected use. Mid-range storage structures can accommodate roughly 10 tonnes to 100 tonnes of bagged product.

### Metal Drums



Photo credit: CIMMYT

These are small silos that have emerged as efficient, low-cost and cost-effective storage containers for pulses. They are inaccessible to rodents, efficient against insects and sealed against moisture.

They can be made from galvanized sheets soldered together into a circular cylinder, fitted with an intake at the top and an outlet at the bottom and can hold up to 30 bags. These smaller silos should be placed on a platform in an area that does not receive direct sun.

When grain is poured from the top, the oxygen is pushed out. To speed up the process, a candle can be lit and placed on top of the grain. When it burns out, all the oxygen has been consumed and the drum can be sealed. Pests or fungi will not be able to grow as there is no oxygen for them to use.

Some plastic molds are available to fabricate plastic silos, but they can be expensive and not as durable, as well as susceptible to grain borers.

### Storage Cribs

In humid countries where grain cannot be dried adequately prior to storage, grain needs to be kept well-aerated during the drying process. An example of a storage crib is a traditional granary that is usually constructed out of plant materials including timber, reeds and bamboo.

## Elements of a good storage structure are:

### TIP

- Structural Strength
- Capacity
- Available Material
- Pest Proofing

Farmers in Uganda and Rwanda have had some success with storage cribs made from wood and chicken wire, but Kenyan farmers prefer cribs made of reeds or bamboo to keep the size of the harvest private.

Cribs are built on a platform, which consists essentially of relatively straight poles laid horizontally on a series of upright posts. Platforms may also be conical in shape, with a point at the bottom up to three meters in diameter to make drying easier.

Supporting poles must have vermin-proof fixtures to prevent rodents from climbing or jumping into the store.



### Hermetic Cocoon

Hermetically sealed cocoons can contain between 50 and 300 metric tonnes of stored grain. Stored grains release carbon dioxide, which replaces the oxygen that pests and fungi need to survive. Once oxygen is withdrawn or exhausted inside the sealed cocoon, it becomes a perfect vessel to store grain for an extended period of time. They must be completely filled and only opened at the time of discharge. The disadvantage of cocoons is that they are very expensive (about \$4,000 for 10 meters). They are also prone to damage from animal horns or sharp instruments and are generally more effective if placed in a building or completely fenced off to protect them from damage.



### Village-Level Warehouses

These communal stores can be operated at the village level to serve farmers and oper-

ators who have created cooperatives or formal groups to provide a larger stock to market. This is a good arrangement for small-holder farmers who do not have the resources to build their own store. Large traders also prefer these types of bulking centers to make it easier to pick up loads of commodity at one time. It reduces costs for buyers but still maintains prices for depositors, since handling costs are minimized.



### Flatbed Warehouses

Flatbed warehouses store commodities in bags on pallets in large stacks. They are essentially larger versions of the communal warehouse. Generally, they have more than one set of doors for access, with ventilation openings that are covered with screens. Some of these warehouses have a separate grading room and an office for recordkeeping, although this is not necessary.



# SECTION THREE: STORE MANAGEMENT

## KEY MESSAGES:

- **Good store management is about organization. Stack management, recordkeeping and cost containment are critical to a profitable store**
- **The EAC has standards for sampling, testing and grading that must be followed**

## INTRODUCTION

Effort, not expense, is what makes a store operator successful. Effort includes attention to detail, attention to hygiene and attention to quality.

Managing a storage facility can be a complex process but it doesn't have to be a complicated or expensive one. Cleanliness, good recordkeeping and quality control are the major responsibilities of a good store operator.

This section details the processes involved in achieving those responsibilities, including the steps in the intake to discharge process. It provides templates for goods received notes, a logbook and a discharge note. How to stack commodities properly is also included in this section.

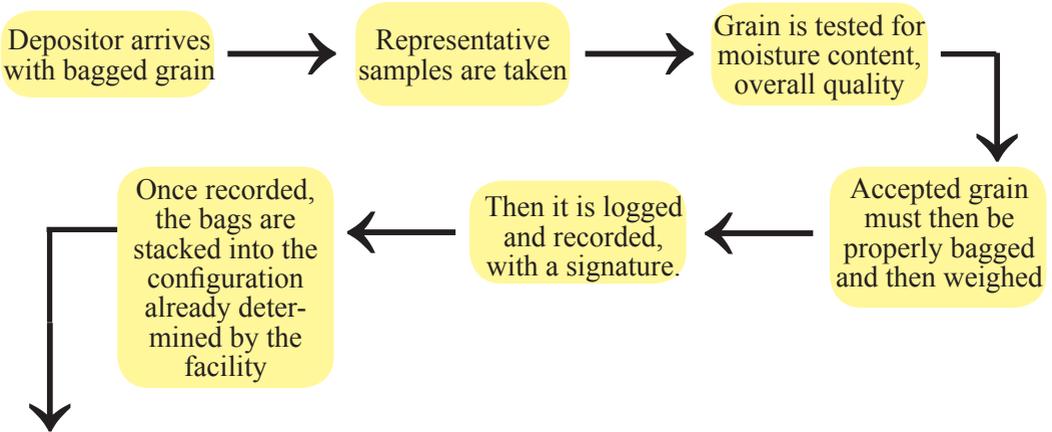
Sampling, testing and grading must be done in line with EAC standards. These standards should be posted in a visible position in every managed store. For more information about EAC standards, storage operators should consult their local agricultural extension worker or representative from the Ministry of Agriculture.

**Effort, not expense, is what makes a store operator successful. Effort includes attention to detail, attention to hygiene and attention to quality.**

DATE	TYPE	NO.	WEIGHT	MOISTURE	TEMPERATURE	QUALITY	REMARKS
= 65 BAGS							

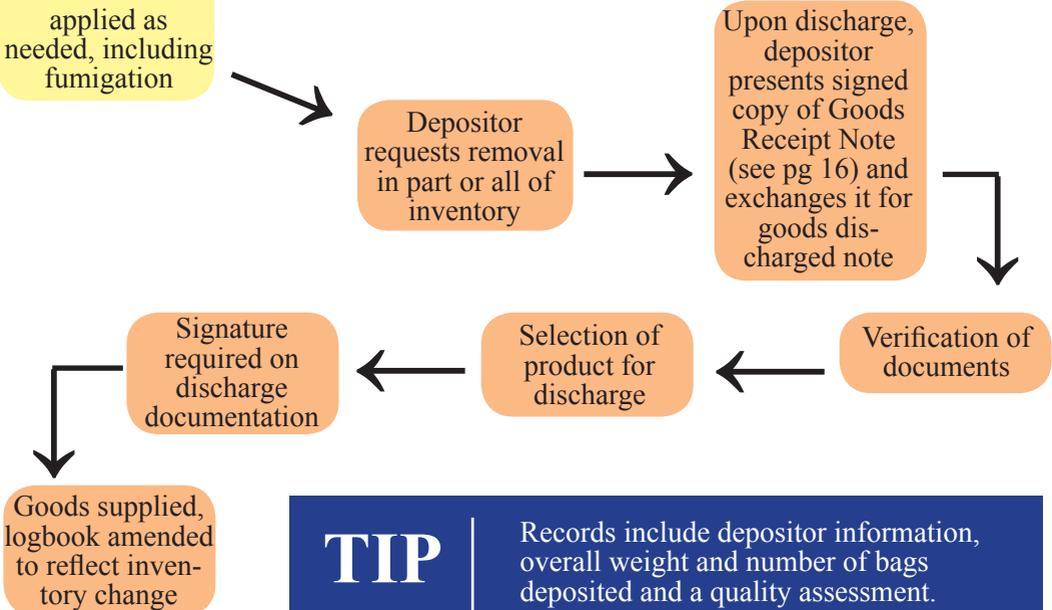
## INTAKE PROCESS

Irrespective of the grain that is to be stored, each step in the process must be followed in order to maintain depositors' confidence in the storage operator as well as a detailed inventory record.



## DISCHARGE PROCESS

Just like with intake, there is a specific process that store operators should follow in order to ensure quality and inventory control and continue to inspire trust in the depositors who use their facility.

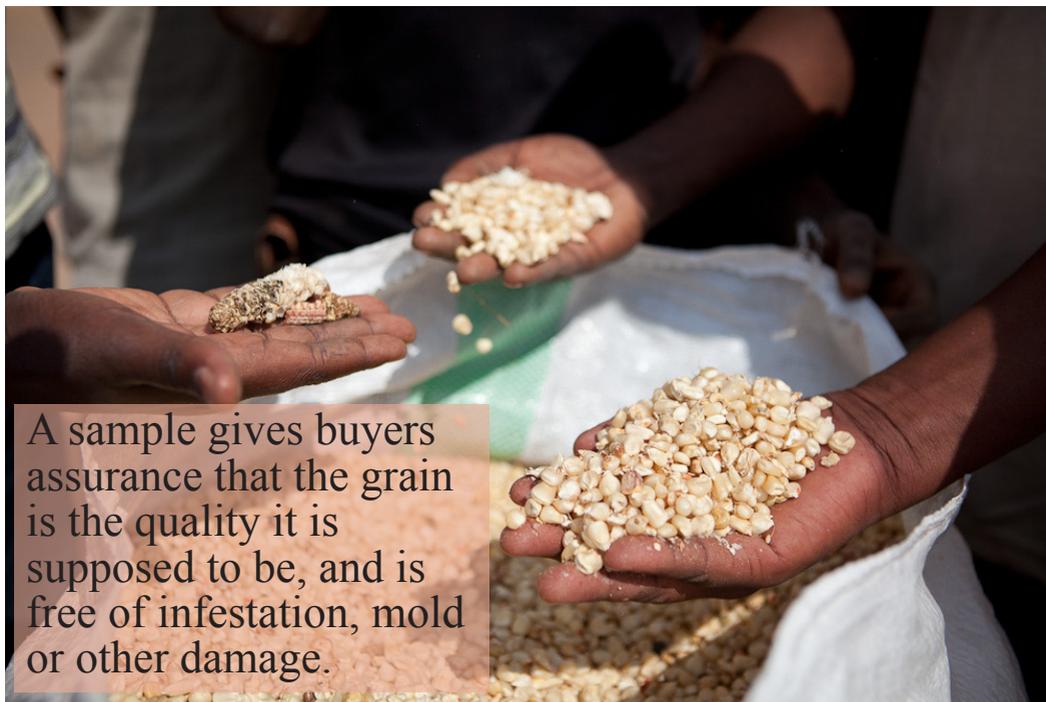


**TIP**

Records include depositor information, overall weight and number of bags deposited and a quality assessment.

## SAMPLING AND GRADING

The EAC has well-established standards for sampling, testing and grading. These standards are important because they help make sure grains from around the region are of the same quality. They also help to ensure a uniform and fair price for the same grade of grains.



A sample gives buyers assurance that the grain is the quality it is supposed to be, and is free of infestation, mold or other damage.

A sample is a unit of the commodity that is tested for quality. The idea is that the sample represents the whole commodity. So, a sample from one bag is meant to reflect the quality of the whole bag. The sample gives buyers assurance that the grain is the quality it is supposed to be, and is free of infestation, mold or other damage. A sample also can reassure buyers that they are getting what they paid for.

Sampling should be done at the facility level. Special equipment including sampling spikes should be made available by the store operator.

Grading should be done by a trained and experienced grader and should be done in line with EAC grading methods. Those grades should be prominently posted at every storage facility. A grade is given based on the sample that is tested. Tests conducted to designate a grade include moisture level, the amount of broken grain, the amount of pest-damaged grain, the presence of foreign matter and any other inconsistencies or evidence of damage, rot or mold in the grain.

The grade given to each bag of grain should be recorded at the time of deposit.

**Remember: even if grain is given  
a lower grade, it still has value!**

# DO'S OF STORE MANAGEMENT

## Do

- Make sure there are no dark areas in the store that will attract pests ✓
- Make sure that the store is well-lit. Natural light is the best ✓
- Make sure that only grain of the same quality fills any one bag ✓
- Make sure that grains meet EAC quality standards ✓
- Store bags on pallets or some sort of floor covering such as a tarpaulin ✓
- Stack bags properly to help good air circulation. Stacks should be even to help with fumigation ✓
- Keep doors and windows open during the day to help air circulation ✓
- Check for “heat spots” in the grain as this can be a sign of pest infestation ✓
- Keep the store clean all the time to get rid of food sources for insects ✓
- Clean all equipment and storage areas before use ✓
- Seal any cracks or crevices ✓
- Eliminate resting and hiding places ✓
- Clean to a schedule which is designed to break insect life cycles ✓
- Inspect the stacks regularly for signs of pests ✓
- Keep good records ✓
- Place copy of EAC standards in prominent place inside store ✓
- Check for any areas of damp in the walls or on the floor ✓
- Dust the storage area BEFORE accepting goods for storage ✓
- Deprive insects of the things they need: food, water and favorable conditions ✓
- Search for evidence of infestation: trails in dust, webbing, damaged grain kernels, droppings ✓
- Collect samples and share them with experts to find best solutions for management ✓
- Recognise sources of possible future problems: ✓
  - Storage area and equipment needs to be thoroughly cleaned before use
  - Moisture issues in the store and any structural problems

## Stacking

Stacking is done so that commodities can be used at a later date.

A 'good' stack is one that makes sure the grain remains as close to its original condition as possible. It makes effective use of space, can be inspected without a problem and provides for easy pest control and pest management.

Commodities must be laid out and stacked in a way that makes sense to storage facility operators and their staff. Space for emergency and normal stacking must be set aside, but all stacks must be constructed as if they are permanent stacks.

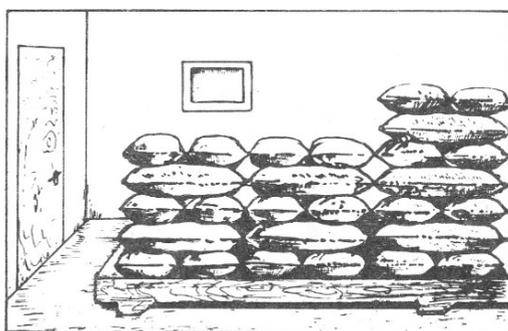
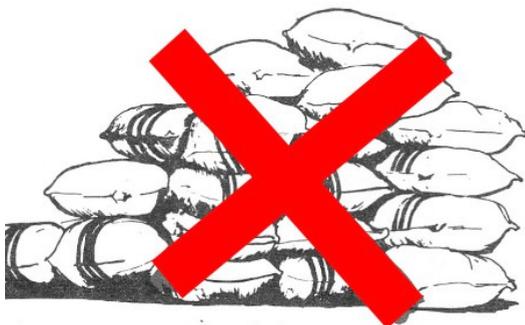
Grain stacks should be grouped by type and a diagram of the stacks should be placed in a visible place in the store so that there are no questions about where new deposits should go.

### A stack plan should take these things into consideration:

- How much grain is coming in
- Different types of grain
- Different grades of grain
- How popular each type is, at different times of year
- How tall the stacks should be
- How big the facility is
- What kind of pests will need to be controlled and managed

### Every stack plan must follow these rules:

- 1 meter distance between walls and stack
- 1.5 meters distance between roof and top of stack
- 1 meter distance between pillars and stack
- A stack must never be higher than its width
- Access space must allow easy loading and unloading



# SUGGESTED TEMPLATES FOR STORAGE

Below are templates for the most common documents used in a store. Goods received and discharge notes should be signed and logged; if possible, they should be carbon-copied, with one copy going to the depositor, one remaining with the store's logbook and one filed.

Group / product Grade / Code Moisture Content In Bags or Bulk No. of Bags Delivered Empty Bags Returned / Retained	<h2>Warehouse Receipt</h2>				TICKET No. A <b>000001</b>
	<b>CODE</b>	<b>CONSEC. NO</b>	<b>DATE</b>	<b>TIME</b>	<b>Re-entered 1st Weight</b>
					1st Weight
					2nd Weight
	Allotment / permit No.				NET Weight
Sender's Name _____					
Address _____					
Vehicle No. _____			Store Receipt No _____		
Remarks _____					
Clerk's Name _____		Signature _____		Driver's Sign _____	ID. No _____

Here's an example of an EAGC warehouse receipt



**EASTERN AFRICA  
GRAIN COUNCIL**



**EAGC**  
EASTERN AFRICA GRAIN COUNCIL

**ORIGINAL WAREHOUSE  
RECEIPT No. 0101**



WAREHOUSE NAME: MAMA MILLERS MOI'S BRIDGE WAREHOUSE

RECEIVED FROM:		Rate of storage and other charges .....			
P.O.BOX	TEL:	Indemnified for Fire/ Flood/ Theft/Misappropriation/ Riots/ Strikes with (Name of Insurance Company)			
IDENTIFICATION (ID)		Goods are accepted for storage on ..... to .....			
Warehouse Licence No.	Validity	Date: .....			
For storage in the above named warehouse, commodity of the quantity and grade as indicated below for which this receipt is issued and weight according to the EAGC standards and in event of dispute as determined by an inspector appointed by EAGC. The undersigned warehouse operator is not the owner of the said commodity either solely, jointly or in common with others unless otherwise stated hereon. Upon return of this receipt properly endorsed and after payment of storage and handling charges claimed hereon, physical delivery of said commodity will be made from the above-named warehouse to the above-named depositor or his ORDER described as transferee on the record of transfer overleaf.		Signature of Warehouse Manager/ Authorised Person			
		<p style="text-align: center;"><b>RECORD OF TRANSFER OF WAREHOUSE RECEIPT</b></p> <p style="font-size: small;">The undersigned transferor, who on the first occasion of transfer shall be the depositor, hereby endorses this and undertakes that on the transfer date stated he is the owner of the commodity covered by this receipt and there are no liens or other encumbrances on other said grain except as stated hereon. Should any dispute arise between any person to the transfer of this receipt, such persons agree that their claims will be limited to monetary claims and that no person will be entitled to claim that he has retained ownership or a real right in the commodity represented by this receipt after transfer of this receipt.</p>			
Goods of the following description:					
Name of Commodity	Commodity specifications	Number of bags	Net quantity in MT		
REF	TRANSFER DATE	TRANSFEROR'S NAME	TRANSFEROR'S SIGNATURE	TRANSFEREE'S NAME	TRANSFEREE'S SIGNATURE
1					
2					
3					
4					

SEE GENERAL CONDITIONS ON THE REVERSE

# GRADING SHEET

.....DEPOT/SILO

Sample of Group	B/Wt	Grade
Grower		
Vehicle No.		Date
Moisture	Weather Damaged	
Foreign Matter	Heat Damaged	
Earth, Sand, Stones	Immature Wheat	
Broken Grain	Darnel	
Germinated	Datura	
Insect Damaged	Mixed Groups	

Result/Remarks

Graders Signature

**001001**

## GOODS RECEIPT NOTE (GRN)

SERIAL NO. **1234**

NAME OF WAREHOUSE/AGGREGATION CENTRE: \_\_\_\_\_  
 COUNTY: \_\_\_\_\_ LOCATION: \_\_\_\_\_

**DEPOSITOR DETAILS:**

NAME: \_\_\_\_\_ ID. NO: \_\_\_\_\_ MOBILE NO: \_\_\_\_\_  
 POSTAL ADD: \_\_\_\_\_ DISTRICT: \_\_\_\_\_ LOCATION: \_\_\_\_\_  
 GENDER:  M  F (tick as appropriate) FARMER GROUP: \_\_\_\_\_ VILLAGE: \_\_\_\_\_

**COMMODITY DETAILS:**

NAME: \_\_\_\_\_ QTY(kg): \_\_\_\_\_ QTY (MT): \_\_\_\_\_  
 UNIT PRICE/KG: \_\_\_\_\_ TOTAL VALUE OF COMMODITY(TC): \_\_\_\_\_ NO. OF BAGS: \_\_\_\_\_

**DEDUCTIONS:**

ITEM	UNIT COST	TOTAL COST
<b>TOTAL DEDUCTION (TD):</b>		
<b>TOTAL AMOUNT PAYABLE TO DEPOSITOR (TC - TD):</b>		

**RECEIVING OFFICER**

NAME: \_\_\_\_\_ DESIGNATION: \_\_\_\_\_ SIGN: \_\_\_\_\_ DATE: \_\_\_\_\_

**DEPOSITOR DETAILS:**

NAME: \_\_\_\_\_ ID. NO: \_\_\_\_\_ SIGN: \_\_\_\_\_ DATE: \_\_\_\_\_

**NOTE:** Commodities recordered above are received, stored & recorded subject to the terms & conditions of the receiving warehouse/aggregation centre

# SECTION FOUR: PEST MANAGEMENT

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## KEY MESSAGES:

- **Pest prevention is better than pest control**
  - **Fumigation is expensive and not always the best solution**
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## INTRODUCTION

Pests are the biggest challenge for storage operators. But if they follow a strict routine for keeping a store clean, pest prevention is possible.

Pest prevention is preferable to pest control as it is less expensive and requires less drastic measures. This means that surveillance of the storage facility is very important and must be the main daily activity. Establishing a routine to clean, observe and rotate the stacks will help in pest prevention. It is important to realize that fumigation is not always the best solution for pest management. In fact, due to its high cost and short effectiveness window, it should only be used as a last resort.

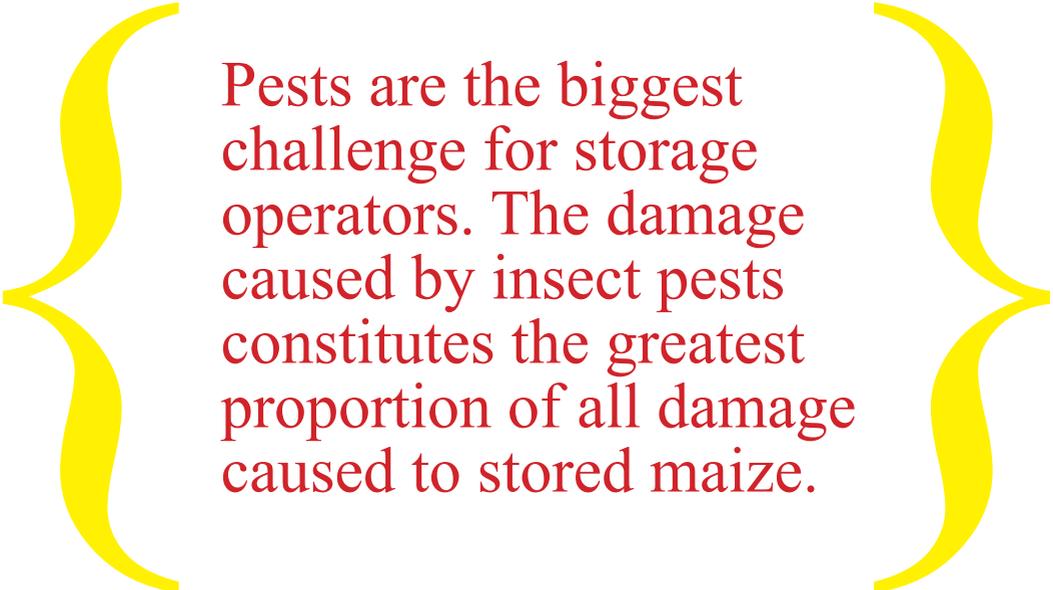
Pest identification can also be complicated. Local agriculture extension workers can help identify pests and suggest the right way to control them.

This section identifies common pests and provides tips about how to manage and control them.



## PEST PREVENTION ROUTINE: BEST PRACTICE

1. Make sure that the store is clean and that excess dirt is removed regularly
2. Ensure that stacks are packed equally to make it easier to fumigate if necessary
3. It is crucial that all areas of the store are well-lit as pests like darker warmer areas in which to settle and breed
4. Stacks should be checked regularly for any heat build-up, as this too can attract pests which like warm and damp areas
5. Air circulation is important in the storage process and it is therefore necessary to open doors and windows on a daily basis, to encourage as much natural air circulation as possible
6. Develop a stacks “turning” program and calendar to make sure it is a regular routine
7. Set traps wherever possible for rodents. Check the traps on a daily basis. There are also traps available for moths and other flying pests, which are not designed to kill but to indicate the presence of pests
8. Check bags regularly to ensure they remain sealed, without holes or snags that could provide an entry for pests



**Pests are the biggest challenge for storage operators. The damage caused by insect pests constitutes the greatest proportion of all damage caused to stored maize.**

# TYPES OF PESTS

## Insects

Insect pests are very destructive. The insects multiply very fast and within a short time they are able to cause massive damage. Insects associated with cereal grains or commodities that are harvested and stored are called “stored-grain insects”. These insects are also called “stored-product insects” because they can infest stored non-cereal commodities and processed cereal or non-cereal products. These insects have spread globally through grain trade.

### Larger Grain Borers



They are reddish brown or dark brown to brown – black in colour. They are also cylindrical in shape. Head is often bent underneath and not visible from above and has jagged teeth along the front of thorax. Larvae are plump, curled and develop within grain kernels. Adults leave distinctive exit holes from kernels. Both adult and larvae are very damaging and difficult to control. Adults about 4 mm, squared off back end.

### Grain Moth



Grain moth adults are small, yellowish or straw-colored insects with thin projections at the outer end of the hind wings. The hind wing is fringed and abruptly narrowed at tip resembling a pointed finger. The mouthparts are viewed sideways and are long, slender, and curved upward like elephant tusks. Moths need intact grain or hard-packed material. They leave a neat emergence hole from a grain kernel, often leaving pupal case hanging out. The young larvae penetrate and feed on grain from inside.

### Grain Weevils



Grain weevils are the primary pest with both adults and legless larvae causing destruction. The three types of weevils are: rice, maize and granary. Typically, any little beetle found in grain is commonly called a weevil, but true weevils are from a particular family with distinctive snouts. The female weevil chews a hole in the seed coat, lays her eggs and then patches

over. The larvae are plump, curled and develop internally. Adult weevil leaves distinctive exit hole. The weevil needs grain at 12% moisture or higher. Weevils infest stored grain and they cause severe post-harvest losses through damage on the grain kernel and by reducing the quality of grain.

### Red Flour Beetles



They are the most important insects in flour mills and bakeries. They are scavengers like other secondary feeders, but also infest interiors of flour systems, thus a contamination and quality problem. The larva is long, slender and cream-colored. Several other little beetles look like flour beetles. Flour beetles have a distinctive notched eye shape.

### Indian Meal Moth



Considered the worst stored product insect worldwide! The larvae produce dense silken webbing on the surface of stored grain. The full grown larvae leave the inside of the grain and pupate in white, silken cocoons on the outside of infested grain mass. Accumulations of silk and debris can clog equipment.

**TIP**

Common primary insect pests can increase rapidly and damage grains stored at temperatures above 15°C.

## PEST CONTROL

### Rodents

In addition to feeding on the grain stocks stored in a facility, rodents contaminate storage facilities with their droppings and hair. They chew holes in bags, and can also destroy store fittings including pipes and electrical wires. Rodents can carry diseases, which if left untreated may lead to plagues or epidemics.

Rodent control begins with meticulous cleaning. Routine inspections must also be carried out to check for nests, as rodents travel in packs or families, and feed on multiple sites each nighttime feeding session. One rodent is always the first to feed, to make sure that the food source is not poisonous. Once one rodent is poisoned, the rest of the pack searches for another, safe source of food.

### Birds

Birds are more of a nuisance than a pest but can still contaminate a store with their droppings, as well as cause damage to bags. Wire mesh should cover all openings, such as windows and doors, and care should be taken every time the store is open so that no birds fly in. Bird droppings are more dangerous, as they can introduce moisture and heat to the preserved grain, creating fertile ground for fungus or mold. Droppings are also unsightly and signal that a store is not clean, which buyers could use as an excuse to purchase their grain elsewhere.

### Dusting

The best way to control insect infestation is by ensuring early treatment. For small consignments that are treated with dust-formulated pesticides or water-soluble sprays, ensure that the dusting is carried out early, during the bagging process. The grain must be cool, or efficacy of the pesticide will be reduced. When properly applied, dust pesticides may protect grains for up to six months. Residues must be rinsed off before use. Pesticides are not universal, so the problem pests must be identified before a pesticide is selected.

### Fumigation

Fumigation should be a last resort effort because if a store is not well-managed, no matter how much fumigant is applied, pests will settle back in immediately.

Fumigation should be carried out by registered personnel who are trained and equipped to do fumigation properly.

Common fumigants are:

- Methyl bromide gas, delivered in cylinders similar to welding gas. This fumigant is being taken off the market because of its effect on ozone depletion
- Phosphine gas, delivered tablets or strips
- Carbon dioxide and nitrogen, substances that are newly available in most markets

## EAGC National Contacts

Following the recommendations and implementing the simple systems outlined in this guide will help store operators provide valuable services to their customers, build their credibility with depositors and establish themselves as the link between smallholder farmers and formal markets. Expanded smallholder use of storage will also help store operators improve their bottom line.

The EAGC is an essential long-term partner in the drive to strengthen the region's storage facilities. For additional information or if you have any questions, please contact your national EAGC office.



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**EASTERN AFRICA GRAIN COUNCIL**

