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Post Harvest Storage as a Rural Household Food Security Strategy in Tanzania

Albinus M. Makalle
Research Fellow, Institute of Human Settlements Studies, ARDHI University, Tanzania

ABSTRACT

The main cause of food insecurity resulting into low income and poverty experienced by smallholder farmers is low crop and animal productivity. However, in rural developing countries some of the factors of food insecurity include post harvest losses. Based on this premise a study was conducted in 2005 to assess the effectiveness of post harvest storage facilities, with emphasis on rural household grain storage structures as part of a larger study to address the issue of food security at household level. Using sample survey to complement PRA methods in selected regions of Morogoro, Dodoma and Rukwa, causes of the limited success enjoyed by certain innovations was explored as well as the insufficient consideration of the needs of the actors involved in the development of the post-harvest systems in particular grain storage structures. Account was taken of the socio-economic aspects and requirements in the post harvest system in order to better understand and anticipate future technological changes. It was established that the ability of smallholder farmers, individually or in groups to effectively and efficiently store a significant part of their harvest at farm level, is a major contributing factor for attaining food sufficiency and eliminate wide spread hunger in the region. This was in particularly true in Kongwa District (in Dodoma Region) semi-arid area/climate where grain pests are prevalent in causing high losses.

Keywords: *Food security/insufficiency, post harvest losses, grain storage facility/structure***.**

1. INTRODUCTION

Food Security is much more than food quantity. More often than not, the issue is about access to existing food, and about the quality of this food. Food security is defined as physical and economic access to sufficient, safe and nutritious foods, which meet the individual's dietary needs and food preferences for an active and healthy life [1]. Food Security can be a survival issue in extreme cases. In many more cases, it is an issue of development, and an issue of human right. Income poverty has been proved to be very closely related to food insufficiency as captured in the Tanzania national accounts. It is reported [2] that since the 1999/2000 season, the food Self Sufficiency Ratio (SSR) has fluctuated between a low 88% (2003/04), 112% (2006/07) and 104% in 2007/08. However, in poor seasons Tanzania as a whole is vulnerable to serious food shortages due to low production and inadequate storage capacity [3].

Figure 1 shows the three key dimensions to household food security as food availability, food access, and utilization of food by the body. Food availability is related on farm production and where there is insufficiency (stock imbalance), it is imported for local consumption.

Access itself is more complex than the popular image of emergency work, moving food to an area where the population is in danger of starvation [1]. Access to food needs to be continuous, adapted in quantity and quality to the needs and the traditions of the different members of a population. Food security can be strengthened through the minimization of post harvest losses, which otherwise lead to too much of the harvest being wasted.

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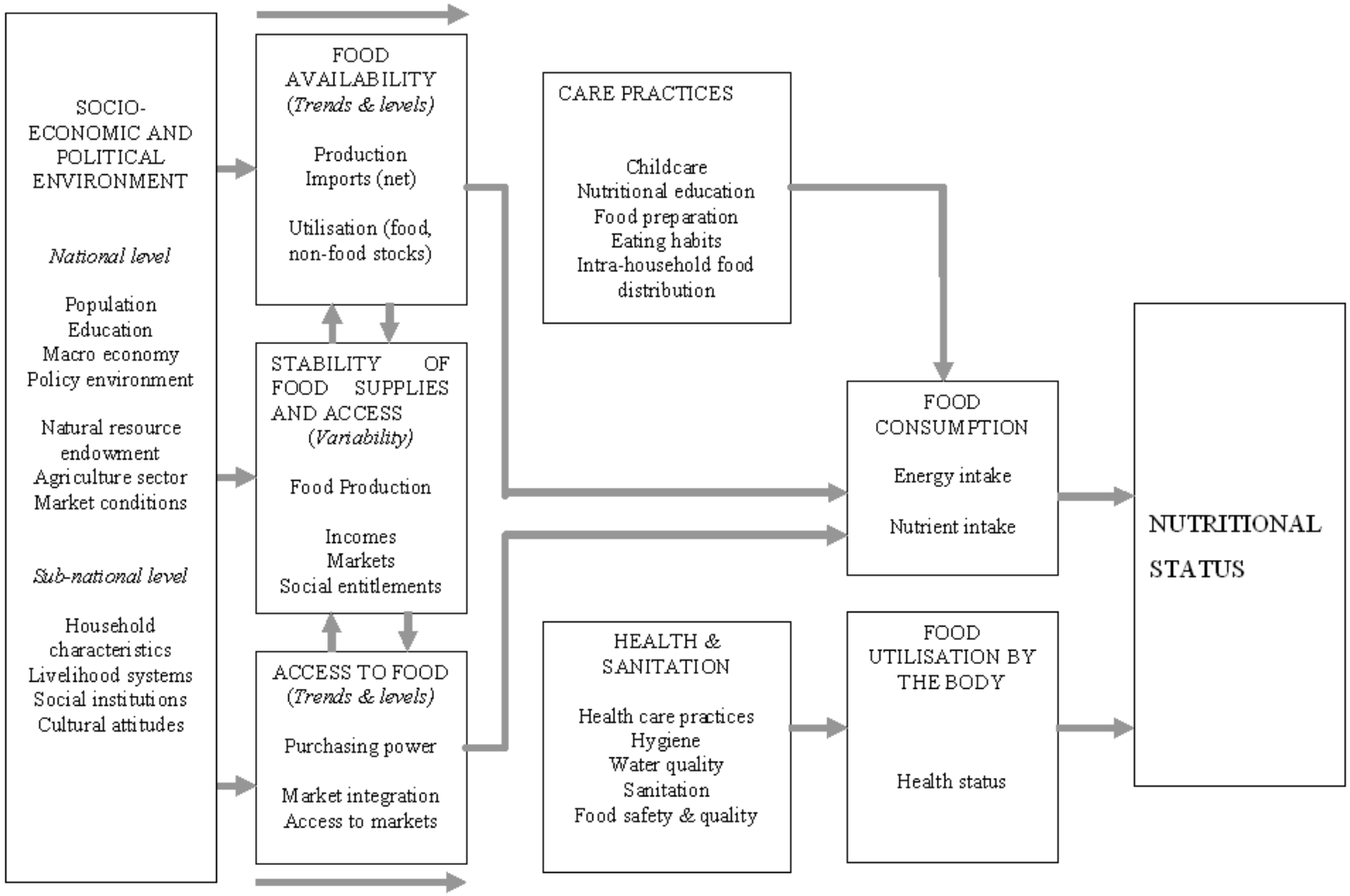

Fig 1: Multiple Factors of Household Food Security [4](Source: UN, 2000)

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Thus, the reduction of post-harvest losses in grains at household level is but a strategic action towards food security. The objective of the paper therefore, is to highlight deficiencies of existing rural household grain storage facilities in Tanzania towards improved access to food.

2. MATERIALS AND METHODS

2.1 Study Area

The selected project sites were in Dodoma, Rukwa and Morogoro Regions. Reasons for selection of these sites were: Dodoma is semi arid and dry area in central Tanzania with a long history of food shortage and post harvest losses [5]. While Rukwa is one of the big four regions in maize production but with poor infrastructure and a history of post harvest losses, Morogoro has the characteristics of coastal weather and being close to Dar as Salaam region, which is the major market of food products, provides a comparative scenery for food storage systems to the others. In view of the need to focus the study and concentrate on the effectiveness of traditional grain storage structures against spoilage vectors, the area selected was Dodoma region.

2.2 Research Design

The study employed different approaches that necessitated both quantitative and qualitative data collection. As Strauss and Corbin [6] have pointed out, quantitative and qualitative techniques are tools that play useful complementary roles. A rapid loss assessment method for estimating storage losses in maize developed by Compton and Sherington [7] was used in the study. The method attempts to incorporate farmer criteria in defining categories of loss, and since the measurement occurs in the field, rather than at a laboratory, results can be discussed with farmers on the spot [8]. While the quantitative methods were used to establish the nature and extent of traditional grain storage facilities, the qualitative methods provided the means of exploring perception of farmers in grain storage and gaining deeper insights of specific grain storage technologies.

2.3 Sampling and Data Collection

The farmers, involved in the study, were determined by the importance of maize production in each district. The maize production figures used to draw the sample frame were extracted from the regional agricultural office corroborating those of the Districts. The selected sites corresponding to Districts in Dodoma Region, the focus of the study, were:

- Lamaiti in Dodoma rural, which is characterised by low rainfall and low elevation and has low potential for maize production;
- Mbane in Kongwa District, which is characterised by medium rainfall and medium elevation and has a medium potential for maize production; and
- Ihanda village in Mpwapwa District, which is characterised by relatively high rainfall and elevation, and has potential for maize production.

From each village, 18 farmers were randomly sampled from the register of households. To increase validity and reliability, farmers were interviewed using structural questionnaire which was developed by the researchers, pre-tested in Morogoro and Rukwa regions and then refined in collaboration with regional, district agricultural officers and extension officers.

2.4 Data Analysis

Analysis of qualitative data (socio-economic characteristics) in the study was a continuous process in order to identify patterns emerging from the interviews and concretized the objectives and research questions. These were then used as a new study guide during the data collection process. In addition to manual techniques, the statistical packages for social sciences (SPSS) were used to arrive at concluding evidence.

3. RESULTS AND DISCUSSION

3.1 Storage Facilities

a. Kilosa (Morogoro Region)

Data obtained from the District Agriculture Officer with subsequent interviewing key informants, revealed that there were efforts which had been taken by the District in collaboration with Non-Governmental Organisations to build improved food storage facilities in some villages, with the aim of improving the existing techniques of food storages (Table 1).

Table 1: Village Go-down Report May 1992 Kilosa District

Go-down	Capacity (Ton)	Materials
Kilosa District ware house	200	Burnt bricks, Asbestos
Ruhembe village Go-down	100	Concrete blocks, Corrugated iron sheets
Ukwamani village Go-down	100	Burnt bricks, Corrugated iron sheets
Dumila village Go-down	100	Concrete blocks, Corrugated iron sheets

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Luhwaji village Go-down	100	Concrete blocks, Corrugated iron sheets
Madudumizi village Go down	300	Concrete blocks, Corrugated iron sheets

The village Go-down Project had built six (6) go-downs since it started in 1989. However, the following were the main findings regarding the use of these built go-downs:

- Villagers were making very little use of the go-downs. They were being used holding meetings and seminars; and
- Most of the go-downs had little or no safety precautions for safety and security against theft and fire, given the fact that insurance of the go-downs is of great importance.

As the villages' Go-down Project failed, the District in collaboration with the Food and Agricultural Organisation (FAO), took another initiative of establishing yet another project called "vihenge" project. Some few "vihenge" (Figure 1) were built in some villages for demonstrations. See the construction details below.

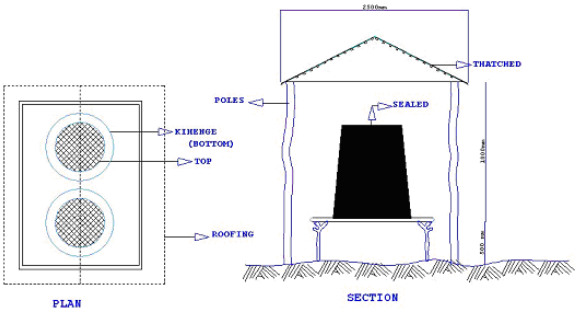

Fig 2: "Kihenge" Construction Details

The plan and section of "kihenge" (Figure 2) shows material and construction techniques used in construction of "kihenge" as well as its size. This type of storage is suspended about 0.5 metres above the ground to protect it from moisture, then a platform or a timber deck is nailed to the wooden stands on which the main structure is fixed (Figure 2). To ensure that the grains are well protected from insects and adverse weather conditions, the storage is sealed and enclosed with a bigger structure constructed by mud and poles and roofed by thatch. As the drawings show (Figures 2 and 3), the material used are readily available in their locality i.e. cow dung, mud and poles.

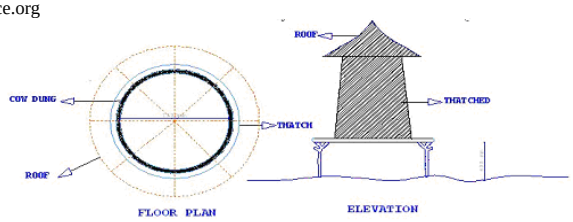

Fig 3: Alternative "Kihenge" Construction Details (Source: Field Visit, 2005)

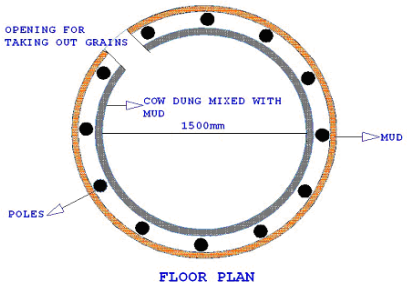

Fig 4: Kihenge Floor Details

Another method of "kihenge" construction is done by construction a platform approximately 0.35 metres above ground, supported by bricks that are erected on the ground. The sacks/ bags containing grains to be stored are protected from weather elements by means of an enclosure constructed using wooden boards see above plan and section.

The villagers again made no use of the constructed "vihenge", their reasons being that:

- They are expensive;
- They cannot be placed within the house because it takes a big place; and
- Since they are placed outside, the safety of the grains has no insurance/guarantee.

Therefore the project also died/ceased to operate in the same way as the Go-downs project

In Kibaoni village, it was observed that food storage systems and facilities that do not meet the minimum standards, thus risking the safety of the food considerably, were commonly used. Apart from Kibaoni villagers, a number of other villagers throughout the region were found to use the same storage system (Plate 1).

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(a)


(b)

Plate 1: Grain storage: Plastic Tins (a) Baskets and Nylon Bags (b) placed over a raised wood platform


(a)


(b)

Plate 2: Grains Storage Facilities: Dark Room - without a single window (a); Same House the Householder Sleeps with livestock

b. Sumbawanga (Rukwa Region)

In many villages of Sumbawanga District, the most common grain storage facilities were found to be of two types, Bags and "Vihenge" (known as Ntanta in the area)". Bags as storage facilities are normally placed on a deck constructed by use of poles/sticks and stone to raise the bags from ground and protect the bags from moisture and pests like mice and rats. "Ntanta/Vihenge" is of two types:

(i) Portable "Ntata/Vihenge": These are made on reeds ('matete') only and the volume is such that it takes the amount of grains, which is going to be stored in it. For example 'Ntata' for 25 bags is put on a deck like that of bags storage facilities but the deck must be finished using clay soil at the top deck. The 'Ntata' is located in a house and not outside since the upper top is left open.

(ii) Fixed 'Ntanta': This type of has two construction types of thatched and mud clay material. The thatched 'Ntanta' is mostly used to store beans. Long thatch material is rolled in at least diameter of about 1.5m then the inside of it is plastered with cow dung to make it smooth and protect the store food grains from pests like termites. The mud-clay 'Ntanta' is constructed by using sticks, mud clay and cow dung. The clay soil is used outside and the inside cow dung.

In any case for both types a deck is necessary to place them from the ground. Where the 'Ntanta' has to be placed outside the house, and then it is necessary to have a roof made of thatch. When it located under a shade then it is sealed at the top normally with a clay soil made cover.

c. Kongwa (Dodoma Region)

Dodoma is almost semi-desert region as it receives very little annual amount of rainfall below 500-650mm. Hence most of the crops grown in the region are those that can withstand prolonged drought. Mostly grown cereal crops to tolerate drought conditions include sorghum, millet, sunflower and groundnuts.

The ability of smallholder farmers, individually or in groups to effectively and efficiently store a significant part of their harvest at farm level, can be a major contributing factor for attaining food sufficiency and eliminate wide spread hunger in the region. This is in particularly true in Kongwa District semi-arid area/climate where grain pests are prevalent causing high losses.

The traditional storage systems observed in Kongwa District include indoor storage and communal village storage facilities. Indoor storage observed in respondents' households included:

- Maize cobs packed in sheaths stringed and hanged above fire place for seeds;
- Maize cobs and groundnuts kept in nylon/sisal bags or laid on bare ground;
- Millet stored in a sewn cylindrical container 'LINDO – (known as Idona in the area)' with walls of mud, cow dung, straw and wattle or from local reeds; and
- A specific storeroom but within a dwelling house.

Communal village storage facilities include large cribs (Plate 3) are used to store crops (millet or maize, etc) for a group of farmers. They are storage facilities that were found in Kongwa district, though they are not a common feature and are not frequently used. The cribs are constructed from burnt bricks and/or stones bonded with mortar, and are mostly round in shape and about 2 metres high. They are roofed with corrugated or plain iron sheets nailed to stretched timber sections, and a very small window or void is left for ventilation at the eve of the wall. The floor is elevated/ raised and made of cement or stones. They are the most expensive of all storage facilities observed, given the nature of construction and building materials used.

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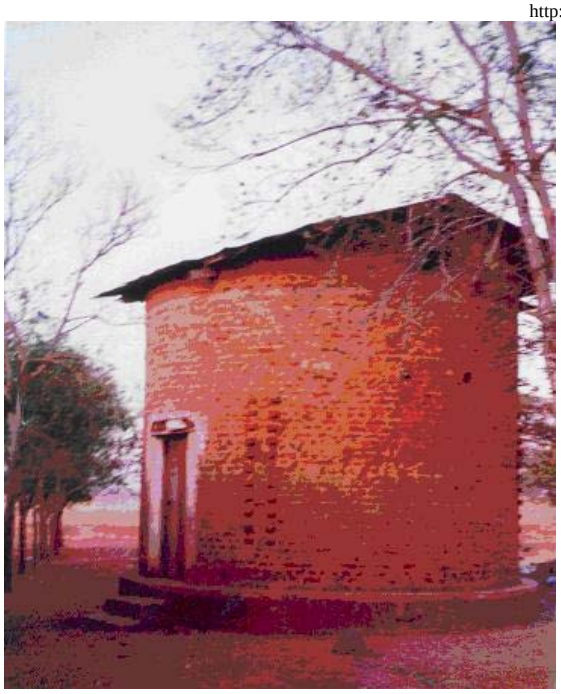

Plate 3: A typical Crib to Store crops

The above-pictured cribs were a type constructed during colonial rule. From their traditional knowledge, the natives developed traditional cribs which are storey like, constructed on pieces of tree trunks erected on the ground, and they may be open-roofed or with a thatch roof, despite being outdoor food storage facilities, making them prone to rain or excessive sun, and other vectors of damage to the stored food.

Indoor storage containers are for storage of small quantities of grain for seeds or other purposes. Various types of containers are used at smallholder farmer level for indoor storage throughout. These include:

- Gourds, nylon bags and jars: storage is done by filling the nylon bags with grains (Maroba), which are then placed over a raised wood platform, inside the house. Here grains are stored in locally woven baskets that are placed over wooden platform, the aim of placing on the platform being to save the grains from moisture absorption. However, this protects the grains against moisture only to a small extent and the grains are therefore vulnerable to moisture after all.
- Sewn cylindrical containers 'LINDO': cylindrical "containers" are constructed using bamboo sticks or other similarly thin but strong sticks that are very closely interwoven to make them as air-tight and moisture-tight as possible (Plate 4). They are erected directly on the ground and no deck is provided inside onto which to lay the grain sacks.

Plate 4: Woven baskets of various shapes and materials

These are indoor facilities in a manner that, they are constructed first and then rolled over to a selected space/room inside the house, where they are erected. These facilities are however not able to protect the stored food against moisture to the required extent, particularly the ground moisture, and also against other elements of weather that damage the stored food.

- Oil drums and a variety of tins with or without lids: Metal drums of approximately 200 – 240 litres capacity are cleaned after removing the oils, dried and used to store grains. They are arranged on top of timber or wooden boards lay on the floor.
- Nylon or sisal/jute bags (Plate 5): These are increasingly becoming popular for indoor storage for maize grains. It is type of indoor food storage means where the dried grains and filled in the nylon woven bags or sisal sacks of approximately 100 kg, and are placed on top of burnt bricks. As for most of the storage faculties, this type of storage makes the food become vulnerable and exposed to damaging weather conditions, and also rats, which like to live in such dark areas and can easily tore the bags and feed on the stored food.
- Another means of storage that was found to have a very close similarity with this is Grain storage using plastic baskets and Nylon bags placed over a raised wood platform.

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Plate 5: Nylon or Sisal Bags for Food Storage

3.2 Effectiveness of the Grain Storage Facilities/Structure to Post Harvest Storage Losses

As discussed in the previous sections, existing grain storage facilities, in rural Tanzania, have varying degrees of effectiveness for grain storage purpose. Based on this finding farmers perception and estimation of losses was investigated.

Due to insects investigation was based on several criteria including quality of conservation between varieties of cereals and period of infestation. Through structured interviews with farmers it was revealed that farmers find it difficult to estimate losses caused by insects, on the other hand they can precisely identify the infestation period. Generally, it was affirmed that insects were causing great grain losses.

In all study areas it was confirmed that high humidity, even during the short dry season, favours development of the principal storage pests: Sitophillus spp (weevils) and Prostephanus truncates (Larger Grain Borer). According to information received from the farmers, losses caused by insects after six months storage were 2% to 3% for husked maize cobs, excluding losses (up to 15%) in threshing from grains spoiled by insects after three months storage. The appearance of the Larger Grain Borer raises doubts as to the effectiveness of granaries and traditional techniques.

In Rukwa region however, climatic conditions do not favour the proliferation of common insects during the first five months of storage (December to April). In May, higher humidity provokes the appearance of insects. Species observed on sorghum and millet in ear ere Corcyra cephalonica (Rice Moth), Rhizopertha dominica (Lesser Grain Borer) and Tribolium castenum (Rust Red Flour Beetle). The wastage caused by the Rice Moth was small since it was limited to the upper 20cm of the stock.

3.3 Other Causes of Post Harvest Storage Losses

a. Moulds

The development of moulds is linked with specific atmospheric conditions (temperature and humidity) as was the case with Kilosa (Morogoro region) humidity is very high, making some “Vihenge” to be unsuitable grain storage facilities.. In Sumbawanga (Rukwa region) and Kongwa (Dodoma region) the climate does not favour the growth of moulds, and granaries installed on platforms are conveniently isolated from the soil. Except where water infiltrates through a defective roof, farmers do not report any cases of moulding in their granaries.

In some areas of Kongwa, Mbande ward serious losses were revealed following the transfer of humidity through the mud floor of granaries, the only screen between the soil and the grain. Where the storage of maize cobs, millet or sorghum is on the ground moulds appear in the lower layers of the stock.

b. Rodents

For most villagers, the presence of mice in granaries was said to be almost permanent. Present in straw granaries, they equally find their way into clay granaries through the roof or by making holes in the base and in some severe case they caused the granary to collapse. In the village of Mbade (Kongwa) rats appeared in large numbers some ten years back. They caused serious wastage of the stored produce (as much as 20% loss per year) both by their consumption and faecal contamination.

c. Theft and Fire

Increasing importance of theft was reported in all study areas as a consequence of the lack of food due to persistent drought periods. The fear of theft is a factor used in determining the choice of storage technique. Farmers increasingly see themselves forced not to store most of their harvests on farm. In Kilosa some farmers were found to prefer storing paddy in their huts or shops, even if they knew that the method was not favourable to conservation.

Straw granaries are subject to fire risk and are therefore constructed away from dwellings. In Sumbawanga villagers have adopted bulk storage in clay Vihenges with metal roofs for fear of fire, even if this type of storage is less effective. Under socio-economic pressure granaries may be built near habitations or in improvised locations to the detriment of storage conditions and despite the fire risks.

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4. CONCLUSION

Existing rural villages household means of grain storage are the result of the evolution of ingenious empirical systems. Through the generations, farmers have developed their own techniques, often very elaborate and masterly. Apart from storage function, the granaries and other tradition structures are designed to reduce to a minimum losses caused by the principle enemies of the harvest: insect; moulds; rodents; and fire. Proliferation of insects and moulds depends on climatic factors (humidity, temperature and interstitial environment of grain). However, the presence of rodents, termites, fire and theft was found to be linked to the techniques of construction of food storage facilities (location, materials and types of architecture). Evaluation of wastage through storage in traditional grain storage facilities has only been subjected to precise measurement recently. There is need to improve them to maintain quantity and nutritional values.

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