TRAINING MANUAL ON GRAINS POST HARVEST MANAGEMENT

Introductions and Training Objectives

This training is intended to be a guide for extension workers to understand post-harvest issues concerning grains and, therefore, be able to advise farmers.

For the purpose of this training the term grain is used to include cereals (maize, sorghum, millet, wheat and rice).

The term pulse refers to all kinds of legumes such as beans and peas.

Post-harvest management is a system of handling, storing, and transporting agricultural commodities after harvest. The importance of post-harvest management has been established over the years—it strengthens the action chain that produces, transports, and processes food and all other related products that give sustenance to the world population.

Moreover, post-harvest management allows the effective planning of how to sustainably manage finite resources for the future. In other words, through effective post-harvest management, action can be done now so that the environment can sustain future generations.

During the post-harvest period, handlers and producers focus on preserving quality, quantity, and the safety of the commodities. For coffee and cocoa producers and traders, maintaining the integrity of the beans is important because it directly affects the price of the commodity. This means having to ensure that **moisture**, contaminants, and insects will not affect the quality of the commodities.

The training is divided four (4) into main sections

The first section describes the role of the extension worker in obtaining information regarding the specific problems faced by farmers and how to share and impart knowledge,

The second section deals with the major causes of deterioration such as moulds

, insects and rodents, and how to prevent and control these losses,

The third section describes traditional and improved types of storage,

The final section provides general recommendations for good storage practice.

Obtaining Information

The responsibility for providing advice and information to farmers rests ultimately with the field extension workers. There are several stages in the advice process, including:

• identifying the problems;

• prioritising the problems;

• finding out what the farmer really wants to achieve; and

• providing appropriate solutions.

HOW TO GET QUALITY GRAINS

If farmers have a market that offers better prices for better quality grain seeds, then producing high quality grain on-farm allows farmers to add value to their work and so raises their incomes. To produce this high quality grain, it is essential to do on-farm postharvest handling in a proper and timely manner. Care taken at this stage is far more cost effective than attempting to upgrade quality later in the postharvest chain, for example at the collection point of a Farmers' Organisation (FO) or in a trader's warehouse. In these places grain may have to be cleaned at the expense of the farmer and large amounts of grain may be lost in the process. This is why farmers selling low quality grain receive a low financial reward Opportunities to raise incomes from the sale of high quality grain are most easily achieved through collective marketing by FOs.

PREPARING FOR NEW HARVEST

Prior to the harvest it is important that farmers are already prepared for their postharvest activities. They must ensure that - the equipment needed for their harvest and postharvest activities is available and in good repair they have decided where important activities will take place (allocating drying and threshing areas) there will be sufficient storage space for the crop grain stores and sacks have been thoroughly cleaned before the new harvest arrives so that the residues of the old harvest (last season's crop) are removed from all cracks and crevices and either burnt or fed to animals (alternatively, they can be stored in a separate place and consumed quickly. Good hygiene is a very important activity to prevent postharvest losses, the new harvest should never be placed on, or with, grain from the previous season as this will encourage the movement of pests from the old to the new.

CLEANING GRAINS

Cleaning can substantially improve its quality and hence its grade and price. Cleaning involves the removal of foreign matter such as stones, plant material from harvesting such as husks, pods etc. and broken grain and dust produced during threshing. At the same time it is possible to remove insect damaged and mouldy grains by hand picking. Cleaning is often done manually by winnowing. This involves tossing the grain into the wind which carries off the lightest impurities, while the heavier grain falls onto a mat. However, this does not separate the heavier impurities. For this a sieve is required, where the grain is retained on the sieve and smaller heavier impurities fall through it. Such a sieve can be either single or double handed.

The double handed sieve can be operated by two people, who rock it back and forth. The mesh sizes of sieves varies according to the size of the grain being cleaned but typically for maize and beans a 4.5mm mesh is used and for sorghum 2.0mm and for millet usually even smaller. FOs may specify sieve sizes to work toward achieving certain grades.

ROUTINE CLEANING IN STORE: The store must be kept clean and tidy and its structure kept in good condition. Inside the store it is important to Sweep it clean at the end of each day. Sweep from the back of the store towards the front so the dust will go out through the door. Carefully clean all cracks and crevices. Each week, sweep the walls, stack surfaces and, if possible, roof beams to remove all dust and debris. Start at the top and work downwards

PREPARATION FOR RECEIVING GRAIN IN STORE

Remove all the old harvest from the store, before the new harvest arrives in store. It is best to ensure that all the old harvest has been discharged. If it cannot be discharged then it would be helpful to isolate it from the new harvest by covering with a tarpaulin and weighting the edges of the tarpaulin with lengths of wood or stones. This will help reduce the movement of insects from old infested grain to the new grain. Sweep the store thoroughly - The store should then be thoroughly swept, to remove all grain residues from the floor, any cracks and crevices, or sliding door runners. The grain residues should be taken out of the store and burnt or fed to animals. Make sure the floor is in good condition.

The floor should be thoroughly inspected for cracks and if any are found they should be filled with cement. Cracks in walls should also be filled. Lay out the pallets and make sure they are in good order - Once the store is clean the pallets should be laid out to receive the incoming crop, with a gap of 1m from the store walls. The pallets should be brushed clean to remove any old grain or grain dust. They should be checked for any protruding nails, which might tear grain sacks, any nails should be removed or hammered in.

Get the weighing scales ready for use - In order to weigh the incoming crop it is important that the weighing scales have had their calibration checked. This needs to be done by the appropriate authority (usually the Bureau of Standards) and at the frequency specified by them (usually every year). It is also advisable to have a test weight kept in the store to check the accuracy of scales every day.

MAJOR CAUSES OF DETERIORATION, PREVENTION AND CONTROL OF GRAINS

The extension worker's job is to help the farmer keep the quality of the stored grain in the best possible condition so that the best price can be obtained at sale. The causes of quality loss are: • insects • moulds • rodents • birds

INSECTS

Insects are usually the most serious storage pests. Nevertheless, insect damage reduces the quality of the grain and therefore the market price. Insects cause loss in weight and also in the nutrient content. Insect developing in grain produce heat, moisture and waste products. This can create conditions suitable for further deterioration, especially the growth of moulds.

CONTROLLING METHODS OF INSECTS IN STORED CEREALS AND PULSES

Control methods can be divided into two groups:

Non-chemical methods of insect control are broadly considered to include any method that does not involve the use of conventional insecticides. They include traditional techniques employed by farmers.

CHEMICAL METHODS OF INSECT CONTROL (INSECTICIDES)

Insecticides, when properly applied to stored cereals and pulses as dusts or sprays can offer long-term protection against insect attack. Insecticides are usually applied to dry threshed grain. This minimizes the amount of insecticide required and provides good protection.

MOULDS

Moulds are growths that develop inside and on the surface of grains that have not been dried properly or become wet during storage. They can be recognized as white, grey, black or green discolouration on the grain surface.

OTHER SIGNS OF THE PRESENCE OF MOULDS

• dustiness of grain; • caking of grain; • feed refusal by animals for no apparent reason; • a bad musty (mouldy) smell; • darkening of feed grain.

Factors that affect mould growth

• Moisture content of the grain; moulds require water for growth, so if the crop is well dried (below 13% for cereals and 7% for groundnuts), moulds will not be able to grow.

• Climatic conditions; hot and humid conditions promote mould growth.

• Field damage caused by insects, birds, rodents, and poultry (moulds can quickly infect grain through holes and cracks made by pests);

• Plant stress caused by drought, infertile soil and even untimely or excessive fertilizer application (allows plants and seed to crack and become exposed to invading moulds and insects).

• Maize cobs, sorghum and millet heads and pods of pulses that fall to the ground and come into contact with mould spores that live in the soil.

• Repeated planting of a crop in the same field may increase the risk of infection by mould.

• Poor handling at harvest, during drying, threshing and transportation can cause damage to grain, rendering it susceptible to attack by mould spores.

• Insect infestation in store (insect respiration produces water, which raises the moisture content of the grain allowing moulds to develop).

PREVENTION AND CONTROL OF MOULD GROWTH

The most effective way of preventing mould growth is to dry the grain as quickly as possible to a moisture content that is low enough for safe storage. Safe storage is achieved when moulds cannot develop. For cereals and pulses in tropical and subtropical countries this point is achieved when the moisture content is below percent, for groundnuts and other oilseeds below 7 percent.

RODENTS

Rats and mice damage storage containers, eat some of the stored produce, carry some away to their nests and spoil much more with droppings, urine and hairs. They usually spoil more than they actually eat.

RODENT CONTROL

The most effective method of preventing rodent damage is to keep the store clean and tidy and to have rodent proofing in place. Rats and mice will stay in a store only if they can get food easily and find somewhere to make a nest. The area around the store must be kept clean.

Birds

Some species of birds commonly feed on stored grain.
Birds can consume large amounts of grain. They also contaminate the grain with their droppings and feathers.

BIRDS CONTROL

Damage and loss of stored grain can be reduced by preventing birds from entering the store. The store should be kept in good condition and the entrance or door to the store kept closed. The area around the store and compound should be kept clean as birds are attracted by spilled grain.

STORAGE METHODS

Traditional methods of storage have evolved over long periods and many generations and are usually well suited to the climatic and social environment in which they are used.

Seed storage

Many farmers retain their own seed each year. Soon after harvest, seed grain is selected from the crop that has just been brought home. Any reduction in the quality of seed, such as insect and mould damage and shrivelling through water loss or heat exposure, will reduce the germination potential and therefore reduce the size of the next crop.

FOOD GRAIN STORAGE

The commonly used methods for storing grains are described below.

Platforms and frames

Platforms constructed in the open may be four-cornered or circular racks made from timber, bamboo or sisal poles. They are usually raised on legs about 1.5 m above the ground. Cereals and pulses are stored un-threshed in heaps or in regular stacks.

Drying and storage cribs
Traditional cribs are circular or rectangular with a framework of wooden poles. Ideally, the width of the crib should not exceed:

• 0.6 m in humid areas where maize is harvested at high moisture content (30-35 percent);

• 1.0 m in dryer zones with a single rainy season where maize is harvested with about 25 percent moisture content;

• 1.5 m in very dry places.

BASKETS

Baskets with an open weave are suitable for drying grain, e.g. sorghum heads and maize cobs, especially without husks.

Dry, shelled grain can be stored in close-weave baskets or baskets that have mudded walls.

SOLID WALL BINS

Solid wall bins may be spherical, cylindrical or rectangular in shape. Designs are often characteristic of communities or localities. The bins may be made of clay (sometimes strengthened by mixing with straw or twigs) or clay blocks or burnt bricks.

METAL STORAGE BINS

Metal storage bins are made from smooth or corrugated galvanized metal sheets. They are usually cylindrical in shape with a flat top and bottom. Most bins are used for small-scale storage. Have a capacity of up to 1 tonne.

UNDERGROUND STORAGE

Pit stores are used in some parts of Africa, the Middle East and Southern Asia, primarily for storage of sorghum, millet and small grain pulses. The best pit stores provide a reliable, hermetic method of long-term storage.

BAG STORAGE

Bag storage is a convenient way of keeping threshed grain and pulses. The need to thresh or shell grain may deter farmers from using bags if labour is in short supply at harvest time.

ROUTINE INSPECTION ON GRAINS

It is important to inspect the inside of the store. At the start of each day check the store for signs of water leakage, check the floor and tops of bag stacks for signs of damage (rodent or insect) eg grains under or around pallets.

Check for holes in the bags that need to be repaired Check for insects in the store, inspect for moving insects in the late afternoon (16.00h), check the ‘ears’ of bags and crevices between bags, listen for the sounds of insects eating grain, and use a torch to inspect the dark areas of the store.

ROUTINE INSPECTION OF THE STORE STRUCTURE

It is important to check the outside of the store and repair it as necessary. Each day the outside for the store should be checked for problems and repairs undertaken as soon as possible. Inspect for problems and check for insects and rodents.

WHAT TO DO IF A FUMIGATION IS NEEDED

If insects are found on the grain during routine inspections then a fumigation will be needed to prevent them causing serious damage to the stock. It will be necessary to employ a fumigation contractor to undertake the fumigation.

Fumigation involves placing a gas-tight sheet over each of the bag stacks in the store. Solid tablets of aluminium phosphide are placed under the pallets (or at least under the sheet) on trays. On contact with air the tablets release a poisonous gas that will kill the insects and could also kill humans.

Normally for each tonne of grain there should be at least two tablets The fumigation should last for at least 5 days. During the fumigation the store should be locked and no one should enter the store. A warning notice should be fixed to the door of the store indicating that a fumigation is in progress and no-one should enter.

MANAGING GRAIN QUALITY

The quality of grain declines with time depending upon the initial quality (grade) and the conditions of the storage environment. For example if grain is kept in bags in an open warehouse in the tropics natural quality decline will happen more quickly than when the same bags of grain are kept in an airtight (hermetic) store in temperate conditions. For a particular grain quality grade and particular storage conditions there is an expected ‘shelf-life’. If grain is maintained for longer than this shelf-life then there is a risk that it will be discharged from the store at a lower grade quality than when it was received. Some types of grain are more prone to quality deterioration than others. When bag stores are well kept and quality management procedures respected then maintaining the grade of good quality cereals is relatively easy for at least 12 months

MAINTAINING THE STORE EXTERIOR AND THE AREA AROUND IT

Maintaining the storage site exterior and there area around it is a very important contribution to the care of your grain stock. It is no less important than maintaining the store interior (which will be mentioned next). It is important to Maintain the boundaries of the storage site, so · the perimeter fence or wall is secure against unauthorised entry · there is adequate perimeter lighting · gates and doors are fitted with good quality padlocks Maintain roads and hard standing · have working drainage · have potholes filled · have sign posts to direct trucks and visitors Keeping the area adjacent to the store clear and neat · Make sure trees do not overhang the store or provide roosts and access for rodents or birds, if rodents are a problem see · All rubbish that might be hiding places for rodents or insects should be cleared , grass and other vegetation should be kept low.

MAINTAINING THE STORE INTERIOR

There should be a programme of planned maintenance which is strictly adhered to · Walls - keep clean, free of cracks and whitewashed · Floors – fill cracks with concrete and fill all floor joints with sand/ bitumen/cement mix to prevent food collecting · Fire precautions – have fire extinguishers in holders just inside doors and serviced regularly; have no smoking sign

DEALING WITH DAMAGED GRAINS

Provided there is good store management then no grain stock in a store should become damaged. Stocks should not suffer any significant insect damage as fumigations will have been ordered in time. Other quality decline will not have significantly reduced the grade of the grain since action will have been taken to discharge it before the end of the normal 'shelf-life' period. Nevertheless, most storage systems are not perfectly managed and delays in management action or failures of systems (e.g. room leaks) may result in damaged or unusable stock. Such stock may present a danger to the other grain in the store and as a decision about disposal may also be delayed then the stock can interfere with normal storage operations by blocking movements and taking up space. Where possible take the following action: The damaged stock should be sampled from the exterior of the stack and its condition verified by an independent grader. If insect infested it should be covered as soon as possible with a plastic sheet weighted to the floor to prevent cross-infestation to undamaged grain. On verification that it is damaged the grain should be moved to a location where it will cause least problem to store operations and present least risk to the good stock.

GOOD STORAGE PRACTICE

If grain is to remain in good condition from harvest to the time that it is to be consumed or sold, the farmer must follow the four pillars of good storage practice.

The Four (4) Pillars of Good Storage

- Ensuring that the crop going into store is in good condition.
- Keeping the store in good condition.
- Practising good store hygiene.
- Maintaining the condition of crop and store throughout the storage season.