

# A PRACTICAL APPRAISAL OF ON-FARM STORAGE LOSSES AND LOSS ASSESSMENT METHODS IN MALAWI

## 2: THE LILONGWE LAND DEVELOPMENT PROGRAMME AREA

by

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### **Abstract**

A survey of farm level storage losses in Central Malawi showed that overall losses were low. Mean losses of maize and groundnuts, by weight, were less than 1.5 per cent and less than 1 per cent respectively. Such losses demonstrate the suitability of local crop varieties and methods of storage to conservation in this area. The likelihood of increased losses of higher yielding but more susceptible varieties of maize, if these are introduced, and the consequent possible need for insecticides, which are not needed at present, are noted.

### **Résumé**

Une étude, portant sur les pertes de stockage enregistrées au niveau des exploitations agricoles situées dans la région centrale du Malawi, a montré que les pertes globales étaient faibles. Les pertes moyennes de maïs et d'arachide, par poids, étaient inférieures, respectivement à 1,5 et 1%. De tels chiffres démontrent l'adaptation des variétés de cultures locales ainsi que des méthodes de stockage pour assurer la conservation des récoltes dans cette région. Il est pris note que des pertes accrues seraient vraisemblablement enregistrées si des variétés de maïs à rendements plus élevés mais plus susceptibles étaient introduites et de la nécessité possible, en conséquence de la mise en oeuvre d'insecticides qui, à l'heure actuelle, ne sont pas nécessaires.

### **Resumen**

A través de un estudio investigativo realizado en Malawi Central sobre las pérdidas de almacenaje registradas a nivel de granja se demostró que el total de pérdidas fue bajo. La media de pérdidas de maíz y cacahuete, al peso, fue inferior al 1,5% y al 1% respectivamente. Dichas pérdidas demostraron la idoneidad de las variedades de cosechas regionales, así como los métodos de almacenaje de conservación en esta zona. Se observa la probabilidad de un aumento en las pérdidas si se introducen variedades de maíz de rendimiento superior pero más susceptibles, así como la resultante necesidad de utilizar posiblemente insecticidas, los cuales no son necesarios en la actualidad.

### **Introduction**

In 1978/9, food losses during storage of maize and sorghum in the Shire Valley Agricultural Development Project (SVADP) area in Malawi were surveyed (Golob, 1981). The losses during the storage season were very low, approximately 3 per cent of the maize and 2 per cent of the sorghum stored, primarily because of the short duration of storage. The SVADP is an atypical area because it is much hotter and drier than the rest of the country and it is a maize deficit area, maize being the main staple of Malawi. In the following season, 1978/80, a similar survey to assess farmer storage losses was undertaken in the Lilongwe Land Development Programme (LLDP) area, which has a high production of maize and is climatically more typical of Malawi than the SVADP.

This agricultural development area is situated in the Central Region of Malawi. It is mostly highland plain at approximately 1200 metres above sea level. It occupies 460,000 hectares west of the town of Lilongwe, bordering Mozambique on its western and southern extremities. The LLDP has a single rainy season which begins in the latter half of November and ends usually at the end of March. Most of the rainfall, 75-80 cm each year, occurs between December and February. The mean monthly temperatures range from 15°C in June to 24.5°C in November.

Maize is the main staple and is grown by all farmers. Most farmers grow a 'local' variety of maize which has lost some of its pest-resistant properties by being crossed, over the years, with recommended, high-yielding composite and hybrid varieties. Local maize is stored for home consumption. Composite and hybrid varieties are grown as a cash crop by some farmers for immediate sale, after harvest, to the marketing board.

The second most important food crop grown in the area is the groundnut. The majority of farmers cultivate groundnuts both for local consumption and for sale. The predominant variety cultivated is a very high-yielding confectionery variety, *Chalimbana*.

Other food crops grown include beans and sweet potatoes. The major cash crop in the area is Western Dark-Fired tobacco.

All the maize that remains on the farm after harvest is stored undehusked in the traditional Malawian cylindrical *nkhokwe*. This structure is similar to that found in the SVADP area (Golob, 1981), but is generally much wider, having a diameter of up to 4.5 metres. Groundnuts are similarly stored but in smaller, less durable structures than those used for maize. Often the groundnut *nkhokwe* is mudded on its external surface to prevent damage to the nuts by livestock. Groundnuts are also stored in hessian sacks or in gourds or clay pots. The nuts are always stored unshelled.

### Procedure

*The survey sample.* The topography and cropping patterns of the LLDP were reasonably constant so that the whole populated area could be included in the survey. By stratified random sampling eight farmers were chosen from a single village in each of 17 extension units, giving a total of 136 farmers. Two reserves were chosen in each village but in only two of the villages were substitutes needed.

*Survey procedure.* At the first visit, made soon after the stores were filled, the amount of produce put into the store by the farmer was calculated from the dimensions of the store and the height occupied by the produce. The volume of produce was expressed as the number of baskets it would occupy by dividing the volume by the capacity of the farmer's basket. Each farmer was instructed to use only one basket to remove food from the store and to level-fill the basket each time. Some farmers filled the basket with cobs when removing maize from the store, others shelled the cobs and filled the basket with grain. Although they were instructed to maintain their pattern of removal subsequent visits showed that farmers were not consistent in removing either cobs or grain and consequent adjustments to the data were necessary. Every four weeks the extension staff from the LLDP visited the farmers to question them about grain utilisation. Information was collected by using a questionnaire that was comprehensively tested in the area, before the survey began, to ensure that it was understood by the extension staff.

Visits made by extension staff were at relatively constant intervals and the information retrieved from the farmers in the LLDP was generally reliable. However, there were occasions when visits were omitted so that the missing data had to be extrapolated. As a check on consumption patterns a visit was made to many farmers just before the storage season finished when the produce remaining in the store was calculated from the volume it still occupied.

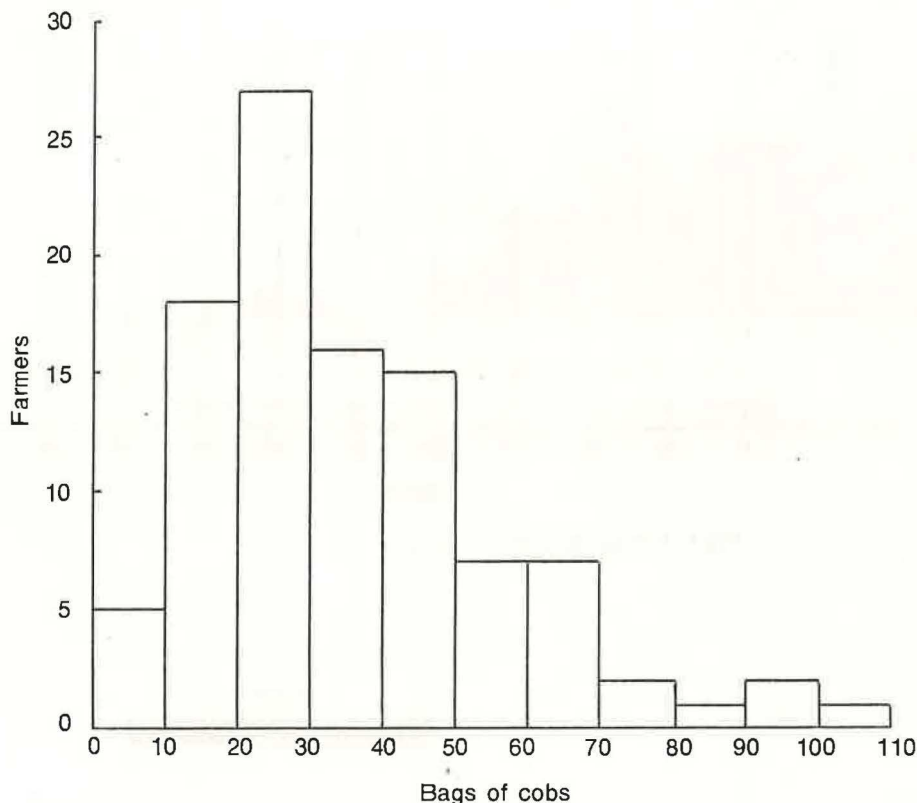
*Collection of grain samples.* At each visit the extension officer collected eight maize cobs and approximately 0.5 kg of unshelled groundnuts. In exchange he gave the farmer 1 kg of maize grain and 0.5 kg of groundnut kernels. This arrangement was fully acceptable to farmers as they received more than they gave. To reduce the cost of purchasing groundnuts, which are relatively expensive, uninfested nuts from the analysed samples were used in the exchange.

*Sample analysis.* Two methods of assessing loss of weight due to insect damage, described by Golob (1981), were used to monitor losses in maize samples. Losses in groundnut samples were assessed using only one method, by calculating the average weight loss of individual grains after sorting, counting and weighing damaged and undamaged grains in the samples.

From aggregate samples of uninfested maize grain collected from farmers in the area a graph was plotted of the standard volume weight (SVW) against different grain moisture contents. The curve was used as a reference standard from which losses from samples were calculated. As occurred in the SVADP survey (Golob, 1981), the reference maize samples were not always representative of samples collected later, some of which had different physical grain characteristics. When this occurred the initial comparisons with the reference curve indicated false losses, sometimes as high as 5 per cent. Subsequent samples showed the same levels of loss, there being no increase in damage during the following months. For these samples a correction was applied so that the initial value was regarded as zero.

## Results

**Maize.** Results from 35 farmers, including 11 who died during the survey period or moved away from the area and those from whom samples were not received on several successive occasions, were omitted. The remaining results from 101 farmers were used to compute their losses. Most of the maize had been cut in May but then stooked for many weeks before being transported to the stores. Sixty-seven of the farmers filled their stores in June, 25 in July and 14 in August. The mean number of bags of cobs stored by each farmer was 36, equivalent to 14 bags of grain. The distribution of the range (3-108 bags of cobs) is shown in Figure 1.



**Fig 1 Quantities of maize stored by farmers.**  
(One bag of cobs is approximately 0.4 bags of 90kg shelled grain)

Seventy eight of the 101 farmers stored more than the equivalent of eight bags of shelled grain, the amount required for an average family of two adults and three children for a year. Unlike the SVADP area, most farmers stored grain into the rainy season. Some farmers had produce in store for more than 40 weeks (Figure 2) and almost half of them stored for 26-40 weeks. However, less than 40 per cent had any maize remaining in store after February (Figure 3), when the following harvest was still three months away.

Very little of the maize was damaged during the period before the rains commenced. From December 1979 the damage by insects increased and by the end of the survey, in May 1980, some samples were found to show 10 per cent loss. However, very little food was left in the store when samples showed heavy damage so the amount of loss evident at these occasions represented only a very small portion of the total quantity stored. Thus the losses sustained, measured by either method, were very low (Figure 4). The mean loss sustained by farmers was found to be 1.4 per cent or 0.9 per cent by the SVW and count-and-weigh (CW) methods respectively, including the quantities of maize reported by the farmers to have been discarded.

**Groundnuts.** Of the farmers who grew groundnuts 60 per cent harvested their crop in June, 22 per cent in May and the rest in July. Most farmers (53 per cent) harvested less than four bags of nuts (Figure 5), though a few produced more than 20 bags. Most of this was sold soon after harvest and very few farmers kept more than two-three bags for their own use. Consequently the storage periods were short. Nearly half of the farmers (45 per cent) had consumed or sold all their nuts within 14 weeks of harvest (Figure 6) and only 8 per cent had any left after 30 weeks. Three quarters of the farmers had no groundnuts in storage at the onset of the rains at the end of November (Figure 7); only two farmers had groundnuts for consumption by the following February.

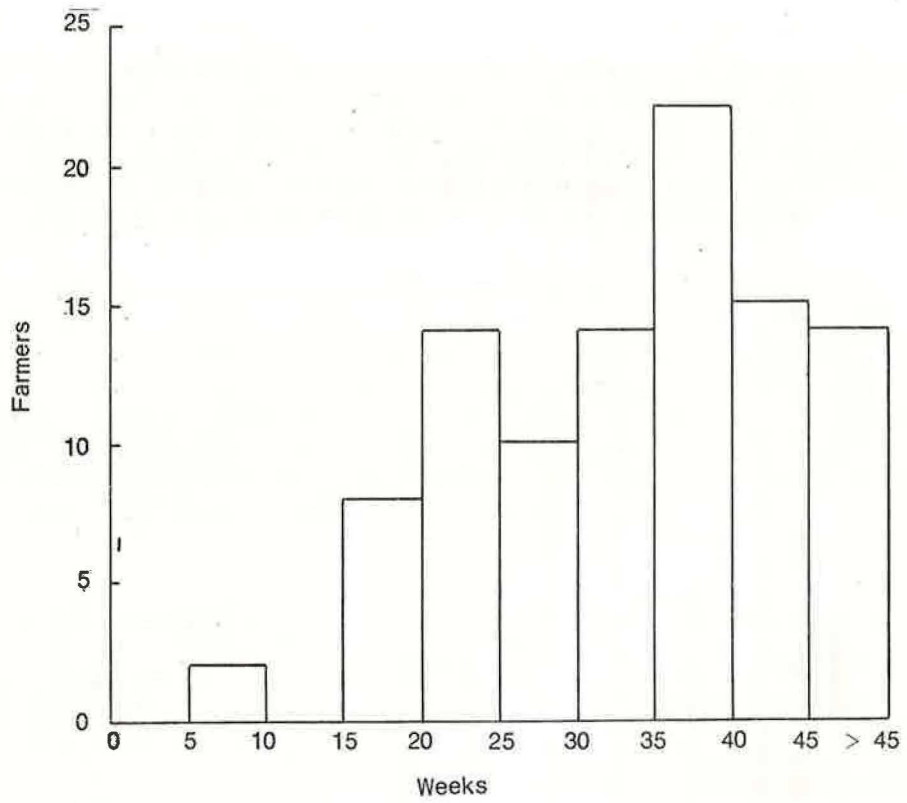


Fig 2 Storage periods for maize.

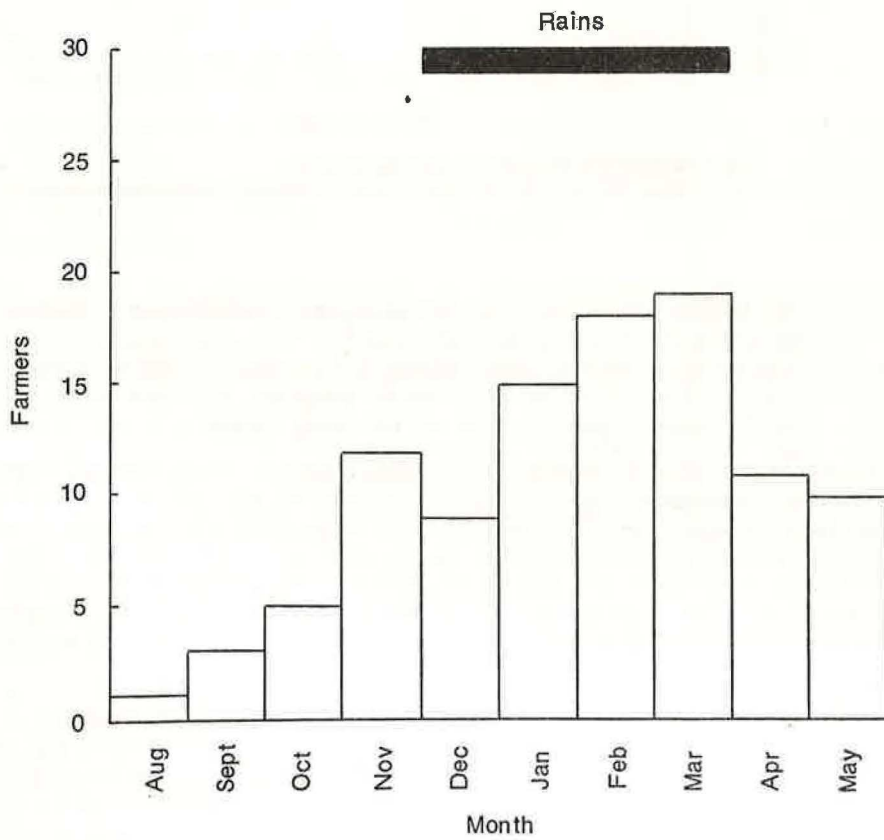
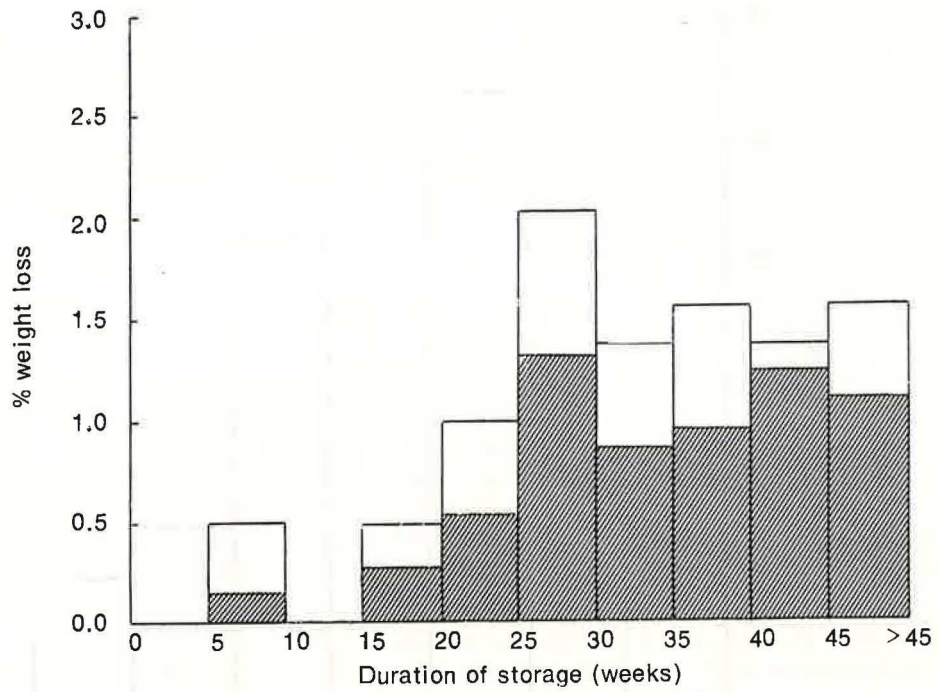
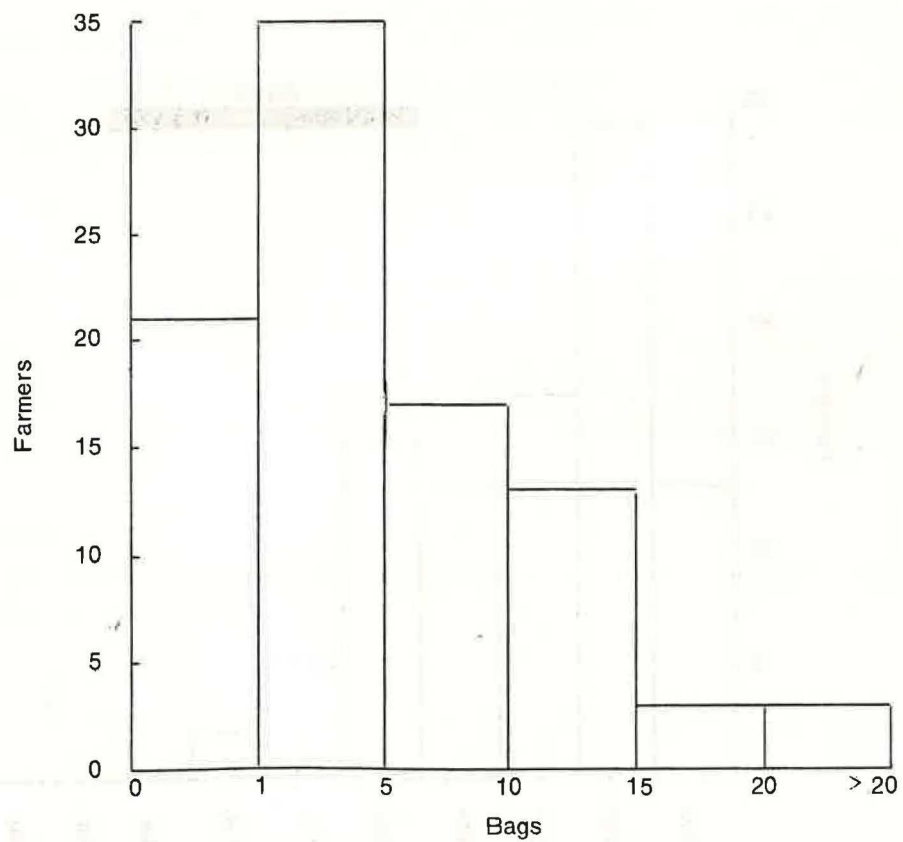


Fig 3 The dates at which maize stores became empty.



**Fig 4 Percentage weight losses of maize during storage.**  
 Hatched areas: loss shown by the counting and weighing method.  
 Solid areas: additional loss shown by SVW method.



**Fig 5 Quantities of groundnuts stored by farmers.**  
 (One bag holds about 90 kg)

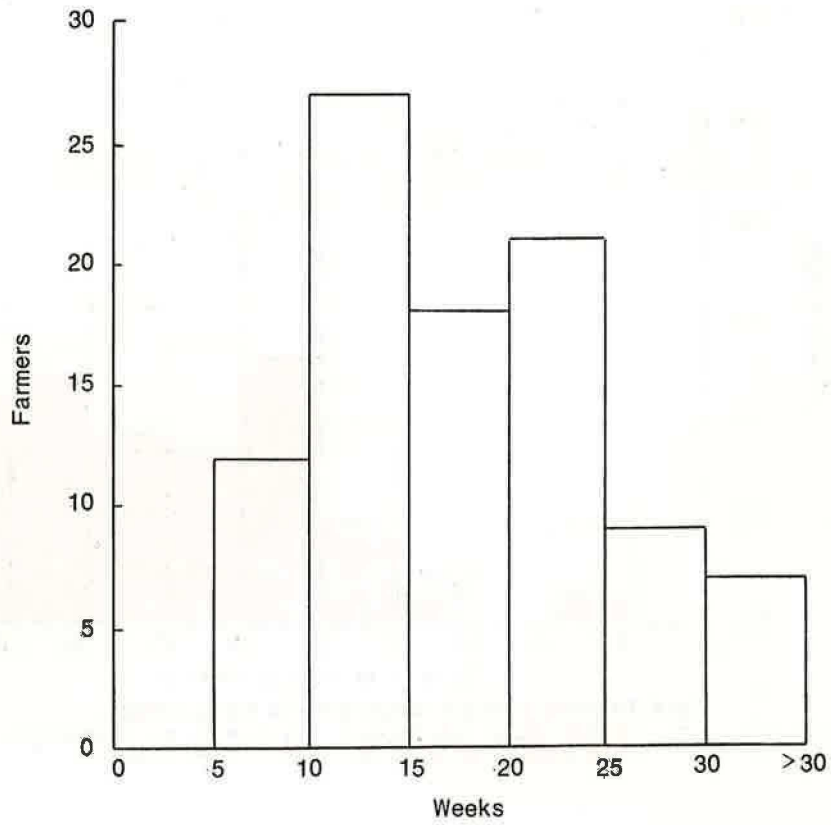


Fig 6 Storage periods for groundnuts.

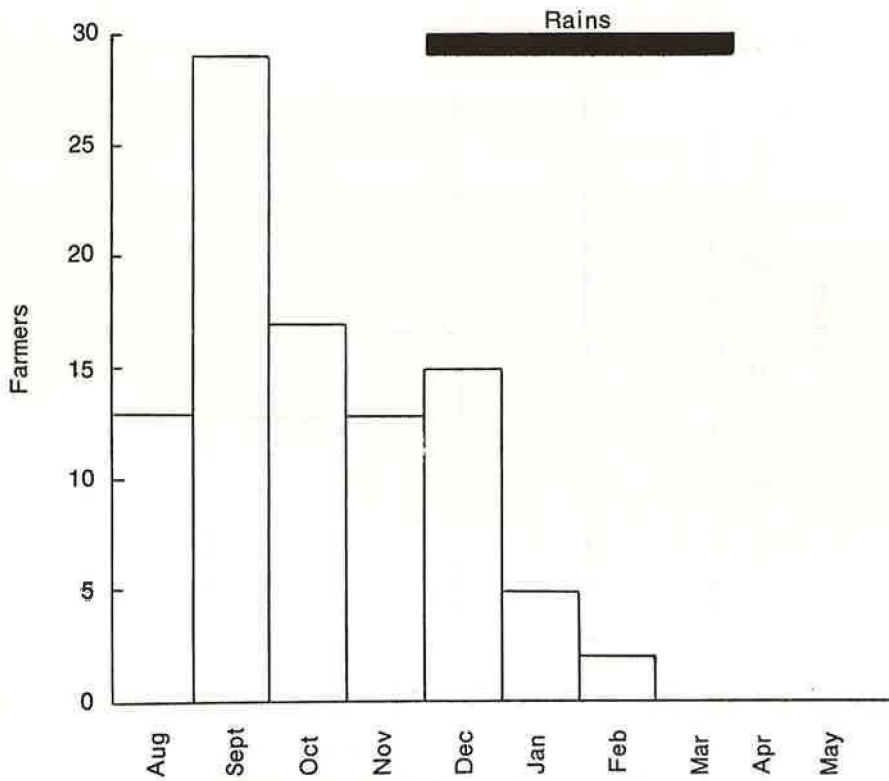


Fig 7 The dates at which groundnut stores became empty.

132 samples of a total of 299 analysed were completely free of visible infestation in the form of insect emergence holes and almost all of the remainder exhibited less than 1 per cent weight loss. The greatest loss recorded in any sample was 1.6 per cent. For most practical purposes groundnuts can be regarded as being uninfested under the conditions in which they are stored in the LLDP.

### **Discussion**

Some of the problems encountered in the SVADP survey (Golob, 1981), occurred in this survey. In particular, collection of samples from the farmer and the subsequent delivery of these to the laboratory for analysis did not always occur consistently. Samples from three units were lacking on more than one occasion and in one case for more than two consecutive months. In most cases however, samples were available on all but one occasion so that the period between observations was never more than eight weeks. Previous testing of the questionnaires allowed the format to be improved with the result that the data collected was more consistently reliable than that collected in the SVADP.

All the maize that was sampled in this survey was a mixed 'local' variety. This local maize was softer and higher yielding than the crop grown in the SVADP because, during the last decade, the grain has been crossed with several hybrid and composite varieties that are used as cash crops in the area. Even so the local maize retains the essential qualities for good storage in that the cobs have long and tight husk leaves and grains that are relatively resistant to insect damage. These characteristics aid the protection of maize against insect damage.

In the LLDP maize is harvested in a period of prolonged dry weather and it dries quickly during stooking. The cobs are stored at about 14 per cent moisture content and they continue to lose moisture until the rains commence, five months after storage begins. Because the cobs are very dry very little insect development takes place even though the ambient temperature increases during the first months after storage; it is not until well into the rainy season, in February, that the insect populations become significant. Very few samples collected up to the end of February exhibited more than 1 per cent loss. Most farmers had either emptied their stores or had very little remaining by the end of February. Thus the quantity of produce exposed to damage by the expanding insect population represented only a small percentage of the total crop put into the store. Thus, although some of the samples collected at the end of storage exhibited relatively large losses in weight, the overall losses were low.

Groundnut losses were low, primarily because they are stored with the shells intact but also because they are only stored for a short period.

As in the SVADP survey the losses of maize calculated by the SVW method were greater than those calculated by counting and weighing grains (Figure 4). The expected under-estimation of the loss due to internal infestation, by the second method, would explain this difference.

### **Conclusions**

Although farmers stored maize through the rains the losses they sustained were very low, less than 2 per cent. Such low losses do not warrant the use of insecticides in storage; the cost of application would be greater than the value of the grain saved. However, of the 101 farmers interviewed, 28 per cent were found to grow improved maize, either composite (UCA) or hybrids (MH12) which are much more susceptible to insect damage and which can sustain heavy losses (Golob, unpublished data). As the proliferation of these varieties continues amongst the farming community their use will lead to maize stored on the farm which lacks the inherent resistance of the current local variety. The benefit of an insecticide input in storage may then become apparent.

### **ACKNOWLEDGEMENTS**

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### **REFERENCES**

GOLOB, P (1981). A practical appraisal of on-farm storage losses and storage loss assessment methods in the Shire Valley of Malawi. *Tropical Stored Products Information* **40**, 5-13.