

**AN ANALYSIS OF THE CAUSES AND EFFECTS OF MAIZE GRAIN POSTHARVEST
LOSSES IN ZAMBIA'S KAFUE DISTRICT**

**A Research Report presented to the Department of Agricultural Economics and Extension
of the University of Zambia.**

BY

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DEDICATION

This report is dedicated to my sisters; Daliso, Chikondi, Beatrice and the rest of my family and my friends.

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LIST OF ABBREVIATIONS

PHL	Postharvest Losses
CSO	Central Statistics Office
MLR	Multiple Linear Regression
FRA	Food Reserve Agency
MACO	Ministry of Agriculture and Co-operatives
SPSS	Statistical Package for Social Scientists
FAO	Food Agricultural Organization
Kgs	Kilograms

ABSTRACT

An Analysis of the Causes and Effects of Maize Grain Postharvest Losses in Zambia's Kafue District

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Maize (*Zea mays*) grain losses contribute to food insecurity and low farm incomes not only in Kenya, but also in Sub-Saharan African countries (Compton, 1992; Azu, 2002; Republic of Kenya, 2004). Therefore, efficient postharvest handling, storage and marketing can tremendously contribute to social economic aspects of rural communities in Zambia as stipulated in Vision 2030. The objectives of the study were to; determine the effect of maize postharvest losses on the availability of food to the farmers, Assess the effect of the losses on the price the farmers sell their maize and examine the social demographic characteristics of farmers that influence postharvest losses. It was hypothesized that postharvest losses reduce availability of food, low quality maize grain reduces the market price for the grain and demographic factors of the farmer influence postharvest losses. A total of 145 farmers to be interviewed were selected from the area. The data collected were analyzed using descriptive and correlation methods.

During the study it was noted that 83.4% of the losses were due to inadequate storage, 76.6% were due to inadequate transport, 70.3% of the losses were due to inadequate labour to help in postharvest handling and 35.2% of the losses were due to adverse weather. Among the factors found to have had a significant (at 95% confidence level) influence on maize postharvest losses were: level of education ($P\text{-value} = 0.04$), distance from field to storage place ($P\text{-value}=0.0235$), inadequate labour ($P\text{-value}=0.03$), inadequate storage ($P\text{-value} = 0.0116$) and type of transport ($P\text{-value}=0.0391$)

In view of the findings, it is recommended that both private and public invention should consider promoting programs that are aimed at teaching the farmers on proper maize storage and post-harvest handling so that the quantity of maize grain lost is reduced. I would also recommend that farmers are involved in Contract Farming and farmers form cooperatives so that they can build storage facilities near their field as to avoid losses that are incurred when transporting the grain for long distances

CHAPTER 1

INTRODUCTION

1.1 Introduction

About 50 percent of the Zambian rural population depends on agriculture as a major source of livelihood; the majority of which are small scale farmers. Zambia has a high agricultural potential based on the location and natural resource endowment. However this potential has not been fully exploited due to a number of factors including macro-economic environment, unfavorable weather patterns and inappropriate sector policies. Past agricultural initiatives/policies were restrictive and constraining with strong government intervention and participation. In addition the strategies pursued were not sustainable. Consequently, these policies and strategies failed to stimulate growth in the sector. Up to early 1990s, the sector was poorly developed and dominated by single crop-maize, hence there few losses recorded. But afterwards the sector begun to expand, policies changed and the sector diversified into growing different crops that a lot of losses started to be recorded. With these changes coming up the Ministry of Agriculture came up with a vision for the sector which is to; “promote development of an efficient, competitive and sustainable agricultural sector, which assures food security and increased income”. This vision can only be achieved by reducing postharvest losses which have affected the agricultural sector for a very long time.

The postharvest sector includes all points in the value chain from production in the field to the food being placed on a plate for consumption. Postharvest activities include; harvesting, handling, storage, processing, packaging, transportation and marketing. Postharvest losses are losses incurred to crops after they have been harvested. These losses are caused by many factors. Some of these causes are:

Biological and Environmental Factors - Biological (internal) causes of deterioration include respiration rate, ethylene production and action, rates of compositional changes (associated with color, texture, flavor, and nutritive value), mechanical injuries, water stress, sprouting and rooting, physiological disorders, and pathological breakdown. The rate of biological deterioration depends on several environmental (external) factors, including temperature, relative

humidity, air velocity, and atmospheric composition (concentrations of oxygen, carbon dioxide, and ethylene), and sanitation procedures. All these factors have been discussed by numerous authors (Bartz and Brecht, 2002).

Socioeconomic Factors - Although the biological and environmental factors that contribute to postharvest losses are well understood and many technologies have been developed to reduce these losses, they have not been implemented due to one or more of the following socioeconomic factors (Kader, 1983).

Inadequate Marketing Systems – This problem exists in many locations within developing countries. It is accentuated by lack of communication between producers and receivers, and lack of market information. Marketing cooperatives should be encouraged among producers of major commodities in important production areas.

Inadequate Transportation Facilities - In most developing countries, roads are not adequate for proper transport of crops. Also, transport vehicles and other modes. This is true whether for local marketing or export to other countries. The majority of producers are small holdings and cannot afford to own their own transport vehicles. In a few cases, marketing organizations and cooperatives have been able to acquire transport vehicles, but they cannot do much about poor road conditions.

Government Regulations and Legislations - The degree of governmental controls, especially on wholesale and retail prices of fresh fruits and vegetables, varies from one country to another. In many cases, price controls are counter-productive. Although intended for consumer protection, such Regulations encourage fraud and provide no incentive for producing high-quality produce or for postharvest quality maintenance.

Unavailability of Needed Tools and Equipment - Most of the tools are neither manufactured locally nor imported in sufficient quantity to meet demand. Various governmental regulations in some countries do not permit direct importation by producers of their needs. It is imperative that the tools that will enable handlers to use recommended technology for a given situation be

available for them to use. In many cases, such tools can be manufactured locally at much lower cost than those imported.

Lack of Information - The human element in postharvest handling of horticultural commodities is extremely important. Most handlers involved directly in harvesting, packaging, transporting, and marketing in developing countries have limited or no appreciation for the need for, or how, to maintain quality. An effective and far-reaching educational (extension) program on these aspects is needed critically now and will continue to be essential in the future.

Poor Maintenance - In many developing countries, some good facilities that were built a few years ago are currently “out of order” or not functioning properly because of lack of maintenance and unavailability of spare parts. This problem is especially true of public-sector facilities. Any new project should include in its plan adequate funds for maintenance to ensure its success and extended usefulness. Rough handling during harvesting, loading, packing and transportation are also a major cause of postharvest losses.

1.2. Statement of the Problem

Zambia has high agricultural potential based on its location and natural endowment. Production of maize is predominantly carried out by small scale farmers. It is estimated in Zambia that 60% of the labour force is engaged in agriculture and they produce 80% of the marketed maize. Even though this is the case, postharvest losses are still very high and many farmers live in poverty and the food they grow doesn't even sustain them to the next harvest. The high postharvest losses are attributed to the fact that farmers don't apply the methods of reducing postharvest losses such as: building silos for storing their maize, applying chemicals during storage, not only do they not utilise the facilities, some farmers don't utilize the readily available market but prefer to store the maize for long periods of time so that they can sell at a later date when the prices go up, hence incurring a lot of losses.

The high postharvest losses have aggravated hunger situation among small scale farmers, this has made the harvested maize lose quality both physically and chemically. Hence making the price

of the maize fall, reduces farmer's standard of living, reduces farmer's income and making it less profitable for farmers.

1.3. Research Objectives

1.3.1. General Objective

To examine the factors that influence postharvest losses among small scale farmers in Kafue district

1.3.2. Specific Objectives

- To determine the effect of maize postharvest losses on the availability of food to the farmers
- Assess the effect of maize postharvest losses on the price the farmers sell their maize
- Examine the social demographic characteristics of farmers that influence postharvest losses

1.4. Statement of Hypothesis

- Postharvest Losses reduce availability of food
- Poor Quality Maize grain reduces the market price of the grain
- Demographic factors of the farmer influence postharvest losses

1.5. Rationale

The research has great importance as it will educate the farmers on the impact of postharvest losses, Thereby reducing the level of poverty among small scale farmers and increasing their income. This will in turn increase productivity and the country will continue experiencing bumper harvests. It is not only targeted at small scale farmers, but also at FRA and the ministry of agriculture. They will also know what really causes high postharvest losses and know how to handle the losses to improve on the food security in the country.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

This section reviews the findings by other researchers and tries to analyse the findings and see how they can be used in the Zambian set up. It reviews the causes of postharvest losses and the solutions that can reduce postharvest losses.

2.2. Definition of Terms

Postharvest Losses: these are losses that are incurred after the product has been harvested. They are incurred during; harvesting, storage, processing, packaging, transportation and marketing (Kitinoja, 1995 and Kader, 1995).

Economic Welfare- the welfare of an individual or group which comes from the purchase and consumption of goods and services (oxford dictionary, 2010)

2.3. Effects of Postharvest Losses

Most Zambian small scale farmers grow maize for survival; they are the major producers of this grain in the country. Though this is the case most of them live in poverty and wait for relief food from the government. The level of postharvest losses among small scale farmers is high; hence most of the maize grown goes to waste. This then aggravates the hunger situation among small scale farmers. Because food prices keep on rising, most small farmers due to low income cannot afford to buy the food to feed their families. The high postharvest losses reduce the quality and quantity of maize, making the enterprise less profitable for the farmers even though they put in a lot of money, they end up making losses. Postharvest losses have reduced the standard of living of most small scale farmers. Though a number of remedies have been proposed and implemented to reduce postharvest losses, the losses are still high because the proposed methods are expensive for farmers to implement. (Persson, 1986)

2.4. Remedy for Postharvest Losses

A systematic analysis of each commodity production and handling system is the Logical first step in identifying an appropriate strategy for reducing postharvest losses of maize (Bell et al. 1999).

It is important to select the technologies that are appropriate for the size of each postharvest enterprise (Clarke, 1994). Marketing companies and cooperatives are essential for handling maize produce and reducing postharvest losses by providing facilities for accumulating, preparing and transporting produce to markets; by coordinating marketing activities; and by distributing profits equitably to members.

Mrema and Rolle (2002) indicated an evolution of priorities within the postharvest sector of developing countries from a primarily technical focus geared towards the reduction of losses, to a more holistic approach designed to link on-farm activities to processing, marketing, and distribution. However, the major constraints continue to be high postharvest losses, poor marketing systems, weak research and development capacity, and inadequacies in policies, infrastructure, and information exchange. The Agricultural and Food Engineering Technologies Service of FAO, in collaboration with the Global Forum for Agricultural Research (GFAR) and the Global Post-Harvest Forum (PhAction) recently embarked upon the development of a new global post-harvest initiative geared toward addressing the challenges faced by the sector in developing countries.

Golletti (2003) listed the most relevant issues for developing countries as follows: the need for a regulatory framework that promotes growth while safe-guarding welfare; for adequate market information to be given to all participants involved; for further investment in postharvest research; and for participation in international agreements that promote trade and food safety. The majority of rural population in developing countries like Zambia have limited to no resources and solely depend on the agricultural sector for their livelihood and revenue; therefore postharvest losses are often felt with greater magnitude than in developed nations (Golletti and

Wolff, 1999). The findings reviewed that since many depend on agriculture the level of postharvest losses are very high amongst the small scale farmers.

2.5. Researches Conducted by FAO in Some Countries

The studies reviewed that postharvest losses aggravate hunger, thereby decreasing the standard of living of the farmers and contributes to high food prices. They mainly focused on ways of reducing postharvest losses, through improved technology and training the farmers on how to reduce postharvest losses. (Jaskaranjit *et al.* 2000)

In trying to reduce the losses, FAO stressed that with adequate investment and training, food losses would drastically reduce, especially in developing countries. FAO corroborated with the World Bank and others to train thousands of people on how to handle harvested food properly, this was done in 3 different continents. Some of the countries the training was done are Kenya, Afghanistan and Guinea. The findings are explained below:

In Kenya where mycotoxin contamination of rain staples was of major concern, FAO with the Ministry of Agriculture provided technical training for stakeholders in food production. The later effects were reduced losses and increased income for the farmers and thereby improving their standards of living.

While in Afghanistan, a FAO project largely funded by Germany provided household metallic Silos to around 8000 beneficiaries and trained a lot of farmers on how to handle postharvest losses. The effect of this was immediate, as participating farmers began using the silos to store grain. The farmers later reported higher incomes and longer storage possibilities. The losses fell between 15-20%. (Jaskaranjit *et al.* 2000),

In Guinea, 70-80% of people depend on agriculture. FAO designed a project to reduce postharvest losses. 100 silos ranging in capacity from 100-1800 kg were distributed. Dozens of artisans were trained in construction and installation of silos, as a result farmers reduced losses

and saved their grain stocks and stored it until better market conditions prevailed. (Jaskaranjit *et al.* 2000),

In all 45,000 silos were installed in 16 countries and more than 1,500 professionals, technicians and craftsmen were trained in constructing and handling them. FAO also set up revolving funds and loans to facilitate the diffusion of better storage containers since most farmers' couldn't afford to buy materials to build the silos. From the projects and trainings done by FAO, a lot can be learnt on trying to reduce postharvest losses among farmers. The programmes adopted could be used in developing countries to try and curb the issue of postharvest losses. Apart from training a lot of funding is required to the Agricultural sector. (Jaskaranjit *et al.* 2000)

The findings by FAO and the measures taken are expensive for the small scale farmers in Zambia as most of them have a low income base. I would suggest that instead of the expensive silos farmers can use grass to make storage facilities, can also make clay pots and mostly dry most of their products as it is cheaper to preserve the products that way. The materials mentioned above are cheaper to obtain and would cost less for the small scale farmers. The drying is one easiest way to preserve food the food as the heat can be obtained directly from the sun and also from fire. (Jaskaranjit *et al.* 2000),

CHAPTER 3

RESEARCH METHODOLOGY

3.1. Introduction

This chapter describes the methods and procedures that were be used to help in the achievement of stated objectives. The chapter also describes the study area, sample that were used and the method of collecting and analyzing data. A research design is defined as a plan used to study a problem or question. (Hines and Vailant, 2000)

3.2. Study Site

This study was conducted in Kafue district, which is in Lusaka province. This area was selected because it comprises mostly of small scale farmers, who were the target group in the research. They mostly grow crops enough for consumption and very few for sale, though the area has a few large scale farmers. This was a true representative of various household characteristics such as age and levels of knowledge, which were some of the variables this study tried to measure. Kafue district was also chosen because of the presence of project activities of the Ministry of Agriculture and Cooperatives (MACO) through the District Agricultural Coordinators Office, and the Ministry of Community Development, which are fighting hard to educate the farmers on the issues of agriculture.

3.3. Sample

A sample of 145 farm households was selected from a sampling frame comprising all the small scale farmers and large scale farmers in the area. Simple random samples of a total of 145 households were selected from a number of camps to ensure representation of all categories of households. A farm household was used as a sampling unit. The sample size was obtained as shown below;

$$n = t^2 * p (1-p) / m^2$$

n = sample size

t = confidence level at 95% (standard value of 1.96)

p = estimated PHL of maize in the project area (10%)

m = margin of error at 5% (standard value of 0.05)

$$=1.96*1.96*0.1(1-0.1)/0.0025$$

$$=138.3 =138$$

5% were added to account for error and non-response, hence a total of 145 farmers.

3.4. Data Collection and Analysis

Primary and secondary data was collected in this study. The Primary data was collected through personal interviews using structured questionnaires which were carefully developed around the overall objectives of the survey. Secondary data was collected from various institutions such as the MACO, CSO, NGOs, relevant publications and the internet. The data from questionnaires were analyzed using SPSS to generate tables, pie charts, and bar and line graphs. Microsoft excel will be used to organize the outputs.

3.5. Conceptual Framework

The data was analyzed using a multiple linear regression model. It was the same model that was used by FAO to determine the factors that cause postharvest losses of maize. The model was;

$$Y= B + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + D_1X_1 + D_2X_2 + D_3X_3$$

Y = quantity of postharvest losses

X₁ = highest level of education attained by the farmer, **X₂** = type of farming the farmer is involved

in, **X₃** = distance from the maize field to the storage place, **X₄** = type of transportation used, **X₅** =

age of the farmer, **D₁** = sex of the farmer, **D₂** = Inadequate labour, **D₃** = Inadequate storage.

CHAPTER 4

STUDY FINDINGS AND DISCUSSION

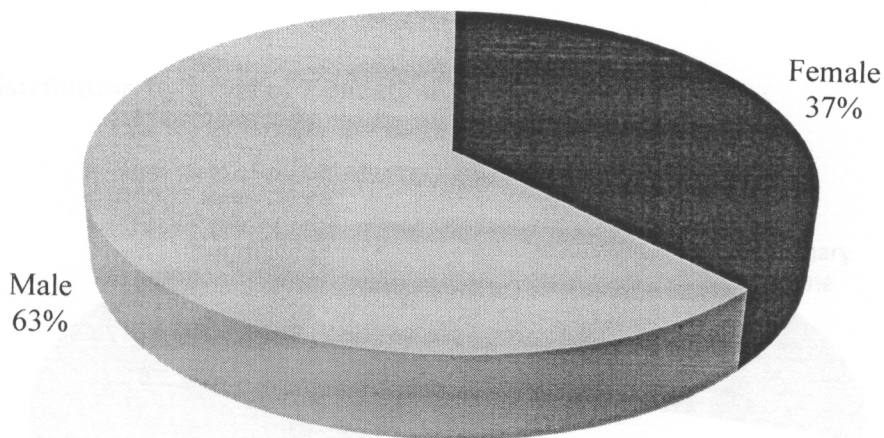
4.1. Introduction

This chapter presents and discusses the study findings. It starts the analysis with a presentation and discussion of the demographic characteristics. The knowledge the farmers have on postharvest losses and the causes of postharvest losses. The multiple linear regression estimates with a discussion of the resulting estimates will be stated later on.

4.2. Demographic Characteristics

The majority of the farmers (62.8%) were males while (37.2%) were females. There are more males because only the household head in each household was the respondent implying that females were respondents only in female headed households. Therefore, there were more male headed households than female headed households (refer to figure 1 below)

Figure 1: Distribution by Gender



The age distribution was: 33 farmers where between the ages of 30-40, 54 farmers where between the ages of 41-50, 29 farmers where between the ages of 51-60, 23 farmers where between 61-70 and 6 farmers where between 71-80 years, with the bulk of the farmers (87 of them representing 60%) being in the productive age group. Refer to table 1 below.

Table 1: Distribution by Age

Age (range)	Frequency
30-40	33
41-50	54
51-60	29
61-70	23
71-80	6

Almost 30% of the farmers attained primary level of education, while 27.6% had attained secondary level of education, 26.2% had gone up to tertiary education, and 16.6% never attended school at all. Refer to figure below

Figure 2: Distribution by Level of Education

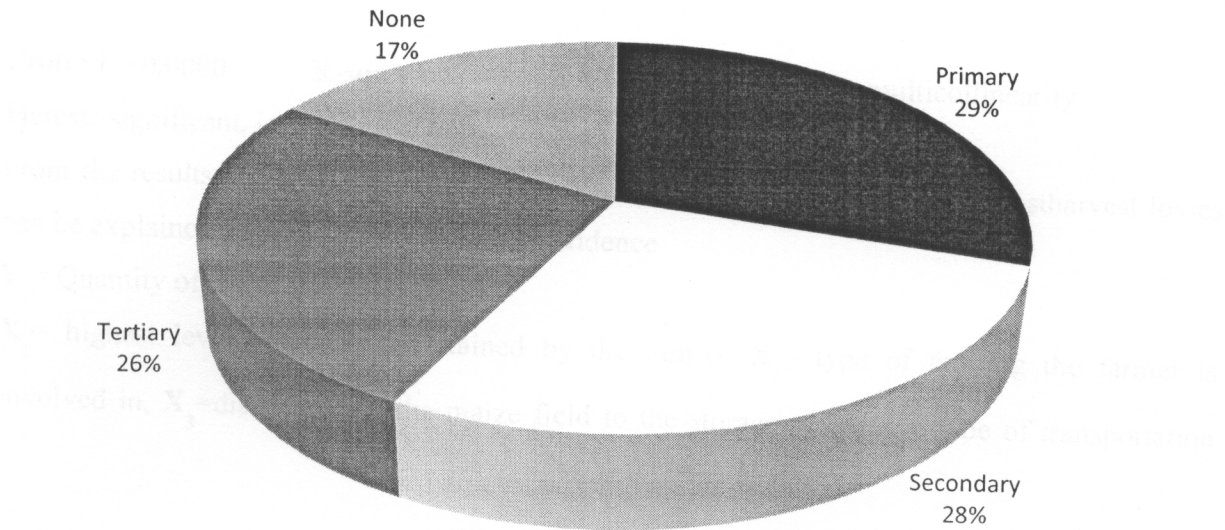
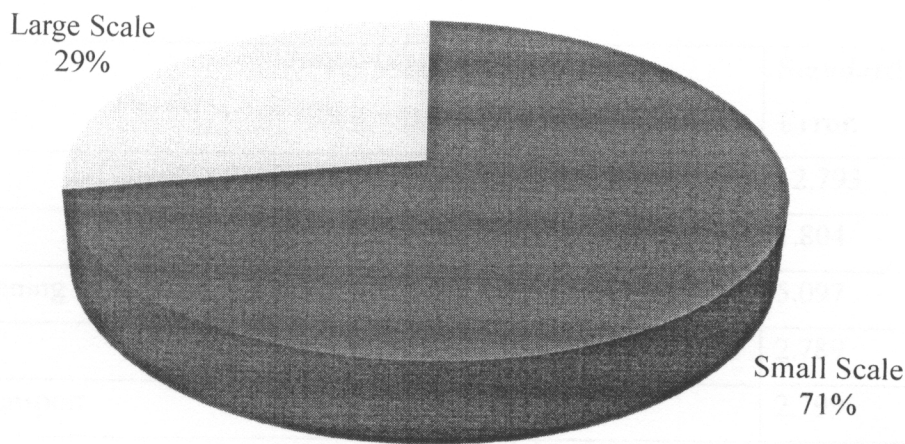


Figure 3 below shows that out of the 145 farmers interviewed, 72.2% of them were small scale farmer and the remaining 28.8% of the farmers were large scale farmers.

Figure 3: Distribution by Type of Farming



4.3. Regression Model Results

The multiple linear regression was done for a total of 145 observations from the sample survey.

The model

Prob> F =0.0000 **R-squared** =0.792, **VIF** < 10, meaning no multicollinearity

Hetest: significant, implying that heteroskedasticity is not present.

From the results the model is significant at 5%, i.e. 79% of the variation in postharvest losses can be explained by the variables at 95% confidence

Y = Quantity of maize grain lost (Kgs)

X₁ = highest level of education attained by the farmer, **X₂** = type of farming the farmer is involved in, **X₃** = distance from the maize field to the storage place, **X₄** = type of transportation

used, X_5 = age of the farmer, D_1 = sex of the farmer, D_2 = Inadequate labour, D_3 = Inadequate storage

TABLE 2: Parameter Estimates of the Multiple Linear Regression
Y = Quantity of maize grain lost (Kgs)

Variables	Coefficients	Standard Error.	P-VALUE
Intercept	8.895	12.793	0.00
Education	-1.108*	1.804	0.040
Type of farming	-3.879	5.097	0.446
Distance	3.328*	2.789	0.0235
Type of Transport	-2.411*	2.799	0.0391
Age	-0.188	0.153	0.220
Sex (dummy variable)	-2.259	3.640	0.536
Inadequate labour (dummy variable)	0.1696*	1.230	0.0256
Inadequate storage (dummy variable)	0.22109*	0.216	0.0116

The intercept is positive. Which means that when the independent variables are constant (zero), the farmer losses 444.75kgs of maize grain. Implying that there other factors that would cause postharvest losses than those studied.

The level of education of the farmer showed a negative coefficient (-1.108). Implying that a one year increase in the number of years of education results in a 55.4kgs decrease in the maize grain postharvest loss, this is because farmers will adopt improved scientific methods in post-harvest operations and it will also increase managerial skill (how to manage harvested maize to avoid PHLs). The educated farmer will also know the right amount of chemicals to apply on the maize to avoid pests. The level of education is statistically significant at 5%.

The type of farming has a negative relationship with postharvest losses. Hence, being a small scale farmer entails that one would have high maize grain postharvest losses of 193.5kgs. This means that small scale farmers face high postharvest losses than large scale farmers, which could be attributed to the fact that the small scale farmers have low income, lack knowledge, and don't have where to store the maize. This causes them not to have good storage facilities to store their maize. With the low literacy levels exhibited among small scale farmers, losses are expected to be high. This is because they don't have technical skills to avoid the losses. Some can't even read the instructions on the chemicals, hence don't know the proper application of the chemicals and they end up applying less in trying to be economical.

The coefficient on distance from the farm to the storage place is positive and was found to be 3.328. This implies that there is a positive relationship between distance from the farm and storage facility. A one kilometer increase in the distance of the field from the storage facility increases maize grain loss by 166.4kgs. Most of the farmers sampled said the distance from the farm to the storage place was long so the reason as to why they incurred a lot of losses. Distance is statistically significant at 5%.

The coefficient on the type of transportation used is negative and was found to be -2.411; hence, using poor transportation entails that one would have high maize grain postharvest losses of 120.55kgs. That is most of the farmers transported their produce by oxen and on foot, which was the major cause of transportation loss. Very few used vehicles to transport the maize; hence they incurred losses as it took long to move the maize from the field to the storage place. The condition of the roads makes it more difficult to move the produce with the means they had.

The coefficient on the age of the farmer is negative and was found to be -0.188. This implies that a one year increase in the age of the farmer would decrease maize grain postharvest losses by 9.4kgs. This is because as one grows the experience in farming also increases and hence would know how to handle their maize grain.

The coefficient of inadequate labour facilities dummy was positive (0.1696) and significant at 5%. Therefore, having inadequate labour entails that the farmer loses 8.45kgs of the maize grain.

This is in conformity with the results obtained by Rao *et al.* (2001). The step-down regression analysis revealed that the post-harvest losses could be reduced by proper storage, proper transportation and timely availability of labour. Because of heavy demand of a labour at the time of harvesting, it was observed that the farmers neglect the corn on the plants because they are in a hurry of completing the harvesting which caused a highest loss at the post-harvest losses at the field level.

The co-efficient of the inadequate storage facilities dummy was positive (0.2210) and significant at 5% level. Hence, having inadequate storage facilities, entails that one would incur maize grain losses of 11.5kgs. In the study area almost all the farmers were practicing the traditional method of storage system i.e. storing at country yard, in gunny bags and farmers were not using insecticides to kill insects, rats which were major causes of storable loss.

Opinion of Sample Farmers Regarding Problems Associated with Post-harvest Losses of Maize Crop

Lack of storage facilities (83%) was the major hurdle in post-harvest handling of maize, because in study area almost all farmers practicing traditional method of storage. Non -availability of separate go down, poor type of storage structure and damages due to rats and insects. Transporting the produce using oxen and on foot was another major problem (77%) faced by the farmers. Singh (2002) opined that non availability of labour (70%) during peak harvesting season in addition to this labour negligence at the time of harvesting led maximum loss in the farm level. About 87 percent of farmers expressed the problem of lack of knowledge about marketing and improved practices of post-harvest handling. About 35% of farmers viewed adverse weather condition by way of rainfall, during the harvesting, drying, storage and transportation led to post-harvest losses. Thus: Suitable infrastructure facilities like storage processing, transportation facilities has to be created for -preventing further post-harvest losses in maize. Hence it may be concluded that maize is very important and useful grain for all. Refer to table 3 below

Table 3: Problems Associated with Post-harvest Losses of Maize Crop: Opinions of Sample Farmers

Participants	No of respondent's n = 145	Percent total
Lack of Knowledge	126	86.7%
Inadequate Storage Facility	121	83.4%
Inadequate Transport Facility	111	76.6%
Inadequate Labour Availability	102	70.3%
Adverse Weather Condition	51	35.2%

4.4. Effects of Postharvest Losses on the Welfare of Small Scale Farmers

Table 4 below shows that postharvest losses have an effect on the price of maize. The maize that is damaged was sold for a lower price than the normal maize grain. 66 farmers said they incurred postharvest losses for their maize and sold the damaged grain at low prices between k 10,000 – 20,000. Implying that the revenue obtained from the sale of the maize is low. Hence, indicating that postharvest losses have a negative effect on the economic welfare of small scale farmers. The normal price for a 50kg bag of normal maize was K65, 000, but the price of the damaged maize of a 50kg bag reduced and the majority of the farmers selling their maize less than K30, 000.

Table 4: Impact of Maize Grain Postharvest loss on the Price of a 50Kg Bag of Maize

		What was the price of a 50kg bag of maize that has damages due to post harvest losses?		
		10,000-20,000	20,000-30,000	30,000-40,000
Have you incurred Postharvest Losses?	Yes	66	22	9
	No	2	2	0

Table 5 below shows that 51 farmers incurred postharvest losses and that the maize they grew doesn't sustain them to the next harvest due to the postharvest losses they incurred. Therefore due to the high postharvest losses most farmers end up starving even though they grew maize because the crop they grow doesn't sustain them to the next harvest. This is attributed to the fact that most of the crop grown is lost through postharvest. The maize that is spoiled is later sold at a low price to people who give the maize to pigs. Hence, indicating that postharvest losses have a negative effect on the economic welfare of farmers.

Table 5: Effect of Postharvest losses on Availability of Food

		Does the Maize sustain you to the next harvest?	
		Yes	No
Have you incurred Postharvest Losses?	Yes	46	51
	No	2	9

Table 6 below shows that 74 of the farmers incurred postharvest losses and couldn't buy their basic needs, due to the high postharvest losses. Therefore it can be concluded that postharvest losses have a bad effect on the welfare of farmers, as most farmers cannot buy basic needs to high postharvest losses. Most of them indicated that they couldn't pay for their children's school fees, as a result of losses

Table 6: Effect of Postharvest Losses on Acquisition of Basic Needs

		From the sale of the affected maize, are you able to buy basic needs, such as clothes, food?	
		Yes	No
Have you incurred Postharvest Losses?	Yes	23	74
	No	0	4

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1. Introduction

The chapter presents the conclusion and recommendations based on the findings and interpretations of the study.

5.2. Conclusion

This study was designed to determine the factors causing postharvest losses and then determine the effect of these losses on the economic welfare of small scale farmers. Multiple regression analysis was employed to analyze and discuss the human, economic and physical factors. The factors studied included; highest education attained by the farmer, age of the farmer, distance from the field to the storage place, type of transportation, age of the farmer, sex of the farmer and the level of education of the farmer. The significance of each of these variables was discussed to reveal its impact on postharvest losses.

Reducing postharvest losses is vital in reducing poverty and increasing the well-being of farmers. As seen from the analysis, the losses affect; price of maize, the acquisition of basic needs, and payment of school fees. Postharvest losses are caused by low literacy levels and infrastructure. Repairs and monitoring of on-farm grain structure in order to reduce the losses is poor leading to losses due to rots, insects and rats. Therefore storage interventional activities must be provided to farmers and traders to reduce maize grain losses for enhanced food security. This will demand farmer's access to drying and storage facilities at strategic maize producing and consuming areas.

5.3. Recommendations

This study has revealed that farmers incur post-harvest losses in maize due to a number of reasons. Poor knowledge on postharvest management of maize grain is one of the important factors that this study has revealed. In light of this, I would recommend that both private and public invention should consider promoting programs that are aimed at teaching the farmers on proper maize storage and post-harvest handling so that the quantity of maize grain lost is reduced. In addition to this, storage interventional activities should also be promoted to farmers and traders alike.

One other intervention that I would recommend to reduce on maize grain post-harvest losses is Contract Farming. Through Contract farming maize growers would have a readily available market for their maize grain at the point of harvest. Thereby reducing the need to store the maize grain for long periods and reducing the losses the farmer incurs.

The study also revealed that poor storage facilities and poor transportation contributed to the maize grain postharvest losses. Therefore, I would recommend that farmers form cooperatives were they pull their resources together so that they can build storage facilities near their field as to avoid losses that are incurred when transporting the grain for long distances. Through the same cooperatives farmers can have access to better transportation; since the cooperative can either own or hire transport and easily transport the grain from the storage area to the market.

REFERENCES

- Anon (1981), **Food loss prevention in perishable crops**. FAO Aric.serv.bull.43, UN Food and Agric. Org. Rome, Italy
- Bartz and Brecht, (2002), **Guidelines for Postharvest Food Loss Reduction Activities**, United Nations Env.Prog, Ind. & Env.Guidelines Series
- Bourne, M.C. (1997). **Postharvest Food Losses—the neglected dimensions in increasing the World Food Supply**. Cornell Univ. In. Agric. Mimeograph No. 53.
- Clark, K.E., S.L. Levy., A. Spurgeon and A.I, Calvert. (1997). **The Problems Associated with Pesticide use by Irrigation Workers**. Occupational medicine
- Golletti. F. and C. Wolff. (1999). **The Impact of Postharvest Research**, International Food Policy Research Institute (IFPRI)
- Jaskaranjit. S. and M. S. Sidhu, (2000), Post-harvest Losses at Farm Level. A case of wheat and paddy in Punjab. **Indian Journal of Agricultural Marketing**
- Kader, 1983, Post-harvest Losses at Farm Level maize grain in the tropics, **journal of Agriculture v. 221**
- Patil, E. R. Autka V. N. and Nagpure S. C. (2000), **Economics of Storage of Food Grains at Farm Levels of Buldana district in Vidarbha regions**. Indian Journal of Agricultural Marketing
- Rao, P. S., Singh, C. P. and R. P. Sharma, 2001, Post- harvest Losses in Maize in Mewar regions of Rajasthan, **Indian Journal of Agricultural Marketing Vol.16 (1)**
- Singh. K. R. (2000) **Assessment of Post-harvest Storage Losses in Wheat: case study in East Uttar Pradesh**. Indian Journal of Agricultural Marketing
- Singaravadivel, K. (1992) **Assessment of Losses in Storage of Paddy with different Moisture**, Bulletin Grain Technology
- Singh, D. S., Narendra Kumar, Gupta and Gupta, B. K. (2002), A study of post-harvest loss of wheat and its management in Kanpur district of Uttar Pradesh. **Indian Journal of Agricultural, Vol.**

APPENDICES

APPENDIX I: QUESTIONNAIRE

Questionnaire serial number.....

University of Zambia
Department of Agriculture Economics and Extension Education
Survey Instrument

This questionnaire is for academic purpose only. Be assured that all the information you provide will be treated as confidential as possible. Please feel free to answer all the questions honestly. Your cooperation will be highly appreciated.

Instructions: please write the answers in the tables, boxes and blank spaces provided.

PERSONAL INFORMATION

1. Name:
2. Gender
 1. Male []
 2. Female []
3. Age at last birthday:
4. Location (Village of the farmer).....
5. Level of education.
 1. Primary []
 2. Secondary []
 3. Tertiary []
 4. None []
5. How many years did u spend in school?
 1. 0-2 []
 2. 3-5 []
 3. 6-8 []
 4. Above 10 []
6. What kind of farming are you involved in?
 1. Small scale []
 2. Large scale []
7. Are you involved in crop production?
 1. Yes []
 2. No []
8. If yes to 7 above, what kind of crops do you grow?
.....

If maize is among the crops you grow, continue with the questions below

POSTHARVEST LOSSES

7. Do you know what postharvest losses are?
 1. Yes []
 2. No []
9. Have you ever had post-harvest losses for the maize crop you grow?
 1. Yes []

2. No []
10. If yes to above question, what do you think were the causes of the postharvest losses you had?
1. Rodents e.g. rats []
 2. Water []
 3. Theft []
 4. other, specify.....
11. How many 50kgs bags of maize do you produce?
1. Less than 20 []
 2. 20-50 []
 3. 50-200 []
 4. 200-500 []
 5. 500-1000 []
 6. Above 1000 []
12. How many bags are lost due to postharvest losses?
1. Less than 20 []
 2. 20-50 []
 3. 50-200 []
 4. 200-500 []
 5. Above 500 []
13. In the previous maize growing season, what was the normal price for a 50Kg bag of maize?
1. 20,000-30,000 []
 2. 30,000-50,000 []
 3. 50,000-65,000 []
14. What was the price of a 50kg bag of maize that has damages due to post harvest losses?
1. 10,000-20,000 []
 2. 20,000-30,000 []
 3. 30,000-40,000 []
15. From the sale of the affected maize, are you able to buy basic needs, such as clothes, food?
1. Yes []
 2. No []
16. If yes to above question, Are you able to pay for your children's school fees?
1. Yes []
 2. No []
17. Does the maize you grow sustain you the next harvest?
1. Yes []
 2. No [], if yes skip next question.
18. Why doesn't it sustain you to the next harvest?
1. Less is grown []
 2. Due to losses []
 3. other, specify.....
19. What is the distance of market/shade from the farm?
1. Far []
 2. Near []
20. How do you transport your maize from farm to the market/shade?
1. By car []

- 2. On foot []
- 3. By water transport []
- 21. Do you incur any losses during transportation?
 - 1. Yes []
 - 2. NO []
- 22. What do you think can be done to reduce postharvest losses?
 - 1. Government building storage facilities []
 - 2. Government educating farmers on Postharvest losses []
 - 3. other, specify.....
- 23. Why do you think postharvest losses are high among small scale farmers?
 - 1. Low income []
 - 2. Low knowledge []
 - 3. Lack of infrastructure []
 - 4. other, specify.....
- 24. Do you have where to store your maize after harvesting?
 - 1. Yes []
 - 2. No []
- 24. What is the condition of your storage facility?
 - 1. Good []
 - 2. Medium []
 - 3. Poor []
- 25. Do you have adequate labour to handle the maize?
 - 1. Yes []
 - 2. NO []
- 26. Does adverse weather contribute to losses incurred?
 - 1. Yes []
 - 2. NO []