Czech University of Life Sciences Prague
Faculty of Tropical AgriSciences

MASTER'S THESIS

A CONTRIBUTION OF MAIZE PRODUCTION TO FOOD SECURITY OF ZAMBIA

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Declaration.

I declare that I have worked on my Master’s thesis titled "**CONTRIBUTION OF MAIZE PRODUCTION TO FOOD SECURITY IN ZAMBIA**" by myself under the supervision and guardianship of Dr. Tomas Ratinger and I have used only the sources mentioned at the end of the thesis in the reference section. As the author of the Master’s thesis, I declare that the thesis does not break copyrights of any other person.

In Prague on 27 /04/2017 Signature: ____________________________

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This thesis is dedicated to my uncle Keith Steve Chipako.

“Your education is the key mantra still lives on”

Rest in eternal peace

CONTRIBUTION OF MAIZE PRODUCTION TO FOOD SECURITY IN ZAMBIA

Abstract

This study was assessing the productivity and efficiency of maize farms, the causes of post-harvest losses, effects of policy and ultimately the contribution of maize to food security at household level in Zambia. Maize constitutes a crucial factor in food security determination.

A total of 170 farming households were sampled through a 3-stage sampling procedure. SPPS was used to determine the relationships between inputs and production as well as the food security situation. Knowing how much is produced, how much is sold and how much is stored for home consumption is essential to determine food security. To determine the DRC_i, complex calculations were carried out to establish the values for tradable and non-tradable inputs, both valued at a social price.

The results revealed an 86 percent of farming households had maize deficits in the long run and stored maize for less than 6 months in a season. This implied that the food security situation is compromised. FISP is occupying a vital position in ensuring food security. 62 percent of the farmers that benefited from the programme have relatively higher production than their counterparts.

Avoidable PHLs are quite high, standing at 10-20 percent for most of the farmers. These losses are mainly due to lack of proper infrastructure in agriculture and rural development. The DRC_i value of 1.3 indicates a non-competitive and an inefficient maize farming system currently. This is attributed mainly to the high costs of production.

N/B: It should be noted that small-scale farmers, farmers, household are interchanged in this study. They simply mean the respondents or target group for the survey.

Keywords: Food security, Maize, Post-harvest losses, Domestic resource cost ratio, Farmer input support programme, Non-competitive, Efficiency. (274 words).

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List of abbreviations.

CSO	Central Statistics office
CSOPHS	Central Statistics Office Post Harvest Survey
GDP	Gross Domestic Product
IAPRI	Indaba for Agriculture Policy Research Institute
BOZ	Bank of Zambia
FSRP	Food Security Research Project
FAO	Food and Agriculture organization
MAL	Ministry of Agriculture and livestock
MACO	Ministry of Agriculture and Cooperatives
NAIP	National Agriculture Investment plan
CAADP	Comprehensive Africa Agriculture Development
FRA	Food Reserve Agency
JAICAF	Japan Association for International Collaboration of Agriculture
RALS	Rural Agriculture Livelihood Survey
FISP	Farmers Input Support Programme
FSP	Food Security pack
PHL	Post harvest losses
APHLIS	African Post Harvest Losses Information System
NAMBOARD	National Agricultural Marketing Board
USAID	United States Agency for International Development
UNWFP	United Nations World Food Programme
USD	United States Dollar

Ha	Hectare
MT	Metric Tonne
SAP	Structural Adjustment programmes
DRC	Domestic Resource Cost
K	Kwacha-Zambian currency
SPSS	Statistical Package for Social Sciences
SADC	Southern Africa Development Community

1. Introduction.

1.1. Country profile.

Zambia is located in Southern Africa, east of Angola, between latitudes 8°S and 18°S and between 20°E and 35°E. It is a landlocked country with eight neighbours (Angola, Botswana, Namibia, Zimbabwe, Mozambique, Malawi, Tanzania and the Democratic Republic of Congo). The total area of about 752,614 sq. km of which, 740,724 sq. km is land and 11,890sq km is water. 60 million hectares of land in use is arable, but only 15 percent of this arable land is cultivated (Bank of Zambia, 2016). Climate is of the Tropical type with 3 seasons. First is the hot and dry season that begins in August and ends in October. Wet and hot season begins in November until the end of April. The third season is the cold and dry season; it begins in May and ends in July. The Terrain is mostly high plateau with few hills and mountains.

Natural Resources: Copper, cobalt, gold, nickel, diamonds, coal, emeralds, uranium, water, wildlife and forests.

The Living Conditions Monitoring Survey (LCMS] conducted by the central statistical office (C.S.O) in 2010 showed that the population of Zambia was 13 million people. The population was mainly concentrated in rural areas, at about 65 percent, compared to about 35 percent in urban areas. The survey also showed that the national average household size was about 5.1. The rural population of Zambia remained predominantly poor with overall poverty levels at 77.9 percent as compared to their urban counterparts at 27.5 percent in 2010.

GDP per capita =US $1,500.00 (B.O.Z, 2016).

1.2. Background.

Zambia is in a unique position to not only leverage agriculture as an engine for poverty reduction and improved nutrition, but also to become the breadbasket of southern Africa. It has an abundance of fertile land, water and a generally favourable climate for agricultural production (FSRP, 2011). Despite these unique endowments, agricultural growth in Zambia remains stagnant. Poverty rates in the rural of Zambia remain stubbornly high at 80 percent of the population (CSO, 2012).

Nearly 75 percent of the population directly or indirectly depends on the agricultural sector which accounts for 22 percent of national GDP. Agriculture in Zambia supports the livelihood of over 79 percent of the population (FAO, 2005). The agricultural growth rate stands at 7 percent, slightly above the Comprehensive Africa Agriculture Development Programme (C.A.A.D.P) goal of 6 percent annual growth rate requirements for all sub-Saharan African countries to be reached by 2030 (M.A.L, NAIP. 2014-2018).

The small-scale farming systems in Zambia are overwhelmingly dominated by a single crop of maize which serves not only as a staple food and livelihood but as a source of income through marketing the surplus. Maize is not only an economical but also a cultural crop in Zambia. It constitutes the main part of livelihood: it serves as the source of food for the 3-course meals; livestock feed and even as a social beverage drink for many. 81.7 percent of all small-holder farmers grew maize in 2009 (CSO-PHS, 2009). Cassava is the second most important staple food crop, but it is geographically confined to the North and north-western parts of the country. Groundnuts are the second most widely cultivated crops in Zambia and an important source of proteins in the diets. Groundnuts in Zambia are often considered as a women's crop due to their importance for the home consumption.

Livestock accounts for about 35 percent of national agricultural output and it is concentrated especially in Western and Southern provinces. Since 2003, the Government has launched the livestock restocking program to restore breeding stock and increase animal draught power, and the Animal Disease Control Programme to preserve the current population of livestock (FAO, 2005).

1.3. Problem statement.

This thesis is focusing on the contribution of maize to food security at household level in Zambia, specifically in Mufumbwe district of the north-western province. The productivity and efficiency of maize farms were assessed with local conditions prevailing. Furthermore, the research looked at post-harvest losses and related agricultural practices. The impacts of subsidised inputs received by farmers as well as the agriculture policies affecting the maize farming system at large were analysed. The areas of research are illustrated in figure 1.

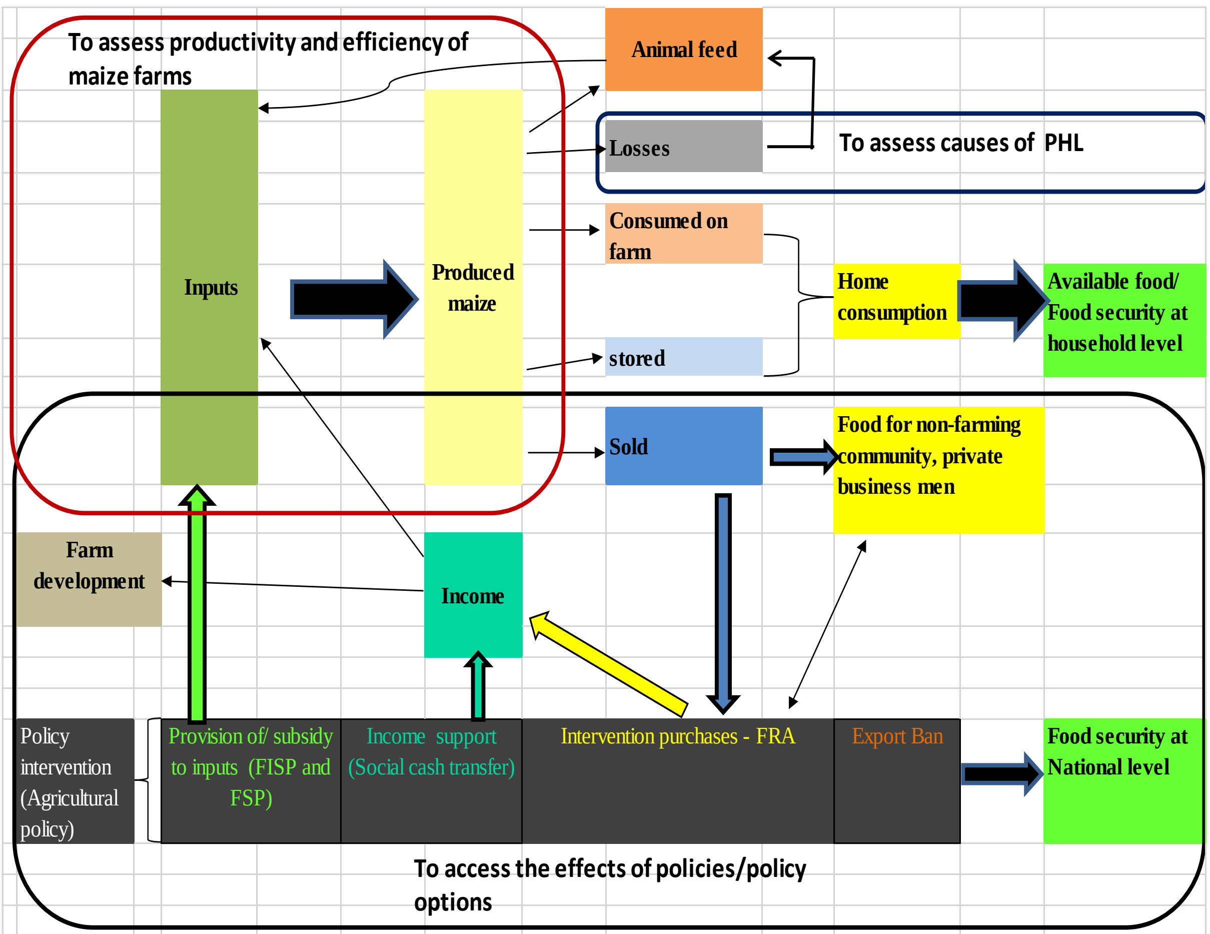

Figure 1: *Research scheme.*
Source: own scheme.

The research areas are further elaborated below:

Assessing effects of policies and food security: The growing grain problems, especially maize deficit in most of Zambia‘s neighbouring countries calls for a great concern over the food security in the country and region at large. In 2016, the government of the republic of Zambia had embarked on an awareness rising to protect the maize meal and other maize products from smuggling. In this same vain, the maize Task force was formed, comprising of FRA and other security wings. This shows how an important staple food has become a "hot cake" in the region, and if not handled well, it can cause serious food insecurities in the country. Coping with this emerging food crisis is critical for fostering economic growth by reducing poverty and enhancing food security for the people, especially the rural population (FSRP, 2011). Maize is always at the centre stage in Zambia when it comes to food security concerns and policies. In recent times the situation has even worsened with maize scandals and politics not being spared. The political importance of maize can be traced back to the earlier colonial period, with maize input and output prices subsidies being the hallmark of the country's policy approach (Chapoto et al., 2015).

Productivity and efficiency of maize farms: It is imperative that we understand how maize issues are affecting the rural community, for they are the pillar and majority of the people in Zambia. Looking at the viability and competitiveness of the commodity is of vital importance if we are to explore and take advantage of the outside market.

Assessment of post-harvest losses: In SSA, most PHL happens during harvesting and post-harvest handling and storage, with 68 percent of the 20.5 percent cereal PHL is estimated to occur during harvesting on the field and the rest during postharvest handling and storage (Kaminski and Christiaensen, 2014). An average of 30 percent of Zambia's post-harvest maize is lost each year due to poor storage techniques. These losses lead to the loss of livelihoods and encourage grain price fluctuations, which hurt farmers economically, especially those operating on a small scale (Jensen, 2008).Worst scenarios are in rural areas where losses begin on the field since farmers lack access to affordable inputs or sometimes are delayed in distribution.

General comment: Lack of policy coherence and coordination makes Zambia although endowed with good agriculture environment a place with high levels of hunger. Agriculture and rural development have been neglected causing impoverishment of the rural majority. Hunger is rather a political issue than an agriculture issue (Olivier De Schutter, 2008-2014). Sustainable agriculture will play a pivotal role in tackling this fundamental aspect of poverty alleviation and food security.

1.4. The theoretical underpinning of maize contribution to food security and its competitiveness.

In this study, the theoretical basis of how maize contributes to the food security at household level looked at food availability in terms of maize, for it is the main staple food for the country. In following the main component of the food balance sheet for Zambia, published annually by MAL/CSO after the crop forecast survey, we adopted an extended concept of food security than the one commonly used – the one which was agreed at the world food summit in 1996 emphasizing “access to sufficient, safe, nutritious food to maintain a healthy and active life”.

Small-scale rural farmers assure food security at the household level by having sufficient amounts of food for their own consumption and contribute to food security at the national level by selling the surplus (Kodamaya, 2011). Knowing how much is produced, how much is sold and how much is stored for home consumption at the household level is essential to determine the food security situation. Farmers who are food insecure suffer from the inaccessibility of food. They either cannot produce enough or fail to buy maize.

To explore the alternatives and analyse the efficiency and competitiveness of the maize system, we used the domestic resource cost ratio (DRC_i). The calculation of private profits, measures the competitiveness of agricultural systems, while calculation of social profits, from estimates of social prices applied to input-output, measures the efficiency of agricultural systems (Monke and Pearson, 1989). The domestic resource cost ratio (DRC_i) of a project is defined as the ratio of the shadow value of its domestic net inputs to the shadow value of its traded net outputs. A DRC value less (greater) than one is taken to imply that net benefits are positive (negative) (Stryker D, 2011). DRC can also be explained as the value added at factor costs divided by the value added at market prices, both evaluated at economic (social or opportunity) prices. To understand the analytical technique of assessing the competitiveness of the maize commodity, we used the formula below to calculate the DRC_i:

a_{ij} – technical coefficient

P^D_j social price of non-traded input j,

$$DRC_i = \frac{\sum_{j=k+1}^{n} a_{ij} P_j^D}{P_i^B - \sum_{j=1}^{k} a_{ij} P_j^B}$$

P^B_j border price of traded input j,

P^B_i border price of traded output i,

DRC_i	Domestic resource cost ratio.
a_{ij}	Quantity of the j-th traded (if $j \leq k$) or non-traded (if $j > k$) input (j = 1, 2... n) used to produce one unit of output i; or in other words it the units of inputs j per unit of i
P^D_j	Social price of non-traded input j,
P^B_i	Border price of output i,
P^B_j	Border price of traded input j.

If DRC<1, domestic resources used less than value added created, which is basically the comparative advantage (competitive) and If DRC>1, domestic resources used greater than value added created, is a comparative disadvantage (Non-competitive) (Stryker D, 2011). Activities that contribute to growth (Net social profits >0) have DRC ratios between zero and one. Unprofitable activities (Net social profits<0) have DRC ratios above one. “Break-even” Activities have DRC ratios of one (Masters and Winter-Nelson, 1995)

2. Literature review.

In this section, many articles, reports, scientific journals, research and survey reports from different accredited organizations, institutions, governmental agencies as well as governmental ministries of the republic Zambia were reviewed. The primary focus was in line with maize production, marketing, policy, input distribution, post-harvest practices and the general outlook of food security in Zambia.

2.1. Maize production and marketing in Zambia.

2.1.1. Origin and history.

Maize (*Zea mays L.)* originates from Latin America. Its cultivation is considered to have started by 3,000 BC at the latest. In 1492, maize caught the eye of Christopher Columbus, who reached Cuba on his voyage to discover Americas. The crop that he brought back to Spain spread immediately around the Mediterranean rim, before it was introduced to West and East Africa probably in the 16th century (JAICAF, 2008). Despite decades of research by botanists, molecular biologists, and archaeologists, the origin and early history of maize remain controversial. Many investigators are convinced by the considerable amount of molecular, cytological, and isozyme data accumulated on the ancestry of maize, which indicates that maize is probably descended from an annual species of teosinte (*Zea mays ssp. parviglumis*) native to the Balsas River Valley on the Pacific slopes of the states of Michoaca´n and Guerrero, Mexico (Flannery K.V, 2000).

During the early times, the Zambian staple crops were sorghum (*Sorghum bicolor (L.) Moench)* and millet *(Eleusine coracana Gartner*), as an African original product, but gradually replaced by maize (JAICAF, 2008). In 1964, when the country gained its independence, maize already accounted for over 60 percent of the planting area of major crops. Particularly in the 1970s, the planting area and production volume of maize increased rapidly as the government introduced chemical fertilizer subsidy programmes and raised the producer price in 1970 (Antony et al., 2015). Unfortunately, the production volume plummeted due to droughts in 1979 and 1980. Sorghum and millet were the mainstay of diet in Zambia for millenniums, before they declined during the 1970s by two-thirds and nine-tenths, respectively (JAICAF, 2008).

The diffusion of hybrids has not helped increase the unit yield of maize: it stands at 1.8 t/ha- 2.1 T/ha, a level comparable to that of traditional varieties. This may be because many of the subsistence farmers cannot afford new hybrid varieties and use recycled seeds of hybrids, instead. Not only that, the new varieties have a higher demand for fertiliser doses and farmer use a limited amount and sometimes skip certain stages of the dosage. The low unit yield may also be explained by chemical fertilizer prices, which are too high to allow sufficient fertilizer application. Zambia reportedly needs 1.2 million tonnes of maize to ensure self-sufficiency. This volume has not been attained in many of the years, thus forcing the country to depend on imports (JAICAF, 2008). But in the recent years, Zambia has been recording successive bumper harvests, as in the case of the 2013/2014 agricultural season, Zambia produced a bumper maize crop amounting to 3.4 million metric tonnes (MT), representing a marketable surplus of 1.9 million MT (CSO/MAL, 2014). For the 2014/2015 marketing season, the production dwindled due to poor rainfall. The 2015/2016 season crop forecast figures showed an increased production of a 2,873,052 MT with a staggering yield of 2.1 metric tonnes per hector**.** Most maize varieties in Zambia have a potential yield of about 8.0 metric tonnes per hector (CSO/MAL, 2016).

2.1.2. Ecological requirements, Agronomical practices, pests, and diseases.

Maize requires well-drained soils with a good supply of nutrients and moisture. It cannot withstand even a slight degree of waterlogging and therefore can be killed if it stands in water for a day. It grows in both cool and warm areas. A good supply of moisture is critical to theestablishment and tasselling stages. For good yields, therefore, maize requires more moisture/rain during these two stages. Optimum rainfall during the first 5 weeks after planting is 200mm, below which irrigation should be applied. The most critical period is at a silking stage whereby a small degree of wilting can cause incomplete pollination, while a severe drought may lead to a complete crop loss. There is need to use early maturing varieties where rains are short (SEEDco, 2008). Maize grows well at all attitudes, but certain varieties are more suitable for the different altitudes ranging from 0 to 2,900 m above sea level (a.s.l.). The optimum temperature for maize growth is 30 ^{o}C (JAICAF, 2008).

According to M.A. L, Extension Manual of 2013, it is recommended that maize is sown by mid-December for rain-fed cultivation during the rainy season. 20-30 kg/ha of seeds with an inter-row space of 75-100 cm, inter-stock space of 15-30 cm and a seeding rate of 4-5 stocks/m^2 to be sown. Bud emergence is the best when seeds are sown at the depth of 5cm or 3-4 cm in hard soil. Regards to hybrid varieties, it is recommended to apply 300-400 kg/ha of D-compound (N: P: K=10:20:10) for basal dressing and 250-300 kg/ha of urea for top dressing. Fertilizer application has an insignificant effect on traditional varieties. Sufficient weeding is required for the first six to eight weeks of growing. Maize streak virus is the primary threat to maize, sometimes causing a substantial drop in yields. To avoid this risk, farmers in rainy areas should use resistant varieties and refrain from late sowing. Other threats include diseases such as cob rot, leaf blight, and rust, as well as cabbage moth and other pests. Damages by armyworm (*Spodoptera exempta*) have also been reported in recent years. According to an article in December of 2012 by Clare Curry, about 6,500 hectares of maize were destroyed by armyworms in Zambia. 2016/2017 season was not spared of the devastating species of armyworms called ‘fall armyworms’ (*Spodoptera frugiperda)*. These are mainly common in the tropical regions of the western hemisphere from the United States to Argentina. The extent of the damage was anticipated to be lower since the government intervened with the distribution of free chemicals and that the nature of the species is non-gregarious.

2.1.3. Crop failure and poor yields.

With all the happiness that rain season particularly brings to the people in Zambian communities, immediately brings the worry of crop management and ultimately either maintaining or increasing the maize yields. Climate change is the probable cause of uncertainty in weather patterns and is one thing that is puzzling the small-scale farmers. Climate variables such as rainfall, temperature variations are quite evident in the sub-Saharan region.

FAO projects that impact of climate change on global crop production will be slight up by 2030.Widespread declines in the extent and potential productivity of cropland could occur, with some of the severest impacts likely to be felt in the currently food-insecure areas of sub-Saharan Africa, which have the least ability to adapt to climate change or to compensate through greater food imports (Fischer et al., 2001). Dry and very hot spells are becoming common during the rainy season. Across many parts of Botswana, Madagascar, Malawi, Mozambique, South Africa, Zambia and Zimbabwe, the 2015/2016 rainfall season (November–April) has been the driest in the last 35 years (FAO, 2015). The national early warning unit of the ministry of Agriculture keeps track of the monthly 10-day dry spell and flooding during rainy seasons to estimate the extent of compromise and help the disaster management unit to plan for the relief food package.

The poor performance of the main rainfall season has grievous implications on households as well as national economies in the region, with particular bearing on food security and medium- to long-term nutrition. The poor rainfall performance leads to delayed planting, poor germination and widespread crop failure in the worst-affected areas, resulting in low production and household food availability (FAO, 2015). Crops have a certain threshold beyond which growth and yields are highly compromised (Porter and Semenov, 2005). In December 2015, FAO's Global Information and Early Warning System issued a special alert on the effects of El Niño in the region, which compelled the Food and Agriculture Organization of the United Nations (FAO) to establish a Global Task Team on El Niño, and based on this the Southern Africa El Niño Response Plan (2016/2017) was drafted. Climate change not only decreases today's incomes but also makes tomorrow's incomes less predictable by changing the probability distributions in ways that are difficult for households to incorporate into their decision-making (Lipper and Thornton, 2014).

Crop failure is also attributed to lack of crop management skills like late planting, which is mainly due to the late supply of inputs as most of the stocks are seasonal. Crops are usually choked by weeds; it takes longer periods of time to weed a small hectarage as Small scale farmers mainly use family labour to do farming activities. Late delivery of inputs is one issue that torments the small-scale farmers in Zambia. In his presentation at the "Pro-poor Agricultural Development: Agricultural Interventions and the Complementary Role of Social Protection" Seminar, 2016, Chewe Nkonde from the University of Zambia, mentioned that 22 percent of the FISP recipients received fertilizer late in 2010/2011 farming season and 35 percent of the target farmers received inputs late in the 2013/2014 farming season (R.A.L.S, 2015). This late receipt of inputs was associated with a Reduction in input use efficiency by 4.2 percent, yield losses complementing to a reduction in national maize output by 85,000 MT and Farm-level income losses (C.S.O, RALS, 2012). Insufficient quantities of fertilizer received, compels farmers to skip recommended stages of fertilizer application and mix the top and basal dressing and make a once-off method of fertilizer application. A considerable yield (4.5t/ha) would be expected if appropriate fertilizer application and watering were ensured along with weeding and pest/disease control (JAICAF, 2008). At the same time, the attractiveness of maize as a cash crop is now fading. Maize production suffers further constraints as growers are switching to cotton and other more easily cashable crops.

Crop protection is essential in crop production. Small-scale farmers 'fields are susceptible to attacks by pests and other insects as seen in the 2012 farming season when armyworms attacked maize crop in most parts of Zambia. Monocropping and lack crop rotation practices make it even worse. Farmers are over ambitious in nature, the majority want to grow enough maize every year to sell mainly and for home consumption, but lack space for cultivation hence avoiding crop rotation, increasing the chances of reappearance of same pests such stalk borers (*Busseola fusca*) and many others.

The scale of farming households and extensive agriculture is a primary factor limiting production .97 percent of the maize growers are small-holder households, often headed by a woman, with only five or six workers available per household. Maize farming is typically subsistence agriculture, rain-fed, extensive agricultural practice, only using hoes and other simple implements with few farmers using draught power concentrated in southern, western and eastern provinces of the country.

2.1.4. Post-harvest losses.

Having the crops ready and harvested is good enough but having no losses is another challenging task that farmers face every season. In an article 'Achieving zero hunger through zero wastage', it was stated that reasons of post harvest wastage differ all around the world and they mostly depend on the location and specific conditions of a given country (Gills et al, 2015). Loss occurs at every stage of the supply chain (FAO,2011). Factors that contribute to food loss range from mechanization of practices such as harvesting to handling, processing and others, to climate change, unfavourable production environments, production practices, management decisions, transportation facilities, grading issues, infrastructure, consumer preferences/attitudes, poor institutional support and poor access to post-harvest technology and resources as consequence of poor governance systems and availability of functional markets (Sharma et al. 2013).

Post-harvest losses (PHL) have an economic impact both at household and national level. PHL is a forgotten factor that exacerbates food insecurity in sub-Saharan Africa (SSA) countries, apart from the known obvious factors of low productivity, difficulty in adapting to climate change, inability to handle the financial burden of high food and fuel prices (FAO, 2010).

PHLs are a measurable, quantitative, qualitative, and economics of grain loss across the supply chain or the post-harvest system, from the time of harvest till its consumption (Aulakh and Regmi, 2013; Tefera, 2012). Quantitative loss indicates the reduction in physical weight and can be readily quantified and valued, example a portion of grain damage by pests or lost during transportation. A qualitative loss is contamination of grain by molds and includes loss in nutritional quality, edibility, consumer acceptability of the products and the calorific value (Zorya et al., 2011; Kader, 2005). Economic loss is the reduction in monetary value of the product due to a reduction in quality and or/ quantity of food (Tefera, 2012).

Weight loss (WL) is the standard international measure of grain loss (De Lima, 1979), generally regarded as a loss of food. WL is expressed as a loss in the dry matter or dry weight basis (Tefera, 2012). According to APHLIS, WL is estimated in two ways; first, ascattering of grain due to poor post-harvesting handling practices includes harvesting, threshing, drying, poor packaging, and transport. Second, from biodeterioration brought by pest organisms such as insects, molds, and fungi, rodents, and birds (Hodges, 2013).

The Food and Agriculture Organization (FAO) of the United Nations and World Bank data revealed that PHL of cereal in SSA ranged between 5-40 percent, worth around 4 billion USD (Zorya et al, 2011). In the same report of a joint FAO/World Bank,it shows that PHL of cereal in Eastern and Southern Africa account for over 40 percent of the total PHL in

SSA countries (Zorya et al, 2011). This represents losses of about 1.6 billion USD in value each year. Such losses are equivalent to the annual calorific requirement for at least 20 million people (FAO, 2013) or more than half of the value of total food aid received by SSA in a decade (Zorya et al, 2011). Furthermore, it has been reported by Meronuck (1987) that post-harvest losses of maize in various storage facilities in undeveloped tropical countries ranged from 15-25 percent.

Minimising losses faced by farmers during post-harvest handling is essential especially in the SSA with struggling food security situations. APHLIS has made available some advisory notes adapted from the UNWFP `Training Manual for Improving Grain Postharvest handling and storage`, which can be used to help farmers to prepare for new harvest; harvest on time; harvest carefully; dry the crop sufficiently; thresh/shell the crop carefully; clean the grain; store the grain using an appropriate method and using insecticides and other ways of killing insect pests in stored grain (Hodges and Stather, 2012).

2.1.5. Storage systems.

The principal objective in any maize grain storage system is to maintain the stored grains in good condition so as to avoid deterioration both in quantity and quality. During storage, the grain must remain dry and clean. Grain storage can be extended for up to 2 years without any significant reduction in quantity and quality (Ministry of Agriculture, Animal Industry, and Fisheries-Uganda)

A good storage structure should:

- Provide protection from common storage loss agents such as insect pests, rodents, moulds, birds, and man.
- Maintain an even, cool and dry storage environment. The maize should be placed on pellets above the floor to avoid cold conditions that may lead to moulds. This will as well prevent ground and rain water from affecting the produce (Guide to Maize Marketing for extension officers- FAO).

In Zambia, thesmall-scale farmer still stores maize in the same old traditional way,mainly in traditional cribs and baskets.But in the recent years,storage systems have changed as a result of market liberalization (FAO, 2010). Farmers store maize in cribs (figure 1) and baskets (figure 2) for drying purposes and not for longer storage to cater for home consumption. This is all because most of the commodity is sold and a small quantity is left for consumption which can easily be stored in polyethene sacks.

In some parts of the country especially in the southern province where the produce lasts almost a year, better methods of storage are being adopted as advised by the extension services from the ministry of agriculture. The most common ones being used are the brick bin, and the mud or cement plastered baskets.

Figure 2: *Traditional maize basket*
Source: FAO.

Figure 3: *Traditional maize crib*
Source: Wikipedia.

2.1.6. Maize marketing and policy outlook.

From the time, Zambia got her independence in 1964 from the British Empire; maize crop marketing system has gone through a lot of changes in structure. Policy inconsistency is one issue that draws Zambia's development programmes backward just like many other African countries. Political and regime change influence policy direction and change, which in actual sense overrides the existing policies to favour the new agenda.

The agricultural policy planning process in Zambia involves several different levels of government including the Ministry of Agriculture and Livestock (MAL), Ministry of Finance and National Planning (MoFNP) and the Ministry of Justice. Any agricultural policy changes or new policies are communicated to the Cabinet through a Cabinet memo. The Policy Analysis and Coordination division in the Cabinet office then sends the memo to relevant ministries for review before the relevant Cabinet committee makes recommendations to the full Cabinet for approval, and the policy decision is communicated back to the Ministry for implementation (Koenen-Grant and Garnett, 1996; Chapoto, 2012). Policies that are approved by Cabinet for implementation are usually more administrative policies. Policies that require enactment of new act(s) or laws are taken to Parliament for debate and vote on the proposed bill. However, it is very rare that Cabinet recommendations fail to pass through parliament because debates and voting is done along party lines.

The political importance of maize can be traced back to the earlier colonial period where maize has always been at the centre of Zambian agricultural policies, with inputs and outputs price subsidies being hallmarks of the country's policy approach (Chapoto A. et al., 2015).

During the first republic (1964-1972), maize crop buying in rural areas were expanded, first through the National Agricultural Marketing Board (NAMBOARD) in 1969 and later through the Zambia Cooperative Federation (ZCF). In this era, trade restrictions were also imposed as a way of protecting the maize sector (Chapoto A. et al., 2015).

Meanwhile, during the second republic (1972-1991) period, subsidies, and price controls continued to be implemented at a large scale. A new system of pan-territorial and pan-seasonal prices for maize was introduced, thus stimulating surplus maize production throughout the country. Unfortunately, to sustain the massive input, credit, output market, and subsidy programs, the government became increasingly dependent on external lenders. This meant that the government had to lose some degree of control over its agricultural policies (Govereh J et al., 2008). To curb this pressure from donors, the government was propelled to implement its first structural adjustment programme (SAP) in 1978 and second SAP between 1985 and 1991 (World Bank, 2004). Consumer and producer subsidies were reduced and the government undertook a partial liberalization of the grain markets (Mwanaumo, Masters, and Preckel 1997; Tembo et al., 2009). However, the partial liberalization of the grain markets, as well as the total removal of maize subsidies coupled with depreciation of the exchange rate led to widespread urban riots in 1986. This led to the government reverting to price controls and subsidy provision in 1987 as a way of curbing the unrest, as well as to try to regain popularity among the people (Mwanaumo, Masters, and Preckel 1997; Thurlow and Wobst 2004). NAMBOARD, the pillar of maize marketing was abolished in 1989, leaving the country with no proper market structure and Farmers were left in limbo.

During the third term (1991-2001), the policy agenda was centred on getting rid of state enterprises, which were seen to be running down the country. The new government accelerating and expanded the reform process by removing input and price subsidies; exchange controls, quantitative controls, and import and export restrictions, thereby, completely liberalizing the foreign exchange market (Howard and Mungoma, 1996). The combination of a sharp withdrawal of government support and the severe drought shaped the early experience of market liberalization and highlighted in the minds of many the problems with food market liberalization (Antony et al., 2015). Food security is often equated to maize self-sufficiency and its interest, the government through the enactment of Food Reserve Agency Act of 1995 established the Food Reserve Agency in 1996. The FRA's original mandate was to establish and administer a national food reserve alongside private maize trade. In addition, FRA was to use the reserve as a buffer stock to cushion maize price variability and to provide liquidity in the maize market. To control maize domestic supply as a way of stabilizing food prices, the government regulated maize trade through the issuance of statutory instruments banning exports or import.

The Ministry of Agriculture and Livestock at times imposed import and export restrictions by issuing fewer permits and/or deliberately delayed their issuance. Nevertheless, all these ad hoc trade restrictions have often distorted the market and create trade uncertainty among the private players resulting in food shortages and price spikes (Chapoto et al., 2010).

During the fourth republic (2001 2011) the new regime, `the new deal` progressively began to roll back the maize market liberalization agenda and pushed for policies that were in line with the social contract position. It introduced the Food Security Pack program in 2001. This was a 100% grant-based programme, which targeted households that cultivated less than 1 hectare of land and were vulnerable households but could be viable farmers. In 2003, the government through the FRA began purchasing maize especially in remote areas as a way of providing market access to the smallholder farmers, as was the case with NAMBOARD. It also resumed large-scale distribution of subsidized fertilizer to registered farmer cooperatives through the newly introduced Fertilizer Support Program (FSP), after discontinuing the Food Reserve Agency Fertilizer Credit Program due to low recovery rates.

In 2005, the government amended the Food Reserve Act (No. 20 of 2005) to give the FRA the authority to participate and engage directly with maize marketing. This led to government resuming active participation in the maize market in all areas of the country. Since then, the role of FRA in the maize market has continued to grow unabated while the FISP has more than quadrupled (Antony et al., 2015b). Although FRA's original mandate did not include setting producer prices, the agency since 2006 has been announcing pan-territorial and pan-seasonal prices. This has encouraged maize production even in areas where maize production was unlikely to be profitable under commercial conditions, thereby reversing the post-liberalization trend of crop diversification (Govereh et al., 2008).

Like the policies in the first and second republic, the Patriotic Front government in the fifth republic increased the budgetary allocations to maize subsidy programs and while promising to revamp the implementation of both the input and out subsidy programs.

Despite the increase in maize production especially in the fourth and fifth republic, formal exports have remained low, mainly because Zambia's maize prices have not been competitive in the region. Zambia is generally a high-cost maize producer and with FRA setting prices above the market, Zambia has often priced its maize above export parity prices in the region (Antony et al., 2015b). The frequent ad hoc marketing policies have led to Zambia failing to take advantage of the regional market despite improved maize production. For a decade or so, Zambia's maize production has been above national consumption requirements while neighbouring countries of Democratic Republic of Congo, Angola, and Zimbabwe have been in dire need of maize. As such, huge food export market potential in these countries exists. However, the above market prices make maize deficit countries source maize from elsewhere at lower prices, more especially from South Africa, which is a major producer of maize in the region (Chapoto A. et al., 2015). On the contrary, in the previous years, the scenario has changed, with a lot of maize flowing out to the neighbouring countries of Malawi and Zimbabwe. Due to the El Niño, Zambia's maize grain is in high demand from deficit countries in the region. This presents an opportunity for Zambia to become the leading exporter of maize in the SADC region (Brian Chisanga and Antony Chapoto, 2016). But export restrictions imposed on the 2016 harvest might have an adverse impact. Zambia might miss the opportunity to utilize its potential to maximize export earnings from maize. The decision was mainly arrived at as a result of political pressures that hinged on suggestions that Zambia needed to secure its food security first before exporting any of the surplus maize (Chisanga B and Chapoto A, 2016).

Every season farmers are left in limbo over the price of the commodity. In the past, the government would strive to quickly set the maize floor prices for the FRA to purchase the stipulated stocks, which in turn would determine the range of the commodity price country wide. non-the-less the so-called "briefcase buyers", a term that refers to private businessmen that would approach farmers in the early days of harvest to buy some maize stocks on lower prices since the farmers are desperately in need of cash to pay for labour and pay for their children 's school fees and other household expenses.

In the recent years, the government has changed the approach. The Government of the Republic of Zambia no longer sets the floor price but instead sets an indicative price which gives a rough estimate of how much a 50kg bag of maize costs in a year. The determination of such a price is based on the cost of producing a 50kg bag of maize as well as the prevailing spatial prices in different regions. The price gives the producer an idea of how much they can offer their maize at or indeed the starting point for bargaining.

With all these structural changes in maize marketing that Zambia has undergone in the past and recent decades, nothing much is left to be desired. The paradigm shifts of the vulnerable small-scale farmers are at the mess of food security. Gone are the times when farmers were wary of the maize stocks for home consumption and stored enough to last the whole season. The seemingly available market from FRA and other private players means that farmers sell more than 60 percent of their produce, leaving them susceptible to food shortages before the season ends. Uncertainty in weather patterns in SSA due to climate changes could one day lead to a famine if neglected.

2.2. Food security concepts and general outlook in Zambia.

2.2.1. Food security concept.

Food security has a diverse perspective that we need to first understand before a situation is addressed in any country especially in the SSA countries and the developing countries where most of the world’s poor live and food shortages are escalating. A comprehensive view of food security, one that considers both food availability and food access require thinking toward a broader view of social protection (Frankenberger and McCaston, 1998). Social protection serves three functions: protection, prevention, and promotion (Ellis et al., 2009). It is imperative to recognise, the credible definition of food security that was introduced at 1996 World Food Summit, which states that `Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2001). It takes a long and difficult path in development for countries especially in the 3rd world to incorporate all the aspects highlighted at the summit. A step by step approach can be beneficial especially that most of the SSA countries depend on mainly starchy crops as their staple food.

In the past years, much conceptual progress has been made in our understanding of the processes that lead to food insecure situations for households (Frankenberger, 1992). In the 1970's food security was mostly concerned with national and global food supplies. The food crisis in Africa in the early 1970's stimulated a major concern on the part of the international donor community regarding supply shortfalls created by production failures due to drought and desert encroachment (Davies et al., 1991). This primary focus on food supplies as the major cause of food insecurity was given credence at the 1974 World Food Conference (Frankenberger and McCaston, 1998).

The limitations of the food supply focus came to light during the food crisis that again plagued Africa in the mid-1980s. It became clear that adequate food availability at the national level did not automatically translate into food security at the individual and household levels (Frankenberger and McCaston, 1998). Researchers and development practitioners realized that food insecurity occurred in situations where food was available but not accessible because of an erosion to people's entitlement to food (Borton and Shoham 1991; Sen's, 1981).

The household food security approach that evolved in the late 1980's emphasized both the availability and stable access to food (Frankenberger and McCaston,1998), is the soul principal that in our view can still be applied and emphasised to countries like Zambia. Other dimensions of food security such as economic and physical access to food, food utilization, can be incorporated at a later stage in development. This approach favours the rural majority and fosters rural development.

To fully explore the food security theme, it is important to recognize the existence of poverty terminologies which are very much associated with food security. People living in extreme poverty are sometimes defined as those who are unable to secure enough food even if all household income were spent on food (Ellis et al., 2009). The destitute comprise households who live in extreme poverty and experience unusually high vulnerability to hunger. The Kalomo scheme in Zambia introduced the notion that the destitute constitute about 10 percent of that country's population. The Kalomo scheme stated that 10 percent of households have per capita food consumption under 1,400 Kcal per day and that most lacked able-bodied labour (Ellis et al., 2009). Destitution is regarded as a criterion determining eligibility for social transfers.

2.2.2. Food security outlook in Zambia.

The 1999–2002 Zambian dietary energy supply was estimated at 1,900 Kcal per person per day, which is below the recommended per capita level of daily caloric availability, 2,100 Kcal, and slightly above the minimum intake level, 1,800 Kcal (Benson, 2004). Zambia's staple foods represent 70 percent of the total diet, which is assumed to be 2,030 Kcal per person per day (CSO-Food balance sheet, 2009).

Maize is the most important food crop (and cash crop) in Zambia. It is predominant in terms of both production and consumption. Maize accounted for 76 percent of the total value of smallholder crop production in 1990/1991, while cassava was 10 percent, and all other crops were under 3 percent (Jayne et al., 2007). Maize accounts for 60 percent of the national calorie consumption and serves as a staple diet in urban areas and most rural areas in Zambia (Dorosh et al., 2010). Among 5 major cereal crops (maize, sorghum, millets, wheat, and rice), maize accounted for 85 percent of the amount consumed in 2002/2003 (Dorosh et al., 2010). National consumption of maize in 2009/2010 (1,747,500 tonnes) was more than twice that of cassava (687,000 tonnes), which is the second most important food crop. Cassava, the nation's second-largest source of calories, accounts for roughly 15 percent of national calorie consumption (Dorosh et al., 2010). Results of surveys conducted in 2007 and 2008 indicated that maize was no longer the dominant staple food in urban Zambia except among the poor (Mason and Jayne, 2009).

Small-scale farmer food security is dependent on their ability to produce sufficient amounts of food crops on their fields for their own consumption (subsistence production). Those farmers who do not produce enough for subsistence can purchase food from other farmers who have harvested a surplus. Food-insecure small-scale farmers suffer from the inaccessibility of food, either because they cannot produce enough for themselves or because they cannot afford to buy or exchange equitablyfor it in markets (Kodamaya S. 2011). In most African countries, smallholders account for much of marketed food staples, even though only a small proportion of the rural population are net sellers. Broadening the base of smallholder maize market participation and increasing their ability to respond to price incentives, therefore, represents both a means to improve food security and a potential opportunity to raise smallholder incomes (Mather et al., 2013)

One thing which is overlooked and causes food insecurity in Zambia is the fact that farmers produce enough to feed themselves but sell over 60 percent of their produce to meet the other needs in terms of income from sales. As the 2 food paradoxes say, “There is enough food to feed the world and the hungry are mostly farmers themselves”. The sources of income to purchase food in the poorest households include off-farm work, sales of natural or processed products, and remittances (UN Millennium Project, 2005).

A report of a food security forum in southern Africa (FFSSA, 2004), which examined the scope of the region’s economic development from different sectors, argued that agricultural smallholders are a suitable growth driver, with impacts on pro-poor growth, food security, and market expansion. Expanded cash crop production by smallholder farmers could contribute both to rural growth (through consumption, labour demand, etc.) and to household food security (for example, through generating cash with which to buy food or inputs). Critically looking at this argument, one would realise that the same push of farmers to venture into cash crop production like the case of energy crops, fabrics like cotton, is the same thing that has left the farmers more vulnerable.

The popular environmentalist, Dr. Vandana Shiva in her publication ‘Empowering women’ once said that the same promise to farmers to use conventional farming methods to grow cash crops in the hope of making profits is the same cause of suicides amongst farmers in India. She further said that people can meet their needs for food and water in a self-provisioning, sustenance economies at less than a 1 USD a day, and farmers can be pushed to suicides and women and children to hunger at more than a 1 USD a day because the cost of living outstrips earning. High cost, low output, low return agriculture is at the root of growing hunger because farmers do not grow diverse crops for their needs and they sell what they grow to pay back debts. This higher “growth” does not translate into higher food entitlements and less hunger (Dr. Vandana Shiva, 2004)

2.2.3. Women and Food security.

FAO highlighted that gender and food security is interrelated. Recognising the importance of women in agriculture and their position in fostering food security is vital. In Zambia, women contribute essentially to agriculture and rural economies just like in all developing countries. They constitute about 50 percent of the labour force in the agricultural sector. Rural women often manage complex households and pursue multiple livelihood strategies. Their activities typically include producing agricultural crops, tending animals. processing and preparing food, working for wages in agricultural or other enterprises, even though these activities are not defined as "economically active employment", they are essential to the wellbeing of rural household (SOFA, 2011).

According to FAO, in the Synthesis report of regional documents: Africa, Asia, "Gender and food security", there are factors and constraints affecting women's roles in food security. Addressing these factors and constraints which include, but not only: Gender blindness and invisibility of women's contribution to food security; access to resources; credit; training and extension and participation in the rural organisation will harness bringing food security both at household and national level and foster economic growth.

In provinces with higher maize production like that of southern and northern provinces of Zambia, women actively participate in the Labour force starting from cultivation, weeding, and harvesting to storing the produce. Also, important is their enthusiasm to grow nutritional crops like groundnuts and other legumes and pulses. Which gained the popularity of being women's crops? Gardens are mainly handled and maintained by women in most of the societies.300 units of inputs produce 100 units of outputs in industrial agriculture. While ecological systems in which women participate, use only 5 units of inputs to produce 100 units of output (Vandana Shiva, 2004). Women are a driver of agricultural development; it's high time misplaced policies are channeled towards women alternatives. Vandana Shiva rebuked the millennium development Goals for ignoring these women alternatives which would have not just halved, between 1990 and 2015 the proportion of people who suffer from hunger but remove hunger by 100 percent. She noted that the displacement of women from agriculture disempowers women and reduces food security. Food systems evolved by women based on biodiversity based production rather than chemical-based production produce hundreds of times more food, with better nutrition, quality, and taste.

2.2.4. Competitiveness of maize farming system.

There is a section of farmers that have increased their production and yields to levels of emergent farmers, yet it is not certain how effective and efficient is their venture, since most of them still depend and benefit from the FISP. The Zambian government has dramatically scaled up its input subsidy program over the last decade, from 2,400 MT of hybrid maize seed in 2002/03 to 8,730 MT in 2012/13. The seed subsidy rate has ranged from 50 to 60 percent. An average of 40 percent of total government agricultural sector spending is devoted to agricultural input subsidies each year (Mason & Smale, 2013). Both compound D and Urea fertilisers are heavily subsidised with subsidy level being around 75 percent. For instance the market price of fertiliser in 2016 averaged K350 per 50 kg bag while farmers were paying K90.

The objectives of the input subsidy programme is to improve household and national food security, incomes, and accessibility to agricultural inputs by small-scale farmers through a subsidy and building the capacity of the private sector to participate in the supply of agricultural inputs (MACO, 2008). Poverty reduction is an implicit objective as the input subsidy programme (the Farmer Input Support Programme) is considered a Poverty Reduction Programme (PRP) by the Zambian government, and accounts for an average of 47 percent of agricultural sector PRP spending (Mason and Smale, 2013).

In the SADC region, Zambia has an opportunity to become the leading exporter of maize. However, while exports were up from previous and export ban effected in 2016, Zambia is unable to take full advantage of the regional situation. Uncompetitive parity prices, high transport costs, and a range of non-tariff barriers undermine Zambia's ability to be competitive. This is a missed opportunity for Zambia (Chisanga B and Chapoto A, 2016).

There are many methods and indicators to assess the competitiveness of the maize farming system, one of which is adopted in this study called comparative advantage with use of the domestic resource cost ratio (DRC). The DRC is defined as the shadow value of non-tradable factor inputs used in an activity per unit of tradable value added. It was developed simultaneously in 1960s by Bruno and by Krueger.In both cases they needed a ratio counterpart to the concept of net social profit (NSP) (Masters and Winter-Nelson, 1995). To campare agricultural activities, the NSP is less useful because it is denominated in specific units with a physical numeraire, such as dollars per hector or per tonne of the product. In this case a unit free ratio (DRC) is used. Minimizing DRC is equivalent to maximizing social profit, if DRC < 1, then the system uses domestic resources efficiently and thus has a comparative advantage. If DRC > 1, then the system shows inefficiency in domestic resource use and has a comparative disadvantage (Minh et al., 2016).

World bank gives a formal Definition of Domestic Resource Cost Ratio through a formula:

$$DRC = \Sigma(D*Pd)/(Wpi - \Sigma ajiWpj)$$

where i and j refer to internationally traded output and inputs respectively and Wp is their world price; aji is the units of input j per unit of i. D is set of domestic factors of production required to produce a unit of i and Pd is their economic or shadow price value. In theory, all indirectly traded inputs into good(s) used to produce i should be included in the denominator with a negative sign as part of Σj.

To determine the DRC, identifying internal resource costs (opportunity) to produce one finished ton of maize. The cost of each item in the production stage is accounted in the total cost of the item for 1 ha of maize divided by the total production of 1 ha after harvest. Land costs which are supposedly opportunity cost of land and determined by household land rent prices to farmers is considered priceless in zambia since most of the small-scale farmers use traditional land. Labour is family based but many opt to hire as family labour is never sufficient for all the stages of production starting from cultivation to harvesting. The labour market is relatively uniform depending on the regions of the country.

The fertilizers are partly imported from abroad, some locally produced, but the cost of synthetic fertilizers is identified as an external cost source. Foreign source fertilizer costs are calculated by CFI mainly from the middle east. Pesticides are considered as external since the raw materials are imported. The transportation costs and other expenses are counted as internal cost source. Actual price from using local rates is applied.

3. Aims of the Thesis.

Mufumbwe district and north-western in general is an interesting region with high rainfall per annum as compared to other parts of the country. It lies in Zone III of the agro ecology zone, characterized by high rainfall of about 1100-1700mm per annum, favourable for rainfed crop production. But to the contrary, it is the least in the country coming to maize production. According to the CSO-PHS of 2002/2003, small and medium scale final report, the lowest proportions of maize production were from North-western, Luapula, Lusaka and Western provinces.

Traditionally the people of north-western province grew cassava as the main crop for their daily consumption, but this has changed drastically with the opening of new markets and rising demands of maize and groundnut crop in the neighbouring Congo DRC and within the country borders. Big mines in the nearby town of Solwezi have boosted the demand indeed due to the influx of people in the region seeking for employment. The crucial factors that have led to this phenomenon are the introduction of the FRA as the main buyer of the commodity, the access to inputs through the FISP programme and FSP under community development has without adoubt brought about the escalation of maize production in the area. The packages of these inputs come with improved hybrid seeds of different varieties that suit the climatic conditions of the region.

Based on the stipulated facts and identified problems, the scope of this work had a well formulated objective and specific objectives on the contribution of maize to food security in Zambia. To elaborate the cardinal contributions of maize to food security in Zambia, we had to assess the effect of current farming practices, post-harvest treatment and policies regarding maize on food security as the main objective and further structured the work into 3 specific objectives as follows:

1. To review food security situation in Zambia and the role of maize in it.
2. To assess the efficiency of maize production including the relationship between the use of inputs and yields, the extent of harvest and post-harvest losses.
3. To investigate the barriers to better performance and suggest policies which might generate the change for improvement.

4. Methods and Material.

4.1. Methodology.

The thesis study was based mainly on primary data collected through the administering of a structured questionnaire targeting small-scale farmers. Furthermore, data was collected through 2 key informants: Mr. Vincent Malata, a Senior economist based at the ministry of agriculture headquarters and Mr. Austin Nakanga, extension methodologist based at the district office in Mufumbwe district. The data collected was not limited to maize production, post-harvest losses, inputs, but also included socio-economic factors such as household head, farm size, and recommendations from the farmers. To keep the work on the track and on schedule, we formulated a methodological flowchart (figure 3).

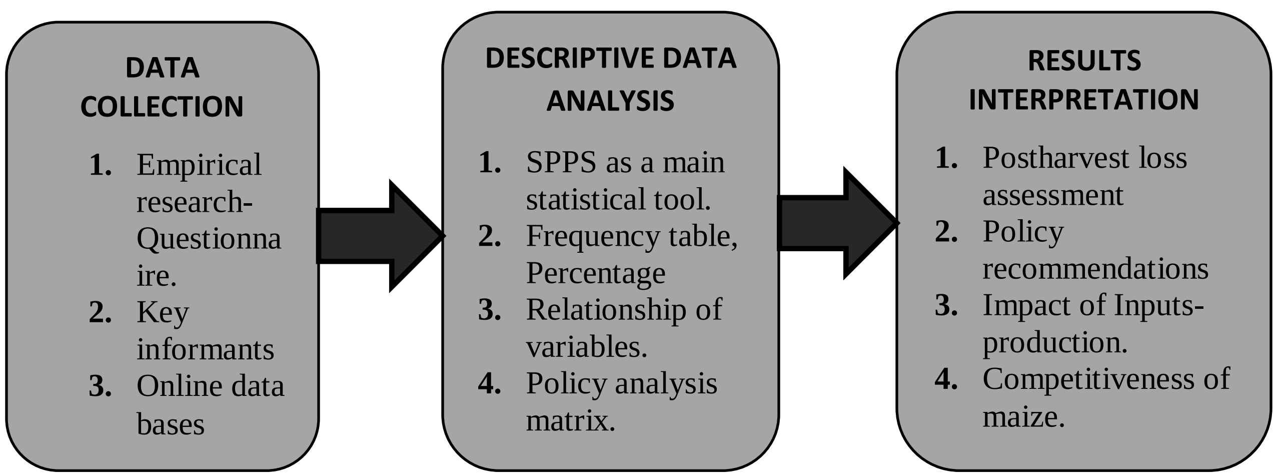

Figure 4: *Methodology flow chart*
Source: Own 2017

4.2. Primary data:

Empirical research was built on an own survey of small-scale maize farmers concerning farming and post-harvest practices, the economics of production and development barriers. Primary data collection was administered through a questionnaire targeting 170 respondents with well-arranged structured interviews. The questionnaire had closed-ended questions and open-ended extra questions as recommendations from the respondents. The structure of the questionnaire had basically 5 parts - Basic information, Objectives, inputs, challenges and recommendations from which main variables were derived (Table 1)

Table 1: *Main variables*

Variable	**Description**
Production	The quantity of maize harvested in 50kg bags per season
Consumption	The quantity of maize kept for home consumption in 50kg bags per season.
Deficit	the source of maize in times of deficit.
Inputs received	Fertiliser and seeds from the government support programmes
Storage facility	Household storage facility for the kept produce
Storage problems	Main storage problems faced by the household in terms of pests, safety.
Damage field	Crop damage/loss on the field in percentage estimates
Postharvest	Crop loss during and after harvest in percentage estimates.
Damage storage	Crop damage during storage in percentage estimates.

Source: own source.

4.2.1. Sampling procedure and size.

To sample the target area with a population of about 71,238 people (CSO, 2014), a population density figure of 3.43 per km^2, household number amounting to about 10,119 households (CSO, 2014) and a total coverage area equalling to about 20,756 km^2, we had to devise a sampling mechanism to get a genuine representation of the general population.

The district is divided into 5 agricultural blocks, which represent subdivisions of the total area within the district. Further, these blocks are divided into about 2-5 camps (figure 5), which in its self,are also divided into smaller sections called zones. Each camp is manned by a camp extension officer from the ministry of agriculture and has their office within the area close to the farms and villages with their houses being also their offices. To suit this kind of arrangement, we used a 3-stage sampling procedure for the study. The first step included a brief meeting with the senior agricultural officer. This was done to get a clear picture of the area, production trends, and market activities. Based on the recommendations from the senior agricultural officer, purposively 3 blocks were ear-marked for data collection. From each of the ear-marked blocks, only 1 camp was picked for data collection. The sampling procedure is schematically demonstrated in figure 6.

To help cover the vast areas at an appropriate time, the agricultural officers were engaged in spearheading in the data collection through structured interviews. Kashima west with the biggest catchment was covered by 2 officers, one from agriculture Mr. M. Daka and the other from the ministry of community development.60 questionnaires were administered in this camp, whilst the other 2 camps, that is Kamabuta manned by Mr. J. Mumba and Kakikasa manned by Mrs. M. Chiyesu received 50 questionnaires each. In total 170 questionnaires were distributed including 12 that were used as a pilot at the central camp near the district offices.

I basically played a supervisory role in making follow ups where the need arose especially when the officer was lagging. I would collect already filled in questionnaires and attend to other logistical issues at the same time. The method employed in the data collection was the convenience type based mainly on the proximity of the officer’s station to the farmer’s household. This was due to the fact that the catchment area was vast and needed a well-equipped logistical strategy if random sampling was to be used.

The administering of the questionnaire took almost 1 month 2 weeks from July to mid-August. It could have been finished earlier but all was delayed because most of the household heads were never found at home during the normal working hour. This was attributed to most of the farmers going to the gardens far from their homes since the season for gardening was underway and the selling of maize to FRA which could take a lot of weeks was also underway.

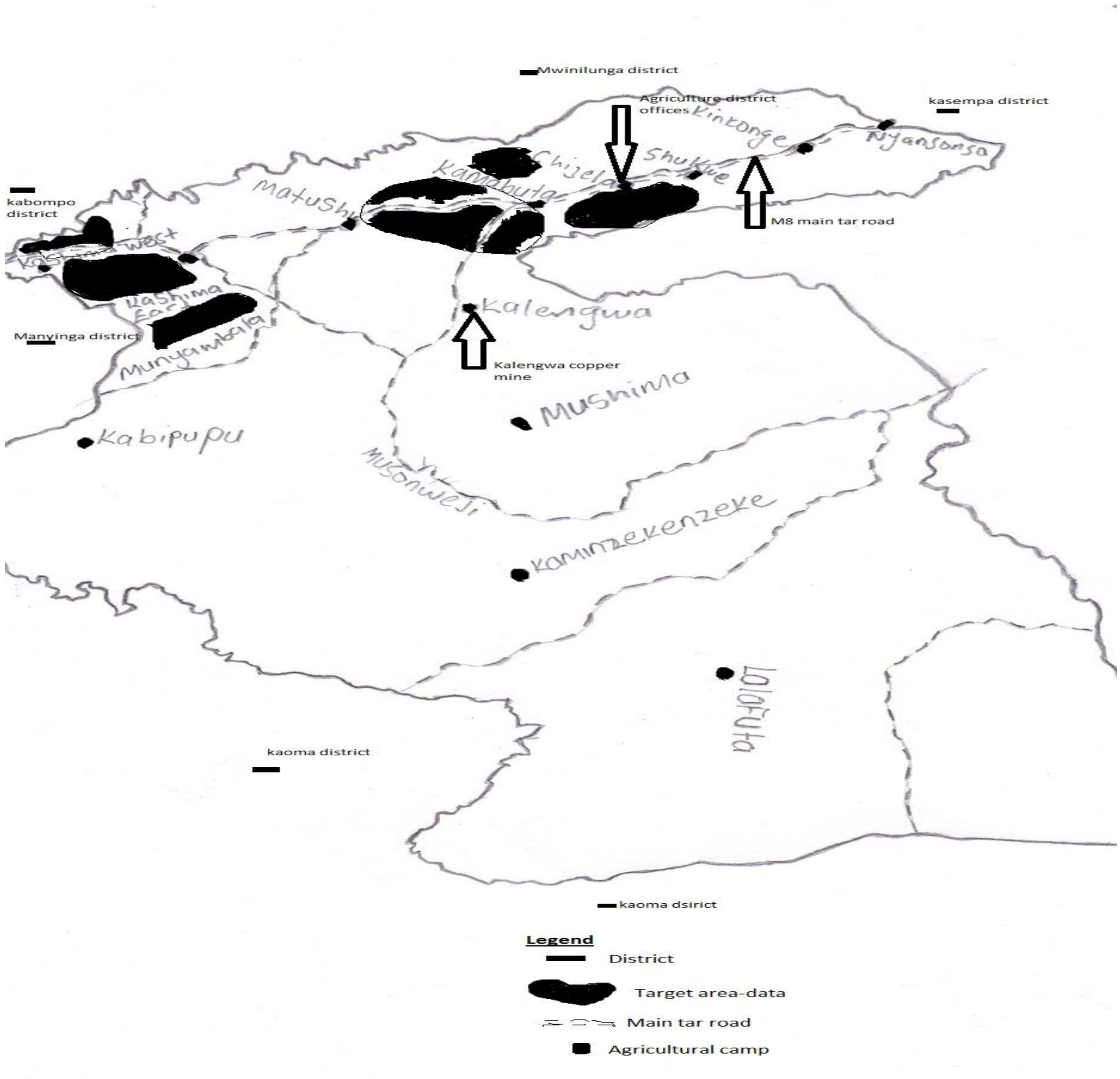

Figure 5: *Agricultural Map of Mufumbwe district.*
Source: Own drawing.

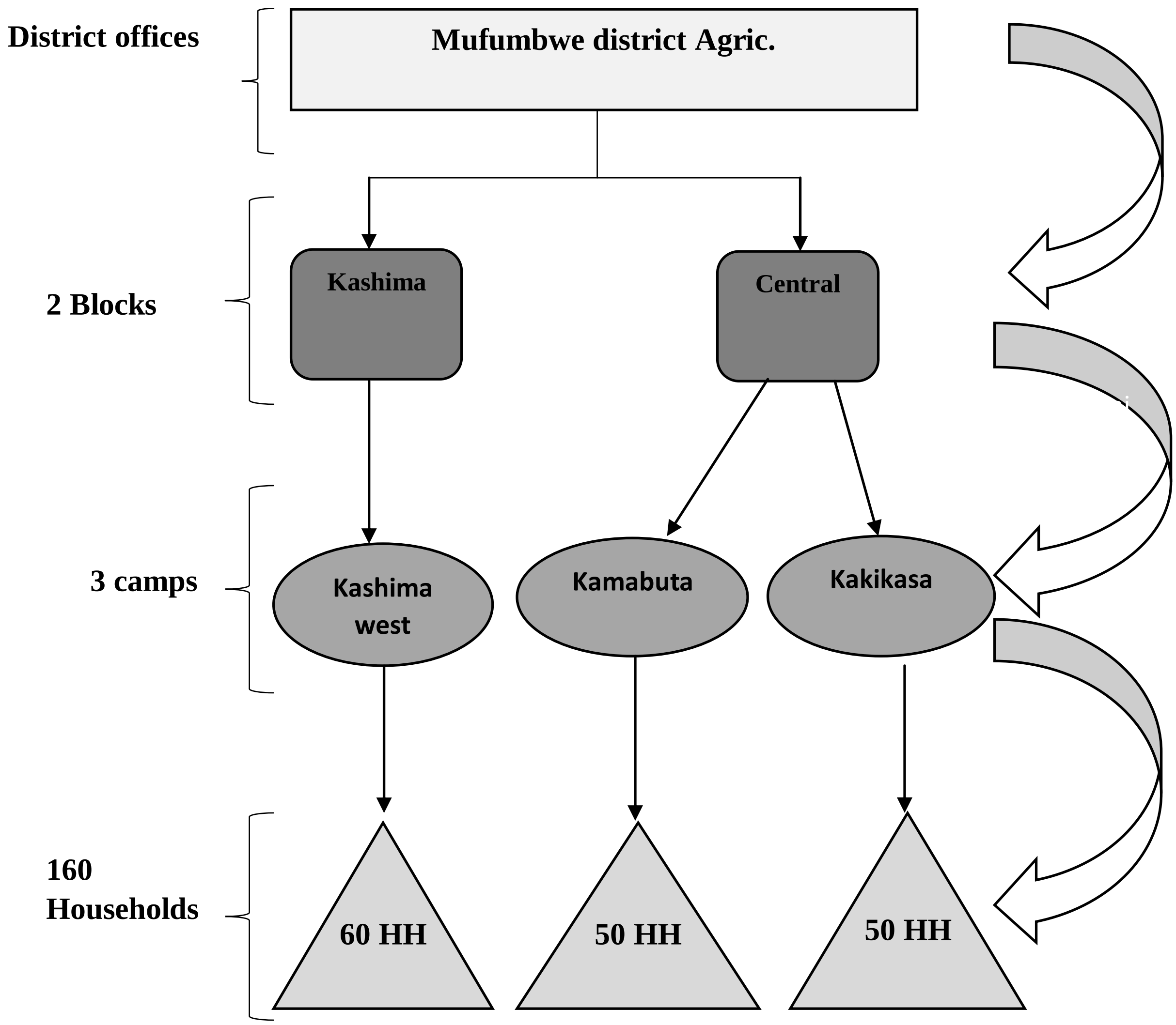

Figure 6: *Schema of the sampling procedure*
Source: Own schema 2017

4.2.2. Methods of data processing.

The raw data obtained from the target groups, (hereinafter called the respondents) on the socio-economical characteristics, agricultural inputs, yields, post-harvest losses and challenges faced was analysed using the statistical package for social sciences (SPSS) as the main statistical software. The variables derived and the codes were directly inputted in SPSS. Descriptive statistics such as frequency tables, clustered bar charts, percentages were used to the data. Further, the contribution of women to food security was analysed as across-cutting issue. For the calculation of the competitiveness of maize, excel was used to generate the tables and to do the calculations.

4.2.3. Limitations.

The target camp areas where data collection was conducted have a vast catchment with basically no proper road structure. To navigate in such an environment, use of robust motorbikes is inevitable. Unfortunately, most the bikes belonging to the officers from the ministry are in deplorable state. This entails that only households near the agricultural camp officer‘s premises were reached.

The questionnaires were designed to be filled in using information from the household head of any sampled farm. This proved to be a big challenge as most of the head were going to the gardens in the early hours of the morning and return in the evening. This was due to the time of the year when horticultural practices such as gardening were underway; also maize marketing season had begun. To get the ‘first come first served’, farmers tend to camp near selling depots for weeks, even months surprisingly to sell their maize early enough. Disbursement of payments is per goods received note from FRA that commercial banks use when paying the farmers.

The sampling was not random, as initially planned. This was attributed to the catchment areas being grandiose, making it almost impossible to cover it fairly. This could show a biased picture of the situation for the entire population.

A pilot questionnaire was only administered in the central Chizela camp and not in all the target camps. Time and financial factors caused the limitation. 10 questionnaires were filled in and a few changes were made to the final draft.

Not enough financial resources to motivate the officers whilst collecting data in the field. It has become a norm for officers to demand an allowance for missing lunch from their homes due to the workload and since most of the NGOs that operate in these areas can give them for each extra work executed, nothing wrong is seen in asking for such. It was really an issue that I had to liaise and beg them to finally help.

4.3. Secondary data:

I conducted a thorough desk research concerning food security, maize production, marketing in Zambia at the ministry of agriculture headquarters as well as at the district office in Mufumbwe. Post-harvest survey figures were gotten from the central statistical office website and department of agribusiness. I did not limit my data collection to only governmental agencies, instead reviewed relevant literature from scientific articles from a web of science, reports from an international organization such as FAO, USAID, and data from IAPRI.

4.4. Description of the study area and target groups.

4.4.1. Profile of Mufumbwe district.

Mufumbwe district lies in the north-western province of Zambia (Figure 5). It has an area of 20,756 km^2 and an altitude of 1,200 m above sea level (asl). Soils are of the farrago's, camisoles, acrisoles, glycols and lavisol type. Plenty of perennial streams and river flow across the district with Kabompo, Dongwe and Lalafuta rivers being the biggest. The area is covered by 418,213 Ha of natural forest, generally the savanna woodlands.

The main ethnic groups are the Kaonde, chokwe, Lunda and Luvale people. The commonly spoken languages are Kaonde, Lunda, and Luvale. The population of Mufumbwe district according to the data from CSO was 71,238 in 2014, with a density of 3.43 per km^2.

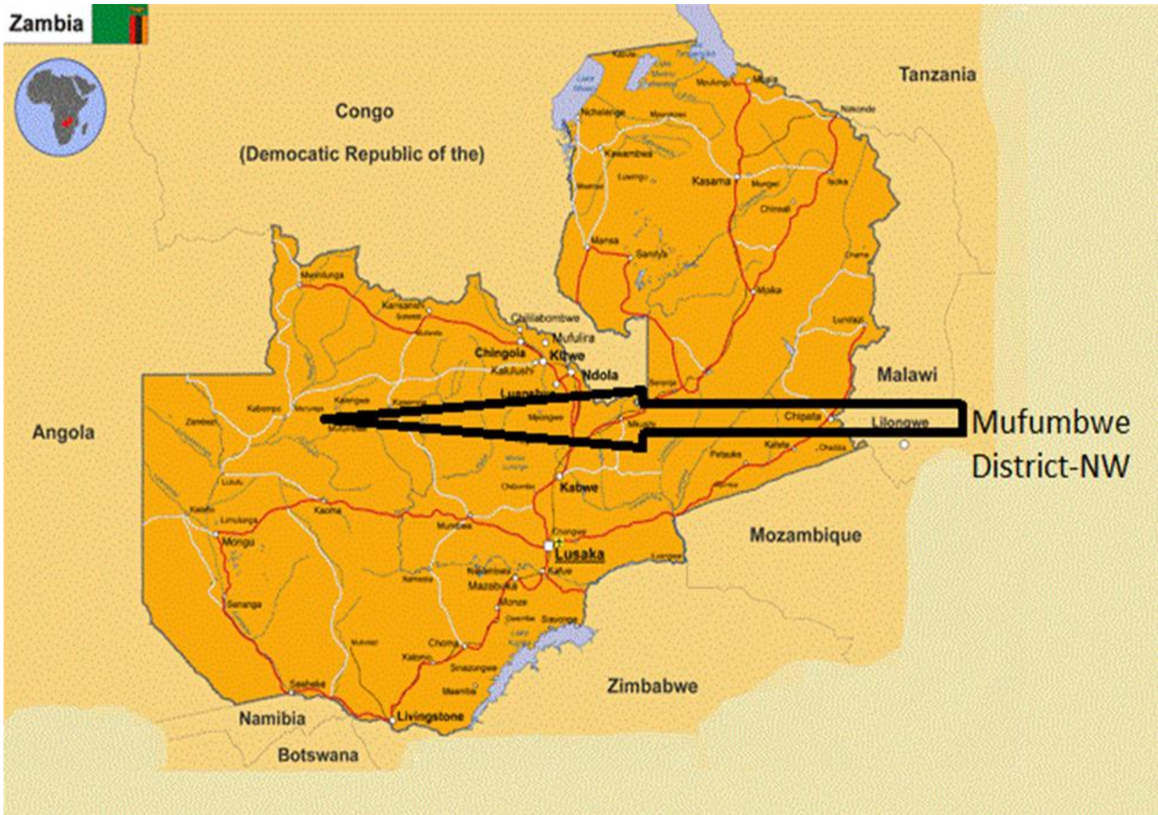

Figure 7: *Map of Zambia*
Source: Zambian Maps.

4.4.2. Climatic conditions.

Zambia has 3 major agro-ecological regions/zones which are primarily based on rainfall characteristics, but also incorporate soil and other climatic characteristics. (Chikowo R, 2010). Region I have rainfall 600-800 mm per annum, with growing season relatively short (80-120 days). Region II has rainfall 800-1,000 mm per annum and a slightly longer growing period (100-140 days). This region is characterised by fertile soils and many commercial farmers are situated there. Region III, where Mufumbwe district falls under have high rain fall above 1,000 mm per annum with growing seasons ranging from 120-150 days (FAO, 2009). Temperatures are favourable for crop production either rainfed or irrigated crops. Temperatures range from 18^{o}C as minimum and 28^{o}C maximum in the hot season.

4.4.3. Agricultural development.

Most Zambian farming communities are subsistence farmers. However, Zambian agriculture has three broad categories of farmers: small-scale, medium and large-scale. Small-scale farmers are generally subsistence producers of staple foods with an occasional marketable surplus. Medium-scale farmers produce maize and a few other cash crops for the market. Commercial farmers (medium and large scale) with farm size above 20 ha, focus on cash crops. Of the estimated 600 000 farmers in Zambia, 76 percent are small-scale subsistence farmers.

In Mufumbwe, no single commercial farmer exists with the majority about 70 percent are small-scale with few emergent and medium scale (Table 2). Dominating crops are maize and cassava with few areas growing groundnuts, sorghum, soybeans, sweetpotatoes, cow-Pease, rice, and beans.

Table 2: *Farmer structure and distribution*

Number of Farmers	**Unclassified Subsistence (<1ha)**	**Small Scale (1-5ha)**	**Emergent (5-10ha)**	**Medium Scale (10-20ha)**	**Large Scale (>20ha)**	**Total**
Female	317	2662	951	293	0	4223
Male	678	6610	2217	348	0	9853
Total	995	9272	3168	641	0	14076

Source: Agriculture-Mufumbwe, 2016.

5. Results and Discussion.

5.1. Results.

5.1.1. Description and characteristics of the farmers/respondents.

After we computed the 172 questionnaires from the study, the results in Table 3 showed that 102 (59.3 percent) of the household heads were males while the remaining 70 (40.7 percent) were females. These percentages showed a fair sampled population between the male headed households and their female counterparts. The significance of women in agriculture is shown in figure 6 where production trends show a balanced ration in all categories only differing in higher quantities which are dominated by male headed house. This was mainly attributed to the lack of access to inputs and many other factors. Table 3 further presented the size of land that the farmers own. A cumulative percentage of 77.9 represented farmers that have farming area 5 Ha and less, and are the majority in the region. The situation is reflecting the general populace of the district as evidenced by the data collected from the district agricultural offices in Table 2.

78.5 percent of the farmers have the propensity to grow maize as the main crop due to the ease of which the commodity is sold and the inputs are quite accessible. There is a growing momentum to grow groundnuts in the region. About 16 percent of the farmers are already engaged in the system. Same reasons of easy access to markets as for maize were given for venturing in groundnuts farming. Soybeans and Cassava were the least preferred crops by many due to lack of proximity to markets, which are mainly situated in or around the far-off big cities.

Storage facilities are highly linked with how long farmers store their produce and the quantities stored. The table showed 70.9 percent of the farmers had no storage facility which correlates to the 76.7 percent that store maize for about 6 to 9 months respectively. The situation on the ground indicates that instead of having storage sheds; farmers opt to store maize temporarily in polyethene bags inside their houses for shorter periods of time.

Table 3: *Social-economical characteristics.*

Variable	Distribution	Frequency	Percent	Cumulative Percent
Household head	male	102	59.3	59.3
	female	70	40.7	100.0
	Total	172	100.0	
Size of farm	0-2ha	86	50	50
	3-5ha	48	27.9	77.9
	6-10ha	34	19.8	97.7
	99	1	0.6	98.3
	6-10ha	3	1.7	100
	Total	172	100	
Preferred crop to grow	maize	135	78.5	78.5
	cassava	5	2.9	81.4
	groundnuts	27	15.7	97.1
	soybean	5	2.9	100
	Total	172	100	
Storage facility	yes	50	29.1	29.1
	no	122	70.9	100
	Total	172	100	
Period of maize storage	less than 3months	18	10.5	10.5
	3-5months	50	29.1	39.5
	6-9months	64	37.2	76.7
	more than 1year	38	22.1	98.8
	N/A	2	1.2	100
	Total	172	100	

Source: Own field survey 2016.

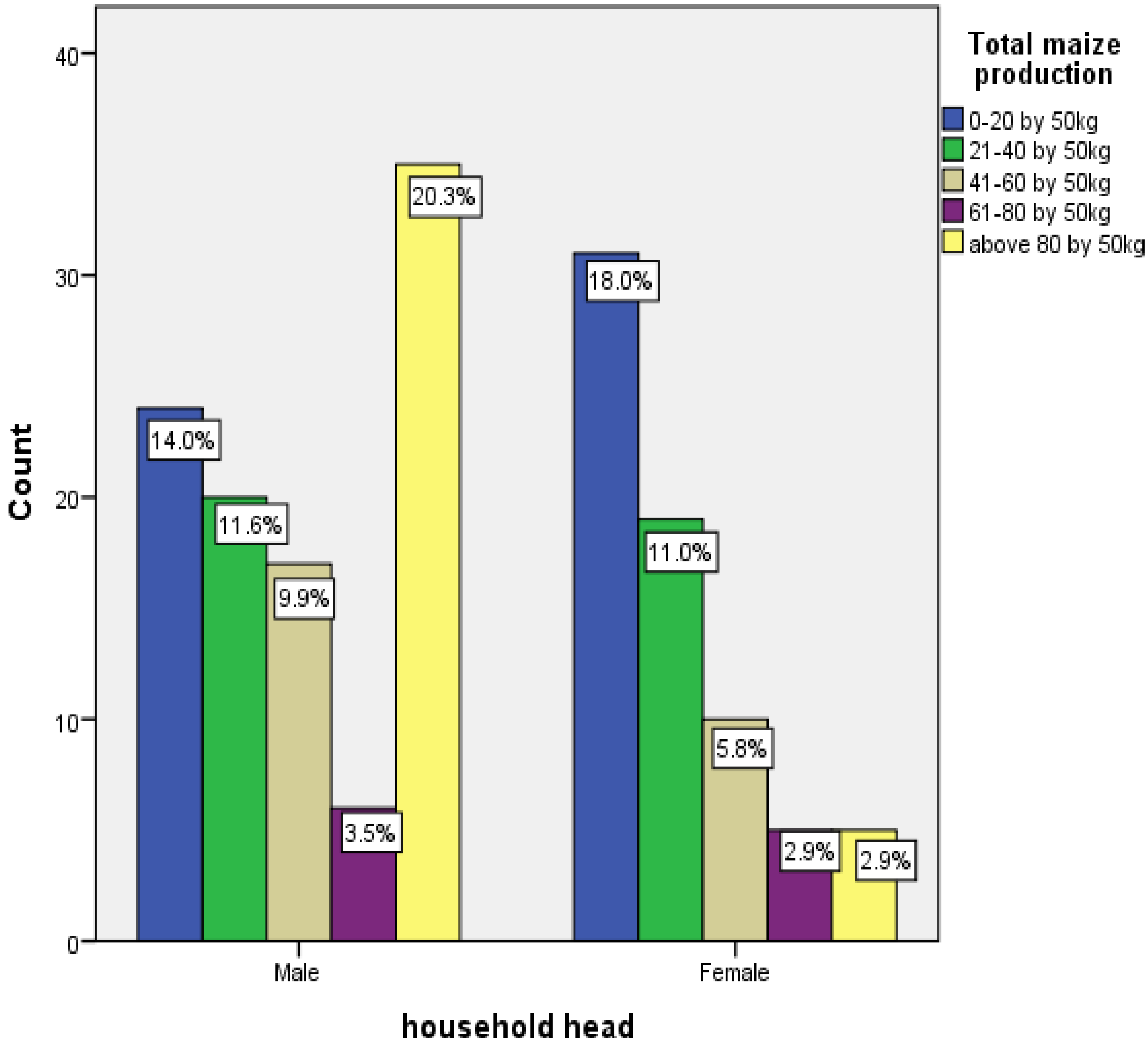

***Figure 8**: Production trends of household heads.*
Source: Computed results in SPSS from field survey 2016.

5.1.2. The impact of inputs on production.

To investigate the relationship between inputs and yields, in this study, we used the inputs received as one variable and production as the other. The results in figure 8 showed that 38 percent of the farmers do not receive subsidised inputs and the remaining 62 percent do receive inputs from the government programme, administered by FISP under the ministry of agriculture and irrigation. In most parts of the country, small-scale farmers determine their production quantities by how many 50 kg bags of maize an individual household produces. In this case, 0 – 20 by 50 kg, simply means per farming household producing 0 – 20 bags with a net weight of 50 Kgs per sack (0 – 1 MT of maize per farming household).

It was interesting to note in figure 7, the 23 percent of the farmers that produced above 80 by 50 Kg bags of maize, being the upper limit for the study, 20 percent constituted those that that received inputs whilst 3 percent did not receive. On the contrary, of the 32 percent farmers that produced 0 – 20 by 50 Kg bags of maize, being the lower limit, 23 percent constituted those that did not receive inputs and only 9 percent received inputs. This result is an indication of how strong the relationship between receiving inputs and levels of production is.

5.1.3. Determining food security situation at the household level.

The descriptive statistics in the Table 4 showed how 2 variables are interconnected and how the percentages tally. An 86-cumulative percentage of farmers sourcing their deficits, either from buying, relief food or substituting with other carbohydrates like cassava, millet, and sorghum, corresponds to a 76.7 percent of farmers that store their maize for less than a year. In a rural setup, you determine how food secure one is by measuring how long a household‘s food stocks last in a particular year or season. It is anticipated that to be food secure, stocks for previous seasons should reach the harvest time for the new season which is basically a year and over. In this study, only a smaller percentage (14 percent) and a corresponding 22.1 percent of farmers had no maize deficits and subsequently stored maize for more than a year.

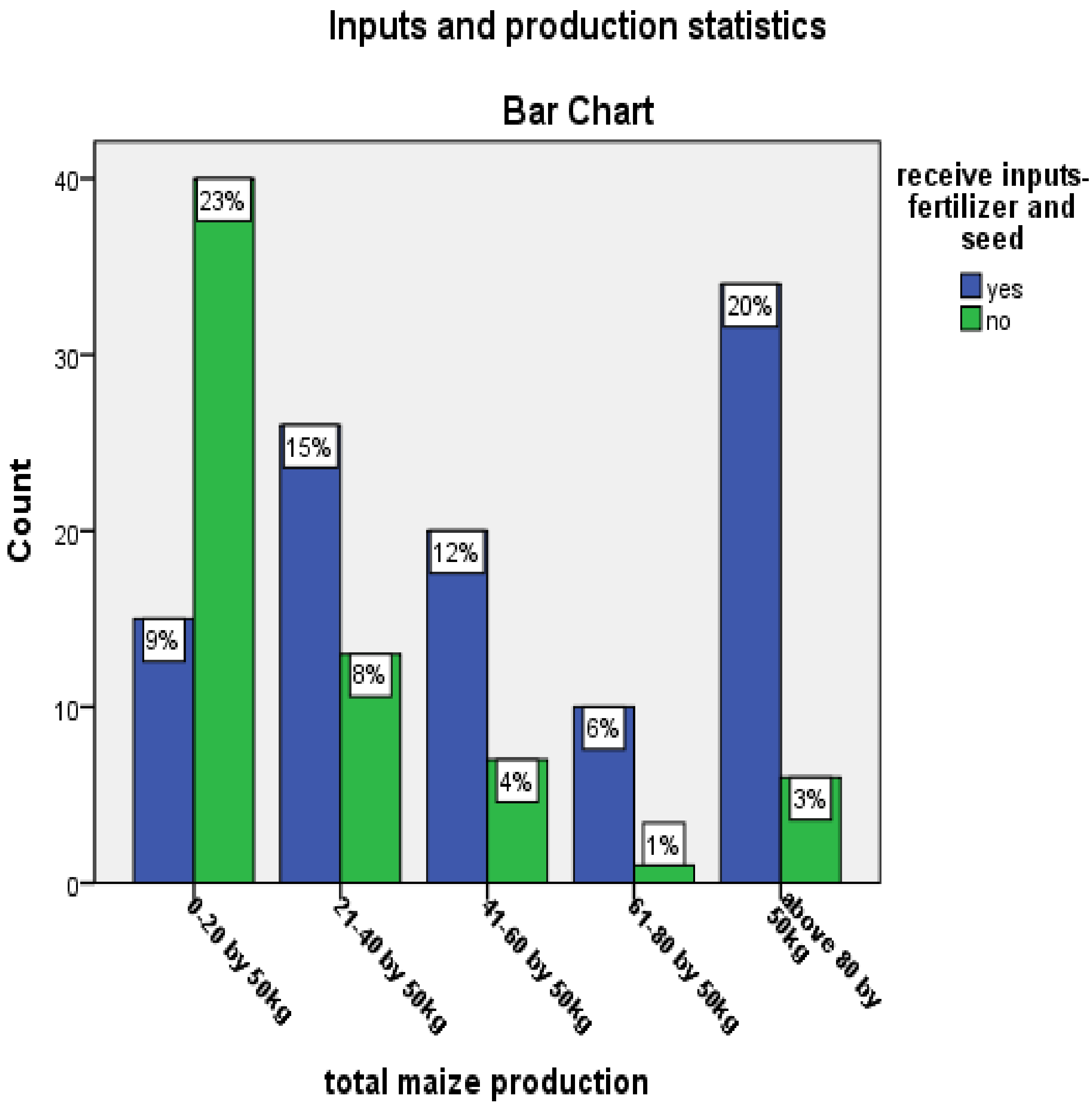

Figure 9*: Input and Production statistics*
Source: Computed results in SPSS from field survey 2016.

Table 4: *Descriptive statistics of maize deficits and periods of storage.*

Variable	Distribution	Frequency	Percent	Cumulative Percent
Source for the deficit	buy	103	59.9	59.9
	from friends	4	2.3	62.2
	relief food	16	9.3	71.5
	substitute with other	25	14.5	86
	no deficit	24	14	100
	Total	172	100	
Period of storage	less than 3months	18	10.5	10.5
	3-5months	50	29.1	39.5
	6-8months	64	37.2	76.7
	more than 1year	38	22.1	98.8
	N/A	2	1.2	100
	Total	172	100	

Source: Own field survey 2016.

5.1.4. Postharvest challenges.

Losses occur at all stages of plant growth and require highly technical skills to establish their estimates. In this study, only postharvest losses were estimated based on the number of bags stored and what is finally consumed. Figure 8 showed 91.3 percent of the respondents having a significant loss of about 10-20 percent and only a smaller percentage either having less or more than the former.

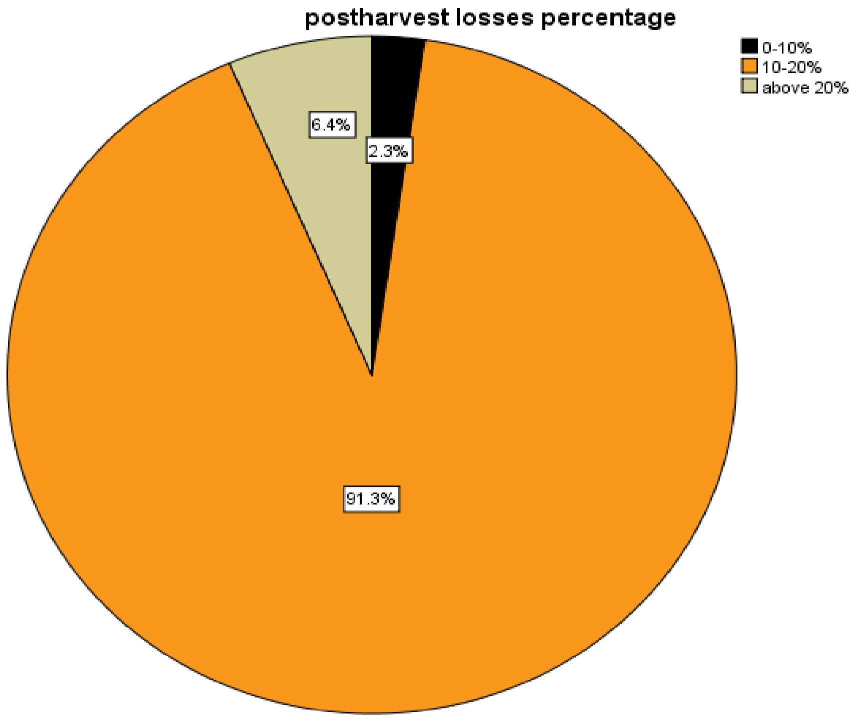

Figure 10*: Postharvest losses estimates.*
Source: Computed results in SPSS from field survey 2016.

5.1.5. Competitiveness of maize.

The figures in table 5, 6, 7 and 8 are the cardinal values for determining the domestic resource ratio. All the amounts are given in kwacha (K), the local currency with an exchange rate of K9.49/1 USD. The calculations in table 5 show the value of the total cost per tonne of tradable inputs ($\sum a_{ij} P^B_j$) as K551.43. This is the amount money needed to purchase inputs to produce one tonne of an output, in this case, maize. Table 6 gives the total of K923.90 for non-tradable domestic factors ($\sum a_{ij}P^D_j$). This is the value added at factor cost at an economic/social price. The output price of maize is shown in table 7 as the social price (P^B_i) amounting to K1, 285.30, while table 8 shows the value added at market price (($P^B_i - \sum a_{ij} P^B_j$) as K734, which is basically the difference between the output price and the total cost of tradable inputs. It further, shows the value of the DRC_i equal to 1.3 and non-competitive because the value is greater than 1.

Table 5: *Calculation of the cost of tradable inputs*

Input	Use (t) per ha	Not used	Avg. yield (t/ha)	Avg. production (t)	Use of input per t (aij)	Social price - def	Social price - value (K)	Cost (K) per t of output
Seeds	0.02	0	2.1	2.1	0.01	import price	570	5.43
Fertilisers	0.4	0	2.1	2.1	0.19	import price	2866.32	545.97
Pesticides	0.0025	0	2.1	2.1	0.00	import price	30	0.04
$\sum a_{ij}P^{B}_{j}$	x	x	x	x	x	x	x	**551.43**

Source: Own calculation 2017
Exchange rate: K9.49/1 USD

Table 6: Calculation of non-tradable domestic factors

Factor	Use per farm	Avg. area per farm (ha)	Avg. yield (t/ha)	Avg. production	Use of factor per t	Possible years of the use	Social price - def	Social price - value (K)	Factor cost (K) per t
Family labour	5.1	1.1	2.1	2.1	2.4	18	local wage (annual)	0.0	0.0
Hired labour	1	1.1	2.1	2.1	0.5	x	local wage	1320.0	628.6
Maize bin	1	1.1	2.1	2.1	0.5	1	market price	600.0	285.7
Hoes	6	1.1	2.1	2.1	2.9	2	market price	55.0	9.6
$\sum a_{ij}P^{D}_{j}$	x	x	x	x	x	x	x	x	**923.9**

Source: Own calculation 2017
Exchange rate: K9.49/1 USD

Table 7: *Output price calculation*

Output	Import price (fob) per t.(K)	Rate tax + subsidy -	Transport distance(Km)	Transport cost per km and t (K)	Transport costs/t (K)	With out tax	Social price($P^B{}_i$) (K)
maize	2704.8	0.00	850	1.67	1419.5	0	**1285.3**

Source: Own calculation 2017
Exchange rate: K9.49/1 USD

Table 8: *Calculation of the DRC ratio*

Value Added at factor costs ($\sum a_{ij}P^D{}_j$)	Value Added at market prices ($P^B{}_i - \sum a_{ij}P^B{}_j$)	DRC_i	Remarks
924	734	1.3	Non-competitive

Source: Own calculation 2017
Exchange rate: K9.49/1 USD

5.2. Discussion.

The results in Table 3 for the description and characteristics of the farmers showed that both males and females are actively contributing to agricultural activities in the district. Scrutinising the production trends in figure 6 unveils an interesting fact which most women activist like Vandana Shiva will conquer with. Women are underprivileged in these societies. They are regarded as second to men when it comes to decision making and leadership. Adversely they struggle to access inputs for farming. But their contribution ratios to production are almost 1:1 with their male counterparts. Right policies that explore and support women alternatives would greatly improve production and enhance food security in the area. Some studies have shown that when women farmers have access to resources, they are more productive than men farmers. For instance, it has been reported that in Kenya the average gross value of output per hectare from male-managed plots was usually 8 percent higher than from female-managed plots, but when women used the same resources as men, their productivity would increase by 22 percent (Saito, 1994).

The easy access to the market created by the FRA has not only boosted production of maize but has also, on the contrary, made farmers be less diversified. We suppose widening the market to other commodities would consequently promote the alternatives as evidenced by the 78.5 percent of farmers preferring to venture in maize all because of the easy access to the market.

In a subsistence farming environment, it is important to store enough food to last the whole season. And to store this kind of quantities, it is inevitable to have facilities that will safely hold it for longer periods of time. But looking at the situation in my study area, a bigger percentage (70.9 percent) of the farmers had no any sort of storage facility. This is not an indication that farmers have meagre produce; it is generally implying that farmers are selling more than 60 percent of what they produce and only remain with a small quantity which is packed in 50 kg bags awaiting to be processed. These quantities do not even last for more than a year. The original concept of subsistence and sustainable agriculture as practiced in the earlier days has been lost along the great path of economic development and agribusiness.

The Farmers input support programme (FISP), although highly politicised is a very important programme for farmers in the whole country at large. 62 percent of the farming households that received inputs had a relatively higher level of production as compared to a 38 percent that did not receive. The programme has been criticised by many international organizations for targeting the wrong beneficiaries. It might be true to some extent especially in the urban peripherals, but in the rural areas, the impact and results are overwhelming. Policy coherence is vital in this aspect to fully yield further results.

The adverse effects as alluded earlier for marketing the larger portion of the produce creates a very unstable food insecurity environment for the farmers. The same commodity that they produced and at the same time marketed is the same commodity that is sort for and demanded by the 86 percent of the household, in the long run, it is a situation where farmers sell at a cheaper price and re-buy the commodity at double the price. The figures in Table 4 indicate how food security is compromised due to the lack of subsistence mentality amongst the farmers. Having known how much was produced, how much was sold and how much was stored for home consumption at household level was essential in that we could determine the food security situation. Farmers who are food insecure suffer from the inaccessibility of food. They either cannot produce enough or fail to buy maize. The 14 percent that could store maize for over a year only shows how worse the situation is.

Losses shown in figure 8 are quite significant, considering that, a lot of losses are still incurred in other stages of production. Zero wastage is what modern and sustainable agriculture should address. 10-20 percent post-harvest loss is avoidable if appropriate measures are taken. Insect pests are the major culprits tormenting the farmers. Chemicals are either expensive or unavailable for purchase in most of the rural areas. Having proper storage facilities would significantly reduce these kinds of losses. Due to lack of infrastructure in agriculture and rural development as documented, it is estimated that 15 percent of crop produce is lost between the farmgate and the consumer because of poor roads and inappropriate storage facilities alone, adversely influencing the income of farmers (World Bank, 1997).

The value of DRC_i was 1.3 (Table 8), indicating an inefficient and non-competitive maize venture. This is mainly attributed to the high cost of production. Inputs, both tradeable and non-tradable are quite expensive. Factoring in the distance to markets where there are better and competitive market prices, farmers must travel more than 600-850 km. These are kind of costs they can barely afford looking at the state of the small-scale farmers. Without accessing the government subsidised inputs, fertiliser, and seed, the prices of inputs are quite expensive for small-scale farmers. Zambia imports most of her fertiliser especially Urea from overseas. Seeds are locally sourced but the prices are still exorbitant. Yields are still tremendously low, with averages ranging from 2-2.1 MT/ha as shown in table 6.Most farmers who cannot afford tend to use local recycled seeds. However, those that afford hybrid seeds still have low yields. The lack technical skills and poor fertilising method even make it worse for the crop production. It was observed that some farmers skip an important basal-dressing stage and the fertiliser only at the top-dressing stage. This tendency causes maize to be stunted and consequently poor yields. This practice is deliberate in the sense that farmers do not have enough quantities of fertiliser to suffice for the whole stages or sometimes inputs are delivered late.

6. Conclusion and Recommendations.

6.1. Conclusions.

The main objective of this thesis study was to assess effects of current farming practices, post-harvest treatment, and policies regarding maize production on food security. Maize constitutes a crucial factor in the food security in Zambia, hence the need to address all its issues both at household and national level. Furthermore, we established levels of subsistence and assessed how competitive and efficient maize production is.

The result showed 70.9 percent of farmers do not have storage facilities of any kind. This is so because they market more than 60 percent of their produce to either FRA or private buyers. The results further showed 86 percent of the farming households had maize deficits in the long run before the season ends. Marketing a larger portion of the produce creates a very unstable food insecurity environment.

The 62 percent of farmers received inputs from FISP had are latively higher level of production than the non-beneficiaries. This is a good indicator especially for the rural community if food security is to be addressed. Post-harvest losses stand at 10-20 percent. This is quite a substantive figure because these are avoidable circumstances. The loss is mainly due to lack of proper infrastructure in agriculture and rural development.

The DRC_i of 1.3 coupled with low yields of about 2-2.1 MT/ha (potential yields can reach 8MT/ha), indicated that the commodity is non-competitive with very high production cost. It is important that a country produces commodities in which they are competitive in the global market.

6.2. Recommendations.

Inefficiencies associated with production should be addressed by lowering the production costs through revamping the nitrogen chemicals of Zambia (NCZ) to full operational standards. If sufficient quantities of both Urea and compound D fertiliser are produced locally, this will effectively reduce imports and lower prices for the inputs.

Technical skills need to be transferred to farmers through extension services. More research is needed in areas that look at the future of small-scale farmers. Reformation of the extension and advisory service of the government is vital. Instilling back the subsistence mentality into farmers is essential in this changing global economy. Introducing sustainable technologies will boost the sector and preserve the environment. Policy coherence is vital to fully implement and improve the agricultural sector. Structural changes in the policy formulation system should be considered. Policies lack consistency due to the nature in which they are formed. Instead of creating export and import bans, important factors like production should be addressed to leverage on existing opportunities for export to neighbouring countries. Public private partnership should be encouraged in the maize marketing sphere.

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8. Appendices.

Appendix 1: *Tradable and non-tradable input prices.*

Input	***unit***	***Unit price/cost(K)***
maize	50 kg	87.20
Maize seed	10 kg	285.00
Maize export	1 tonne	2,705.00
Fertilizer(U&D)	50 kg	385.29
Labour	50 man days	1,320.00
Pesticide acteric super	1 kg	30.00
Hoes	1 piece	55.00
Ox plough	1 piece	1,350.00
Transport cost	1km/tonne	1.67

Source: Malata-senior economist, MAL- Zambia 2017
Exchange rate: K9.49/US $.

Appendix 2: *Social prices calculation of the inputs.*

Input	**Unit**	**Import price (fob) per unit**	**Import price (fob) per t**	**Rate tax + subsidy -**	**Transport distance**	**Transport cost per km and t**	**Transport costs/t**	**Without tax**	**Social price(K) (PBj)**
Seeds	10kg	285	28500	0	850	1.67	1420	0	29920
Fertilisers	50kg	385	7700	0	850	1.67	1420	0	9120
Pesticides	1kg	30	30000	0	850	1.67	1420	0	31420

Source: Own calculation 2017
Exchange rate: K9.49/US $.

Appendix 3*: National food balance sheet.*

National Food Balance for Zambia for the 2013/2014 Agricultural Marketing Season
Based on the 2012/2013 MAL/CSO Crop Forecasting Survey and MAL/Private Sector Utilization Estimates (Metric Tonnes)

		Maize	Paddy rice	Wheat	Sorghum & Millet	Sweet and Irish potatoes	Cassava flour	Total (maize equivalent)
A. Availability:								
(i) Opening stocks (1st May 2013)	1/	455,221	2,737	168,255	6,036	0	0	629,556
(ii) Total production (2012/13)	2/	2,532,800	44,747	273,584	38,914	210,392	1,114,583	3,984,553
Total availability		**2,988,021**	**47,484**	**441,839**	**44,950**	**210,392**	**1,114,583**	**4,614,109**
B. Requirements:								
(i) Staple food requirements:								
Human consumption	3/	1,429,739	55,769	281,321	40,540	199,872	721,901	2,533,816
Strategic Reserve Stocks (net)	4/	500,000	0	0	0	0	0	500,000
(ii) Industrial requirements:								
Stockfeed	5/	223,300	0	0	0	0	0	223,300
Breweries	6/	100,000	0	0	0	0	0	100,000
Grain retained for other uses	7/	34,347	4,478	0	2,464	0	0	41,088
(iii) Losses	8/	126,640	2,237	13,679	1,946	10,520	55,729	199,228
(iv) Structural cross-border trade	9/	120,000						120,000
Total requirements		**2,534,026**	**62,484**	**295,000**	**44,950**	**210,392**	**777,630**	**3,717,432**
C. Surplus/deficit (A-B)	10/	**453,995**	**-15,000**	**146,839**	**0**	**0**	**336,953**	**896,677**
D. Potential Commercial exports	11/	-453,995	15,000	-146,839	0	0	0	0
E. Food aid import requirements	12/	0	0	0	0	0	0	0

Source: Ministry of agriculture-Zambia. 2014.

Appendix 4: *Rural agricultural activities.*

Table 4.6: Rural Households by Type of Agricultural Activity, 2002/2003

Province	Household Reporting	Type of Agricultural Activity			
		Crops	Livestock	Poultry	Fish Farming
Central	108,918	93.2	31.2	80.7	2.1
Copperbelt	66,909	94.5	9.5	64.9	0.5
Eastern	225,047	97.7	42.1	70.9	0.9
Luapula	106,784	92.2	21.7	67.2	0.7
Lusaka	18,876	87.1	26.1	63.7	0.7
Northern	191,915	95.1	32.6	80.6	2.5
N/Western	74,290	94.9	20.1	61.5	0.9
Southern	122,342	94.9	48.2	86.8	0.2
Western	106,048	94.5	28.7	61.1	1.2
Zambia Total	1,021,128	94.9	32.3	73.1	1.2

Source: CSO-Structural Type and Post-Harvest Data 2002/2003.

Appendix 5: *Average farm gate commodity prices*

AVERAGE FARMGATE PRICES FOR SELECTED COMMODITY PRICES

		2015	**2016**
S/N	**NAME OF COMMODITY**	**PRICE PER KG**	**PRICE PER KG**
1	*MAIZE*	1.85	1.94
2	*SOYA BEANS*	4.75	4.67
3	*GROUNDNUTS*	5.34	5.38
4	*SUNFLOWER*	2.40	2.53
5	*RICE*	1.45	1.53
6	*WHEAT*	4.57	4.62
7	*BEANS*	5.50	5.64
8	*SORGHUM*	1.50	1.54
9	*CASSAVA*	1.61	1.68
10	*COWPEAS*	4.00	4.50
11	*POPCORN*	2.48	2.56
12	*COTTON*	3.00	3.20
13	*SUGAR CANE*		
14	*IRISH POTATOES*	2.45	2.58
17	*MILLET*	5.35	5.45
18	*COFFEE*		
19	*TEA*		
20	*TOMATO*		
21	*CABBAGE*		
22	*ONION*	4.00	4.35
	LIVESTOCK PRODUCTS		
23	*BROILER CHICKEN*		22.50
24	*VILLAGE CHICKENS*		31.50
25	*DAIRY (Milk)*		
26	*PIGS*		19.50
27	*BEEF*		20.50
28	*GOATS*		305.00

Source: Agricultural Market Information Centre (AMIC)- MAL-Zambia 2016

Appendix 6: Questionnaire 2016

Purpose: Survey on the contribution of maize production to food security.
Target: House Hold.
Respondent: Household Head.
Location: Mufumbwe District, North-Western province of Zambia.
Selection method: structured interviews, simple random sampling and convenient method.

Data item 1.

DI1. 1. Household Head? 1.male 2.female **DI1. 2.** Size of farm plot? …………………………………Ha **DI1. 3.** Size of land cultivated for maize? ………………………………...Ha	**DI1. 4.** Total maize production per season? ……………………….by 50 kg bags. **DI1. 5.** How much is kept for home consumption? …………………………by 50kg bags. **DI1. 6.** How long Does this stored quantity? 1.less than 3months 2.more than 3months but less than 6months 3.more than 6 months 4.1year.

Data item 2.

DI2. 1. In a situation where the household runs out of the stored food, how do you source for the deficit? 1.buy 2.from friends 3.Relief food 4. Substitute with other foods. (Specify……………………………………………………) **DI2. 2.** Do you receive any inputs as support from the available programmes? 1.Yes 2.No	**DI2. 3.** If the answer to **DI2. 2.** Is "YES'', Are the inputs sufficient for your required production? 1.yes 2.No **DI2. 4.** If the answer to **DI2. 2.** Is "NO", Why don't you benefit from the programme(s)? 1. No money to pay for the subsidised cost. 2. Don't belong to a cooperative. 3. Don't depend on the programme for inputs.

Data item 3.

DI3. 1. Given the chance to choose the crop to grow, which one would you choose? 1.Maize 2.Cassava	**DI3. 2.** Why did you choose that crop? 1.Easy to sell 2.Easy to grow

3.Groundnuts 4.Soy bean 5. Others (Specify)…………………………………………..	3.Traditional crop

Data item 4.

DI4. 1. Do you have any storage facility for your harvested crops? 1.Yes 2.No **DI4. 2.** If the answer to question **DI4. 1.** Is "YES", which type? 1.Traditional wood/grass structure 2.Improved concrete structures 3.Metallic structure **DI4. 3.** If the answer to question **DI4. 1.** Is "NO", what are the reasons for not having a storage facility? 1.Expensive to construct 2.No surplus to store	**DI4. 4.** Do you face any storage problems (pests, rodents, thieves)? 1. Yes (specify)…………………………………………… 2.No **DI4. 5.** Mitigation measures to the storage problems in question **DI4. 4.** 1.Traditional method 2.Chemical treatment 3. Other (specify)…………………………………………... **DI4. 5.** On the scale of 100%, how would you rate your crop loss/damage? 1. In the field………………………. % 2. After harvest……………………% 3. Storage……………………………. %

Data item 5.

Recommendations towards maize production in terms of marketing, inputs, postharvest challenges? 1. 2. 3.

End of the questionnaire……………………………Thank you for your cooperation.

Signed by:
Date: / /2016
Place:

compiled and designed by:
Lutangu Andrew Litia.