FEED CONCENTRATES VALUE CHAIN AND PROSPECTS FOR SORGHUM UTILIZATION IN ZAMBIA

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

By

SOMBO MAKECHE

In Partial Fulfillment of the Requirements for the Degree of Bachelor of Agricultural Sciences

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This report is dedicated to my Dad Mr L. Makeche, Mum Mrs J. Makeche, my siblings Muzala, Ndumba, Paul, Mooba, Ngambo, Kalumbu, Chinyama, Luke Jr, the rest of my family and friends particularly, Pardon Kapasa, Tiwonge Gondwe and Alefa Banda for their love and support. I also dedicate this report to Brian Bweupe for being there for me and encouraging me all the way.

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KEY TO ABBREVIATIONS

CSO       Central Statistical Office
DEA       Data Envelopment Analysis
FRA       Food Reserve Agency
INTSORMIL International Sorghum and Millet Collaborative Research Program
ICRISAT   International Crop Research Institute for Semi-Arid Tropics
PAZ       Poultry Association of Zambia
SMIPS      Sorghum and Millet Improvement Program
SPSS      Statistical Package for Social Science
WPF       World Food Program
Zambia, like most developing countries has a lot of people with low incomes and hence faces a critical need to find ways of improving these incomes in order to promote equity as well as national development. This could be done through the utilization of household crops such as sorghum in industry. One of such industries is the feed concentrate industry. Therefore, understanding the feed concentrate value chain and prospects for sorghum utilization is a central concern. The Zambian feed concentrate industry has been dependent on maize as the main grain in the feed. Recently, there has been an increase in the demand for feed as the livestock numbers in the country have been increasing. There is therefore need to promote the use of other grains such as sorghum. The result would be an improvement in smallholder farmers’ productivity and ultimately an increase in their incomes as the sorghum they would produce would be demanded by the feed concentrate industry.

A study was carried out in Lusaka district, aimed at understanding the feed concentrates value chain and prospects for sorghum utilization in Zambia. The main objective of the study was to understand new market opportunities and value chain constraints for sorghum in the Zambian feed concentrate industry. The structured questionnaire was the primary instrument used for data collection. Descriptive statistics were generated using Statistical Package for Social Sciences (SPSS). Parameters hypothesized to help understand the feed concentrates value chain and prospects for sorghum utilization were hypothesized using Porters Model.

The key players of the feed concentrate value were identified to be maize farmers, small scale traders, commodity broker, feed manufacturers, distributors, retailers and livestock keepers. The opportunities for sorghum were found to exist. There was willingness to substitute sorghum for maize and the majority of the feed buyers interested in knowing the nutrient content suggested the use of sorghum in feed. The constraints were the lack of knowledge on the sorghum nutrient content by the key players and the feed manufacturers not being assured of a steady supply of sorghum to be used in feed production.

In view of the findings it is recommended that feed manufacturers and sorghum farmers work together through contract farming so as to ensure that feed manufacturers have adequate supply of sorghum and farmers have a ready market. An increase in the number of sorghum buyers would also encourage sorghum production among smallholder farmers. Furthermore, a proven formula should be created to provide knowledge on the nutrient content of sorghum and the nutrients it would provide for the livestock.

SomboMakeche
University of Zambia, 2012

Supervisor:
Dr G. Tembo
CHAPTER ONE

INTRODUCTION

1.1 Introduction

Sorghum is a drought tolerant crop that is produced in drier parts of Zambia and, in most cases, regarded as a low-input, drought tolerant crop. In places where it is produced, sorghum is an important food security and income source. In Zambia, sorghum is produced mainly in Eastern, Southern and Western Provinces. In Kazungula District of Southern Province, sorghum has become a major livelihood/fall-back crop following recurrent droughts and recent NGO interventions that promoted its production (Murray and Mwengwe, 2005). Often, sorghum, like millet, cassava and maize is used to make nshima, a main staple in Zambia.

Despite its apparent production advantages, sorghum production levels among smallholder has remained low and low commercial marketing opportunities have been cited as some of the major reasons (Hancock, 2009). Much of smallholder sorghum marketing takes within the rural farming communities with very little trade beyond those areas. Locally, sorghum is mostly used to brew traditional beers which are common in rural areas. Rice and maize are preferred to sorghum by most people in urban areas. Maize production has also been strongly supported by agricultural policies, which have provided input and output subsidies, leading to an artificial relative advantage even in areas where sorghum would be more appropriate.

In recent years, this seems to be changing as new industrial uses for sorghum have continued to emerge. Examples of new industrial uses, which present real potential for smallholder sorghum farmers, include commercial beer brewing, and food and feed processing. In the feed concentrate industry, sorghum is used primarily as a feed grain for livestock. The feed value of grain sorghum is similar to corn, although it has more protein and fat than corn but lower in vitamin A. Thus, like maize, it can be mixed with soybeans to produce a higher protein silage crop. In Zambia, a recent surge to consider sorghum as a serious substitute for existing substrates like maize and soyabean is especially apparent in the poultry sub-sector, where frequent, and sometimes severe, maize and soyabean shortages have been seen to lead to substantial increases in feed
prices (PAZ, 2009). According to Subramanian and Metta (2000), sorghum can replace maize to a percentage of about 50 to 74 percent as maize and sorghum have nearly similar chemical composition. However, development of markets for sorghum among urban populations and for industrial utilization has remained a major challenge as sorghum is viewed as a poor man’s crop. The World Food Programme (WFP) has used sorghum in its school feeding programmes in Tanzania to help stimulate the demand for sorghum.

1.2 Problem Statement

Several projects under the Sorghum and Millet Improvement Program (SMIP), supported by the International Crop Research Institute for Semi-Arid Tropics (ICRISAT) and more recently by the International Sorghum and Millet Collaborative Research Support Program (INTSORMIL), have been involved in sorghum variety development in many African countries (Makindara et. al 2008). In a concerted effort to improve the production and productivity of these crops, governments in southern Africa pooled their resources together and established Sorghum and Millet Improvement Programme (SMIP) in the early eighties.

Significant efforts were made through the regional programme SMIP to acquire new and enhanced germplasm from all possible sources and these efforts were successful (Chisi, 1998). In sorghum and millet, crop improvement activities have largely used the pedigree and backcross method to advance the breeding material. In Zambia, several new improved sorghum and millet varieties have been released. These include Kuyuma, Sima, WP-13, MMSH-1324 and MMSH-1257 sorghum varieties among others and Kaufela, Kuomboka, Sepo, Tusa, Lima and Nyika millet varieties (Martella et. al, 1997). These new improved varieties are high yielding and disease resistant. However, there is still very little empirical evidence on value addition opportunities and prospects, one of the reasons INTSORMIL is now also focusing on marketing and entrepreneurial support programs.
Although a number of studies have looked at value chains for sorghum seed and utilization (Mbiha 2010 & Hamukwala, 2010), few have focused on sorghum's prospective utilization in the food and feed concentrate industry. In Asia, it was found that only 34% of the total sorghum produced is used in feed production (Rooney, 2002). The reason for this low utilization is a lack of knowledge on the market opportunities of increased sorghum utilization in the feed industry. In the study done in Nigeria (Ajayi, 1993) it was found that despite the willingness to use sorghum in feed production, the quantities of sorghum currently being used in food and feed industries are still limited. This is because of lack of familiarity with the utilization of this crop and uncertainty about consumer demand of sorghum based feed. In another study done in Tanzania, Mgaya (2010) found that, although animal feed manufacturers were willing to substitute sorghum for the more expensive traditional substrates, they did not have proven formulations for sorghum and millet-based animal feed. Their level of knowledge of utilizing sorghum in feed and its advantages is low. Such scanty level of knowledge on innovative industrial uses of sorghum is unfortunately wide-spread in Africa. In Zambia, no study has explored sorghum's potential in the feed industry.

1.3 Objectives of the Study

The overall objective of the study is to understand new market opportunities and value chain constraints for sorghum in the Zambian feed concentrate industry.

The Specific Objectives were:

i) To identify the key players in the feed concentrate value chain and the roles played by each player.

ii) To identify opportunities for utilization of sorghum in feed concentrates.

iii) To identify constraints to the utilization of sorghum in feed concentrates.
1.4 Rationale

The use of sorghum as a substitute for maize as a feed ingredient can help in making lives of many small scale farmers better as well as reduce the over-dependence of many agricultural industries on maize, hence the need to understand the value chain of sorghum with particular reference to the feed concentrate industry. Sorghum grain is just as ideal as maize for animal feed. Sorghum is a low-input crop and thus its production is cost effective in comparison to maize and this would lead to a reduction in cost. Its utilization in feed can help sustain income for the farmers, particularly small-scale farmers as they will have a market for their crop.

Understanding the feed concentrate value chain can improve farmers’ income through the identification of enterprises that contribute to production as well as the constraints affecting increased utilization. Identifying the market opportunities for sorghum would help educate the farmers on the industrial utilization of sorghum and this would increase the market value of sorghum thus benefiting the farmers. Market opportunities for sorghum is also beneficial in that low income farmers will have knowledge on how much to produce so as to meet demand. This would further lead to an increase in the volume of production of sorghum by the farmers as sorghum will not only be produced for household consumption but for industrial use as well.

Using sorghum as a substitute for maize would lead to consistent availability of the grain source for the feed, this so because sorghum can be grown even in drought seasons. This consistent availability would therefore lead to less price fluctuations of feed prices in the peak and slack seasons for maize.

The feed manufacturers would also benefit in that they would have consistent supply of input both in the wet and dry seasons. Having a substitute for maize would result in the reduction of maize prices as people will have an alternative source of grain for their feed. This will in turn lower the prices of maize as there would be a cheaper alternative. Lower maize prices entail lower feed prices and this will benefit the livestock keepers as they would be able to afford the feed and thus acquire the adequate feed quantities needed by
their livestock. Livestock keepers formulating their own feed can use low-input sorghum as opposed to maize.

1.5 Organization of the Report

This report opens with chapter one which highlights the background information about the subject. It covers the problem statement, objectives and rationale of the study. Chapter two focuses on literature review in which the meaning of value chain and previous studies on value chains are discussed. Chapter three looks at the methods and procedures that were used for the study. It encompasses the area of study, data sources and data entry and analysis Chapter four highlights the findings and interpretation of the findings of the study, while chapter five looks at conclusion and recommendations based on the findings of the study.
CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

Value chain analysis is important as it helps the various players in the chain to sustain firm and industry competitiveness. Many studies have been done concerning value chains of different enterprises in different fields. In agriculture, value chain analyses are done on different crop and livestock enterprises. A large body of literature has investigated different aspects of sorghum production and marketing using value chains.

This section will synthesize the existing empirical evidence on value chains of sorghum as well as feed concentrate value chains. It will identify studies that have been done concerning value chain analyses of sorghum. A synthesis of the studies will be given in order to see what has been done so far.

2.2 Known Findings

A feed concentrate value chain study conducted in Tanzania (Mgaya, 2010) showed that the main constraints which hinder utilization of sorghum in the feed industry were the tendency of animal feed stakeholders to prefer maize to sorghum as it readily available and they have no proven formulations for sorghum and millet in animal feed thus their level low levels of knowledge on the utilization of sorghum in the feed industry. These results implied that increasing sorghum supply and productivity would increase sorghum availability. Educating feed manufacturers on proper rations, and more competitive prices are also fundamental to expanding sorghum utilization in animal feeds as this will increase the levels of knowledge of sorghum utilization in the feed. The findings of this research matched those of another study conducted in Nigeria (Ajayi, 1993) whose findings revealed limited utilization of sorghum in the food and feed industries. The reasons for this low utilization were found to be lack of familiarity with the utilization of sorghum in feed and uncertainty about consumer demand of sorghum-based feed. However, these study findings were not representative as the samples did not include all the major feed manufacturing companies in these countries. This current study on the
A study on China Feed Concentrate industry identified inadequate feed as a main challenge in the feed industry. This is due to high demand for maize for both human and animal consumption which in turn leads to a limited proportion of the maize being available for feed production (Yves, 2008). The results of this study meant that the use of grains other than maize such as sorghum and millet in feed production would help address this challenge. This presents an opportunity for increased sorghum utilization in the feed industry in China. However, this increased utilization would only be feasible if the challenges revealed in the findings of a study conducted in Botswana (Seleka, 2000) are addressed. In this study, several feed manufacturers complained that sorghum does not mill well compared to maize. Whereas maize can be cracked in a hammermill, sorghum grains become powder. These results implied that the use of harder-grained sorghum would improve the milling properties of sorghum. However, no information was given on the utilization prospects for sorghum in this industry.

In a study that was carried out on sorghum and pearl millet industrial utilization (Hancock, 2010) the key actors in feed industry were found to be farmers, local markets, middlemen, feed manufacturers, agents, traders, livestock keepers, supermarket, processor, hotels, and local vendors. However, the actors that mostly use sorghum were not identified. This current study on the other hand identified the actors that mostly deal with sorghum as well as the prospects for increased sorghum utilization in the feed concentrate industry.

The performance of Eagle Lager and the opportunities it presents to smallholder farmers in Zambia was also assessed. The key players in the sorghum clear beer value chain were identified. Some of the opportunities were that the introduction of eagle lager provided farmers with a ready market for their produce, ensured reliable reasonably priced sorghum to Zambian Breweries and the provision of employment and business opportunities to their distributors and employees. (Chimai, Tembo, 2010). These results
showed that there were opportunities for sorghum use in the brewing industry. The implication is that sorghum farmers would increase their production as they would have a market for their produce. The industrial utilization of sorghum would also increase as farmers would not only produce for home or domestic consumption but for use in beer brewing as well. However these opportunities identified in the brewing industry cannot be generalized to the feed concentrate industry, hence the reason for identifying market opportunities for sorghum in the feed concentrate industry.

In a study on the evaluation of new market development and marketing strategies on sorghum and millet farmers’ income in Tanzania and Zambia (Larson et. al, 2006), four market developments that offer opportunities to increase farmers’ income were found to be the agro-food industry, especially food processing, feed concentrates, beer brewing, and energy markets. However, the opportunities or prospects for increased sorghum utilization in each of these industries, particularly the feed industry were not identified. In a study on Commercial Dynamics in Zambia’s Cassava Value Chain, cassava markets in Zambia were found to hold significant potential for commercial growth (Haggblade and Nyembe, 2007). In the cassava belt the largest market would be for cassava based convenience foods such as cassava based maheu and gari. These findings implied that prospective markets for cassava existed and these could lead to an increase in cassava production. However no study has been done in Zambia on the prospects for increased sorghum utilization or the potential for the commercial growth for sorghum utilization.

As can be seen from the above studies, there is a dearth in knowledge concerning utilization of sorghum in the feed concentrate industry as well as the prospects for increased sorghum utilization in the feed industry.

2.3 Conceptual Framework

Any market comprises groups of interlinked firms, contributing to the final product released on the market (Larson et al, 2010).
A value chain is a procession of activities for a firm in a particular industry (Kaplinsky and Morris, 2010). It relates to value added at each stage.

Several other definitions of a value chain exist. Kaplinsky et al., (2000), describes a value chain as a “full range of activities required to bring a product or service through the different phases of production, including physical transformation, the input of various producer services, and response to consumer demand.” Keyser (2006) on the other hand describes a value chain as “all of the factors of production including land, labor, capital, technology, and inputs as well as all economic activities including input supply, production, transformation, handling, transport, marketing, and distribution necessary to create, sell, and deliver a product to a certain destination.” A sorghum value chain in this study refers to the entire sequence of actions necessary to get sorghum from the farmer to the feed concentrate producers.

The sorghum based feed concentrate industry consists of a number of organizations with each organization trying to capture as much of the market share as possible. A useful tool in determining the competitive position of an organization in its industry is the value chain analysis based on Michael Porter’s value chain model (Recklies, 2001). Value chain analysis entails a detailed description of a particular organization’s activities and relating them to its competitive advantage. The value chain activities can be grouped into primary activities and secondary activities according to Porter’s Model as follows:

2.3.1 Porters Value Chain Model

Porter’s Model is one of the models for studying value chains. It consists of primary activities and secondary activities. The primary activities comprise the inbound logistics, operations, outbound logistics, marketing and sales as well as services. The secondary activities consist of procurement, human resource management, technology development and infrastructure management. The market is broken down into key activities of primary and secondary activity components. Primary activities can be classified into product related and market related activities. Product related activities are the activities that the organization performs to add value to
the product and service. The activities are classified as inbound logistics, operations and services.

Inbound logistics refer to all the activities related to receiving goods from the suppliers, decisions about the transportation scheduling, storing the goods as inventory, managing the inventory, and making the inputs ready to use for the production of end products. Operations include the production process, development activities, testing, packaging, maintenance, and all other activities that transform the inputs into finished product. The organization offers the services after the products and/or services have been sold. These service activities enhance the product’s value in the form of after sales guarantees, warranties, spare parts management, repair services, installation, updating and trainings. Market related activities are those that the organization performs to transfer the finished products or services to the customers. These activities are classified as outbound logistics and marketing and sales.

The outbound logistics involve the development of finished products using the product related activities. These activities are required to transfer the finished products to the customers via warehousing, order fulfillment, transportation, and distribution management. Marketing and Sales activities include the advertising, channel selection, product promotion, selling, product pricing and retail management. The activities are performed to make sure that the products are transferred to the targeted customer groups. The primary value chain activities can be depicted graphically as

<table>
<thead>
<tr>
<th>Inbound Logistics</th>
<th>Operations</th>
<th>Outbound Logistics</th>
<th>Marketing &amp; Sales</th>
<th>Service</th>
</tr>
</thead>
</table>

Support or Secondary activities are the activities that the organization performs to assist the primary activities to gain the competitive advantage. These activities are classified as Procurement, technology management, human resource management and infrastructure.
Procurement is the purchasing activity of the inputs to transform these into finished products or services. Procurement adds value by the acquisition of appropriate goods or services at the best price, at the right time, and in the desired place with the desired quality and quantity. Technology Management is very important in today's technological driven environment. Technology can be used in production to reduce cost, to develop new products, increase customer service facility and build up cost effective process. It supports the value chain activities such as research and development, process automation and process design.

Human resource management activities relate to selection, recruitment, training, remuneration and replacement of the workforce. This is an essential activity in any organization because the efficiency of the workforce affects the quality of the goods and services produced and the cost structure of the organization. Infrastructure includes the planning management, legal framework, financing, accounting, public affairs, quality management, general management, etc. These are required to perform the value added activities efficiently to drive the organization forward to meet the strategic plan and the objectives.

To form a successful product for an organization it is important to add value in each activity that the product goes through during the life cycle. The best possible value can be achieved in the product development process by adding value in each stage. For that it needs all, or a combination of, value chain activities and a proper synchronization among all the related activities.

In this study, the inbound logistics included the total quantity of commodity or input handled as well as the average price of commodity. The other variables included were average transportation cost for the quantity purchased, the quantity of stocks held per month as well as the storage costs per month. The outbound logistics included the produce or output handled in 12 months, storage costs for quantity produced, delivery charges and the price per unit of output sold. The marketing activities and their total cost
in 12 months were also included in this study and the possible after-sales included the provision of support equipment, delivery of product, complaint handling and training.

The inbound and outbound logistics were used to compute the value added at each stage of the value chain. The value added was computed by subtracting the cost of input (computed by multiplying the quantity of input used by the average cost per unit) from the value of output which was computed by multiplying the quantity of output produced by the average price per output.

An alternative model to evaluate value chain efficiency is the Data Envelopment Analysis Model (DEA). Data envelopment analysis (DEA) is a widely applied linear programming-based technique first developed by Charnes et al. in 1978 to evaluate the efficiency of a set of decision-making units. It serves as a tentative solution for measuring the efficiency of the systems.

The Porter’s Model is chosen in this research as it is easier to use and more applicable in this study. The Data Envelopment Analysis Model is used to evaluate value chain efficiency but efficiency is not of interest in this case therefore Porter’s Model is more applicable in this study as it helps in the mapping of the value chain players as well as in obtaining the variables necessary to compute value addition.
The commodity broker which in this case is Food Reserve Agency buys maize from the farmers. These maize farmers however, were not interviewed as the farmers of interest were the sorghum farmers. The maize is then sold by the Food Reserve Agency to the feed companies. The price of maize sold by Food Reserve Agency to the feed companies was at an average of K1300000 per ton. The commodity brokers also sell maize to those livestock keepers who formulate their own feed.

The Feed Manufacturers are the various feed companies in Lusaka and all of them produce maize-based feed. Their role is to manufacture feed bought by livestock keepers. They buy their maize from the commodity broker or directly from the farmers. There is a feedback process between the farmers and the feed manufacturers in that the feed manufacturers can get back to the farmers on the quality and quantity of maize that they want. The distributors distribute feed to retailers around the country and the Retailers are the ones that distribute the feed to the ultimate consumers through their stores. The retailers sell the feed at an average price of K149,000 per 50Kg bag.

The Livestock keepers are the keepers of animals that buy the feed from the retailers and they are the end-users in this value chain. These livestock keepers do at times buy feed directly from the manufacturing firms and they can also give feedback to these firms on the quality of feed that they produce based on the performance of their livestock. They do also give recommendations of what nutrients should be added among other suggestions. The value added by the feed manufacturer was computed and was found to be K24,431 per unit of output or feed produced.
Table 1 below shows the major feed manufacturers in Zambia as well as their production, that is, quantity produced annually in metric tons. The quantities ranged from 8.92 to 72 metric tons.

**Table 1: Major Feed Manufacturers and their Production, Zambia, 2012**

<table>
<thead>
<tr>
<th>Name of Manufacturer</th>
<th>Province</th>
<th>Quantity Produced (Metric Tons Per Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Milling Plc</td>
<td>Lusaka</td>
<td>72</td>
</tr>
<tr>
<td>Tiger National Feeds</td>
<td>Lusaka</td>
<td>50</td>
</tr>
<tr>
<td>Meadow Feed Zambia</td>
<td>Lusaka</td>
<td>16</td>
</tr>
<tr>
<td>Simba Milling Company Ltd</td>
<td>Lusaka</td>
<td>10</td>
</tr>
<tr>
<td>Dipo Animal Feeds</td>
<td>Lusaka</td>
<td>9</td>
</tr>
<tr>
<td>Piggery Animal Feeds</td>
<td>Lusaka</td>
<td>12</td>
</tr>
<tr>
<td>Nutri Feed Co.Ltd</td>
<td>Lusaka</td>
<td>19</td>
</tr>
<tr>
<td>Olympic Milling Stock Feed</td>
<td>Lusaka</td>
<td>43</td>
</tr>
<tr>
<td>Stock Feeds Ltd</td>
<td>Lusaka</td>
<td>9.5</td>
</tr>
<tr>
<td>Victory Animal Feeds</td>
<td>Lusaka</td>
<td>20</td>
</tr>
<tr>
<td>High Protein Foods</td>
<td>Lusaka</td>
<td>8.92</td>
</tr>
<tr>
<td>Novatek Co. Ltd</td>
<td>Lusaka</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total Production</strong></td>
<td></td>
<td><strong>293.420</strong></td>
</tr>
<tr>
<td><strong>Mean Production</strong></td>
<td></td>
<td><strong>24.45767</strong></td>
</tr>
</tbody>
</table>

**Source: Own Survey Data (2012)**

The total production of feed was 293.420 metric tons per year with a mean production of 24.45167 metric tons annually. The highest producer among the feed manufacturers is National Milling Co. producing 72 metric tons annually and the lowest producer is High Protein Foods which had annual production of 8.92 metric tons per year.
In the survey, the different chain players in the sample were identified and a number of variables of these chain players and their means were computed. This is as shown in table 2 below:

**Table 2: Different variables on Chain Players in the sample and their Means**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chain players handling sorghum</td>
<td>43.8</td>
</tr>
<tr>
<td>Chain players willing to substitute with sorghum</td>
<td>63.6</td>
</tr>
<tr>
<td>Chain players with knowledge of maize nutrient content</td>
<td>100</td>
</tr>
<tr>
<td>Chain players with knowledge of sorghum nutrient content</td>
<td>25</td>
</tr>
<tr>
<td>Chain players with knowledge of millet nutrient content</td>
<td>25</td>
</tr>
<tr>
<td>Chain players with knowledge of soya beans nutrient content</td>
<td>100</td>
</tr>
<tr>
<td>Feed buyers interested in knowing grain source in feed</td>
<td>72.7</td>
</tr>
</tbody>
</table>

Source: Own Survey Data (2012)

Of the players in the Feed Concentrate value chain, 43.8% handle sorghum or its products and all of these are the sorghum farmers that were interviewed. The higher percentage of these players does not handle sorghum or its products and accounted for 56.2% (Table 2). This showed that sorghum utilization in this industry is low.

72.7% of the feed buyers were interested in knowing the grain source in feed concentrate. This statistic was obtained by interviewing the feed retailers and distributors. The remaining 27.3% did not express an interest in knowing the grain source of the feed. Of the feed buyers interested in knowing the grain source in the feed, 63.3 % suggested the use of sorghum as the grain in the feed. The major reason given was that most people think sorghum contains more protein than maize. The other reasons given were that sorghum would be available even in the dry season and this would lead to stable feed prices which do not fluctuate sharply. The above outlined reasons present opportunities for increased sorghum utilization in the feed industry.
The other opportunity for sorghum is as identified here. Of the respondents interviewed, 63.6% expressed the willingness to substitute sorghum for maize and the major reason given was that there would be a constant or consistent supply of feed as sorghum can be grown in most parts of the country even in the dry regions. This provides an opportunity for increased utilization of sorghum in the feed industry. The remaining 36.4% however were not willing to substitute sorghum for maize (table 3). The major reason given was that they have little knowledge on the nutrient content of feed as shown in table 3 above.

Of the respondents interviewed, 100% had knowledge on the nutrient content of maize and soya beans whereas only 25% had knowledge on the nutrient content of sorghum and millet with the majority (75%) not having knowledge on the nutrient content. This lack of knowledge on nutrient content of sorghum was the major reason for no utilization of sorghum in the current feed industry in Zambia as well as the unwillingness of some industry players to substitute sorghum for maize. This can therefore be viewed as the major constraint to increased sorghum utilization in the feed industry.

The feed manufacturers’ characteristics and their willingness to substitute sorghum for maize were also analyzed in this study and it was found that the feed manufacturers with a higher production of output were more willing to substitute. Those who used a larger quantity of input were also more willing to substitute sorghum for maize. This is as shown in table 3 below:
Table 3: Feed Manufacturers characteristics vs. willingness to substitute sorghum for maize

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of Operation</td>
<td>Mean (%)</td>
<td>Mean (%)</td>
</tr>
<tr>
<td>Total production</td>
<td>77.3</td>
<td>22.7</td>
</tr>
<tr>
<td>Quantity of input used</td>
<td>64.8</td>
<td>35.2</td>
</tr>
<tr>
<td>Type of Livestock Feed</td>
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<tr>
<td>Cattle Feed</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Pig Feed</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Chicken Feed</td>
<td>40</td>
<td>60</td>
</tr>
</tbody>
</table>

Source: Own Survey Data (2012)

The total production of the feed manufacturers who were willing to substitute sorghum for maize was 3870.02 metric tons representing a percentage of 77.3 of the total production and that of those who were not willing to substitute was 1138 metric tons (22.7%). The quantity of input used for those who were willing to substitute sorghum for maize was 254.04 metric tons representing a percentage of 64.8 and that of those who were not willing to substitute was 137.9 metric tons representing 35.2% of total input used.

All the feed manufacturers producing cattle feed (100%) were willing to substitute sorghum for maize and of the feed manufacturers producing pig feed, 50% were willing to substitute and the other 50% were not willing to substitute. The chicken feed manufacturers had the least mean for the willingness to substitute, that is, 40%. It can be seen that the feed manufacturers producing cattle feed were the most willing to substitute sorghum for maize and the main reason given for this was that sorghum in feed would increase milk production.

Of the feed manufacturers willing to substitute sorghum for maize, 57.1% said they are not currently using sorghum because it is not readily available, 28.6% said the reason
they are not using sorghum is that there is no proven formulation and 14.3% gave unknown demand for sorghum-based feed as the reason for currently not using sorghum.

Table 4 below shows the main challenges faced by the different chain players in the sample. The challenges faced include scarcity of inputs, high cost of non-feed inputs, low feed prices among others.

Table 4: Main Challenges faced by different chain players.

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Sample Size for Sorghum Traders</th>
<th>Sample Size for Feed Manufacturers</th>
<th>Sample Size for Livestock Keepers</th>
<th>Total Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scarcity of inputs</td>
<td>18</td>
<td>4</td>
<td>6</td>
<td>28</td>
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<tr>
<td>High Cost for non-feed inputs</td>
<td>22</td>
<td>2</td>
<td>9</td>
<td>33</td>
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<tr>
<td>Low Feed Prices</td>
<td>38</td>
<td>2</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>High Cost of Feed</td>
<td>9</td>
<td>0</td>
<td>16</td>
<td>25</td>
</tr>
<tr>
<td>Low Output Prices</td>
<td>44</td>
<td>0</td>
<td>16</td>
<td>25</td>
</tr>
<tr>
<td>Scarcity of white sorghum</td>
<td>44</td>
<td>0</td>
<td>0</td>
<td>44</td>
</tr>
<tr>
<td>Inconsistent Feed Supply</td>
<td>44</td>
<td>0</td>
<td>0</td>
<td>44</td>
</tr>
</tbody>
</table>

Source: Own Survey Data (2012)

Of the respondents interviewed, 44 were sorghum traders, 25 were livestock keepers with the least being the feed manufacturers and these were only 11. The sorghum traders had the highest figures as they consisted of maize farmers, distributors and retailers (Table 4).

The greatest challenges for the sorghum traders were found to be low output prices and scarcity of white sorghum with the latter reason being given by sorghum farmers who have difficulties accessing white sorghum seed. Low feed price is also a great challenge.
for sorghum traders as it affects the sorghum farmers who are also classified under sorghum traders. When feed prices are low, the maize farmers will have to sell their maize at a low price. Given that they face high costs of inputs, they may end up making losses. The least challenge for these sorghum traders was found to be high feed cost and this reason was given by distributors and retailers as this was the complaint of most feed buyers.

For the feed manufacturers, the greatest challenge was scarcity of inputs (18 out of the 44 feed manufacturers) with the least being low feed prices (2 out of the 11). The rest of the challenges were non-applicable. Scarcity of inputs was as a result of low maize production in the slack periods or when the maize is off-season.

For the livestock keepers, high cost of feed (80%, that is 16 out of 25) was the greatest challenge with the least being scarcity of inputs (that is, only 6 of the 25 livestock keepers).

The companies surveyed also gave suggestions for improving company performance. These are presented in table 5 below and they include support to rail network, feed companies delivering feed to livestock keepers, constant supply of input from farmers among other suggestions.
Table 5: Suggested ways of improving company performance

<table>
<thead>
<tr>
<th>Suggestions</th>
<th>Sample Size for Sorghum Traders</th>
<th>Sample Size for Feed Manufacturers</th>
<th>Sample Size for Livestock Keepers</th>
<th>Total Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support to rail network</td>
<td>44</td>
<td>11</td>
<td>25</td>
<td>73</td>
</tr>
<tr>
<td>Feed companies delivering feed to Livestock keepers</td>
<td>22</td>
<td>6</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>Constant supply of inputs from farmer</td>
<td>0</td>
<td>11</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Removing restrictions on importation of chemicals and ingredients</td>
<td>22</td>
<td>6</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>Provision of sewing machine for sewing feed bags</td>
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<td>11</td>
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<td>11</td>
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<tr>
<td>Reduced prices of inputs</td>
<td>24</td>
<td>1</td>
<td>10</td>
<td>35</td>
</tr>
<tr>
<td>Encouraging the use of other grains other than maize</td>
<td>18</td>
<td>7</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Reduction in the cost of feed Concentrates</td>
<td>19</td>
<td>0</td>
<td>3</td>
<td>22</td>
</tr>
<tr>
<td>Increase the amount of government support</td>
<td>35</td>
<td>0</td>
<td>5</td>
<td>40</td>
</tr>
<tr>
<td>Improving market strategies to increase demand</td>
<td>44</td>
<td>0</td>
<td>0</td>
<td>44</td>
</tr>
</tbody>
</table>

Source: Own Survey Data (2012)

For the sorghum traders, the suggestion with the greatest percentage was found to be improving market linkages so as to increase demand. The distributors and retailers
recommended that market linkages should be improved and this would lead to an increase in demand.

For the feed manufacturers, constant supply of inputs from farmer was the main suggested way or recommendation to improve company performance and it accounted for 100%, that is, all the 11 feed manufacturers in the sample. This would be possible if there was a substitute or even complement of maize in the dry season. This provides a prospect or opportunity for sorghum utilization in the feed industry. The lowest percentage was reduced prices of inputs which accounted for only 10 of the 11 feed manufacturers in the sample. For the livestock keepers, the suggested way of improving company performance with the highest percentage was found to be feed companies delivering feed to Livestock keepers and this suggestion accounted for 60%, that is, 15 out of the 25 livestock keepers in the sample. Most of the livestock keepers found the long distance they have to travel to buy feed challenging and they suggested feed companies delivering the feed to them.
CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction
This chapter presents the conclusion and recommendations of the study based on the findings and interpretations of the study.

5.2 Conclusions

The Feed industry is one of the potential opportunities for the growth of sorghum markets. The key players in the chain were identified using Porter’s Model. These key players are maize farmers, small scale traders, commodity broker, feed manufacturers, distributors, retailers and livestock keepers.

The commodity broker which in this case is Food Reserve Agency buys maize from the farmers. These maize farmers however, were not interviewed as the farmers of interest were the sorghum farmers. The maize is then sold by the Food Reserve Agency to the feed companies. The price of maize sold by Food Reserve Agency to the feed companies was at an average of K1300000 per ton.

The Feed Manufacturers are the various feed companies in Lusaka and all of them produce maize-based feed. Their role is to manufacture feed bought by livestock keepers. The distributors distribute feed to retailers around the country and the Retailers are the ones that distribute the feed to the ultimate consumers through their stores. The retailers sell the feed at an average price of K149, 000 per 50Kg bag.

The Livestock keepers are the keepers of animals that buy the feed from the retailers and they are the end-users in this value chain. Described above are the feed concentrate value chain players and the roles played by each player.

The main constraint to increased sorghum utilization was the lack of knowledge on the sorghum nutrient content by the key players in the value chain. There is thus reluctance to try out a new grain when maize, which is the tradition grain for the industry and for
which knowledge on nutrients is available. The feed buyers or those livestock keepers who formulate their feed do not have knowledge on the nutrients that the sorghum will provide to their animals. They therefore prefer to continue using maize as opposed to sorghum. The feed manufacturers are also not assured of a steady supply of sorghum to be used in feed production and thus are not willing to risk having inconsistent feed supply. They therefore prefer to continue using maize in the production of feed. The sorghum farmers are also skeptical about producing large volumes of sorghum as they are not assured of a ready market. They are therefore not willing to take such a risk.

The market prospects or opportunities for sorghum were found to exist. These were portrayed by the willingness of the feed industry players to substitute sorghum for maize. The reasons given for this willingness to substitute sorghum for maize were that there would be a constant or consistent supply of feed as sorghum can be grown in most parts of the country even in the dry regions. This is unlike the case for maize which is grown only in the rainy season. This provides an opportunity for increased utilization of sorghum in the feed industry.

The majority of the feed buyers were also interested in knowing the feed concentrate nutrient source. Of these feed buyers interested in knowing the nutrient content, a large percentage suggested the use of sorghum as the grain in the feed. The major reason given was that most people think sorghum contains more protein than maize. The other reasons given were that sorghum would be available even in the dry season and this would lead to stable feed prices which do not fluctuate sharply. This is also another opportunity for the increased utilization of sorghum in the feed concentrate industry.
5.3 Recommendations

Based on the results, I would recommend that the feed manufacturers and sorghum farmers work together through contract farming and this will ensure that feed manufacturers have adequate supply of sorghum and farmers have a ready market. This would minimize uncertainties by both parties on where to buy and who will buy for the feed manufacturers and sorghum farmers respectively.

An increase in the number of sorghum buyers would also encourage sorghum production among smallholder farmers. Currently, the main buyer of sorghum is CHC. An increase in the number of buyers would therefore lead to an increase in sorghum demand which would in turn lead to an increase in the incomes of smallholder sorghum farmers as well as the betterment of the nation as a whole as even the rural disadvantaged would have improved incomes.

I would also recommend that a proven formula is created so as to enable the feed industry stakeholders have knowledge on the nutrient content of sorghum and the nutrients it would provide for the livestock. This would in turn increase sorghum utilization in the feed concentrate industry.
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APPENDICES
Appendix I

Questionnaire

Feed Concentrates Value Chain and Prospects for Sorghum Utilization in Zambia

Questionnaire serial number: [ ___ ___ ]

Company/Ranch(Farm) identification

1.1 Province ____________________________ prov

1.2 District ____________________________ dist

1.3 Company name ____________________________ comp

1.4 Address of the company ____________________________
Email address ____________________________ Telephone number ____________________________

1.5 Name of main respondent ____________________________

1.6 Designation of main respondent rdes
   1 = Proprietor  2 = Manager
1.7  *Do you handle sorghum or millet or their products?*

0 = No  →  End interview  
1 = Yes

Use  

1.8  Response status

1 = Complete  
2 = Refusal  
3 = Non-contact

1.9  Name of enumerator  

__________  

Date  

__________
## Inbound logistics

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<td>1= Delivered to company</td>
<td>1=Central</td>
<td>1=Metric tons</td>
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<td>2=Copperbelt</td>
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<td>3= Wholesalers</td>
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<td>3=Eastern</td>
<td>3=Crates</td>
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<td>4= Retailers</td>
<td>4= Market place in Lusaka</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12= Other (Specify)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Outbound logistics

<table>
<thead>
<tr>
<th>Product</th>
<th>Do you sell this product?</th>
<th>How much ... did you produce in the past 12 months?</th>
<th>Unit</th>
<th>Storage costs for the quantity produced? (ZMK)</th>
<th>Main buyer of product</th>
<th>Codes in table 2</th>
<th>Delivery location</th>
<th>Codes below</th>
<th>Price per unit of output sold?</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>See codes below</td>
<td>0= no go to next product</td>
<td>1= yes</td>
<td>Quantity</td>
<td>1= tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>prod</td>
<td>OL01</td>
<td>OL02</td>
<td>OL03</td>
<td>OL04</td>
<td>OL05</td>
<td>OL06</td>
<td>OL07</td>
<td>OL08</td>
<td>OL09</td>
<td>OL10</td>
</tr>
</tbody>
</table>

Codes in table 2 include:
- OL01
- OL02
- OL03
- OL04
- OL05
- OL06
- OL07
- OL08
- OL09
- OL10
Codes for prod

1 = sorghum
2 = maize
3 = millet
4 = other (specify)
5 = livestock feed
6 = opaque beer
7 = clear beer
(Millet based)
8 = livestock feed
9 = opaque beer
10 = clear beer
11 = fortified food processing
12 = other (specify)

(sorghum based)

Codes for OL05

1 = consumers, direct sales through own outlet
2 = wholesalers
3 = retailers
4 = Feed companies
5 = Livestock keepers
6 = other (specify)

Codes for OL07

1 = own premises
2 = buyers premises
3 = storage shed
4 = market place in Lusaka
5 = market place in buyers province
6 = other, specify

......................
8 = fortified food processing
9 = other
specify.................
## Marketing

*Marketing activities and their respective costs*

<table>
<thead>
<tr>
<th>What activities do you perform to market your product?</th>
<th>Total cost of ......(activity) in the past 12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>MK01</td>
<td>MK02</td>
</tr>
</tbody>
</table>

...
**Marketing**

*Marketing activities and their respective costs*

<table>
<thead>
<tr>
<th>What activities do you perform to market your product?</th>
<th>Total cost of ......(activity) in the past 12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>MK01</td>
<td>MK02</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How do you determine the price per unit of your output?  \( CL01 \)

1. use prevailing market price
2. inscribed in government regulation
3. cost plus fixed profit margin
4. percentage of cost
5. other, specify

Service activities

Do you offer any after-sales services?  \( CL02 \)

0. no → go to section 7
1. yes

After-sales services and costs

<table>
<thead>
<tr>
<th>What after-sales services do you offer?</th>
<th>Total costs in the past 12 months (ZMK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service</td>
<td>AS01</td>
</tr>
<tr>
<td>Service</td>
<td>Do you outsource this service?</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Serv</td>
<td>OS01</td>
</tr>
<tr>
<td>1= Transportation of inputs</td>
<td></td>
</tr>
<tr>
<td>2= Transportation of outputs</td>
<td></td>
</tr>
<tr>
<td>3= Advertising</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>4</td>
<td>Auditing</td>
</tr>
<tr>
<td>5</td>
<td>Human resource</td>
</tr>
<tr>
<td>6</td>
<td>Management</td>
</tr>
<tr>
<td>7</td>
<td>other, specify</td>
</tr>
</tbody>
</table>

0 = no → go to section 7.

1 = yes
### 6. Information flow

I will ask you some questions on how you obtain different types of information.

<table>
<thead>
<tr>
<th>Type of information</th>
<th>Source of ……… information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Codes below</td>
<td></td>
</tr>
<tr>
<td>1=price</td>
<td></td>
</tr>
<tr>
<td>2=quality</td>
<td></td>
</tr>
<tr>
<td>3=quantity</td>
<td></td>
</tr>
<tr>
<td>4=customer preference</td>
<td></td>
</tr>
<tr>
<td>5=Input market</td>
<td></td>
</tr>
<tr>
<td>6=product market</td>
<td></td>
</tr>
<tr>
<td>7=other (specify)…</td>
<td></td>
</tr>
<tr>
<td>8=other (specify)…</td>
<td></td>
</tr>
</tbody>
</table>

**Source Codes**

1= Survey  
2= Other firms  
3= Zambia Bureau of Standards  
4= Mass media  
5= Other Government Departments  
6= NGOs  
7= Other (specify) …………………………………………………
7. Challenges and policies

7.1 What are the main challenges faced? CL04

1= Scarcity of inputs
2= High input cost
3= Low feed demand
4= Low feed prices
5= Other, specify

7.2 Do you know of any policies that affect marketing and utilization of sorghum or millet and their products? CL05

0= no
1= yes

7.3 What are these policies and how do they affect you?
7.4 What do you think should be done to improve the performance of your company/ranch?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

8. What kind of player in the chain are you?  

CL06  

1= If sorghum trader (sorghum supplier to feed manufacturer), feed distributor or retailer go to section 9

2= If feed manufacturer, go to section 10

3= If livestock keeper, go to section 11
9. TRADERS’, DISTRIBUTORS’ & RETAILERS’ SECTION

9.1 Operations
I am going to ask you about the activities that you do to add value to Sorghum or Millet.

9.11 Commodity processing
9.111 What value addition activities do you perform?          CL07   

1= Cleaning
2= Packaging
3= Re-packaging
3= Labeling
4= Grading
5= Other, specify ....................................................
10. FEED MANUFACTURERS' SECTION

10.1 Operations
I am going to ask you about the activities that you do to add value to Sorghum or Millet.

10.11 Commodity processing

<table>
<thead>
<tr>
<th>Main product (codes on the next page)</th>
<th>By-product (codes on the next page)</th>
<th>Quantity</th>
<th>Unit</th>
<th>What other inputs are used in the production of your main product?</th>
<th>Quantity of input used</th>
<th>Price of input per unit (ZMK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP01</td>
<td>SP02</td>
<td>SP03</td>
<td>SP04</td>
<td>SP05</td>
<td>SP06</td>
<td>SP07</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Codes for SPO1 and SPO2**

1 = Livestock feed  
2 = Manure  
3 = Other (Specify)

**10.12 What type of livestock feed do you produce and what are the sources of nutrients?**

<table>
<thead>
<tr>
<th>Type of feed (See codes on the next page)</th>
<th>Main nutrient</th>
<th>Source of nutrient (See codes on the next page)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LF01</td>
<td>LF02</td>
<td>LF03</td>
</tr>
<tr>
<td></td>
<td>Energy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Protein</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Protein</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Protein</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Protein</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Energy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Protein</td>
<td></td>
</tr>
</tbody>
</table>

**Codes for LF01**

1 = Cattle feed

**Codes for LF03**

1 = Maize
2 = Pig feed 
3 = Chicken feed 
4 = Goat feed 
5 = Sheep feed 
6 = Other feed 

10.13a Given unlimited availability of sorghum and millet, are you willing to substitute maize with sorghum or millet?

CL08  
0 = No 
1 = Yes 

Give a reason for answer above

10.13c If yes to q10.13a, why are you not using sorghum? CL09

10.13d Does price of sorghum affect willingness to substitute? CL10 
0 = No 
1 = Yes 

10.13e Does the availability of sorghum affect willingness to substitute? CL11 
0 = No 
1 = Yes 

10.13f Does the nutrient content of sorghum affect willingness to substitute? CL12 
0 = No 
1 = Yes 

10.13g Does personal preference of feed manufacturer affect willingness to substitute? CL13 
0 = No 
1 = Yes 

10.13h Does income levels of feed manufacturers affect willingness to substitute? CL14 
0 = No 
1 = Yes
10.14 Who are the consumers for your end products? 
1= Livestock keepers
2= Wholesalers
3= Retailers
4= Other, specify ...........................................................................

10.15 Are there any feed buyers who are interested in knowing the grain source in the feed? 
CL16
0= No
1= Yes

10.16 If yes, are there any who have suggested the use of sorghum as opposed to maize as the grain in the feed? CL17
0= No
1= Yes

Give a reason for your answer.
...................................................................................
...................................................................................
...................................................................................
### 11. LIVESTOCK KEEPERS' SECTION

11.1 What type of livestock do you keep and how many of each?

<table>
<thead>
<tr>
<th>Livestock (See codes on the next page)</th>
<th>Number</th>
<th>Purpose (See codes on the next page)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LN01</td>
<td>LN02</td>
<td>LN03</td>
</tr>
<tr>
<td>1= Traditional cattle (Specify)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2= High breed cattle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3= Traditional chickens</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4= Modern chickens</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5= Goats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6= Sheep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7= Pigs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8= Other (Specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Codes for LN01**

<table>
<thead>
<tr>
<th>Codes for LN01</th>
<th>Codes for LN03</th>
</tr>
</thead>
<tbody>
<tr>
<td>1= Traditional cattle (Specify)</td>
<td>1= Milk</td>
</tr>
<tr>
<td>2= High breed cattle</td>
<td>2= Meat</td>
</tr>
<tr>
<td>3= Traditional chickens</td>
<td>3= Eggs</td>
</tr>
<tr>
<td>4= Modern chickens</td>
<td>8= Other (Specify)</td>
</tr>
<tr>
<td>5= Goats</td>
<td></td>
</tr>
<tr>
<td>6= Sheep</td>
<td></td>
</tr>
<tr>
<td>7= Pigs</td>
<td></td>
</tr>
</tbody>
</table>

### 11.2 Source of Livestock Feed

11.21 What source(s) of animal feed do you feed your livestock?

<table>
<thead>
<tr>
<th>Source</th>
<th>Do you use this source of animal feed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>i Products from Feed Manufactures</td>
<td>0=No, 1=Yes</td>
</tr>
<tr>
<td>ii Crops</td>
<td></td>
</tr>
</tbody>
</table>
Grown Pasture
Agricultural by-products
Natural Grasses
Other sources (specify) ........................................

If the answer to (i) is 0, go to question 11.24, if otherwise go to question 11.22

11.22 How do the feed manufactures supply their products to you? CL18

1 = Through local agents
2 = Through middlemen
3 = From manufactures’ stores
4 = Other (Specify) ........................................................................................................

11.23 Who pays for transportation costs? .................................................................

11.24 Do you have a specific supplier of animal feed? CL19

1 = Yes
2 = No

(If Yes go to question 11.25 If No go to question 11.27)

11.25 Why do you prefer a specific supplier? CL20

1 = price difference
2 = quality
3 = transportation costs
4 = Other (Specify) ........................................................................................................

11.26 Are you willing to substitute feed made using maize with product made from sorghum or millet? CL21

1 = Yes
2 = No

Give reason for answer above

........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
11.27 Do you have any knowledge on nutrient contents in grains which may be used in animal feed?

<table>
<thead>
<tr>
<th>Grains used in animal feed</th>
<th>Knowledge on nutrients 0=No, 1=Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td></td>
</tr>
<tr>
<td>Soya Beans</td>
<td></td>
</tr>
<tr>
<td>Sorghum</td>
<td></td>
</tr>
<tr>
<td>Millet</td>
<td></td>
</tr>
<tr>
<td>Other (Specify)</td>
<td></td>
</tr>
</tbody>
</table>