

Empowering Communities

**POST HARVEST LOSSES IN SELECTED CROPS IN MALAWI**

**REPORT**

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**EXECUTIVE SUMMARY**

Malawian farmers have been facing a number post harvest losses of various crops they grow. This has resulted into farmers having inadequate food in their households hence post harvest losses undermine household food security. Lack of the agriculture policy in Malawi that could help in dealing with such losses may be through capacity building of farmers on issues to do with post harvest losses management is exacerbating this challenge. As such even though farmers can grow more, they are seen to realize inadequate yields due to these post harvest losses. To identify the degree of post harvest losses of some of the major crops grown by smallholder farmers in Malawi CADECOM through Global Poverty Action Fund (GPAF) programme is implementing various agricultural and livelihoods improvement interventions in diocesan CADECOMs of Dedza, Chikwawa, Mangochi and Zomba. This report highlights various post harvest losses and recommendations made so that these losses can be minimized.

This report highlights various post harvest crop losses in crops such as maize, groundnuts, soy bean sorghum and vegetables. The findings reveal that most of maize harvest is lost through stoking, actual harvesting, processing and shelling, storage and marketing. Sorghum is lost through poor harvesting methods, drying, threshing, and field to home transportation, field to home transportation, storage and marketing. Crops such as soy beans, beans and millet have similar losses trends with maize and sorghum. Most of the vegetables are lost during harvesting, drying and storage and including marketing.

This study has confirmed that post-harvest losses occur at each stage of the value chains of the selected crops in which the farmer is directly involved, from harvest to markets but these exist in varying degrees. The major causes of these losses include methods of post-harvest handling and pests. The main pests that are responsible for post-harvest losses that have been identified in this study include weevils, livestock, birds, large grain borer, and wild animals such as elephants; rodents and thieves.

Farmers are experiencing a number of challenges during storage of the selected study crops. Key among them are the lack of knowledge on the appropriate pesticides to apply and the appropriate rate of application, lack of financial resources to acquire some of the storage technologies including sacks and metallic silos. In some areas the problem of elephants and thieves has led farmers not to use traditional or improved granaries constructed outside of their houses.

Despite the fact that the Malawi Vision 2020 had envisioned the development of a clear policy and programmes on post-harvest losses and had set a target of 5%, there is no single policy specifically on post-harvest losses in Malawi although various strategic and policy documents of government do make reference to post-harvest losses. This policy gap obviously makes it difficult to develop a clear strategy and programmes for dealing with post-harvest losses. In addition, post-harvest losses have largely been focussed on maize and food rather than the broader range of crops which farmers grow including those for the market.

Based on the findings of the study, the following recommendations have been made: Farmer capacities in managing post-harvest losses, especially in the selected study crops, should be developed to enhance farmers’ ability to make appropriate decisions in what crops to grow as well as how to store them; As the results suggest high losses at harvest, promotion of improved methods of harvest and training in proper harvest timing should be embarked upon, especially considering that some of the post-harvest losses start in the field; Advocacy efforts should be mounted towards the development of a post-harvest loss –specific policy and strategy to guide the work of all those involved with post-harvest losses including researchers, extension workers, private sector players, government, NGOs international aid organizations and farmers;

Devise strategies through which smallholder farmers in the project area and elsewhere can access modern storage and other post-harvest technologies that are currently too expensive for individual farmers to acquire. Such strategies could include subsidies and shared ownership and use through such farmer organisations as cooperatives and associations or clubs; A follow up study to be conducted during or soon after harvesting and should include actual measurement of post-harvest losses should be considered during the lifetime of the project or in future projects of this nature; use of herbal/methods/technologies for crop storage should be promoted because it is working in some of the GPAF impact areas though on a small scale.

# INTRODUCTION

The Episcopal Conference of Malawi (ECM) is implementing a three year project on increasing food security, income and resilience to climate change through the Catholic Development Commission (CADECOM). The project which is funded by DFID and coordinated by TROCAIRE is targeting 51,800 people in Chikwawa, Dedza, Mangochi and Zomba districts. One of the challenges being faced by the targeted communities is post-harvest losses of crops. To address this challenge ECM commissioned a study on post-harvest losses of selected key crops in Malawi. The study was undertaken in the four dioceses between 4th and 7th March 2014. This report presents the major findings and recommendations of the study.

# OBJECTIVES OF THE STUDY

The objectives of the study on post-harvest losses were as follows:

1. To establish major pests for maize, sorghum, beans, soy beans, groundnuts and vegetables and storage structures and methods for each crop that communities currently use and assess their effectiveness and efficiency
2. To determine percentage storage losses for the above mentioned crops arising from current storage structures and methods
3. To determine the challenges faced by communities during storage of crops under study
4. To document at least four traditional storage best practices being carried out by communities for sharing with other communities
5. To recommend proper storage structures and methods of the crops under study (scientific and indigenous storage structures and methods)

# CORE STUDY QUESTIONS

The study focused on the following core questions:

1. What issues, challenges, skills and capabilities do/should smallholder farmers (especially female smallholders), prioritize in order to reduce waste and spoilage and increase their incomes and off-farming livelihood options?
2. What are the key crop value chain intervention points to consider for the most effective and efficient (value-for-money) ways for waste and spoilage reduction?
3. How do culture-specific intervention opportunities vary by crops under study?
4. How do technology-specific intervention opportunities vary by crops under study and geographic area (areas that have rapidly accelerating infrastructure and market access or more remote areas)?
5. To what extent do waste and spoilage levels for a particular crop influence farmers’ decision to cultivate it or not?
6. What technologies best provide opportunities for smallholder farmers, especially women to engage in waste and spoilage reduction?

# METHODOLOGY OF THE STUDY

In conducting this study,a combination of data collection techniques was employed. Desk research and literature review were the main sources of secondary data on the study. A list of documents that have been reviewed during the study is presented in Annex 1. Primary data was collected through a structured household questionnaire that was administered to a random sample of 300 farmers, a total of 8 focus group discussions involving 109 farmers of whom 58% were female and key informant interviews.The study was conducted in seven districts namely, Nsanje and Chikhwawa in Chikhwawa Diocese, Zomba and Machinga in Zomba Diocese, Balaka in Mangochi Diocese and Dedza and Ntcheu in Dedza Diocese. Table 1 shows the distribution of the sample for the household survey.

**Table 1: Distribution of the sample for household survey**

|  |  |
| --- | --- |
| **District** | **Number of farmers** |
| Dedza | 46 |
| Ntcheu | 35 |
| Zomba | 46 |
| Mangochi | 29 |
| Chikhwawa | 39 |
| Nsanje | 36 |
| Balaka | 69 |
| **Total** | **300** |

Data collected using the structured questionnaire was analysed using SPSS software and all data collected using the unstructured questionnaires will be processed manually and analysed thematically.

# LIMITATIONS OF THE STUDY

The study was undertaken during the period of the crop season when crops were still in the field and most of them, except for vegetables, had not yet reached maturity stage. This meant that the study relied heavily on farmer and key informant knowledge and recall of experiences with regards to post-harvest losses of the selected crops. It was thus not possible to verify the information from farmers and key informants with actual measurements of the post-harvest losses which would have been possible had the study been undertaken during the post-harvest period.

The study also focussed on the part of the value chain of each crop in which farmers are actively involved in. The results do not, therefore, reflect the post-harvest losses over the entire value chain of each crop. For example, the study does not include losses that occur when the crop is in the hands of traders and processors. Finally vegetables encompass a wide range of crops. In this study the targeted vegetables were not clearly defined before data collection.

The above notwithstanding, the study provides a more current insight and estimates of post-harvest crop losses than other available studies. In addition, the study is not limited only to maize which has been the focus of similar efforts in the past.

# RESPONDENTS DEMOGRAPHICS

Of the 300 farmers sampled, 27.7% were male and 72.3 were female (Table 2). Approximately 74% of the households in the study area were male headed and 26% were female headed.

**Table 2: sex distribution of respondents of the household survey**

|  |  |  |  |
| --- | --- | --- | --- |
| **District** |  | **Sex of respondent** | **Total** |
| **Male** | **Female** |
| Dedza | Number. | 6 | 40 | 46 |
|  | %  | 13.0% | 87.0% | 100.0% |
| Zomba | Number. | 12 | 34 | 46 |
|  | %  | 26.1% | 73.9% | 100.0% |
| Chikhwawa | Number. | 18 | 21 | 39 |
|  | %  | 46.2% | 53.8% | 100.0% |
| Balaka | Number. | 7 | 62 | 69 |
|  | %  | 10.1% | 89.9% | 100.0% |
| Ntcheu | Number. | 15 | 20 | 35 |
|  | %  | 42.9% | 57.1% | 100.0% |
| Nsanje | Number. | 21 | 15 | 36 |
|  | %  | 58.3% | 41.7% | 100.0% |
| Machinga | Number. | 4 | 25 | 29 |
|  | %  | 13.8% | 86.2% | 100.0% |
|  **Total** | Number. | **83** | **217** | **300** |
| **%**  | **27.7%** | **72.3%** | **100.0%** |

Thirty percent of the respondents had not received any formal education, 2.3% had been through adult literacy classes, and 32.7% had junior primary school as the highest education they had attained while 25.3% were educated up to senior primary school level. Approximately 5% were educated up to junior secondary school level, 5% up to senior primary school level and only one respondent in Zomba district, representing 0.3% of the sample had tertiary education. This means that the majority of the respondents only had primary school education.

# KEY FINDINGS

## Post-Harvest Losses

### **Maize**

#### **7.1.1.1 Maize Production**

Focus Group Discussions, Key Informants and the household survey showed that maize was grown in all the districts covered by the study. Almost 87% of the farmers grew the crop. Nsanje had the least proportion of farmers growing maize at 33.3% followed by Chikhwawa which recorded 64.1% (Table 3).

**Table 3: Proportion of farmers that grew maize**

|  |  |  |  |
| --- | --- | --- | --- |
| **District** |  | **Do you grow maize?** | **Total** |
| **Yes** | **No** |
| Dedza | Number. | 45 | 1 | 46 |
|   | %  | 97.80% | 2.20% | 100.00% |
| Zomba | Number. | 45 | 1 | 46 |
|   | %  | 97.80% | 2.20% | 100.00% |
| Chikhwawa | Number. | 25 | 14 | 39 |
|   | %  | 64.10% | 35.90% | 100.00% |
| Balaka | Number. | 69 | 0 | 69 |
|   | %  | 100.00% | 0.00% | 100.00% |
| Ntcheu | Number. | 35 | 0 | 35 |
|   | %  | 100.00% | 0.00% | 100.00% |
| Nsanje | Number. | 12 | 24 | 36 |
|   | %  | 33.30% | 66.70% | 100.00% |
| Mangochi | Number. | 29 | 0 | 29 |
|   | %  | 100.00% | 0.00% | 100.00% |
| **Total** | **Number.** | **260** | **40** | **300** |
| **%**  | **86.70%** | **13.30%** | **100.00%** |

#### **7.1.1.2 Maize Crop Losses at Harvest**

The majority of the farmers (62.2%) harvest their maize by removing cobs from standing stalks by hand while 37.8% cut the maize stalks using a panga knife, stook the maize and then remove the cobs from the stooked stalks by hand. In both cases farmers harvest their maize by hand. The practice of stoking before cob removal was most common in Dedza district where it was reported by almost 66% followed by Ntcheu district with 53%. It was least common in Nsanje where only 8.3% of the farmers that grow maize reported the practice followed by Chikhwawa district where it was practised by 12% of those who grew maize.According to 57% of the farmers the harvesting of maize is done by the whole family, involving both the man and woman of the house as well as both male and female children in the family.

During harvest the majority (76.2%) of the farmers lose between 10-30% of the cobs. Slightly over 21% reported crop losses of 10% while almost 26% and 29% reported 20% and 30% respectively. Almost 12% of the farmers across the study area reported losses of up to 40% (Table 4).

 **Table 4: Estimates of maize losses at harvest**

|  |  |  |  |
| --- | --- | --- | --- |
| **District** |  | **Percent cobs lost at harvest as bad (unusable) cobs** | **Total** |
| **0%** | **10%** | **20%** | **30%** | **40%** | **50%** | **60%** | **100%** |
| Dedza | Number. | 4 | 8 | 9 | 18 | 5 | 1 | 0 | 1 | 46 |
|  | %  | 8.7% | 17.4% | 19.6% | 39.1% | 10.9% | 2.2% | 0.0% | 2.2% | 100.0% |
| Zomba | Number. | 4 | 15 | 10 | 12 | 3 | 0 | 1 | 0 | 45 |
|  | %  | 8.9% | 33.3% | 22.2% | 26.7% | 6.7% | 0.0% | 2.2% | 0.0% | 100.0% |
| Chikhwawa | Number. | 3 | 8 | 6 | 4 | 2 | 2 | 1 | 0 | 26 |
|  | %  | 11.5% | 30.8% | 23.1% | 15.4% | 7.7% | 7.7% | 3.8% | 0.0% | 100.0% |
| Balaka | Number. | 2 | 9 | 22 | 22 | 11 | 3 | 0 | 0 | 69 |
|  | %  | 2.9% | 13.0% | 31.9% | 31.9% | 15.9% | 4.3% | 0.0% | 0.0% | 100.0% |
| Ntcheu | Number. | 1 | 6 | 11 | 12 | 3 | 0 | 0 | 0 | 33 |
|  | %  | 3.0% | 18.2% | 33.3% | 36.4% | 9.1% | 0.0% | 0.0% | 0.0% | 100.0% |
| Nsanje | Number. | 0 | 4 | 4 | 1 | 3 | 0 | 0 | 0 | 12 |
|  | %  | 0.0% | 33.3% | 33.3% | 8.3% | 25.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| Mangochi | Number. | 7 | 5 | 5 | 7 | 4 | 1 | 0 | 0 | 29 |
|  | %  | 24.1% | 17.2% | 17.2% | 24.1% | 13.8% | 3.4% | 0.0% | 0.0% | 100.0% |
| **Total** | **Number** | **21** | **55** | **67** | **76** | **31** | **7** | **2** | **1** | **260** |
| **%**  | **8.1%** | **21.2%** | **25.8%** | **29.2%** | **11.9%** | **2.7%** | **0.8%** | **0.4%** | **100.0%** |

The main causes of cob loss at harvest were damage by termites which was reported by 28% of the farmers, damage by weevils (24.2%), heavy rains/floods (22.9%) and mould growth (16.9%). Loss due to heavy rains/floods was most common in Nsanje where it was reported by 45.5% of the farmers (Table 5). Damage by weevils was most common in Dedza district where it was reported by 45.2% of the farmers. Other reported causes were damage by mice and grain not fully developed.

**Table 5: Main causes of maize cob losses at harvest**

|  |  |  |  |
| --- | --- | --- | --- |
| **District** |  | **What are the main causes of bad maize cobs?** | **Total** |
| **Termite damage** | **Damage by weevils** | **Mould growth** | **Damage by mice** | **Grain not fully developed** | **Heavy rains/floods** |
| Dedza | Number. | 8 | 19 | 4 | 1 | 1 | 9 | 42 |
|  | % | 19.0% | 45.2% | 9.5% | 2.4% | 2.4% | 21.4% | 100.0% |
| Zomba | Number. | 9 | 6 | 9 | 0 | 5 | 11 | 40 |
|  | % | 22.5% | 15.0% | 22.5% | .0% | 12.5% | 27.5% | 100.0% |
| Chikhwawa | Number. | 9 | 5 | 4 | 0 | 2 | 3 | 23 |
|  | % | 39.1% | 21.7% | 17.4% | .0% | 8.7% | 13.0% | 100.0% |
| Balaka | Number. | 21 | 15 | 11 | 1 | 4 | 15 | 67 |
|  | % | 31.3% | 22.4% | 16.4% | 1.5% | 6.0% | 22.4% | 100.0% |
| Ntcheu | Number. | 10 | 8 | 8 | 1 | 0 | 5 | 32 |
|  | % | 31.3% | 25.0% | 25.0% | 3.1% | .0% | 15.6% | 100.0% |
| Nsanje | Number. | 2 | 2 | 1 | 0 | 1 | 5 | 11 |
|  | % | 18.2% | 18.2% | 9.1% | .0% | 9.1% | 45.5% | 100.0% |
| Mangochi | Number | 7 | 2 | 3 | 0 | 3 | 6 | 21 |
|  | % | 33.3% | 9.5% | 14.3% | .0% | 14.3% | 28.6% | 100.0% |
| **Total** | **Number** | **66** | **57** | **40** | **3** | **16** | **54** | **236** |
| **%** | **28.0%** | **24.2%** | **16.9%** | **1.3%** | **6.8%** | **22.9%** | **100.0%** |

For 59.8% of the farmers the amount of maize crop loss at harvest does not depend on the time of harvest. About 36% of those who reported that the crop losses at harvest depend on the time when harvesting is done reported that they lost up to 20% of the crop when they harvest before the crop is completely dry.

#### **7.1.1.3 Maize Crop Losses during Drying**

Approximately 12% of the farmers did not dry their maize while 29.5% dried it on stalks in the field, 27.8% dried it on mats and 18.1% on plastic sheets. The majority of the farmers (74.2%) reported that they suffer maize crop losses during drying. Out of those farmers who left their maize to dry on the stalk in the field 43.1% reported crop losses of less than 10% while 21.6% reported crop losses ranging from 12-20%. Similarly the majority of those who dried the maize in stooks reported losses of less than 10%. Losses of less than 10% were also reported by the majority (78.1%) of those who dried their maize on plastic sheets, the majority (65.2%) of those who dried maize on bare ground and those who dried on mats (84.7%). The main cause of maize crop loss during drying is that the crop is eaten by livestock which was reported by 41.4% of all farmers and was the main cause in all study districts. Reduction in moisture content was the second most important cause of maize crop loss during drying which was reported by 16.7% of the farmers. However, moisture loss is weight loss that needs to be borne if the crop is to store well, unless the loss is excessive. Other causes of crop loss during drying were mould growth (9.9%), attack by termites (8.0%), attack by weevils (8.0%), eaten by birds (6.8%) and attack by rodents (3.7%).

#### **7.1.1.4 Maize Crop losses during shelling**

Most farmers (91.4%) shelled their maize by hand while 7.4% shelled the maize by beating it with sticks while placed in a sack, 0.8% by hand held maize sheller and 0.4% by beating the maize with a stick while it is spread on a mat or plastic sheet. The reason given for using the reported shelling methods were that farmers did not have other methods of shelling (43.4%), not much grain was damaged using the method practised (20.3%), they cannot afford other methods (12.1%) and that it was cheaper (8.2%).

Shelling of maize is an activity that is undertaken by the whole family as reported by 74.2% of the farmers. Maize crop losses are suffered during shelling by 72.4% of the farmers and the main cause was that some of the maize fell to the ground during which was reported by 89.1% of the farmers while 10.9% reported grain damage as the main cause. Regardless of the shelling method used the maize crop losses were estimated at less than 10%. Approximately 80% of the farmers reported less than 10% loss when shelling by hand while 72.2% reported the same levels when shelling by beating with stick while placed in a sack.

#### **7.1.1.5 Maize crop losses during field to home transportation**

The predominant method of transporting maize from the field to the homestead is by head portarage in baskets which was reported by 81.7%. This is followed by the use of bicycles which was reported by 58.9% and then by use of hired oxcarts reported by 25.3%. The use of own oxcarts was reported by 12% of the farmers and only in Dedza, Chikhwawa, Balaka and Ntcheu while 12.5% reported the use of hired bicycles (*kabaza*).

Maize crop losses during field to homestead transportation were reported by 38.7% of the farmers. The main cause of loss was reported as the crop falling or spilling to the ground which was reported by 95.9%. Of those who suffered maize crop losses during field to homestead transportation, 80% reported losses of less than 10% and 15.6% reported losses of 10%.

#### **7.1.1.6 Maize crop losses during storage**

Table 6 presents the methods/technologies used by farmers to store maize. Forty seven percent (47%) of the farmers stored their maize as shelled maize in new bags that are placed on wood pallets inside their houses. The storage of shelled maize in used bags placed on pallets was the second main way of storing maize which was reported by 25% of the farmers followed by string of shelled maize in used bags placed on the floor inside the house. The storing of shelled maize in bags inside homes was confirmed by FGDs and key informants as the preferred method as it kept the maize away from thieves and also allowed farmers to know exactly how much maize they had and be in a better position to know their food security situation. The use of traditional granaries (*nkhokwe)* was reported by only 9%. Discussions in FGDs, especially in Mangochi diocese revealed that the low usage of traditional granarieswas out of fear of thieves and elephants which destroy the granaries.

**Table 6: Main methods/technologies for maize storage**

|  |  |  |  |
| --- | --- | --- | --- |
| **District** |  | **Maize Storage method/technology** | **Total** |
| **Shelled in used bags placed on ground in house** | **Shelled in new bags on the ground inside house** | **Shelled in new bags on pallets inside house** | **Shelled in used bags on pallets inside house** | **Unshelled in traditional *nkhokwe*** | **Unshelled in improved *nkhokwe*** | **Shelled in metal silos** |
| Dedza | Number | 9 | 3 | 12 | 5 | 14 | 0 | 0 | 43 |
|  | % | 21% | 7% | 28% | 12% | 33% | 0% | 0% | 100% |
| Zomba | Number | 0 | 2 | 28 | 22 | 0 | 0 | 0 | 52 |
|  | % | 0% | 4% | 54% | 42% | 0% | 0% | 0% | 100% |
| Chikhwawa | Number | 5 | 1 | 11 | 8 | 0 | 0 | 0 | 25 |
|  | % | 20% | 4% | 44% | 32% | 0% | 0% | 0% | 100% |
| Balaka | Number | 14 | 0 | 30 | 2 | 5 | 0 | 0 | 51 |
|  | % | 27% | 0% | 59% | 4% | 10% | 0% | 0% | 100% |
| Ntcheu | Number | 9 | 0 | 13 | 3 | 2 | 0 | 0 | 27 |
|  | % | 33% | 0% | 48% | 11% | 7% | 0% | 0% | 100% |
| Nsanje | Number | 1 | 0 | 2 | 8 | 0 | 0 | 0 | 11 |
|  | % | 9% | 0% | 18% | 73% | 0% | 0% | 0% | 100% |
| Mangochi | Number | 1 | 0 | 18 | 14 | 2 | 0 | 0 | 35 |
|  | % | 3% | 0% | 51% | 40% | 6% | 0% | 0% | 100% |
| Total | Number | 39 | 6 | 114 | 62 | 23 | 0 | 0 | 244 |
|  | % | 16% | 2% | 47% | 25% | 9% | 0% | 0% | 100% |

A total of 77.3% of the farmers reported maize crop losses during storage against 22.7% who reported not losing maize during storage. A greater proportion of farmers reported maize crop losses during storage of less than 10%. Slightly over 41% reported this level of maize crop loss when maize is stored as shelled maize in used bags placed on the ground inside the house, 33.3% when maize is stored as shelled maize in new bags placed on the ground inside the house and 60.8% when stored in new bags placed on palettes inside the house. No farmers reported using improved granaries and metal silos to store maize.

Almost 86% of the farmers applied pesticides to their maize when storing it. The lowest reported application of pesticides was in Chikhwawa where 65.2% reported applying pesticides to their maize during storage followed by Dedza where pesticide use was reported by 70.1%. Actellic dust is the most commonly used pesticide during the storage of maize which was reported by 71.4% of the farmers. Super Shumba dust was the second most commonly applied pesticide and was reported by 15% of the farmers. Other pesticides were liquid actellic (8.7%), ash from crop residues (2.4%) and phostoxin (1.5%). In Chikhwawa Nsanje and Zomba the use of leaves of pesticidal plants, namely Neem, *mtutu* and *Nkina* was also reported but by only a small proportion of the farmers. Focus Group Discussions and key informant interviews identified the main causes of maize loss during storage as weevils, large grain borer, thieves, rodents and in some districts such as Mangochi, elephants which were destroying granaries.

Some of the challenges faced by farmers during storage of maize were lack of financial resources to buy sacks in which to store maize and lack of financial resources to purchase recommended storage pesticides. Farmers also reported lack of knowledge in the appropriate type of pesticide to use and the correct application rate. Only 37.1% of the farmers had undergone training in the proper storage of maize.

They also found the cost of pesticides to be prohibitive and that in some cases they were sold fake pesticides. Thieves, including household members and the lack of proper storage rooms were the other challenges encountered by farmers in the storage of maize.

Storability of maize is not a factor considered when deciding whether to grow maize or not. Overall 68% of the farmers reported this compared to 32% who considered storability as one of the factors used in deciding whether to grow maize or not.

#### **7.1.1.7 Maize crop losses during marketing**

Only 30.5% of the farmers reported selling the maize they harvested. The lowest proportion of farmers who sold their maize was recorded in Chikhwawa where only 4.8% reported selling maize while the highest was recorded in Ntcheu where 55.9% sold maize. Overall marketing of maize is largely a man’s activity as reported by 48% of the farmers compared to 27.4% who reported it was done by women and 23.3% by girls.

Approximately 84% of those who sold their maize sold about 25% of their harvest. Almost 69% sold the maize to vendors located within their communities or those who came from outside the communities. About 23% sold to their neighbours. Almost 52% of those who sold their maize sold it from their homes while 35.4% sold it at the local market, 8.9% at the market at the trading centre and 3.8% in the nearest major town.

The major challenge faced by those who sold their maize was the low prices offered by buyers. This was reported by 74% of the farmers who sold maize. Theft was the second major challenge that farmers faced as reported by 17.8%. The long distances to markets was reported as a challenge by 4.1% of the farmers.

#### **7.1.1.8 Maize crop losses during home to market transportation**

Head portarage is the main means if transportation of maize to the market. This was reported by 87.1% of the farmers compared to 12.9% who used own bicycles. Only 24.3% of those who sold maize reported maize crop losses during transport to the market. Falling/spilling of the crop to the ground was reported by the majority of the farmers(84.6%) who sold their maize as the main cause for loss of maize crop during home to market transportation.

### **Sorghum**

#### **7.1.2.1 Sorghum Production**

Sorghum was grown mainly in Chikhwawa, Nsanje and Balaka Districts where 94.9%, 91.7% and 50.7% of the farmers, respectively, reported growing the crop. Only 21.4% of the farmers in Mangochi grew sorghum while in the districts of Dedza and Zomba less than 5% grew the crop while in Ntcheu none of the farmers reported growing sorghum.

#### **7.1.2.2 Sorghum Crop Losses at Harvest**

The main method of harvesting sorghum is by cutting the head using a knife. This was reported by 67.6% in Chikhwawa and Balaka districts and 97.1% in Nsanje district. The other method was removing the head by hand. In both instances harvesting is done manually.

Harvesting is a task that is undertaken by the whole family in Nsanje and Chikhwawa. Almost 67% of the farmers in Chikhwawa and 55% in Nsanje reported that harvesting of sorghum was done by the whole family. In Balaka 36% reported that it was done by the whole family and the same proportion reported it was done by women only.

Overall, 78% of the farmers who grew sorghum harvested when the crop is completely dry and 73.2% harvested when the crop is fully mature. Sorghum losses at harvest ranged from 10-20% in Chikhwawa, 20-30% in Balaka, Mangochi and Nsanje. For 17.1% of the farmers in Chikhwawa the amount of sorghum lost at harvest depended on the timing of the harvest period compared to 72.2% and 31.3% in Balaka and Nsanje, respectively. The low numbers of farmers in Chikhwawa and Nsanje who did not link time of harvesting with levels of crop losses could indicate a lack of understanding of the relationship between time of harvest and harvest losses of crops.

The main cause for sorghum losses at harvest is damage by birds in Balaka and Nsanje where it was reported by 83.3%, and 50%, respectively. In Chikhwawa damage by weevils (34.3%) and termite damage (17%) were the main causes of sorghum losses at harvest followed by mould growth (14.3%).In Mangochi district the main cause was damage by weevils (60%) followed by bird damage (40%). A second main cause for sorghum loss in Nsanje was damage by weevils (35.3%).

#### **7.1.2.3 Sorghum Crop Losses during Drying**

Most farmers leave the sorghum to dry on its stalks in the field before harvesting. Sorghum losses are experienced during the drying of sorghum. In Chikhwawa district 77.4% of the responded reported losses during drying and 80.6% and 63.6% reported losses in Balaka and Nsanje, respectively. The reported sorghum loss estimates during drying were less than 10% in all districts and regardless of the method of drying. The main causes of loss during drying is birds which eat the sorghum. This was reported by 52.2% of the farmers in Chikhwawa, 63% in Balaka and 52.6% in Nsanje. The second most important cause was livestock which also consume the sorghum when it is being dried. This was the case in Balaka (14.8%) and Nsanje Districts (26.3%). Weevils were another cause for sorghum losses during drying in Nsanje (15.8%) while termites were a cause of loss in Chikhwawa district (13%).

#### **7.1.2.4 Sorghum Crop losses during Threshing**

In Chikhwawa and Balaka the majority (of the farmers thresh sorghum by placing it a sack and then beating it with a stick. In Nsanje this method was used by 40.6% of the farmers. The most common method of threshing sorghum in Nsanje was beating the sorghum with a stick while it is placed on a mat or plastic sheet. This was reported by 59.4% of the farmers. This method was also used in Balaka (38.9%) and Chikhwawa (26.3%). The reason given for placing the sorghum in a sack and then beating it with sticks by 60% of the farmers in Balaka, 13.2% in Chikhwawa and 29% in Nsanje was that this method was faster. In Chikhwawa 71.1% of the farmers and 32.3% in Nsanje, it was because they did not have other methods of threshing the sorghum.

In Mangochi, Zomba and Balaka threshing of sorghum is done mostly by women only. This was reported by 45.5% in Zomba, 83.3% in Balaka and 71.4% in Mangochi. In Chikhwawa and Nsanje threshing of sorghum is done by the whole family as reported by 56.4% and 57.6% of the farmers, respectively.

In all the districts where sorghum is grown the majority of the farmers lose some of the sorghum during threshing (Table 7).

**Table 7: Whether farmers lose sorghum during threshing**

|  |  |  |  |
| --- | --- | --- | --- |
| **District** |  | **Response** | **Total** |
| **Yes** | **No** |
| Zomba | Number | 11 | 0 | 11 |
|  | % | 100.0% | .0% | 100.0% |
| Chikhwawa | Number | 33 | 5 | 38 |
|  | % | 86.8% | 13.2% | 100.0% |
| Balaka | Number | 28 | 8 | 36 |
|  | % | 77.8% | 22.2% | 100.0% |
| Nsanje | Number | 23 | 11 | 34 |
|  | % | 67.6% | 32.4% | 100.0% |
| Mangochi | Number | 5 | 2 | 7 |
|  | % | 71.4% | 28.6% | 100.0% |
| **Total** | **Number** | **101** | **26** | **127** |
| **%** | **79.5%** | **20.5%** | **100.0%** |

In Balaka district the main cause of sorghum losses during threshing was grain breakage while in the other districts grain falling onto the ground was the main cause of sorghum loss. The estimated losses were 12-20% when threshing is done through placing the sorghum in sacks and then beating with sticks while losses of less than 10% were reported when sorghum is threshed by beating with sticks while placed on mats or plastic sheet.

#### **7.1.2.5 Sorghum crop losses during field to home transportation**

The main means of transport for bringing the sorghum from the fields to the home in Balaka, Nsanje and Mangochi was head portarage using baskets. In Chikhwawa the use of own bicycles was the main means of transport but head portarage was also used.

Except in Chikhwawa where 65.8% of the farmers reported losing sorghum during field to home transport, the majority of farmers in the other districts (55.6% in Balaka, 70.6% in Nsanje and 83.3% in Mangochi) did not report any losses during field to home transportation of sorghum. Those that reported sorghum losses during field to home transportation stated falling of grain to the ground as the main cause for the loss. The estimated loss was less than 10% of the harvested crop.

#### **7.1.2.6 Sorghum crop losses during storage**

Table 8 shows the methods/technology used in storing sorghum in the districts where it is grown. In Nsanje and Mangochi the main method/technology used in storing sorghum was used bags placed on pallets inside the respondent’s house while in Chikhwawa and Balaka it was new bags placed on pallets inside the house. The use of improved technology such as improved *nkhokwes* and metal silos was almost non-existent. A small proportion (13%) of farmers in Nsanje mentioned the use of a traditional technology called *chikwa* in the storage of sorghum.

**Table 8: Methods/technology for storage of sorghum**

|  |  |  |  |
| --- | --- | --- | --- |
| **District** |  | **Storage Method/Technology** | **Total** |
| **Threshed, Used bags on the floor in house** | **Threshed, new bags on the floor in house** | **Threshed, new bags on pallets inside house** | **Threshed, used bags on pallets inside house** | **Unthreshed in traditional nkhokwe** | **Unthreshed in improved nkhokwe** | **Threshed in metal silos** |
| Zomba | Number | 0 | 1 | 0 | 0 | 0 | 0 | 0 | **1** |
|  | % | 0% | 100% | 0% | 0% | 0% | 0% | 0% | **100%** |
| Chikhwawa | Number | 8 | 1 | 16 | 12 | 1 | 0 | 0 | **38** |
|  | % | 21% | 3% | 42% | 32% | 3% | 0% | 0% | **100%** |
| Balaka | Number | 5 | 13 | 15 | 1 | 0 | 0 | 0 | **34** |
|  | % | 15% | 38% | 44% | 3% | 0% | 0% | 0% | **100%** |
| Nsanje | Number | 0 | 1 | 12 | 17 | 0 | 0 | 1 | **31** |
|  | % | 0% | 3% | 39% | 55% | 0% | 0% | 3% | **100%** |
| Mangochi | Number | 0 | 0 | 1 | 4 | 1 | 0 | 0 | **6** |
|  | % | 0% | 0% | 17% | 67% | 17% | 0% | 0% | **100%** |
| **Total** | **Number** | **13** | **16** | **44** | **34** | **2** | **0** | **1** | **110** |
|  | % | **12%** | **15%** | **40%** | **31%** | **2%** | **0%** | **1%** | **100%** |

The majority of the farmers in all districts growing sorghum reported sorghum losses during storage. The estimated losses were less than 10% for all methods/technology used to store the sorghum.The main causes of loss during storage were weevils and rats. A study by Ngaiyaye and Nyirenda in 2008 in Chikhwawa district reported similar causes and levels of sorghum losses during storage. Ngaiyaye and Nyirenda further reported that the losses could increase to more than 50% if the quantity stored was large and suggested that the low storage losses were due to the harvested sorghum being exhausted within a short period of time due to consumption by the household.

In Balaka district 72% of the farmers and 74% in Nsanje applied pesticide during storage of sorghum while in Chikhwawa and Mangochi districts 66% and 100%, respectively, did not apply pesticide to sorghum in storage. The most common pesticide applied was actellic dust. Some of the traditional pesticides mentioned included pesticidal plants such as neem and *nkina* in Nsanje and Chikhwawa and *mtutu* in Mangochi.

The main challenges experienced during storage of sorghum were the lack of financial resources to purchase sacks in which to store threshed sorghum in the safety of their homes and the lack of knowledge in the appropriate pesticides to apply when storing sorghum as well as the correct rate of application. Overall, only 40% of the farmers in the sorghum growing districts had been trained in proper storage of sorghum. The largest proportion of farmers who had received training in proper storage of sorghum was in Balaka where 53% reported having been trained.

Like with the other crops, 53% of the farmers did not consider storability as one of the factors taken into account when deciding whether or not to grow sorghum.

#### **7.1.2.7 Sorghum crop losses during marketing**

Only 25% of the farmers in sorghum growing districts sold their sorghum. The highest proportion of farmers who sold their sorghum was recorded in Nsanje where 41% reported doing so. Eighty percent of those who sold their sorghum sold about 25% of their harvest. About 42% sold to their neighbours while 31% sold to vendors from within their communities and 23% to vendors who came from town. Fifty eight percent (58%) of those who sold their sorghum sold from their homes, 21% in the local market, 12.5% in the market at the nearest trading centre and 8.3% in the nearest major town. Selling of sorghum is mainly done by men as reported by 46%. Women were the next main players in the marketing of sorghum. The main challenge faced when selling sorghum was the low prices offered by buyers (58.3%) followed by markets being too far away (29.2%).

#### **7.1.2.8 Sorghum crop losses during home to market transportation**

Those who sold their sorghum away from their homes transported it using head portarage in baskets or using own bicycles. Of these, 53.3% experienced sorghum losses during transportation to the market. The only reported cause for the loss was grain falling to the ground.

### **Soybeans**

#### **Soybeans Production**

Soybeans is grown by 28.9% of the farmers in Dedza district, 4.5% in Zomba, 7.7% in Chikhwawa, 11.6% in Balaka, 80% in Ntcheu, 2.8% in Nsanje and 14.3% in Mangochi. Soybeans is thus not grown by many of the farmers except in Ntcheu district.

#### **Soybeans Crop Losses at Harvest**

The majority (88.7%) of those who grow soybeans harvest it by uprooting the whole plant compared to 11.3% who harvest by removing each pod from the plant by hand. Most farmers (74.3%) harvest the soybeans when they are completely dry and after the rains have stopped. Harvesting is done by the whole family. Overall, the majority (45%) of the farmers who grow soybean experienced no losses during harvest while 29.8% did. In Ntcheu where the largest proportion of soybean growers was recorded 46% of the growers experienced up to 20% loss at harvest. The main causes of loss were termite damage (22%), mould growth (11%), weevil damage (7.4%) and unfilled pods (7.4%).

#### **Soybeans Crop Losses during Drying**

The main methods of drying soybean is on mats (44.2%) and by spreading on bare ground (26.9%). Only 13.5% leave the soybeans to dry on the stalks in the field. Of the farmers who grow soybeans, 89.1% experience losses during drying of less than 5% of the harvested crop. The main causes of loss during drying are livestock (48.8%), termites (17.1%), birds (14.6%) and mould growth (12.2%).

#### **Soybeans crop losses during field to home transportation**

Carrying soybeans in baskets on the head is the main method of transport for taking soybeans from the field to the home as recorded among 92.2% of the farmers who grow soybeans. The other method reported by 38.5% was the use of own bicycles and hired ox carts which was reported amongst 15.4% of the farmers. About 57% of the farmers did not experience any losses of soybean during transportation to the home. The main cause of the loss for those that experience losses was grain falling or spilling to the ground and the estimated losses were less than 10% of the harvested crop.

#### **Soybeans crop losses during storage**

The main methods/technology used to store soybeans were as threshed beans stored in new bags placed on pallets inside the house (41%), used bags placed on pallets inside the house (32%) and new bags placed on the floor inside the house (22%). Traditional and improved *nkhokwes* and metal silos were not used to store soybeans in all the districts where it is grown. Approximately 64% of the farmers experienced soybean losses in storage and the losses were estimated at less than 10%. The majority (78.4%) of farmers did not apply pesticides when storing soybeans and among those who applied pesticides the commonly applied pesticide was actellic dust. Approximately 17% reported the use of crop residues ash in storage of soybeans. According to key informants soybeans hardly get attacked by weevils and it can take up to 2 years before they suffer from weevil attack.

The main challenges farmers encountered in the storage of soybeans was the lack of financial resources to purchase sacks in which to store the soybean and pesticides and the lack of knowledge regarding the correct pesticide to apply in storage. The lack of knowledge in what pesticide to apply could be explained by that almost 53% of the farmers had never undergone any training in the proper storage of soybeans.

#### **Soybeans crop losses during marketing**

Almost 63% of the farmers sell their soybean crop and of these 47.4% sell 25% of their harvest, 26.3% sell 50% and 26.3% sell 75% of the crop. Marketing of soybean is largely undertaken by men. Most of the farmers sold their soybeans to vendors that came from town (45.7%) while 28.6% sold to vendors from within the community, 8.6 to ADMARC, 5.7% to their neighbours and 2.9% to large farmers. A total 56% of those who sold their soybeans sold it at the local markets and 29.4% sold from home, 11.8% at the nearest trading centre and 2.9% in the nearest major town. The major challenge faced during marketing of soybeans is the low prices offered by the buyers.

#### **7.1.3.8 Soybeans crop losses during home to market transportation**

Eighty eight percent (88%) of those who sold their soybeans transport the beans to the market by carrying basket loads on their heads and 12% use own bicycles. Soybean losses are not experienced by 76% of those who sold their soybeans. For the 24% who experienced losses during transport to the market reported the main cause of the loss as grain falling or spilling to the ground.

### **Beans**

#### **Beans Production**

Beans were mainly grown in Dedza, Ntcheu, Nsanje and Chikhwawa districts (Table 9). Dedza district had the largest proportion of farmers who grew beans while Balaka had the smallest. These findings are in line with known production patterns of beans in Malawi. Magretta and Jambo (2012) reported that in order of importance the major bean growing areas in Malawi were Dedza, Thyolo, Mulanje, Ntchisi, Chitipa, Dowa, Mzimba, Mangochi and Ntcheu.

**Table 9: Proportion of bean growers in the study area**

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Do you grow beans?** | **Total** |
|  | **Yes** | **No** |  |
| Dedza | Number | 39 | 7 | 46 |
|   | %  | 84.80% | 15.20% | 100.00% |
| Zomba | Number | 3 | 41 | 44 |
|   | %  | 6.80% | 93.20% | 100.00% |
| Chikhwawa | Number | 22 | 17 | 39 |
|   | %  | 56.40% | 43.60% | 100.00% |
| Balaka | Number | 3 | 66 | 69 |
|   | %  | 4.30% | 95.70% | 100.00% |
| Ntcheu | Number | 25 | 9 | 34 |
|   | %  | 73.50% | 26.50% | 100.00% |
| Nsanje | Number | 20 | 16 | 36 |
|   | %  | 55.60% | 44.40% | 100.00% |
| Mangochi | Number | 4 | 23 | 27 |
|   | %  | 14.80% | 85.20% | 100.00% |
|  | **Number** | **116** | **179** | **295** |
| **Total** | **%**  | **39.30%** | **60.70%** | **100.00%** |

#### **Beans Crop Losses at Harvest**

Removing pods from the bean stalks by hand while in the field was the main method used to harvest beans for 57% of the farmers and uprooting the whole plant was used by 43%. Harvesting was done by the whole family (57.5%), men and women only (25.7% and women only in 16.8% of the cases. Half of the farmers harvested when the crop was completely dry, 24% after the rains and 13% before the crop was completely dry. Of those who grow beans, 42% experienced bean losses of up to 20% at harvest while 18.3% reported bean losses of 30%. The main causes of bean losses during harvest were insect damage (29.7%) unfilled pods (27.1%) and mould growth (12.7%). For 63% of the farmers the extent of bean loss at harvest did not depend on the time of harvest.

#### **Beans Crop Losses during Drying**

Three main methods of drying beans were reported. Almost 40% of the farmers left the beans to dry on the stalk in the field, 35% dried the beans on mats and 17% dried beans spread on bare ground. Across the study area, 68% of the farmers experienced losses during drying of beans. Regardless of the drying method used bean losses during drying were estimated at less than 10% of the harvested crop. As shown in Table 10 the main cause of loss during drying of beans was livestock followed by weevils and mould growth.

**Table 10: Main causes of bean loss during drying**

|  |  |
| --- | --- |
| **Cause of loss** | **Proportion of farmers experiencing cause** |
| Livestock eating crop | 42% |
| Weevils | 13% |
| Mould growth | 13% |
| Rodent damage | 10% |
| Termites | 7% |
| Theft | 7% |
| Reduction in moisture | 3% |
| Birds | 4% |

#### **Beans crop losses during field to home transportation**

The majority of the farmers carry the harvested beans on their heads in baskets when transporting them from the fields to the home. Sixty percent of the farmers did not experience any losses during transportation from field to the home. Of those that experienced loss, 98% reported grain falling or spilling the ground as the main cause of loss and the estimated losses were less than 10% of the harvested crop.

#### **Beans crop losses during storage**

The bagging of beans in sacks within their houses was the preferred method of storing beans. Farmers stored their beans threshed in new sacks (39%) or used sacks (24%) and placed on pallets inside the house. Other farmers bagged the threshed beans in new bags and placed them on the floor in the house (13%) or used sacks placed on the ground (12%). Only 6% stored the beans unthreshed in either traditional or improved *nkhokwes*. No farmer reported the use of metal silos.

Bean losses were experienced during storage by 70.5% of the farmers in the study and the extent of losses was estimated at less than 10%. The main causes of loss were weevils and bruchids. About 61% of the farmers applied pesticides to beans in storage and the main pesticide applied was actellic dust (62.9%). Shumba super dust was applied by 14.5% while 12.9% applied ashes from crop residues, especially bean leaves and stalks, 3.2% applied liquid actellic and 1.6% DDT.

The main challenges faced by farmers during the storage of beans were the lack of financial resources to purchase sacks and pesticides and the lack of knowledge regarding what pesticides to use and at what rate to apply them. The lack of knowledge in what pesticide to apply and at what rate could be explained by that the majority of the farmers (70.1%) had not undergone any training in proper storage of beans. However, it is worth noting that 51.9% of farmers in Ntcheu had done so compared to 33% in Chikhwawa, 25% in Mangochi, 16.7% in Dedza and 29.4% in Nsanje.

Across the study area, the majority of the farmers (67.2%) did not consider storability of beans as a factor when deciding whether grow beans or not. However 55% of farmers in Nsanje and 59% in Chikhwawa considered storability as a factor.

#### **Beans crop losses during marketing**

About 54% of the farmers sold their beans. The highest proportion of farmers who sold their beans was in Ntcheu where 75% did, Dedza where 70.6 sold and Nsanje where 62.5% did. The majority sold only 25% of their annual production and 35% sold 50% of their total annual production. Bean marketing was largely undertaken by men (44.2%) compared to women (26.9%) and girls (28.8%). However, when women and girls are combined they form the main players in bean marketing suggesting that bean marketing is a female activity. Vendors who came from town and those from within the communities were the main buyers. Other less important buyers were neighbours and large scale buyers. Local markets were the main outlets at which farmers sold the beans. Slightly over 65% of the farmers sold at the local market and 20% sold from home. The major challenge farmers faced during marketing of beans was the low prices offered by buyers. Loss through theft was also experienced by 16% of the farmers.

#### **Beans crop losses during home to market transportation**

Like with the other crops above, transportation of beans to the market was through head portarage in baskets as reported by 89.7% of the farmers. Own bicycles were used to a lesser extent and was reported by only 10.3% of the farmers. The majority of the farmers (70.7%) did not experience losses during transport to the market and of the 29.3% who did 90.9% experienced loss caused by grain falling to the ground.

### **Groundnuts**

#### **Groundnuts Production**

More farmers in Ntcheu grew groundnuts than in any other of the study districts. Slight over 88% of the farmers grew groundnuts in the district. The lowest proportion (23.1%) was recorded in Chikhwawa district.

#### **Groundnuts Crop Losses at Harvest**

Digging whole plant using hand hoes was the main method of harvesting groundnuts employed by 84.1% of the farmers compared to 15.9% of farmers who uprooted the groundnuts by hand. Uprooting by hand was most common in Nsanje (76.2%) and Chikhwawa (55.6%). Harvesting was done by the whole family amongst 55.6% of the farmers, by men and women only among 28.5% and by women only among 11.9%. The groundnut loss level ranged from 20-40% of harvest and the main causes were unfilled pods which were reported by 32.3% and termite damage (15.2%), damage from hoes (8.9%), damage by rodents (15.5%) and mould growth (7.6%).

Slightly above half (51%) of the farmers harvested groundnuts when the crop was mature and 28% harvested after the rains and 16% when the crop is completely dry. The majority of the farmers (63.1%) reported that the extent of loss at harvest did not depend on the time of harvest.

#### **Groundnuts Crop Losses during Drying**

Groundnuts were dried by spreading nuts on bare ground by 37% of the farmers, and on mats by 22.5%. Other methods used to dry groundnuts were drying on the vine in the field (11.6%), in heaps in the field (10.9%), on the roof (8%) and spread on plastic sheet (5.8%). During drying 76.3% of the farmers experienced losses of less than 10% regardless of the drying method used and the losses were attributed to livestock (27%), rodent attack (26.1%), birds (14.4%), termites (12.6%) and theft (11.7%).

#### **Groundnuts crop losses during field to home transportation**

Table 11 presents the means of transport used to bring the groundnuts to the home from the field. Like with the other crops the majority carry baskets of groundnuts on their heads and about 45% used own bicycles.

**Table 11: Main means of field to home transportation**

|  |  |
| --- | --- |
| **Means of Transport** | **Proportion of farmersusing means of transport** |
| Carry on heads | 83.9% |
| Own bicycles | 49.4% |
| Own oxcarts | 0.0% |
| Hired oxcarts | 4.9% |
| Hired motor vehicles | 1.7% |
| Kabaza (hired bicycle) | 5.0% |

Only 39.3% of the farmers experienced losses during transportation from field to home and for the majority of these (92.6%) the main cause was crop falling to the ground. Nut breakage was reported by 5.6% and theft by transporter by 1.9%. The loss due to crop falling to the ground was estimated at less than 10% and the same level was reported for the other two causes.

#### **Groundnuts crop losses during storage**

The storing of groundnuts in sacks was predominant with 44% storing in sacks placed on pallets inside their houses, 21% in new sacks placed on the ground inside the house, 24% in used sacks on pallets and 11% in used sack placed on the ground inside the house (Table 12).

**Table 12: Methods used to store groundnuts**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **District** | **Shelled in used bags on ground inside house** | **Shelled in new bags on ground inside house** | **Shelled in new bags on pallets inside house** | **Shelled, used bags on pallets inside house** | **Unshelled in traditional nkhokwe** | **Unshelled improved nkhokwe** | **Total** |
| Dedza | 4 | 5 | 6 | 7 | 0 | 0 | 22 |
|  | 18% | 23% | 27% | 32% | 0% | 0% | 100% |
| Zomba | 0 | 0 | 2 | 7 | 0 | 0 | 9 |
|  | 0% | 0% | 22% | 78% | 0% | 0% | 100% |
| Chikhwawa | 0 | 0 | 9 | 1 | 0 | 0 | 10 |
|  | 0% | 0% | 90% | 10% | 0% | 0% | 100% |
| Balaka | 10 | 17 | 21 | 3 | 0 | 0 | 51 |
|  | 20% | 33% | 41% | 6% | 0% | 0% | 100% |
| Ntcheu | 2 | 8 | 13 | 2 | 0 | 0 | 25 |
|  | 8% | 32% | 52% | 8% | 0% | 0% | 100% |
| Nsanje | 0 | 0 | 10 | 8 | 0 | 0 | 18 |
|  | 0% | 0% | 56% | 44% | 0% | 0% | 100% |
| Mangochi | 0 | 0 | 2 | 6 | 0 | 0 | 8 |
|  | 0% | 0% | 25% | 75% | 0% | 0% | 100% |
| **Total** | **16** | **30** | **63** | **34** | **0** | **0** | **143** |
|  | **11%** | **21%** | **44%** | **24%** | **0%** | **0%** | **100%** |

Almost 77% of the farmers experienced loss during storage and the main causes were rodents and mould growth. Of these 56.5% reported losses of less than 10%. Only 20.8% applied pesticides to the groundnuts during storage and the main pesticide was actellic dust which was used by 71.4%. The other pesticide used was ash from crop residues which was used by 21.4%. Almost 65% of the farmers did not consider storability as factor in deciding whether to grow groundnuts or not.

The main challenges that farmers encountered during storage of groundnuts were lack of resources to purchase sacks and lack of knowledge regarding what type of pesticides to apply and at what rate. Again this may be explained by that Most of the farmers (60%) did not undergo any training in proper methods of storing groundnuts.

#### **Groundnuts crop losses during marketing**

About 58% of the farmers sold groundnuts. Of these 46.6% sold 25% of their annual harvest, 20.7% sold 50% of their harvest and 24% sold 75% of their annual production. Vendors were the main buyers of groundnuts. Vendors from town bought from 46.4% of the farmers and vendors from within the community were the main market for 23.2% of the farmers while neighbours were the market for 21.4%. Farmers mostly sold from their homes (42.4%) and at the local market (39%). The rest sold either in the nearest major town (10.2%) or at the market at the trading centre (8.5%). The main players in selling of groundnuts were men. The main challenge faced by the farmers was the low prices offered by buyers.

#### **Groundnuts crop losses during home to market transportation**

Of the farmers who sold groundnuts at the market 77.8% carried them on their heads in baskets and 22.2% used own bicycles as a means of transport. Only 26.7% experienced losses during transport to the market and the major cause was produce falling to the ground.

### **Vegetables**

#### **Vegetable Production**

Table 13 shows the types of vegetables grown in the study area. Mustard and rape were the main vegetables grown. Others that were mentioned during FGDs and by key informants included tomatoes, Chinese cabbage and pumpkin leaves. In general, not many of the farmers in the study area grow vegetables.

**Table 13: Proportion (%) of farmers growing type of vegetables**

|  |  |
| --- | --- |
| **District** | **Type of vegetable** |
| **Cabbage** | **Lettuce** | **Rape** | **Spinach** | **Mustard** |
| Dedza | 4.7 | 2.3 | 20.9 | 2.3 | 26.2 |
| Zomba | 0.0 | 0.0 | 2.3 | 2.3 | 18.6 |
| Chikhwawa | 2.7 | 0.0 | 13.2 | 0.0 | 26.3 |
| Balaka | 1.4 | 0.0 | 4.3 | 0.0 | 15.9 |
| Ntcheu | 5.9 | 0.0 | 32.4 | 0.0 | 38.2 |
| Nsanje | 6.3 | 0.0 | 6.3 | 0.0 | 14.8 |
| Mangochi | 0.0 | 0.0 | 10.7 | 0.0 | 14.8 |
| **Total** | **2.8** | **0.3** | **11.8** | **0.7** | **20.7** |

#### **Vegetable Crop Losses at Harvest**

Farmers who grew mustard and rape harvested these by cutting the leaf off the stalk using a knife. This was reported by 91.4% of the farmers in the sample and confirmed in FGDs and key informant interviews. The whole family participate in harvesting of these leaf vegetables although women only were reported by 31% as responsible for harvesting rape and by 33% as responsible for harvesting rape mustard.

Harvest losses for cabbage were estimated at less than 10% with insect damage as the main cause. For mustard and rape the estimated crop loss was estimated at 30% and insect damage was also reported as the main cause. The majority among the few who grew vegetables harvested the vegetables when the crop was mature.

#### **Vegetable Crop Losses during Drying**

Approximately 46% of those who grew vegetable did not dry the vegetables while 35% dried them on mats, 5% in solar dryers and 5% spread them on plastic sheets. Solar drying was reported only in Balaka while spreading on plastic sheet was recorded in both Balaka and Nsanje districts.

About 64% did not experience any losses during storage. Losses among those who experienced them were estimated at less than 10% and the main cause was livestock (50%) and mould growth (15%). Other causes were birds (10%) and termites (10%).

#### **Vegetable crop losses during field to home transportation**

The main means of transporting vegetables from the field to the home was head portarage in baskets as reported by 96.8% of those who grew vegetables. Some 22% use own bicycles. Losses in transport were estimated at less than 10% and were cause mainly by crop falling to the ground.

#### **Vegetable crop losses during storage**

Before storing vegetables 65% boil and dry the vegetables and then store them in baskets inside the homes. Almost 55% experience losses during vegetable storage due to weevil attack. Only 23% considered storability of vegetables as a factor for deciding to grow or not to grow a vegetable and 72% had never undergone training in proper storage of vegetables. The main challenge faced by farmers in storage of vegetables was the lack of knowledge in modern methods of storing vegetables.

#### **Vegetable crop losses during marketing**

Less than half (48%) of the farmers who grew vegetables sold their vegetables and the majority of these were found in Chikhwawa (72.7%), Ntcheu (64.3%) and Balaka (53.3%). Vegetable marketing is largely a women’s activity with 83% of the farmers reporting so. Vendors from both within the community and from town were the main buyers of vegetables and they bought the vegetables from either the local market (57.1%) or the home (33.3%). The main challenge faced by those who sold their vegetables were the low prices offered by buyers.

#### **Vegetable crop losses during home to market transportation**

Home to market transportation of vegetables is mainly done using baskets carried on the head. Only 15% reported use of own bicycles as the other means of transport. The majority (76%) of those who sold their vegetables did not experience any vegetable losses in transport to the market and of the few that did 75% lost the vegetables due to breakage. 12.5% due to wilting and 12.5% due to crop falling to the ground.

## Available Traditional and Modern Crop Storage Technologies

### **Available Traditional Technologies/Methods**

The following traditional technologies/methods for crop storage were recorded in the study:

* Use of pesticidal plants such as neem and *nkina* in Chikhwawa and Nsanje and *mtutu* in Mangochi
* Use of ash from livestock waste
* Use of traditional *nkhokwe*
* Use of ash from crop residues, especially bean leaves and stems
* Use of *chikwa* in Nsanje, a traditional granary kept indoors
* Use of *thandala*and *khungulu*(storage racks constructed above the fire place inside the house)
* Use of *chikwatu* in the storage of vegetables

The use of ash for storage of crops was also reported by Kamanulu *et al* (2011) for the storage of beans in the northern region of the country. The type of ash that was used, however, was wood ash as opposed to ash from either livestock waste of crop residues. Kamanulu et al also reported the use of pesticidal plants amongst 28% of the farmers sampled although 61% of the farmers were knowledgeable about the use such plants.

According to farmers the use of chikwa and chikwatu are now limited due to the fact that plant materials used to make them are no longer readily available. Experts consulted during the study also indicated that most traditional storage technologies are not effective against pests such as rodents and weevils and as such most farmers prefer to store in sacks.

### **Available Modern technologies/Methods**

The following modern technologies/methods are available for use in storage of the study crops:

* Improved granaries, especially where thieves and elephants are not a problem
* Use of recommended storage pesticides at recommended application rates
* Small metal silos
* Hermetic bags also known as super grain bags
* Concrete silos
* Sacks

The major problem with the modern technologies has been low uptake. According to experts consulted the low uptake is due to lack of awareness, lack of access to the technologies and prohibitive acquisitions costs such as in the case of metal silos. That metal silos were perceived as expensive was also reported by Maonga, Assa and Haraman (2013)

## Farmer Capabilities and Opportunities

It was clear from FGDs, key informant interviews and household survey that majority of the farmers do not have the appropriate capabilities to make appropriate decisions on storage of their crops. They do not have knowledge regarding the appropriate way to store their crops as most of them have never undergone any training in this subject matter. In addition they do not have the financial resources needed to adopt pesticide application and buy such items as storage sacks as demonstrated by the use of used sacks instead of new ones. They also do not have appropriate structures for storing crops, most of them preferring to store inside their homes.

However, the farmers do have opportunities that would enable them to make appropriate decisions regarding the storage of their crops. These include the availability of and access to training and extension services offered by NGOs as well as government workers, availability of agro-dealers who supply agro-chemicals including storage pesticides, the availability of improved storage technologies such as metal silos, concrete silos and hermetic bags and the availability of local materials which can be used in the construction of some of the technologies. Some communities reported the use of pesticidal plants such as neem and *nkina* which if proven through scientific research with regards to effectiveness could provide another opportunity for low cost storage of crops.

## Post-Harvest Policy Environment

There are no specific policies on post-harvest losses despite the Malawi Vision 2020 identifying the development of a clear policy and programmes on post-harvest technology in order to reduce losses to 5% as one of the strategic challenges. The Malawi Vision 2020 identified the following as options for reducing post-harvest losses:

* Supporting research in low cost post-harvest technologies with financial and human resources
* Promoting crop varieties with less susceptibility to post-harvest losses
* Ensuring that findings of research benefit farmers by developing guidelines on storage, processing and preservation for each major food commodity
* Training personnel in post-harvest handling, processing, preservation and storage of food crops
* Introducing village or community level storage facilities to realise economies of scale
* Promoting cottage industries on food processing in rural areas to provide employment as well as improve food processing and preservation, and
* Making the foods available to the consumers at affordable prices.

However, post-harvest handling and storage are included in various agricultural and food security related policies and other strategic documents of government. All policies that include post-harvest losses recognize the impact that post-harvest losses have on the food security situation of farm families in Malawi and that preventing these would go a long way to saving the little that farmers produce. For example, reducing post-harvest losses is one of the strategies through which food security is to be attained under the Malawi Growth and Development Strategy (MGDS) II. Reducing post-harvest losses is also one of the means through which food security is to be achieved under the ASWAp. In fact one of the outcomes of the ASWAp is a reduction in post-harvest losses from 30% to 15% and this is to be achieved through the promotion of improved on-farm storage technologies and facilities (granaries, silos, large grain borer control etc).

The Crop Production Department of the Ministry of Agriculture and Food Security has as one of its functions, the promotion of post-harvest management of crops, including agro-processing. Similarly the Agriculture Extension Services Department has training on food and nutrition, processing and storage as one of its functions. The Department of Agricultural Research Services includes provision of advisory services on post-harvest management as one of its functions. Unfortunately the focus of these strategies, policies and functions has been on maize at the expense of other equally important food and cash crops such as those under the current study.

# CONCLUSIONS

This study has confirmed that post-harvest losses occur at each stage of the value chains of the selected crops in which the farmer is directly involved, from harvest to markets but these exist in varying degrees. The major causes of these losses include methods of post-harvest handling and pests. The main pests that are responsible for post-harvest losses that have been identified in this study include weevils, livestock, birds, large grain borer, wild animals such as elephants; rodents and thieves.

Farmers are using human power to perform almost all of the post-harvest processes including harvesting, shelling and threshing and transport. The use of improved technologies is dominated by the use of sacks for storing grain crops. Threshing and shelling are done by hand. The majority of the farmers lack knowledge in proper storage of the selected crops as most of them have never received any training in the same.

The study findings suggest that losses during harvest are the largest single portion of crop losses ranging between 10% and 40% of the crops while losses at other post-harvest stages have been estimated at less than 10% of the harvested crop. The low levels of losses reported could be, as a result of the low production levels as was observed by Ngaiyaye and Nyirenda (2008) for sorghum in Chiklhwawa district. These findings should be used with caution though as they are based on farmer’s recall and not on physical measurement.

Farmers are experiencing a number of challenges during storage of the selected study crops. Key among them are the lack of knowledge on the appropriate pesticides to apply and the appropriate rate of application, lack of financial resources to acquire some of the storage technologies including sacks and metallic silos. In some areas the problem of elephants and thieves has led farmers not to use traditional or improved granaries constructed outside of their houses.

Most farmers do not have the capabilities to make appropriate decisions on storing their crops. For example, although it would be expected that storability would be an important factor in deciding what crop to grow the majority of the farmers in study did not consider it as such. However, farmers have a number of opportunities that can build their capacities in making appropriate decisions in storage of their crops. These include availability and access to training and extension services provided by NGOs and government, presence of agro-dealers who can supply them the appropriate agro-chemicals including pesticides and availability of improved technologies which they can access if the appropriate strategies are put in place, especially for those technologies that are beyond the financial capacities of individual farmers.

Although a number of traditional technologies for storing crops have been mentioned in the study, they are considered by experts in the field as ineffective in preventing post-harvest losses. For some of them the lack of materials for constructing them is another impediment over their wider usage. There are however, more modern technologies that farmers can adopt for storing their crops. These include solar dryers, small metallic silos, pesticides and super bags

Despite the fact that the Malawi Vision 2020 had envisioned the development of a clear policy and programmes on post-harvest losses and had set a target of 5%, there is no single policy specifically on post-harvest losses in Malawi although various strategic and policy documents of government do make reference to post-harvest losses. This policy gap obviously makes it difficult to develop a clear strategy and programmes for dealing with post-harvest losses. In addition, post-harvest losses have largely been focussed on maize and food rather than the broader range of crops which farmers grow including those for the market.

# RECOMMENDATIONS

Based on the findings of this study the following recommendations are proposed:

* Farmer capacities in managing post-harvest losses, especially in the selected study crops, should be developed to enhance farmers’ ability to make appropriate decisions in what crops to grow as well as how to store them
* As the results suggest high losses at harvest, promotion of improved methods of harvest and training in proper harvest timing should be embarked upon, especially considering that some of the post-harvest losses start in the field.
* Advocacy efforts should be mounted towards the development of a post-harvest loss –specific policy and strategy to guide the work of all those involved with post-harvest losses including researchers, extension workers, private sector players, government, NGOs international aid organizations and farmers
* Devise strategies through which smallholder farmers in the project area and elsewhere can access modern storage and other post-harvest technologies that are currently too expensive for individual farmers to acquire. Such strategies could include subsidies and shared ownership and use through such farmer organisations as cooperatives and associations or clubs.
* A follow up study to be conducted during or soon after harvesting and should include actual measurement of post-harvest losses should be considered during the lifetime of the project or in future projects of this nature.
* Use of herbal methods/technologies for crop storage should be promoted fully in areas where they are working.

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[www.moafsmw.org](http://www.moafsmw.org) Accessed 09/03/2014

# ANNEXES

## Annex 1: List of people consulted

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **Name of person** | **Position** | **Organization** |
| 1. | Linley Asani  | Field Officer | CADECOM, Zomba |
| 2. | Banani Binali | Field Officer | CADECOM, Zomba |
| 3. | McAngel Mpheluka | Field Officer | CADECOM, Zomba |
| 4. | Elean Makwinja | PMSE Coordinator | CADECOM, Mangochi |
| 5. | Fodreck Nyongani | Secretary | CADECOM, Mangochi |
| 6. | Jame Kaiya | Agricultural Field Officer | CADECOM, Balaka |
| 7. | Elias Munkha | Extension Worker | CADECOM, Dedza |
| 8. | Efelo Jonasi | Village Headman | Zomba |
| 9. | Jamila Mtambo Kasimu | AEDO | Ministry of Agriculture and Food Security (MoAFS), Zomba |
| 10. | Rabecca Chiwanda | Field Officer | CADECOM, Zomba |
| 11. | Grey Mangoni | Assistant AEDC | MoAFS, Nsanje |
| 12. | Laston Katole | Assistant Animal Husbandry Officer | MoAFS, Nsanje |
| 13. | Mr Ngwenya |  | MoAFS, Nsanje |
| 14. | Matias Mtima | Field Officer | CADECOM, Nsanje |
| 15. | Mr Tsabola | Field Officer | CADECOM, Chikhwawa |