Food and Agriculture Organization of the United Nations

SUSTAINABLE DEVELOPMENT GOALS

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Guidelines on the measurement of harvest and post-harvest losses

Estimation of maize harvest and post-harvest losses in Zimbabwe

FIELD TEST REPORT

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Abstract

In the framework of the Global strategy to improve agriculture and rural statistics (GSARS), FAO provided technical assistance to Zimbabwe on the measurement of harvest and post-harvest losses through sample surveys. The technical assistance was provided in the form of a pilot study on estimating harvest and post-harvest losses for major crops in the Makonde district in the communal and A1 farming sectors. The survey focused on maize and sorghum and included the measurement of on-farm losses.

The survey captured losses through interviews of farmers as well as through physical measurements. The number of usable data points for sorghum were too few to provide reliable production and loss estimates, hence the results presented in this report mostly refer to maize.

The results show that 5.2 percent of grain is lost at harvest and 3.8 percent lost at drying. The comparison of the loss estimates according to the measurement method used shows mixed results; in A1 farming sectors, farmers' own loss estimates tend to be lower than physical measurement, while the opposite is evidenced in the communal sector (except for drying). Timely harvesting was used by most farmers to limit losses, followed by stooking when harvesting and the use of chemicals to protect crops from pest infestations during storage.

Keywords: Post-harvest losses, Zimbabwe, Makonde, Grains

In collaboration with:

Global strategy to improve agricultural and rural statistics (GSARS)

Zimbabwe Ministry of Lands, Agriculture, Water, Climate and Rural Resettlement

Zimbabwe National Statistics Agency

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Abbreviations and acronyms

A1	Model of farm resettlement instituted in year 2000
AGRITEX/ DCLP	Agriculture technical and extension services *now* Department of crops and livestock production
ECD	Early child development
FAO	Food and Agriculture Organization of the United Nations
GSARS	Global strategy to improve agricultural and rural statistics
MAMID/MLAWCRR	Ministry of Agriculture, Mechanization and Irrigation, Development *now* Ministry of Lands, Agriculture, Water, Climate and Rural Resettlement
PHL	Post-harvest losses
OPV	Open pollinated variety
SPSS	Statistical Package for the Social Sciences
UZ	University of Zimbabwe
ZIMSTAT	Zimbabwe National Statistics Agency

1. Introduction

1.1 Background

Through the Global Strategy to improve agricultural and rural statistics (GSARS), the Food and Agriculture Organization of the United Nations (FAO) is providing support to Zimbabwe's Ministry of Lands, Agriculture, Water, Climate and Rural Resettlement (MLAWCRR) in the measurement of crop losses. It is in this context that three missions were organized beginning from June 2017 to September 2018 in Zimbabwe to prepare and implement activities on the measurement of post-harvest losses (PHL)[1]. Several activities were conducted: a questionnaire validation workshop, technical trainings on PHL methodologies, sample design and data analysis.

The first workshop was held on November 13–17, 2017 in Zimbabwe and drew delegates at national level from MAMID, Zimbabwe National Statistics Agency (ZIMSTAT) and the University of Zimbabwe (UZ). The objectives of the workshop were as follows:

- Provide a general training to country stakeholders on general concepts and measurement methods for PHL;
- Present, discuss and agree on the PHL questionnaire to be used from April 2018 in the Makonde district;
- Discuss and agree on the overall strategy for the field-test, sample design, and organization of the field activities;
- Exchange on the content of the next technical assistance activities, especially the work on the enumerators' manual, supervisor's manual and listing manual;
- Discuss and agree on enumerators training, the personnel involved in the training and field work.

Another training workshop was organized in March 2018, its main objectives being:

- A general training on the main concepts of PHL measurement;
- A detailed presentation, discussion and training on the questionnaire to be tested;
- Tests of the questionnaire (mock interviews);
- Improvement and finalization of the questionnaire to take into account the comments received from the field teams and the lessons learned from the tests.

[1] In this document, we refer to Post-Harvest losses as losses occurring from (and including) the harvest to (and including) retail markets.

1.2 Methodology

The methodology of the survey was based on farmer's declaration and physical measurements to estimate and triangulate the loss data. The method used a value chain approach, which consists in assessing losses at various post-harvest stages, such as harvesting, drying, threshing, cleaning and storage.

The project targeted a total of 355 households, 300 households drawn from 20 enumeration areas in communal lands and 55 from 11 A1 farms in the Makonde district, Mashonaland West Province of Zimbabwe. These households were randomly selected by ZIMSTAT in conjunction with the Department of crops and livestock production (DCLP). The survey targeted maize and sorghum.

The field work was organized as follows: 10 enumerators and 3 team leaders were used for the data collection, each enumerator was assigned two enumeration areas, with 15 sampled households per enumeration areas in the communal lands. Each enumerator conducted the declarative loss assessment in both enumeration areas, but only in one of them were physical measurements also carried-out. Two national coordinators and the provincial supervisors monitored each stage of the data collection process.

The field activities commenced with a listing of farms and households in the selected enumeration areas, which was conducted in the first week of April 2018. This listing constituted the frame from which the supervisors randomly selected the sample households to be part of the survey. The marking of sub-plots for the physical measurements begun during the second week of April. The data collection was done in two phases, from July to August 2018 and from October and December 2018.

1.3 Data collection activities

Questionnaires were administered and farmers declared the level of losses they incurred for various operations performed on the farm. The declarative losses by farmers were followed by physical measurements, which was carried out by the enumerators.

For physical measurements, 25 m^2 sub-plots (5m * 5m) were marked before harvest in one randomly selected field in every household, containing one of the targeted crop (maize and sorghum). The harvest from the sub-plot was tracked throughout all stages up to cleaning to assess losses for the different operations.

During harvesting, grains which remained on the ground and those which remained on the stalks were counted and weighed, and expressed as a proportion of the total yield from that sub-plot. Farmers' methods of harvesting, transportation, drying, threshing, cleaning and storage were followed. Comparisons of losses estimated for the different methods used by farmers were then carried out during the analysis. The need to avoid explaining the purpose of the experiment to those who carried-out harvesting and other field measurements was highlighted, to avoid biases. It was suggested that farmers can better carry out the process using their methods without the interference of the enumerator. The enumerator can measure losses after each operation is performed by the farmer.

During storage, grain samples (weighing 1 kg) were collected from the storage facilities/containers and were analysed by the University of Zimbabwe and Institute of Agricultural Engineering laboratories for grain weight loss, pest infestation, moisture contents and other parameters used in this type of analysis. Losses were calculated using the count-and-weigh (gravimetric) method. Farmers were not financially rewarded for the provision of the grain samples but were thanked for their support to the project.

1.4 Data processing and dissemination

The completed questionnaires were sent to head office for data entry, editing, validation and processing. The data was entered using the CSPro package and analysed using the Statistical Package for the Social Sciences (SPSS). The final results are presented in the following sections of this report.

2. Household socio-economy

2.1 Household holdings main economic activities

Table 1 below shows the number and percentage of households according to their main activity, agricultural or non-agricultural. The results show that all the listed households in both communal lands and A1 farming sectors were practicing agriculture as their main activity. This shows that agriculture production is the main source of livelihood in Makonde district. Agricultural production is incentivized by the government's crop inputs support schemes.

Table 1: Household holdings by main economic activities

	Communal		A1		Total	
	Number of households holdings	%	Number of households	%	Number of households	%
Agriculture	5 192	100	7 429	100	8 030	100
Non Agriculture	0	0	0	0	0	0

Source: Post-harvest losses test, Makonde district, 2018.

2.2 Type of agricultural activities

Table 2 shows that households in both A1 farms and Communal lands depend wholly on rain fed field crops. There are 7 429 households in A1 farms as compared to 5 192 households in the communal area whose livelihood solely depend on rain fed field crops. Irrigated field crops, horticulture, livestock and fishing are not practiced as main activities in both A1 and Communal area farmers.

Table 2: Household holdings by main agricultural activities

Type of agricultural activities	Communal		A1		Total	
	Number of households	%	Number of households	%	Number of households	%
Rainfed field crops	5 192	100	7 429	100	12 690	100
Irrigated field crops	0	0	0	0	0	0
Horticulture	0	0	0	0	0	0
Livestock	0	0	0	0	0	0
Fishing	0	0	0	0	0	0

Source: Post-harvest losses test, Makonde district, 2018.

2.3 Level of education in the household

According to the survey, the number of people living in the communal area and A1 farming sectors were 25 271 and 46 850, respectively. The proportion of uneducated household members in communal area is 8 percent, higher than in A1 farms (5 percent). 49.2 percent of the household members reached secondary-level education and 39.6 percent declared having reached primary education only. Very few went through tertiary-level education (1 percent). Communal land household members tend to be less educated than those living in A1 areas. In the latter, for example, 53.2 percent have reached secondary education, compared to 42.0 percent in communal areas.

Table 3: Level of education of the members of the household holdings

Education level	Sector					
	Communal		A1		Total	
	Number of people	%	Number of people	%	Number of people	%
No education	2 116	8.4	2 328	5.0	4 444	6.2
Early child development	867	3.4	2 075	4.0	2 943	4.1
Primary school	11 561	45.7	16 971	36.2	28 532	39.6
Secondary school	10 604	42.0	24 903	53.2	35 507	49.2
Tertiary	122	0.5	572	1.2	694	1.0
Total	25 271	100.0	46 850	100.0	72 120	100.0

Source: Post-harvest losses test, Makonde district, 2018.

2.4 Level of literacy and participation in the farming activities

Table 4 shows the distribution of household members in the communal lands and A1 farming sectors who know how to read and write in any language and their participation in the farming activities of the agricultural holding.

Table 4 Level of literacy and participation in the agricultural activities

Participation in the farming activities of the holding				Yes	No	Total
Communal	Knowing how to read and write in any language	Yes	Number of people	19 935	1 468	21 403
			%	93.10	6.90	100
		No	Number of people	2 449	1 418	3 867
			%	63.30	36.70	100
A1	Knowing how to read and write in any language	Yes	Number of people	40 154	3 271	43 425
			%	92.50	7.50	100
		No	Number of people	2 496	930	3 426
			%	72.90	27.10	100
Total	Knowing how to read and write in any language	Yes	Number of people	60 089	4 739	64 828
			%	92.70	7.30	100
		No	Number of people	4 945	2 348	7 293
			%	67.80	32.20	100

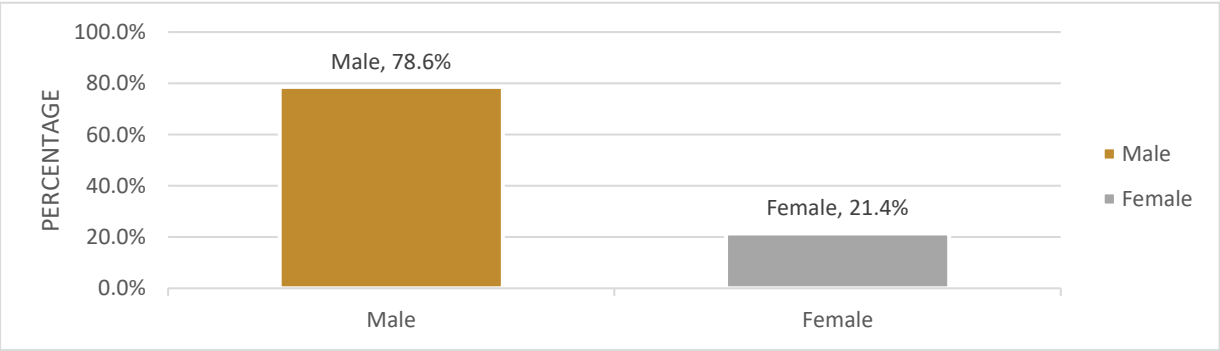
Source: Post-harvest losses test, Makonde district, 2018.

In communal lands, a vast majority of the household members declared knowing how to read and write. Among the literate household members, more than 90 percent participate in farming activities. This high literacy rate among the target population of this pilot survey contributed to facilitate the data collection activities and to strengthen the overall confidence in the results. Illiterate household members are also mostly involved in agricultural activities, but in a lower proportion than literate household members (67.8 percent compared to 92.7 percent).

2.5 Head of the household holding by gender

The survey allowed to estimate the distribution by gender of the household members that make the day-to-day decisions on the affairs of the household, including agriculture production. The graph below shows the proportion of male and female heads of household. Among the 13 871 head of households in both farming sectors, 10 898 are male headed households (78.6 percent).

Figure 1 Sex of households' head



3. Agricultural practices

3.1 Crop and area planted by the household holdings

The respondents from both communal lands and A1 farming sector were asked about the type of crop and area planted during the agricultural season. Table 5 below shows the number of households by crop grown. All the households planted maize. This cereal crop is a staple food in the district, followed by sorghum (10.4 percent and 3.8 percent of households planted this crop in A1 farms and communal lands respectively). A relatively high number of household planted beans in the A1 farming sectors (14 percent), but very few in the communal areas (0.5 percent).

Farmer from the A1 farming sectors also planted several cash crops, such as groundnuts, soybeans (40 percent each), cotton (15 percent) and tobacco (10 percent). The planting of tobacco has risen in the past years due to the high prices that producers can obtain for this crop on the market. Cash crops, however, were not investigated in this survey that focused on the basic food security crops.

Table 5: Crops planted by household holdings

Crops	Sector			
	Communal		A1	
	Number of households reporting	%	Number of households reporting	%
Maize	5 340	100.0	8 358	100.0
Sorghum	205	3.8	869	10.4
Wheat	0	0.0	0	0.0
Burley	0	0.0	0	0.0
Pearl millet	0	0.0	0	0.0
Finger millet	0	0.0	0	0.0
Rice	18	0.3	0	0.0
Oats	0	0.0	0	0.0
Sesame	0	0.0	0	0.0
Nyimo	25	0.5	468	5.6
Sweet potatoes	0	0.0	0	0.0
Yams/Cassava	0	0.0	0	0.0
Beans	25	0.5	1 193	14.3
Cowpeas	212	4.0	694	8.3
Groundnuts	730	13.7	3 362	40.2
Cotton	643	12.0	1 218	14.6
Tobacco	0	0.0	806	9.6
Soyabeans	164	3.1	3 321	39.7
Sunflower	16	0.3	109	1.3

Source: Post-harvest losses test, Makonde district, 2018.

6 397 ha were used to grow maize by communal farmers in Makonde district, translating into an average maize area per household of 1.2 ha (Table 6). In A1 sectors, maize farms are more than twice as large (2.7 ha per household on average), with a total area planted of 225 504 ha.

Table 6: Area planted by the household holdings

Crops	Sector			
	Communal		A1	
	Area planted		Area planted	
	Total (ha)	Average per household holding	Total (ha)	Average per household holding
Maize	6 397	1.2	22 504	2.7

Source: Post-harvest losses test, Makonde district, 2018.

3.2 Production and yield of maize

Table 7 presents the estimates of maize production and yields by sector. The sampled A1 farmers produced a total of 40 979 tonnes, with a yield of 1.8 tonnes per ha. In communal areas, the estimated yield was half that amount (0.9 tonne/ha), for a total of 4 862 tonnes produced. Given the differences in average farm sizes and yields, the average production per household was much higher in A1 farming sectors than in communal lands (5.5 tonnes and 0.9 tonnes, respectively).

Table 7: Quantity harvested and yield for maize

Crops	Sector					
	Communal			A1		
	Production (t)		Yield	Production (t)		Yield
	Total	Average per household	Average	Total	Average per household	Average
Maize	4 862	0.94	0.76	40 979	5.52	1.82

Source: Post-harvest losses test, Makonde district, 2018.

3.3 Quantity of seed and seed rate

Respondents in the district were asked about the quantity of maize seed used during the planting season in communal lands and A1 farming sectors. A1 farmers used a total of 582 641 kg of maize seed, corresponding to a seed rate of 27 kg per ha (Table 8). The seed rate was slightly lower in communal areas (26.5 kg per ha), for a total of 163 690 kg of seeds used. These seed rates are only slightly above the recommendations of extension officers, which is to use 25 Kg per ha.

Table 8: Quantity of seed and see rate for maize

Crops	Communal		A1	
	Total seeds used (kg)	Seed rate (kg per ha)	Total seeds used (kg)	Seed rate (kg per ha)
Maize	163 690	26.5	582 641	27.0

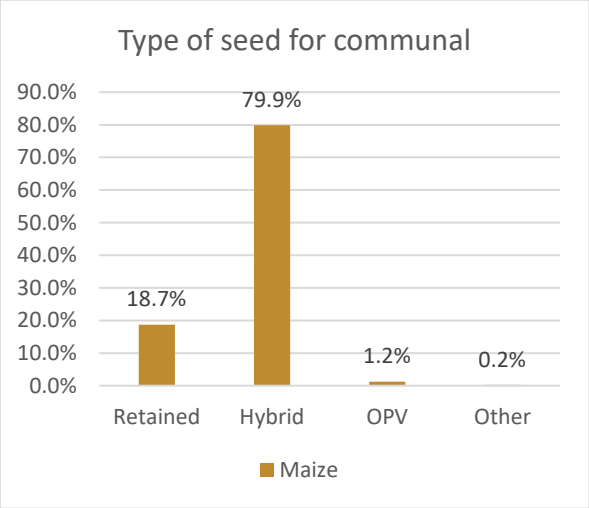
Source: Post-harvest losses test, Makonde district, 2018.

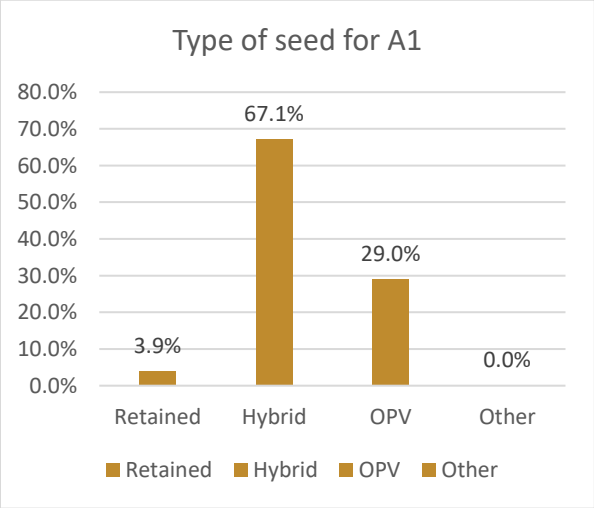
3.4 Type of maize seed used by sector

Farmers from communal areas and A1 farming sectors were asked the type of seed used during the season, among the following: retained seed, hybrid seed and open pollinated variety (OPVs) seeds. 79.9 percent of the communal area farmers used hybrid maize seeds and 18.7 percent used seeds from their previous harvest, or retained seeds (Figure 2). Only 1.2 percent of the farming households used the open pollinated variety. In A1 farms, the percentage of household using the OPV variety is much greater (29 percent), while retained seeds were only used by 3.9 percent of the household. The majority of households in A1 sectors still rely on hybrid seeds (67 percent).

The predominance of hybrid varieties in communal areas may be due to the presidential input scheme, of which communal farmers are the main beneficiaries. In addition, given the smaller areas in communal lands, the hybrid seeds provided through scheme may have proved sufficient for the farmers in this sector. In A1 sectors, characterized by larger maize farms, households may have had to use a larger amount of OPV varieties, which are cheaper than hybrid seeds and readily available on the market.

Figure 2: Type of seed used for maize according to the farming sector





Source: Post-harvest losses test, Makonde district, 2018.

3.5 Use of fertilizers and pesticides on maize

The survey also inquired the main type of fertilizer used for maize, either organic or inorganic, as well as the main type of pesticides used for maize during the farming season.

93.1 percent of the households in the A1 farming sector mainly used inorganic fertilizer, compared to 75.9 percent in the communal area (Table 10). As regards pesticides, 97.5 percent of the farming households in A1 sector mainly used herbicides and only 2.5 percent insecticides (Table 9). In the communal areas, 88.6 percent of the holdings used herbicides and 11.4 percent insecticides as their main type of pesticide. The wide use of herbicides in both sectors is due to the government command input scheme that benefited both the A1 and communal area farmers.

Table 9: Types of fertilizer and pesticides used on maize by A1 farmers

Crop	What is the main type of fertilizer used?				What is the main type of pesticide used?							
	Organic		Inorganic		Herbicides		Insecticides		Fungicides		Other	
	Number HH	%	Number HH	%	Number HH	%	Number HH	%	Number HH	%	Number HH	%
Maize	567	6.9	7 644	93.1	6 155	97.5	158	2.5	0	0,0	0	0.0

Source: Post-harvest losses test, Makonde district, 2018.

Table 10: Types of fertilizer and pesticides used on maize by communal farmers

Crop	What is the main type of fertilizer used?				What is the main type of pesticide used?							
	Organic		Inorganic		Herbicides		Insecticides		Fungicides		Other	
	Number HH	%	Number HH	%	Number HH	%	Number HH	%	Number HH	%	Number HH	%
Maize	2005	24.1	6 304	75.9	1 425	88.6	184	11.4	0	0.0	0	0.0

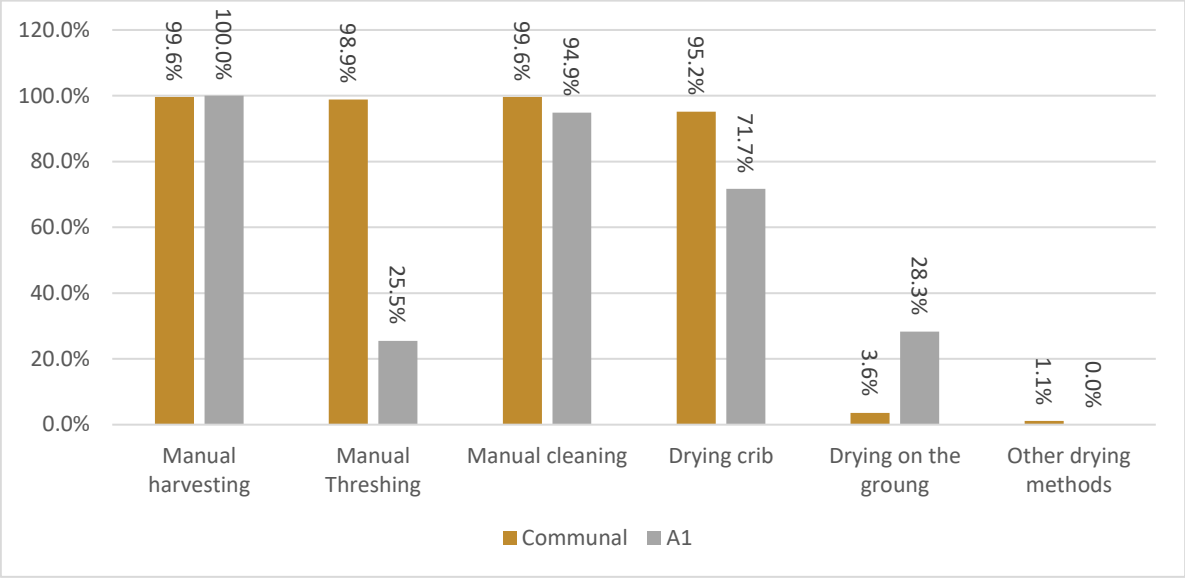
Source: Post-harvest losses test, Makonde district, 2018.

3.6 Harvest and post-harvest methods for maize

Figure 3 below shows the number and the percentage of households performing manual and mechanical methods for harvest, threshing/shelling, cleaning/winnowing and drying. In the communal area and A1 sectors, close to all farmers harvested manually. Most of the A1 farmers, about three quarters of them, used mechanical shellers while manual shelling concerns 98.6 percent of the communal farmers. The cleaning of maize was done manually for a vast majority of farmers in both communal areas and A1 sectors. Drying cribs is the most common method used to dry maize. In the

A1 sector, drying directly on the ground is used by a significant number of farmers, most likely because cribs are not adapted to the large volumes of maize harvested in this sector.

Figure 3: Post-harvest operations methods



Source: Post-harvest losses test, Makonde district, 2018.

3.7 Quantities of maize stored

In line with the estimates of maize production, the communal area farmers are storing on average 1.8 tonnes of maize per household, lower than A1 farmers with 2.6 tonnes per household. These results refer to the storage season of 2016–2017 and to the maize stored for at least one month.

Table 11: Quantity of maize stored from previous harvest

Crop	Communal			A1		
	Number of Holdings that stored	Total quantity stored (Kg)	Average quantity stored per holding (Kg)	Number of Holdings that stored	Total quantity stored (Kg)	Average quantity stored per holding (Kg)
Maize	5 340	9 134 456	1 767	8 358	19 202 961	2 585

Source: Post-harvest losses test, Makonde district, 2018.

Table 12 below presents the results in terms of utilization of stored maize. The A1 farmers consume about half (48.4 percent) of their stored grains and sell 35.9 percent. The proportion of stocks used for own consumption is higher in communal areas (61.8 percent), where only 22.1 percent of the stock has been destined to the market. The higher market-orientation of A1 farmers is in line with other results of the survey in terms of production and production practices.

At the time of the survey, the communal farmers had more maize in their stores compared to A1 farmers (7.0 percent vs. 1.7 percent, respectively) and they gave away less (4.3 percent vs. 8.0 percent, respectively). Again, these results are consistent with the higher share of farmers which are subsistence-oriented in communal areas and the higher production levels in A1 sectors.

Table 12: Utilization of stored maize

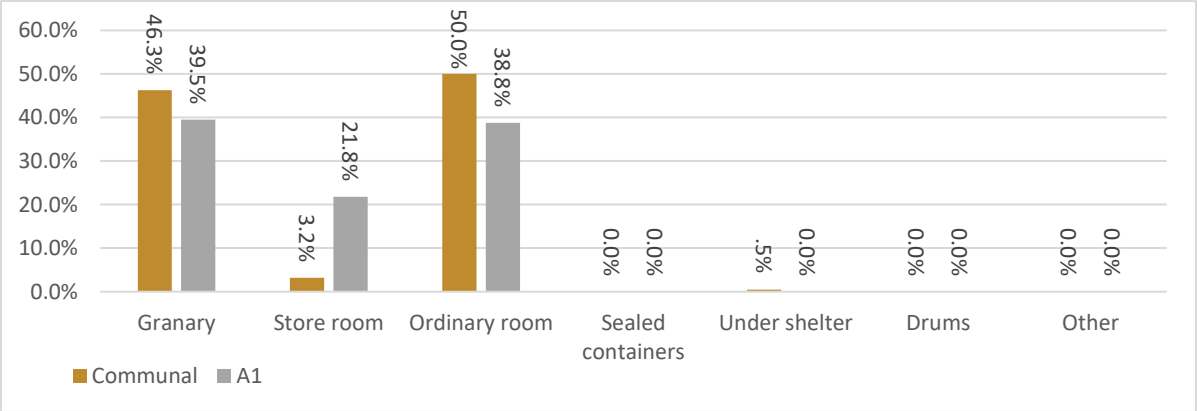
Crop	A1				Communal			
	Share of consumption over stock	Share of sales over stock	Share of given away over stock	Remaining over stock	Share of consumption over stock	Share of sales over stock	Share of given away over stock	Remaining over stock
Maize	48.4	35.9	8.0	1.7	61.8	22.1	4.3	7.0

Source: Post-harvest losses test, Makonde district, 2018.

3.8 Storage facilities used

Figure 4 below shows the percentage of households by storage facility used. Granaries and ordinary room storage is common in both sectors. The importance taken by storage in ordinary rooms may be linked to the perceived higher vulnerability to theft of the traditional pole and data structures as well as to the lack of skills of the younger generations for constructing traditional storage structures. In the A1 sector, a significant proportion of maize is stored in storerooms, the commercial orientation of most farmers in this farming sector justifying the cost of constructing such storage structures. On the contrary, the proportion of farmers using storerooms in the communal sector is very low, the investment required being for most households too high compared to their agricultural income.

Figure 4: Storage facilities used by household holdings



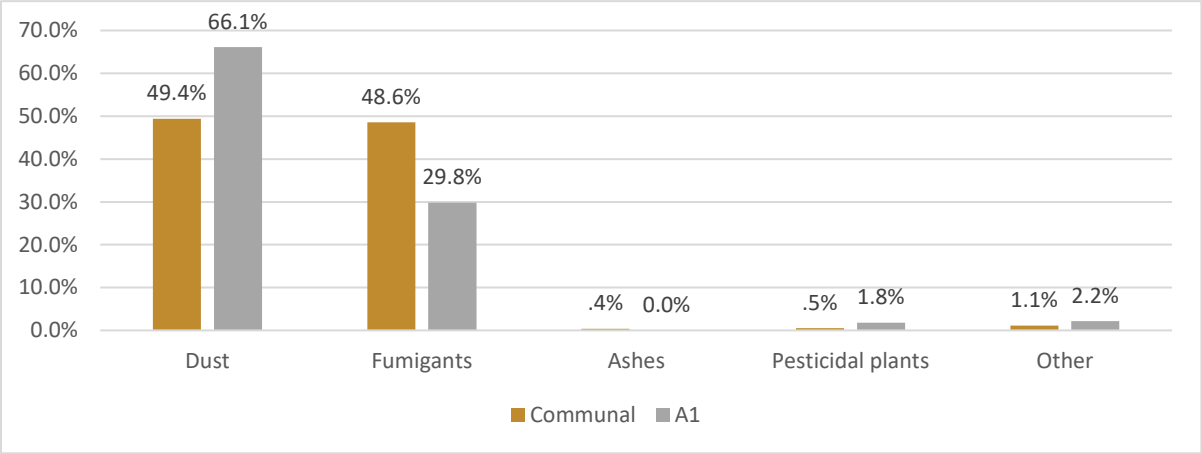
Source: Post-harvest losses test, Makonde district, 2018.

Ordinary rooms used for storage may include sleeping quarters. The fact that pesticides may be used in these storage facilities (Figure 5) pose serious health risks to the household members. Non-chemical pest control (e.g. pesticidal plants) is being seldom used, and more in the A1 farming sector than in communal sector lands.

3.9 Protection of the grains during storage

Figure 5 below provides information on the crop protection practices used during storage. Dusts and fumigants (chemical pesticides) are the most common crop protection practice used in both sectors. The latter are most widely used in the communal sectors, whereas the use of dust is predominant in the A1 area. Communal farmers use fumigants as much as they use dusts due to their perceived effectiveness and affordable prices compared to dusts. The lack of knowledge about the effects and conditions of use of pesticides may contribute to their over or inappropriate utilization: unawareness about their residual effect, the fact that they should be used in air tight environments (which is not the case of most of the storage facilities used) and that they should be handled used by trained people away from dwellings, for example.

Figure 5: Products used to protect the grains



Source: Post-harvest losses test, Makonde district, 2018.

4. Analysis of losses based on farmers' declaration and physical measurement

This section presents a set of tables providing information on quantitative and relative losses for each production stage (harvesting, drying, threshing/shelling, cleaning/winnowing, storage) as well as aggregate loss, for the two assessment methods used: farmers' declarations and physical measurements.

4.1 Loss quantities

Tables 13 and 14 below show the loss estimations resulting from farmers' declarations and physical measurements. In the A1 farming sector, the farmers perceive that they lose more at harvest, drying and cleaning than what the physical measurements indicate. The opposite applies to farmers of the communal sector, except for the harvest phase. Physical measurements were not performed to assess storage losses due to the limited time available for the survey.

The quantitative losses are important: According to physical measurements, from harvest to cleaning/winnowing, 1 599 tonnes are lost for A1 farmers and 742 tonnes for communal farmers. This amount, when converted to monetary values, represent important economic losses for farmers as these foregone resources may have been used to purchase food and other products of basic necessity.

Table 13: Declarative and physical measurement losses quantities for A1 farmers

Crop	A1								
	Loss quantity at harvest (Kg)		Loss quantity at drying (Kg)		Loss quantity at threshing/shelling (Kg)		Loss quantity at cleaning/winnowing (Kg)		Loss quantity at storage (Kg)
	Farmer's declaration	Physical measurement	Farmer's declaration	Physical measurement	Farmer's declaration	Physical measurement	Farmer's declaration	Physical measurement	Farmer's declaration
Maize	873 807	681 784	349 059	55 522	617 555	808 465	156 153	53 695	410 898

Source: Post-harvest losses test, Makonde district, 2018.

Table 14: Declarative and physical measurement losses for communal farmers

Crop	Communal								
	Loss quantity at harvest (Kg)		Loss quantity at drying (Kg)		Loss quantity at threshing/shelling (Kg)		Loss quantity at cleaning/winnowing (Kg)		Loss quantity at storage (Kg)
	Farmer's declaration	Physical measurement	Farmer's declaration	Physical measurement	Farmer's declaration	Physical measurement	Farmer's declaration	Physical measurement	Farmer's declaration
Maize	149 444	126 668	68 700	308 708	63 303	262 342	35 567	44 150	184 462

4.2 Relative losses

Relative losses assessed through physical measurements tend to be higher than those resulting from farmers' declarations for A1 farmers. The latter are estimated to lose 7.6 percent of the grain during harvest, when physically measured, compared to 5.2 percent declared by farmers. In communal areas, an opposite situation is faced, with physical measurements lower than declarations (3.7 percent vs. 8.2 percent). The losses tend to be lower for the other farm operations, irrespective of the assessment approach. For storage, relative losses are significant, at approximately 3 percent for both areas. For the communal farmers, the relative losses at drying, when measured through physical measurements, are high (5.7 percent).

Table 15: Declarative and physical measurement percentage losses for A1 farmers

Crop	A1								
	Relative loss at harvest (%)		Relative loss at drying (%)		Relative loss at threshing/shelling (%)		Relative loss at cleaning/winnowing (%)		Relative loss at storage (%)
	Farmer's declaration	Physical measurement	Farmer's declaration	Physical measurement	Farmer's declaration	Physical measurement	Farmer's declaration	Physical measurement	Farmer's declaration
Maize	5,17	7,56	0,35	0,44	0,59	0,01	0,35	0,40	3,35

Source: Post-harvest losses test, Makonde district, 2018.

Table 16: Declarative and physical measurement percentage losses for communal farmers

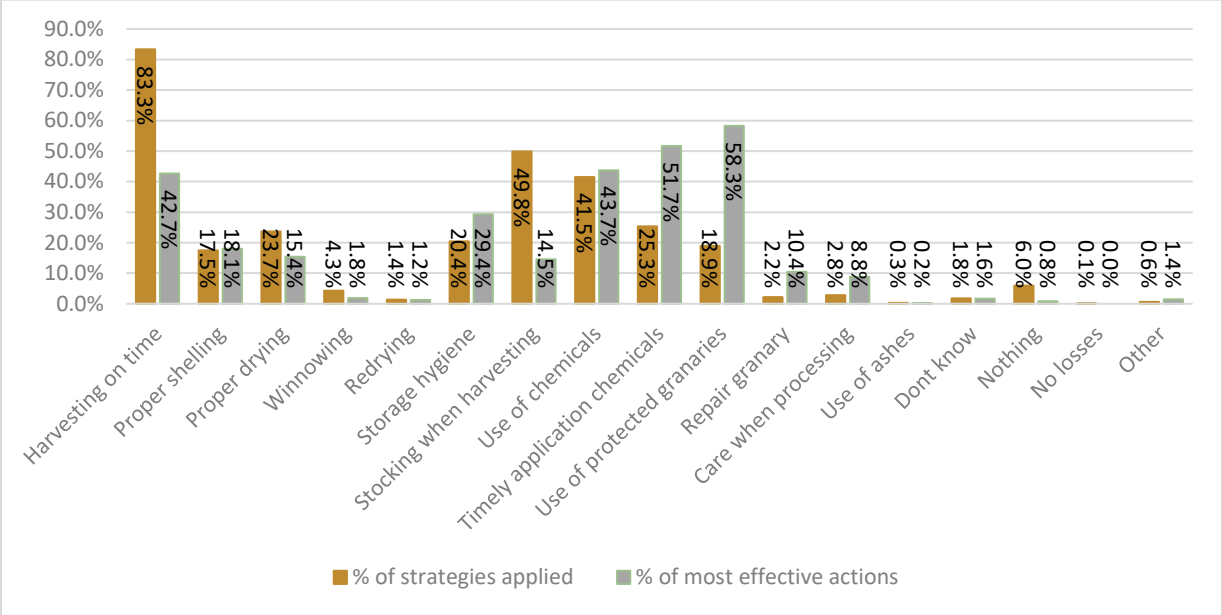
Crop	Communal								
	Relative loss at harvest (%)		Relative loss at drying (%)		Relative loss at threshing/shelling (%)		Relative loss at cleaning/winnowing (%)		Relative loss at storage (%)
	Farmer's declaration	Physical measurement	Farmer's declaration	Physical measurement	Farmer's declaration	Physical measurement	Farmer's declaration	Physical measurement	Farmer's declaration
Maize	8,19	3,72	0,49	5,74	0,54	1,29	0,49	0,92	2,88

Source: Post-harvest losses test, Makonde district, 2018.

4.3 Loss prevention strategies by agricultural households

Figure 6 below shows the number and percentage of households according to the loss prevention method used, on the one hand, and according to the most effective prevention action considered by farmers on the other hand. 58.3 percent consider that protected granaries will be the most effective strategy to prevent PHL, followed by timely application of chemicals, use of chemicals and harvesting on time. Although these are the perceived most effective strategies to prevent losses, the farmers applied different strategies. The main strategy used is to harvest on time, a practice adopted by 83 percent of the farmers to prevent losses.

Figure 6: Post-harvest losses prevention methods according to farmers

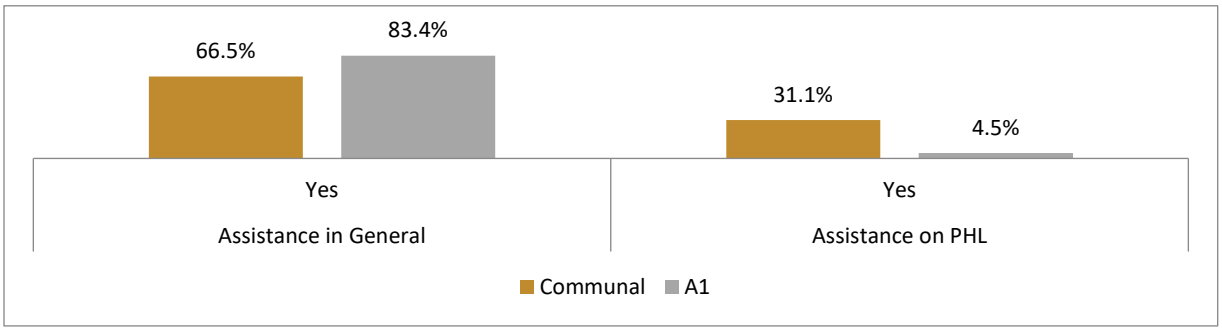


Source: Post-harvest losses test, Makonde district, 2018.

4.4 Assistance received from government or non-governmental organizations

Figure 7 below shows that 66.5 percent of farmers in the communal sector and 83.4 percent in the A1 sector receive some assistance in their farming activities either from the government or NGOs. Of the households that received assistance in general, 31.1 percent and 4.5 percent received specific guidance on PHL, in the communal area and A1 sectors respectively. This shows that there is little that is being done to assist farmers with PHL management. This gap needs to be filled either by government or NGOs in the form of training and introduction of some technologies which effectively help to control PHL.

Figure 7: Assistance received by household holdings

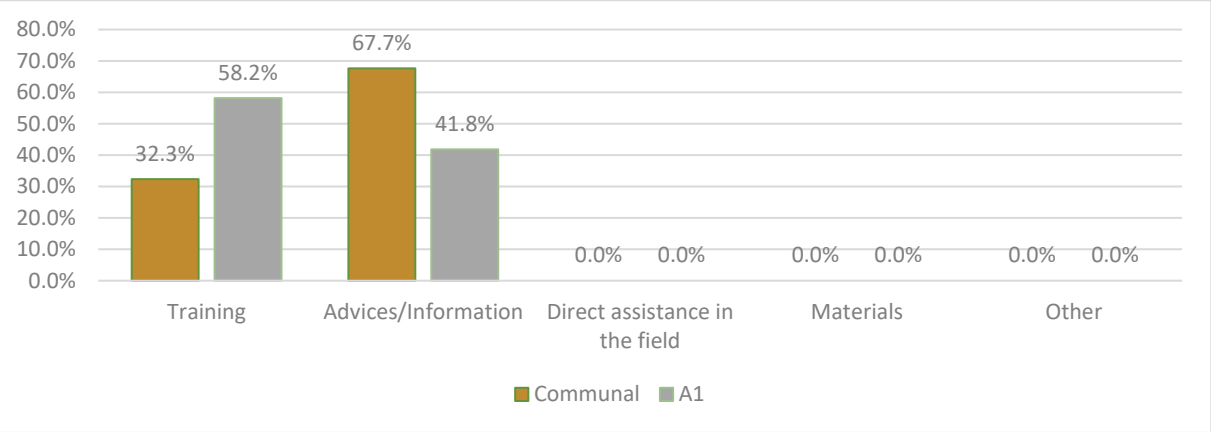


Source: Post-harvest losses test, Makonde district, 2018.

4.5 Main kind of assistance received by household holdings

Figure 8 shows that of the farmers that receive some technical assistance on PHL, more farmers from the A1 sector received trainings, compared to those in communal areas (58.2 percent against 32.3 percent, respectively). Hands-on trainings are expected to be more efficient than more general advices and information, which are the most common form of assistance for communal farmers (67.7 percent).

Figure 8: Most important assistance received on post-harvest losses



Source: Post-harvest losses test, Makonde district, 2018.

4.6 Main source of information used to obtain post-harvest management information

Table 17 shows that the communal farmers obtain most of their information on post-harvest management from the radio, agricultural fairs, from other farmers and a small proportion do not get any information at all. In the A1 sector instead, 58.2 percent of the farmers obtain information on post-harvest management from other farmers. A high number of farmers in this sector do not have access to any information at all (41.8 percent), which is consistent with the small number of farmers that receive assistance on this topic (4.5 percent). The table also indicate that 7.6 percent of farmers obtain information on post-harvest management through their participation to agricultural fairs.

Table 17: Source of post-harvest management information

Post-harvest managements	Communal		A1	
	Number of holdings	%	Number of holdings	%
Other farmers	60	4.4	30	58.2
TV/Radio	1 102	80.4	0	0.0
Agro-dealers	0	0.0	0	0.0
Platform	52	3.8	0	0.0
Agricultural fair	104	7.6	0	0.0

Other	0	0.0	0	0.0
None	52	3.8	22	41.8
Total	1 369	100.0	52	100.0

Source: Post-harvest losses test, Makonde district, 2018.

5. Limitations and recommandations

Farmer declarations may have under reporting or over reporting as shown in Table 13 and Table 14 where farmer perception was very different from the physical measurements in which they either over estimated or under estimated. The sample size is not representative of the whole country and representative estimates at country level cannot be provided from this survey. Errors in data entry in the field increase the complexity and length of data analysis, which requires lengthier data validation procedures. Computer Assisted Personal Interviewing minimizes challenges related to data entry and analysis and allows for consistency controls in the field, during data collection.

To establish a solid baseline on losses, the survey would need to be conducted over several years with a fairly large sample. The post-harvest loss assessments can be incorporated into the existing crop and livestock survey since it is representative of all districts at country level. A sub-sample from the crop estimates can be drawn in each district for the PHL survey. This will establish the baseline and there would be no need to have a PHL survey every year once a baseline is set. Physical measurement can be done every 4–5 years after baseline establishment.

6. Conclusions

All households have field crops as their main agricultural activity in both sectors and there are slight differences in the social demographics of the two sectors investigated, communal lands and A1 farming sectors. There is a higher than expected use of chemicals among the sampled farmers, likely because of the increased awareness of these products among the farming community and because of public incentives to expand the use of these products (command agriculture program). The yields and production in the A1 sector are higher than those of the communal sector.

Estimated relative losses for maize in the A1 sector amounts to 3.4 percent, slightly above the estimate for communal farmers (3.4 percent). Farmers perception of losses either over or under-estimated estimates from physical measurements, depending on the sector and operation investigated. Results for physical measurements of storage losses were not analyzed because the results of the laboratory analysis were not available at the time this report was prepared.

Farmers perceived that the use of protected granaries and timely application of chemicals during storage are the most effective strategies to reduce losses. There are differences between these perceptions and the strategies effectively adopted by farmers, which can be explained by a range of

reasons: lack of knowledge or skills to implement certain approaches, high cost of the prevention practices, unawareness of the true loss levels experienced by farmers, to name the main ones.

References

Global strategy to improve agricultural and rural statistics (GSARS). 2018. *Guidelines on the measurement of post-harvest losses. Recommendations on the design of a harvest and post-harvest loss statistics system for food grains (cereals and pulses).* Global Strategy Guidelines. Rome. (Also available at: http://www.fao.org/3/ca6396en/ca6396en.pdf).

Guidelines on the measurement of harvest and post-harvest losses

Estimation of maize harvest and post-harvest losses in Zimbabwe

FIELD TEST REPORT

In the framework of the Global strategy to improve agriculture and rural statistics (GSARS), FAO provided technical assistance to Zimbabwe on the measurement of harvest and post-harvest losses through sample surveys. The technical assistance was provided in the form of a pilot study on estimating harvest and post-harvest losses for major crops in the Makonde district in the communal and A1 farming sectors. The survey focused on maize and sorghum and included the measurement of on-farm losses.

The survey captured losses through interviews of farmers as well as through physical measurements. The number of usable data points for sorghum were too few to provide reliable production and loss estimates, hence the results presented in this report mostly refer to maize.

The results show that 5.2 percent of grain is lost at harvest and 3.8 percent lost at drying. The comparison of the loss estimates according to the measurement method used shows mixed results; in A1 farming sectors, farmers' own loss estimates tend to be lower than physical measurement, while the opposite is evidenced in the communal sector (except for drying). Timely harvesting was used by most farmers to limit losses, followed by stoking when harvesting and the use of chemicals to protect crops from pest infestations during storage.

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