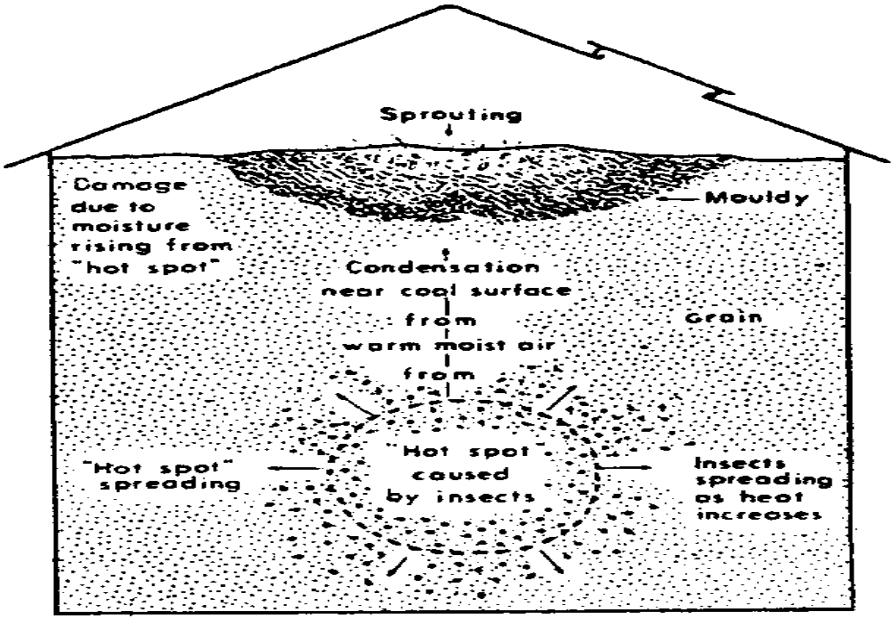
FOOD SECURITY BY IMPROVED STORAGE OF GRAINS AND PULSES

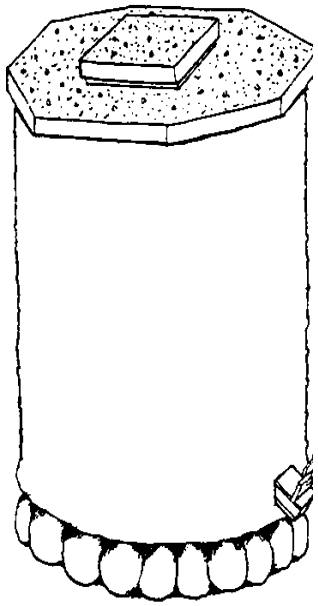
Causes of losses: Cereal stocks in Tanzania are mostly kept at households. An average household may store between 400-600 kg. although many households accommodate several tons of grains and pulses for consumption and sale. High post-harvest and storage losses are common. In Tanzania maize losses range from 20-100%, averaging 40%. Losses are mainly due to insects, rodents, heat, and improper drying, the last which allows growth of molds and aflatoxins.

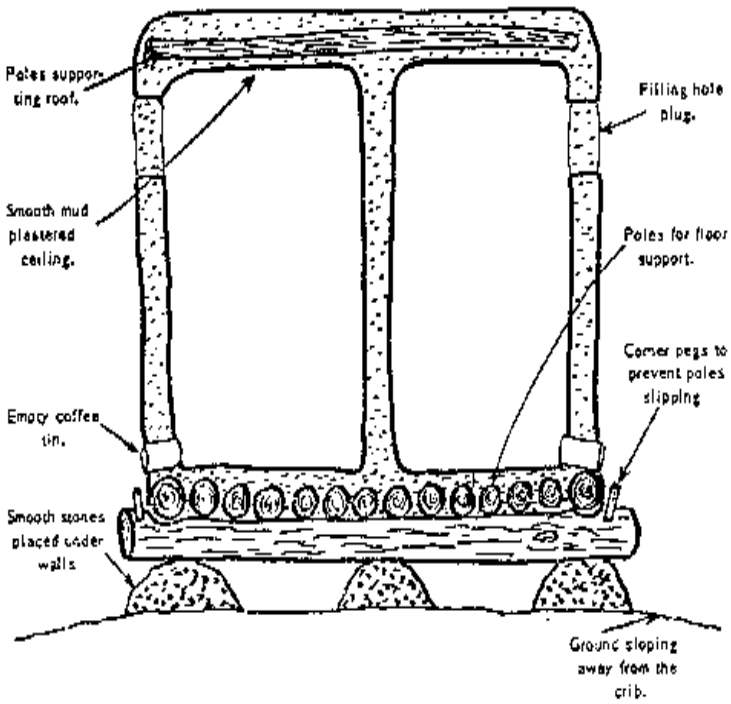


Common causes of spoiling of grains in storage

Insects and rodents must be denied access to the grains and pulses because they consume a part and spoil a larger part from their contamination by feces, urine and hair. Knowledge of which insects or rodents may attack the grains and pulses, and effective treatments to control them are essential. Alternatives such as plant-based compounds must be effective if they are to be promoted. Excessive moisture may allow dangerous aflatoxins making grains and pulses unfit for human consumption. Even small amounts may be carcinogenic and higher concentrations acutely toxic. Aflatoxin contamination in grains and pulses is especially severe after long-term crop storage whereby excessive heat, humidity, insects and rodents cause damage and enhance the spread of fungi. Rural populations are often exposed to high aflatoxins throughout their lives. Rural health data shows that more than 98% of children and adults have detectable amounts in their blood of a magnitude higher than those allowed by regulation in the developed world.

How to promote improvements: The potential demand for any technology needs to be tested by its intended users. The first step to identify an appropriate technology is to assess the needs of potential users. If storage losses are perceived to be high, the demand for improved storage technologies plus altering cultivation and post-harvest activities may be great. The potential for reducing high losses may motivate users to adopt new technologies. Successful economic and social analysis in the planning and design of storage interventions depends upon deriving improvements for which the perceived benefits outweigh the costs. Losses from grain storage may already be perceived as low and acceptable to farmers and traders who are likely to tolerate quite high storage losses before undertaking complex or expensive changes. Improved storage systems may not rank high among farmers' priorities. Traditional storage systems adapted to local conditions present less risk and need for re-education. The two pictures below describe improvements in traditional grain stores.



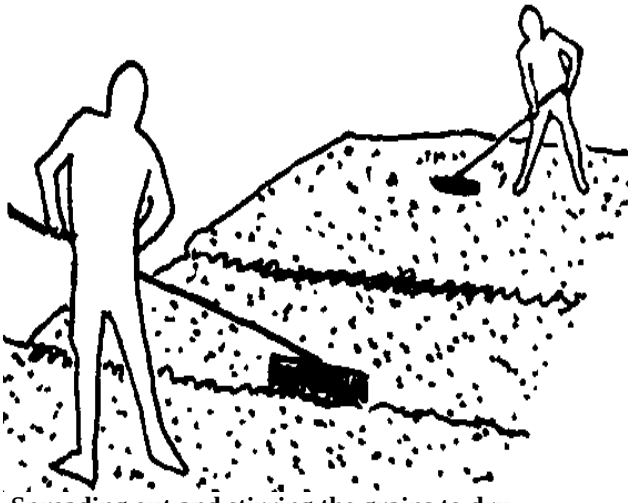


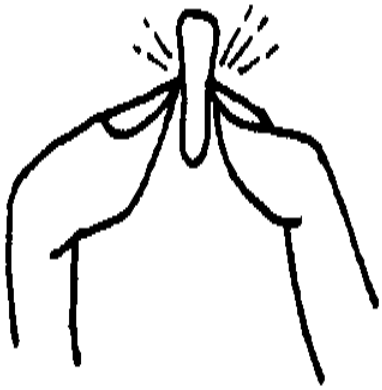
An improved mud store filled from top

Detail in construction of an improved grain store filled from the side, two separate chambers

Even if losses appear quite high, it may be that post-harvest problems do not rank higher than reducing labor or other costs. Grain mills may reduce labor but marginalize poorer women laborers whose source of income was from hand threshing and milling. Even where there is a demand for technical change, financial or labor constraints, or lack of materials and storage chemicals may limit adoption. Normally if an increasing proportion of grain production is destined for the market rather than for home use, this lends to improving storage requirements on the farm and elsewhere in the marketing chain.

Remedies to post-harvest grain losses: Improvement of post-harvest and storage facilities and techniques at household level can contribute to food security and be cost-effective. These will allow a continuous supply of food throughout the year either for domestic consumption or for trade, providing a reserve during droughts and selling when prices are more favorable.

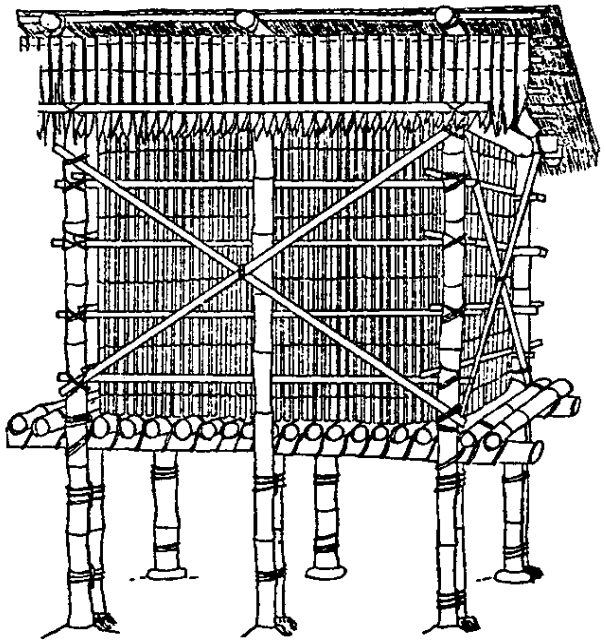




Spreading out and stirring the grains to dry

When dry enough, seed is very hard

Much attention should be given to proper drying and storage. A low moisture content of less than 12% can reduce insect multiplication and fungal growth. Better grain quality reduces exposure to dangerous aflatoxins and allows grains and pulses to fetch higher market prices. Remedies include the following:

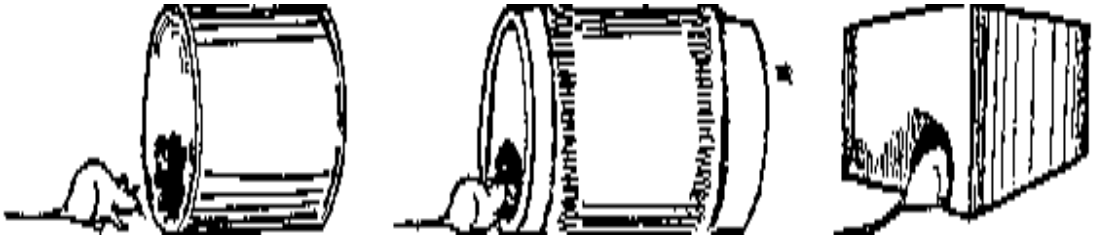


An improved crib using local materials, and hard for rodents to access grains

(Illustrations adapted from Volunteers In Technical Assistance/United States Peace Corps Manual PREPARING GRAIN FOR STORAGE VOLUME I by Carl Lindblad, Peace Corps and Laurel Druben,, VITA, 1980)

Improved post-harvest practices: sufficient solar drying – enabling the grains and pulses to be dry enough to store. This reduces their vulnerability both to insects and to fungal growth. Mold growth is prevented when grains and pulses are dry. Improvement therefore starts from harvesting where grain is properly dried. Sun drying should be improved by spreading grains and pulses on mats and plastic sheets to reduce the risk of soil contamination and susceptibility to humidity and to enable rapid collection in case of unexpected rain

(a) shelling maize instead of storing it on the cob may aid in drying and preventing growth of molds and aflatoxins.
(b) separating out grains and pulses which are visibly moldy and damaged, because cracked and broken grains and pulses enhance fungi growth and insect infestation**.**
(c) care in transportation can reduce physical damage and grain spilling. Losses should be reduced through improved packing, loading, handling, and keeping the seeds clean**.**



Safe rodent traps using tin cans, bamboo, or boxes, in which to place poison inaccessible to other pets

Improved storage: Storage life in cereal grains and pulses is enhanced by low temperatures and low humidity in storage. Improved and appropriate storage practices include:

(a) traditional underground pits lined with vapor barriers such as maize/sorghum stalks or better, plastic sheets. Grains and pulses stored in underground pits lose some quality but are still fit for human consumption after 1 year. Traditional underground pits have different shapes, sizes and depths and are mostly not lined with protective material so that the main problem is moisture

from the surrounding soil walls seeping into the store favoring the development of storage fungi and insects. Underground pits keep cool and cause a decrease of oxygen and increase of carbon dioxide concentration due to grain respiration making insects and rodents inactive. To improve their efficiency, good drainage systems should be dug around the pits or digging the pits in elevated areas. Stored grains and pulses may become unfit for human use if heavy rainfall is not adequately diverted. Moisture in pits favors fungal growth and aflatoxins.

(b) traditional above-ground storage bins, usually round or rectangular, built with the floors above the ground to reduce moisture, made from organic materials and lined with mud/manure or cement and thatched. These are of many different sizes and types. If well built they provide all the necessary elements for good grain protection from moisture, heat, rodents and insects. Modifying traditional storage structures [vihenge] with stronger barriers to moisture, rodents and insects, such as using cement or plastic, may be the most cost-efficient option in rural areas in Tanzania, but modifications should be tested.

(c) drums and metal bins which are impervious to rodents, moisture and insects are a good option where they are available and affordable. Recycled oil drums are relatively low cost and effective as on-farm storage containers for cereal grains and pulses. They should be placed in the shade, protected from direct sunshine and other sources of heat. Metal drums conserve market quality and value for up to 5 years, and are effective in humid and flood prone areas where underground pits are at risk.

(d) mixing plant-derived insecticides such as neem, tobacco, chili peppers or pyrethrum in the grain prior to placing in the existing storage systems often gives high returns. Burnt wood-, manure-, or rice husks- ash may also reduce insects. The main constraints may be availability of appropriate insecticide at the right time, stability of the formulations used, whether they are available in sufficient quantity to be economical, and whether they prove tedious and cumbersome. Some of these materials' effects have yet to be investigated but they are in common use for several years by farmers without known negative effects.

Other options:

(a) introducing varieties with improved storage characteristics – usually higher producing varieties also produce softer grains and pulses which are more susceptible to attack by insects, whereas smaller grains and pulses have harder seed coats. Sacrificing higher yields from new varieties in order to reduce susceptibility to storage losses potentially can reduce losses to pests.

(b) complementing high-yielding short season varieties and traditional varieties differently during the wet and dry seasons. By increasing cropping intensity further storage problems may occur if one of the harvests occurs in the wet season, making it difficult for farmers to dry the grain sufficiently for storage. Farmers in some areas grow high yielding varieties for immediate sale such as for roasting maize, and traditional varieties for storage and home use. In some cases labor constraints at harvest lead to early or late harvesting of the crop, with consequent losses and low prices. Combining use of these grain varieties and practices reduces the risks caused by high yields of grain all at one time of year which may force farmers to sell at harvest for lack of storage and in order to free up the labor for field preparation of the next crop.

(c) cooperative or community grain banks can be mobilized which can provide not only an improved storage facility for monitoring grain condition, but enable communities to obtain initial advance payment for a crop, with an second payment when the actual sale of grain stocks is delayed until prices rise, thus increasing incomes to farmers. Training in the management of community grain banks, proper record keeping, building trust among members and good leadership are essential.

(d) engaging the private sector may be possible to buy up and store surplus produce. However, generally in Tanzania, traders and millers are not heavily engaged in storage, requiring farmers to maintain their storage activities.

(e) care in storage – select only healthy grain for storage; placing new grain apart from old grain; filled grain bags on wooden slats or poles to keep off the floor; repacking with insecticides every 3-4 months; shelling before storing of maize; keeping grain store clean; watching for signs of rodents, birds, insects.

(f) using integrated pest management = reduced chemicals; use burnt manure ash or neem seeds and leaves to cover the seeds before storage; pack in sealed, water-proof containers; analyze local methods of pest management and choose the most effective.