A dissertation submitted in partial fulfilment of the requirements for the Bachelor of Science Honours in Agricultural Economics and Management.

Bindura University of Science Education

Faculty of Agriculture and Environmental Science

Department of Agricultural Economics, Education and Extension

Muresherwa Caleb

B200647B

Academic Advisor/Supervisor: Dr A.C Mujeyi

May 2024

RELEASE FORM

Name of Candidate: Muresherwa Caleb

Reg Number: B200647B

Degree: Bachelor of Science Honours in Agricultural Economics and Management.

Project Title: Assessing the Impact of Pen Fattening on Beef Productivity and Profitability in Small Scale Commercial Farming Systems: A Case of Chireka Farm, Zimbabwe.

Permission is hereby granted to **Bindura University of Science Education Library** to produce a single copy of this dissertation and lend such copy for private, scholarly or scientific research only.

Signed: 

Permanent Address: 18983 Hungwe Street, Mutual Park CABS, Harare

APPROVAL FORM

The undersigned certify that they have supervised and recommended to the Bindura University of Science Education for acceptance of the dissertation **entitled 'Assessing the impact of pen fattening on beef productivity and profitability in small scale commercial farming systems: A case of Chireka Farm, Zimbabwe,"** submitted in partial fulfilment of a Bachelor of Science Honours in Agricultural Economics and Management.

Name of supervisor: Dr. Angeline C Mujeyi

Signature: 

Date: 31/5/24

DECLARATION

I hereby declare that this research project entitled **"Assessing the impact of pen fattening on beef productivity and profitability in small scale commercial farming systems: A case of Chireka Farm, Zimbabwe",** submitted to the Bindura University of Science Education, Department of Agricultural Economics, Education and Extension is a record of my work under the guidance and supervision of Dr. A.C Mujeyi. It has not been copied or lifted from any source without the acknowledgment of the author, source, or published elsewhere either electronically or otherwise and was submitted in partial fulfilment of the requirements for the Bachelor of Agricultural Science Honours Degree in Agricultural Economics and Management award. The results in this dissertation have not been submitted to any University or Institute for the award of any degree.

Student Name: Muresherwa Caleb

Reg Number: B200647B

Signature: .....

ACKNOWLEDGEMENT:

I would like to express my deepest appreciation to my supervisor Dr. A.C Mujeyi for the invaluable guidance, unwavering support and the insightful feedback throughout this research project and her encouragement have been instrumental in shaping the direction and quality of this work. I also want to thank the CEO of Chireka Farm, Dr Mbizvo and Dr Jongi, the managing director for allowing me to do attachment at their farm as an intern which enabled me to collect data which was used in this research project. Additionally, I am deeply indebted to my family for their endless patience, support, understanding as well as encouragement which have been a source of strength and motivation. Finally, I want to extend my gratitude to my friend Zibonda Caroline for the encouragement she gave me in my academic journey as well as to thank all the individuals who works at Chireka farm who participated in interviews as their valuable insights formed the cornerstone of this study.

DEDICATION

This project is dedicated to my loving family whose unwavering support and encouragement have been the driving force behind my academic journey. Their belief in my abilities and their endless encouragement have been my guiding light. I am forever grateful!

ABSTRACT

Beef production is a crucial component of the agricultural sector in Zimbabwe, contributing significantly to the country's gross domestic product (GDP) and providing crucial livelihoods for rural populations. However, small-scale commercial farming systems face numerous challenges that can impact the productivity and profitability of cattle production. One strategy that has gained attention is the practice of pen fattening, where cattle are confined to small areas and fed a controlled diet. This study, conducted at Chireka Farm in Zimbabwe, aimed to assess the impact of pen fattening on beef productivity and profitability within the small-scale commercial farming context. The research utilized a range of methods, including descriptive statistics, gross margin analysis, and SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis, to compare the growth patterns of pen-fattened cattle, compare the performance of pen-fattened beef versus veld/grass-fed cattle, and identify the key challenges and constraints faced by the farm. The findings of the study provide valuable insights into the potential benefits and limitations of pen fattening. The descriptive analysis revealed detailed information on growth patterns of pen-fattened cattle at Chireka Farm, including the breeds, feeding regimes, and management strategies employed. The gross margin analysis demonstrated that pen fattening can indeed contribute to enhanced beef productivity and profitability, with the pen-fattened cattle exhibiting superior performance compared to their veld-fed counterparts that is in pen fattened cattle a gross margin of $310 was obtained and in those raised under veld a gross margin of $170 was also obtained. Therefore, from the results of the study revealed that the small-scale commercial cattle fattening enterprise is profitable and viable venture. However, the study also identified several key challenges and constraints that small-scale farmers like Chireka Farm face in implementing effective pen fattening systems. These include issues related to feed availability and cost, disease management, financial and asset barriers, and competitiveness in the market. The SWOT analysis provided a comprehensive assessment of these factors, highlighting the need for targeted interventions and policy support to address the identified weaknesses and threats. The findings of this study hold significant implications for the development of small-scale commercial farming systems in Zimbabwe. By understanding the potential benefits and limitations of pen fattening, policymakers and agricultural extension services can work to devise strategies that empower small-scale farmers to optimize their cattle production practices and enhance the overall

productivity and profitability of the beef industry. This, in turn, can contribute to improved food security, employment opportunities, and sustainable rural livelihoods in the country.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS/ ACRONYMS:

GDP	Gross Domestic Product
FAO	Food and Agriculture Organization
ADG	Average Daily Weight Gain
FCR	Feed Conversion Ratio
GM	Gross Margin
Vet Care	Veterinary care
TR	Total Revenue
TVR	Total Variable Cost
SWOT	Strengths weaknesses opportunities and threats
HGPs	High-potency growth-promoting implants

CHAPTER ONE: INTRODUCTION

1.1 Background of the study:

In Zimbabwe, small-scale commercial farming systems are an important component of the agricultural sector, which includes cattle production. The importance of cattle production in Zimbabwe lies in its ability to sustain the livelihoods of the rural population, provide food security, and contribute 35%-38% to the country's gross domestic product (GDP) (FAO, 2018). Livestock plays a significant role in the national economy, particularly in rural areas, by generating income for farmers, providing draught power, ensuring food security, and contributing to the asset, social, cultural as well as environmental values, to sustain people's livelihoods (Estefanos et al., 2014). Moreover, it is a source of high-quality food (meat and milk), industrial raw materials and a family 'asset bank' for rural households (FAO, 2015; Bush et al., 2014; Gebremariam et al., 2013).

Additionally, appropriate cattle breeds must be carefully selected to enhance cattle production for small-scale commercial farming systems in Zimbabwe. The ideal breeds would be those that exhibit fast growth, high fertility, disease tolerance, and low feed requirements, as these traits would be most beneficial for small-scale farmers (FAO, 2018). A wide range of beef breeds are found in Zimbabwe but not all breeds can virtually suit every type of environment and/or breeding program for instance pen-fattening. Some of these breeds that are used for the process of pen fattening include the following which are brahman, tuli, beef-master as well as the limousine.

Zimbabwe's commercial farming systems face several challenges in producing beef cattle, which could have an impact on the industry's profitability and productivity. In addition, the FAO (2018) suggests that a few issues affecting cattle production in commercial farming systems are the following: high rates of animal mortality from diseases like the January disease and tick-borne illnesses, which account for approximately 65% of deaths (FAO, 2018), farmer's lack of knowledge and expertise regarding cattle production (Ndebele et al., 2007), shortages of feed and water (Homann et al., 2007), financial and asset barriers and competitiveness and risk factors.

There are several contrasting grazing systems used in Zimbabwe for cattle production. These include controlled grazing systems, uncontrolled grazing systems and the intensive grazing system. The intensive grazing involves cattle being confined to small areas fed with controlled diet which can be referred as penning (Mapiye et al., 2006). On the other hand, because of the numerous

livestock production activities, such fattening beef cattle, they are seen as sources of employment opportunities and a way to increase the amount and quality of meat produced in order to reduce poverty in the nation (Tomy, 2003). Additionally, fattening cattle for beef provides an option to meet foreign export markets by delivering live, fattened animals straight to slaughterhouses in order to target foreign markets (Tomy, 2003).

In most communal areas of Zimbabwe, traditional grazing management is practiced mainly through herding cattle during the rainy season. In some areas, grazing schemes have been promoted as an attempt to improve livestock production in communal areas. A combination of measures aimed at controlling livestock numbers, restricting access to communal rangelands and controlling the movement of animals using fences is known as a 'grazing scheme' (Cousins, 2016). Grazing schemes involve fencing of the grazing area and internally dividing the area into paddocks so that rotational grazing can be implemented as a veld management practice. The system of rotation recommended in grazing schemes is short-duration grazing. Short-duration grazing is a multi-paddock, one-herd grazing system involving rapid livestock rotation (Gillen et al., 2011).

Nevertheless, pen fattening serves as a remedy for certain issues that impede Zimbabwe's cattle productivity, such as a lack of grazing pasture and low-quality fodder. Cattle fattened in pens are therefore fed a specially prepared diet consisting of grains, hay, beef max, coarse salt, cotton cake, sunflower cake, and other feed items at a feedlot. Better cattle feed management would follow, leading to increased meat quality and weight increases. Due to their confinement to a smaller area, this may also lessen the likelihood of diseases spreading (Madzimure 2017). By using this technique, butchers and abattoirs like Koala and Bellevue prepare livestock for slaughter and maximize their market value (Akuoku 2022).

1.2. Statement of the Problem:

For a variety of reasons, the adoption of cattle fattening in small-scale farming systems has not been as widespread as it could be. Van Zyl (2017) claims that cattle fattening is not used and accepted because of a lack of funding for the construction of the facilities and machinery needed for the operation. Furthermore, a few farmers lack access to a market where they may profitably sell their fattened cattle. Furthermore, not much is known about the effects of pen fattening. Consequently, knowing how pen fattening works in small-scale agricultural systems may help

increase this business's earnings. Marufu et al. (2020) support this, indicating that pen fattening led to higher net returns and profits due to lower production costs and higher market prices.

Moreover, this is important as performance of pen fattening varies with the type of feed used, management practices, age and the breeds of cattle used. Musvuugwa (2021) also shows that implementing pen fattening techniques has resulted in higher average daily weight gains as there is a need to select appropriate cattle breeds and ensuring that the cattle have an adequate nutrition for optimal growth. However, Chireka farm is now keeping beef cattle so as to maximize returns after hearing the program from local extension officers as well as the social media groups and this also remains a gap in identification of benefits of pen fattening practice.

Therefore, in order to make informed decisions based on the findings, this study will be carried out to evaluate the fattening performances, examine the procedures used to fatten cattle, and identify the challenges associated with using this technology on a farm. The study was carried out with a view to improving beef cattle production for the Zimbabwean small-scale farmers so that they contribute to meeting the increasing demand for beef and improve their incomes. The study is in line with Education 5.0 which encourages students to generate solutions for communities that they live in. To increase the uptake and profitability of this method, which can help to raise the productivity of livestock and the incomes of smallholder farmers, it is essential to comprehend the advantages and disadvantages of pen fattening in small-scale agricultural systems.

1.3. Research Questions:

1. What are the growth patterns of pen-fattened cattle at Chireka farm?
2. What are the performance differences (profitability/ productivity) for veld versus pen-fattened beef at Chireka farm?
3. What are the challenges/ constraints faced in pen fattening at Chireka farm?

1.4. Objectives of the study.

1.4.1. Main objective:

The main objective of the study is to evaluate the impacts of pen fattening on the livestock performance of beef cattle at Chireka farm.

1.4.2. Specific objectives:

The specific objectives for the study are;

1. To investigate growth patterns of pen-fattened cattle.
2. To compare the performance of veld /grass versus pen-fattened beef at Chireka farm, Zimbabwe.
3. To identify the challenges and constraints of beef pen fattening at Chireka Farm, Zimbabwe.

1.5. Hypotheses:

The study is based on H_1 hypothesis (alternative hypothesis): There is a significant impact of pen fattening on beef productivity and profitability at Chireka Farm.

1.6. Significance of the study /Justification:

The study for the assessing the impact of pen fattening on beef productivity and profitability in small scale commercial farming systems is of significant importance in order to understand the improved pen fattening techniques, to assess the performance of both veld and pen fattened beef, enhanced beef productivity and profitability, making informed agricultural policies and contributing to local content. It also helps to identify the challenges/ constraints of beef pen fattening which would result in making informed decisions.

1.6.1 Improved understanding of pen fattening practices.

Chireka Farm and other small-scale farmers may find this study to be very helpful in understanding the advantages and difficulties of implementing pen fattening techniques. These methods, which include weighing cattle and feeding them properly, can assist farmers in making more informed decisions about their operations related to the production of beef. These small-holder farmers may be able to enhance their methods for producing beef and possibly boost their output and profitability using the insights acquired from this study.

1.6.2. Enhanced beef productivity and Profitability.

This study would also benefit the small-holder farmers by providing valuable information on the advantages of pen fattening practices. These advantages include increased growth rates, improved weight gain, better carcass quality, and higher profitability in terms of net returns.

Furthermore, the study could help guide the farmers' decision-making process regarding feed management, investment in necessary infrastructure, and marketing strategies for their beef production. Adopting the pen fattening technique can lead to improved overall beef productivity and the development of more profitable beef production systems for the small-scale farmers resulting in enhanced beef operations and financial outcomes.

1.6.3. Informing agricultural policy.

If research on pen fattening proves to be advantageous, policy officials will take that into account when formulating agricultural policies, including incentives like infrastructure development, financial support, and training programs. Smallholder farmers would be encouraged to use this technology as a result.

1.6.4. Contribution to local content.

It provides insights into the feasibility and applicability of the technique in the local environment.

1.7. Organization of the report:

This research project is well organized into five chapters as shown below;

- **Chapter one:** It outlines the background of the study, statement of the problem, research questions, objectives of the study, main objective, specific objectives, hypotheses, significance of the study or justification as well as the organization of the report.
- **Chapter two:** It covers the literature review.
- **Chapter three:** This chapter builds up the methodology and it comprises of the study area, data collection methods and data analysis methods.
- **Chapter four:** It focus on the interpretation of research findings and discussion of results.
- **Chapter five:** It is the last chapter which conclude the research by outlining the conclusion and recommendations.

Therefore, this is how the research is organised.

CHAPTER TWO: LITERATURE REVIEW

1

2.0 Introduction

Pen fattening is a common practice in small-scale commercial farming systems, where cattle are kept in pens and fed a high-energy diet to promote rapid weight gain. However, the impact of pen fattening on beef productivity and profitability in these systems is not well understood and more so by resettled farmers in Zimbabwe who are yet to reach high profitability levels. This chapter thus discusses the literature on the impact of beef pen fattening specifically on profitability and productivity in small-scale commercial farming systems.

2.1 Role of Pen Fattening in Sustainable Beef Production: Global Perspective

A quarter of the world's land area is made up by livestock systems, which also generate income for 1.3 billion individuals who participate in international trade networks (Steinfeld et al., 2006). According to Sejian et al. (2012), livestock production is now acknowledged as a critical component of agriculture. According to Mapiye et al. (2018), the beef business in Zimbabwe is important to the nation's economy and welfare of farmers as well as food security. With limited resources, small-scale farmers may find relief in pen fattening, a feeding method designed to increase beef productivity and profitability (Radebe et al., 2021).

Approximately 26% of the planet's ice-free terrestrial area is occupied by cattle grazing, making the livestock industry a significant consumer of natural resources (Steinfeld et al., 2006). In addition, it is estimated that the livestock sector contributes 14.5% of the world's greenhouse gas emissions, the bulk of which originate from ruminant animals like cattle (Gerber et al., 2013). Nonetheless, there is a chance that environmentally friendly methods of raising cattle, like better feeding and waste management, can lessen the negative effects of the livestock industry (Thornton and Herrero, 2010).

According to Gororo (2015), pen fattening involves providing cattle a diet high in energy and protein that is balanced for a duration of 70 to 120 days. The cattle are kept in small pens during this procedure in order to aid in weight increase and raise the standard of the meat grades at the abattoirs (Gororo, 2015). By offering regulated surroundings and well-balanced foods, the

technique seeks to promote ideal growth and weight gain (Greenwood et al., 2021). Small-scale farmers can increase the productivity and efficiency of their farming operations by fattening cattle in pens (Radebe et al., 2021). This strategy can maximize cattle growth rates, feed conversion efficiency, and eventually increase productivity and profitability by maintaining a controlled environment and offering a balanced diet (Greenwood et al., 2021).

In developing nations, where access to grazing pasture and fodder resources may be restricted, small-scale farmers have benefited greatly from the use of pen fattening (Mapiye et al., 2018). These farmers can increase the weights and quality of their carcasses by concentrating on intensive fattening in a regulated setting, which enables them to command higher market prices (Radebe et al., 2021). Furthermore, the less reliance on grazing can lessen the negative effects of animal production on the ecosystem, like overgrazing and land degradation (Gerber et al., 2013).

2.2 Productivity and Profitability in Beef Pen Fattening

The productivity of beef pen fattening is affected by various factors, with diseases and the seasonal availability of feed resources being the primary drivers (Teklehaymanot et al., 2017). Other influential factors include the suitability of the cattle genotype, climate conditions, health considerations, nutritional supplementation, and the duration and frequency of the fattening periods (Radebe et al., 2021; Mapiye et al., 2018).

According to Radebe et al, (2021) and Greenwood et al, (2021), suggest that profitability, is influenced by various factors such as feed costs, financial availability, market prices, carcass performance traits as well as an effective resource allocation. The high cost of feed, which can account for up to 70% of the total production costs, poses a significant challenge for small-scale farmers who are engaged in pen fattening (Gororo, 2015). Access to affordable and high-quality feed resources is crucial for improving the profitability of this practice (Mapiye et al., 2018).

Furthermore, the performance of cattle in pen fattening systems is strongly influenced by their genetic potential. Crossbreeding programs that combine the desirable traits of indigenous and exotic cattle breeds have been shown to enhance growth rates, feed conversion efficiency as well as the carcass quality (Greenwood et al., 2006 and Mapiye et al., 2018). Effective management of health and disease risks is also essential to maintain the productivity and profitability of pen fattening operations (Teklehaymanot et al., 2017).

2.3. Significance of beef pen fattening

Gororo (2016) implies that beef pen fattening which is known as feedlot finishing or feedlot fattening, is a method employed by small-scale farmers to raise cattle for slaughter. This method includes confining the cattle in selected areas called feedlots in which they are provided with a high-energy diet so as to promote rapid weight gain (Radebe et al., 2021).

The practice of pen fattening offers several advantages for small-scale farmers. It allows them to add extra weight to the cattle at a younger age, thereby increasing turnover and maximizing output from the beef enterprise (Mapiye et al., 2018). Additionally, according to Greenwood et al., (2021), pen fattening can result in higher meat grades due to increased fatness and fleshiness which is also supported by Gororo (2016). This can enable small-scale farmers to command higher prices for their finished cattle, finally improving the profitability of their beef production enterprises (Radebe et al., 2021).

Nevertheless, the success of beef pen fattening is influenced by numerous factors which includes the availability and cost of feed, the suitability of the cattle genotype, health management as well as an effective resource allocation (Teklehaymanot et al., 2017 and Mapiye et al., 2018). Moreover, (Greenwood et al, 2021), suggest that farmers who are able to address these challenges and optimize their pen fattening operations can achieve significant gains in productivity and profitability which is supported by Radebe et al., (2021).

According to Tachiona (2023), beef cattle should be fed with a protein-balanced and high-energy diet to improve their live weights within a period of around 90 days in which this feeding strategy can also result in a high degree of finish and better grades at the abattoirs. Moreso, to determine the significance of pen fattening of beef, there is a need to have full information or knowledge regarding pen fattening practices such as cattle fattening techniques, management practices and a good plan Mapiye et al, (2018). Breed of cattle, age and sex are some of the factors to consider when selecting cattle for beef pen fattening as male calves are often selected to be fattened as steers (Greenwood et al., 2006 and Teklehaymanot et al., 2017).

The success of beef pen fattening is also influenced by the availability and cost of feed (Mapiye et al., 2018), the suitability of the cattle genotype (Greenwood et al., 2006), health management (Teklehaymanot et al., 2017) as well as an effective resource allocation (Radebe et al., 2021).

Farmers who are able to address these challenges and optimize their pen fattening operations can achieve significant gains in productivity and profitability (Radebe et al., 2021 and Greenwood et al., 2021).

There are potential benefits of implementing pen fattening for beef production. This can be supported by a study from Musvuugwa (2021) which also found that pen fattening can improve overall beef productivity and can lead to higher average daily weight gains (ADG) compared to grazing on veld alone. The selection of appropriate cattle breeds and ensuring adequate nutrition are critical factors in achieving optimal growth for cattle in pen fattening systems Mapiye et al, (2018). Chikumba et al. (2022) also suggested that the adoption of pen fattening has led to a significantly higher feed conversion efficiency and improved beef quality compared to grazing veld techniques. These benefits of pen fattening are more beneficial for small-scale farmers as they can enable higher productivity, profitability as well as competitiveness in the beef market (Radebe et al., 2021 and Greenwood et al., 2021).

In addition, pen fattening techniques have the potential to increase profitability in the cattle business, according to recent economic research. According to Marufu et al. (2020), the use of pen fattening increased net returns since it resulted in lower production costs and higher market prices. The study also underlined how crucial it is for farmers who engage in pen fattening to have access to market data and to efficient financial planning. Similarly, Sithole (2023) found that adopting pen fattening was positively correlated with higher gross margins, suggesting that farmers who used these practices saw a significant improvement in their financial performance.

The results of this study align with the findings of Manyuchi et al. (2021), who found that the use of pen fattening techniques raised live weights and carcass yields, hence increasing profitability for cattle producers. Moreover, Jonga et al. (2022) emphasized that through increased feed efficiency and decreased acreage needs, pen fattening may lessen the environmental impact of beef production.

2.4. The performance of pen fattened versus veld

Armstrong et al. (2023) define pen fattening as a production strategy in which cattle are kept in feedlots or pens and fed a diet restricted to grains, silage as well as hay. This method speeds up weight gain by allowing for the control of nutrition and feed intake. But the researchers also point

out that because feedlot waste management and additional feed provision are required, pen fattening also comes with significant input costs. They also warn that poor management techniques might cause stress and health problems for the animals who are confined.

On the other hand, by giving cattle access to a variety of food sources, veld fattening which involves allowing them graze on grasslands or natural pastures it offers various nutritional advantages (Muleya et al., 2022). Due to the cow's primary dependency on natural flora for nutrition, veld fattening is related with cheaper input costs even though it may take longer for animals to attain market weight than pen fattening (Moyo et al., 2021). Additionally, the use of diverse natural feeds by calves during veld fattening might give the meat distinct flavor characteristics that some consumers may find attractive (Jonga et al., 2022).

A beef carcass comprises muscle, fat and bone. At birth, there is very little fat in a carcass and initial development is mainly bone and muscle growth. As the animal matures and gains mass, a stage is reached when fat deposition accelerates. Once an acceptable level of carcass fat is reached, an animal is said to be finished and can be slaughtered. The live mass and fat content considered acceptable for slaughter should be decided by market demand.

Research conducted by Ndlovu et al. (2020) research, had found that veld fattening methods can enhance the general health and welfare of cattle, resulting in higher-quality meat and greater acceptance by consumers. In a similar manner, Chikwanda et al. (2021) highlighted how veld fattening might lessen resource inputs and the carbon footprint associated with beef production, hence improving environmental sustainability.

Studies show that cattle reared in pen fattening systems gain weight more quickly and finish more consistently than calves raised in veld fattening systems, for instance a study which was done by (Molatek, 2023). These enhanced production results are a result of the regulated food and feeding schedule used in pen fattening (Ndlovu et al., 2020). The ingestion of a varied diet of natural forages by cattle grown under veld fattening, on the other hand, has been proven to yield meat with a more complex flavor profile (Jonga et al., 2022).

It's important to remember that pen fattening usually needs more effort than veld fattening (Molatek, 2023). Additional effort is required for the intense management of pen fattening, which

includes keeping an eye on feed consumption and maintaining ideal feedlot conditions. In contrast, veld fattening requires less human intervention and is dependent on cattle grazing naturally on grasslands or pastures (Moyo et al., 2021).

According to Chikwanda et al. (2021), shows how veld fattening systems can lessen resource inputs and carbon footprints while still improving the environmental sustainability of beef production. Additionally, Muleya et al. (2022) noted that the variety of natural forages cows eat during veld fattening can improve their general health and wellbeing which will increase the quality of their meat and promote consumer acceptance.

2.5. Growth patterns of pen fattened cattle

In the growth patterns of pen fattened cattle, it is a process which involves the careful management of feeding the steers, hosing and the genetic factors in order to achieve an optimal weight gain as well as meat quality. This process is characterized by confining the cattle into pens for a period of 70 to 120 days. The growth pattern of pen fattened beef is influenced by many factors that include the following breed characteristics, feeding regime, type of feed used, housing requirements and the environmental conditions. Growing bulls, steers and heifers can also be back grounded or finished on pasture. Pasture based back grounding and finishing is an alternative to the forage-based back grounding and grain-based finishing employed in confined feedlots. Rates of gain are generally lower than those achieved in confinement, unless intensive grazing practices are employed.

(Gororo, 2015) suggested that planted pastures can be used for fattening and growing out animals and the growth rates achieved are better than on veld. For instance, summer pastures such as kikuyu can also be used, but this practice is often not economic because feeding starts in spring when the price of feeders is relatively high and finished animals are only ready in autumn, when beef prices are relatively low. Steers or male cattle, in general, are more preferred than females (cows or heifers), as they respond better when feeding. Young animals perform better in feed lots due to low feed conversion ratio.

2.5. Factors affecting performance of pen fattening vs veld:

Pen fattening and veld performance is influenced by a number of factors. When it comes to calculating weight growth and feed conversion, performance refers to the productivity and

efficiency of animals, such as cattle. On the other hand, feed conversion indicates the quantity of feed needed by the animal in order to gain weight, whereas weight growth indicates the amount of weight that an animal accumulates over time.

Feedlot managers must be aware of the fact that keeping a feedlot enterprise running, a continuous income is needed. The only way this can be achieved is by having livestock to sell all the time. This is a difficult part of feed lotting, because animals remain in a feedlot for 90 to 120 days. The feedlot must therefore predict market demand and consequently predict the selling price at least three months ahead. A continuous source of feeders is needed, but not always available. According to Anderson, (2021), cattle performance is influenced by a wide range of elements that are critical to their health, growth, and economic viability. These consist of initial weight and age, feedlot efficiency, grazing and consumption patterns as well as controlled performance assessments of management techniques.

2.5.1. Starting age and weight.

In particular, younger cattle can convert feed more effectively than older cattle because they are generally more adapted to pen-fattening systems and the steers, for example, usually achieve market weight in 90 to 120 days after maturing, earlier than bulls (Gororo, 2015). When compared to animals fed in feedlots, animals grown on veld which is natural grazing typically take longer to attain maturity and gain less weight, muscle as well as fat (Gororo, 2015). This is because the two systems feeding schedules and food availability differ (Muleya et al., 2022).

The results align with previous research that has investigated the impact of beginning weight and age on the performance of cattle. For instance, Ndlovu et al. (2020) study indicated that younger cattle in pen fattening systems gained weight more quickly and efficiently from feed, while Chikwanda et al. (2021) study revealed that the constraints of natural fodder caused veld-fattened animals to take longer to attain market weight. Overall, the weight and age at which calves are started have a major impact on how much feed they consume, how quickly they grow, as well as efficiently they use it. These characteristics have implications for the sustainability and economic viability of various fattening systems (Moyo et al., 2021).

2.5.2. Feedlot performance factors.

According to the research by Karisch et al. (2022), several key factors, such as average daily feed intake, average daily gain, feed conversion, disease incidence as well as mortality rates, can significantly influence the overall performance of cattle in pen fattening operations. One particularly crucial factor is the use of growth-promoting implants, which are widely used in feedlot systems so as to enhance the performance of cattle and these implants work by stimulating the production of muscle tissue while minimizing fat deposition which would result in improved growth rates and feed efficiency (Karisch et al., 2022).

From the point of view of producers, livestock diseases are essentially an economic problem. Diseases that reduce production, productivity, and profitability are associated with the cost of their treatment, disruption of local markets, international trade, and exacerbate poverty on rural, local, and regional communities. At the biological level, pathogens compete for the productive potential of animals and reduce the share that can be captured for human purposes (FAO 2009; Rushton 2009). Adaptability of an animal can be defined as the ability to survive and reproduce within a defined environment or the degree to which an organism, population or species can remain/become adapted to a wide range of environments by physiological or genetic means (Mirkena et al. 2010).

Moreover, the proper utilization of these implants can lead to an increase in average daily gain for growing calves of about 10% to 20% as well as 15% improvement for finishing cattle. The feed efficiency can be increased by 6% to 8% for growing cattle and 8% to 10% for finishing cattle when implants are used effectively (Karisch et al., 2022).

A study by Manzanilla-Pech et al. (2020), found that the strategic use of growth implants in combination with optimal feeding and health management would significantly improve the overall productivity as well as profitability of feedlot operations. Similarly, Moriel et al. (2021) reported that minimizing disease incidence and mortality rates can have a substantial positive impact on the economic viability of feedlot enterprises.

Growth-promoting implants can fail for a number of reasons, such as an incorrect implant placement site, an implant that is missed through the ear, a partial implant as a result of the implant

gun malfunctioning, a damaged or crushed implant pellet, and inadequate implant storage facilities as a result of inadequate refrigeration and moisture contamination (ZoBell et al., 2006).

Table 1: Shows steer ready for growth-implant insertion and the location for implant insertion:

Figure 1: Steer ready for implant insertion

Source: Picture taken by Muresherwa Caleb at Chireka Farm. (07/01/2023)

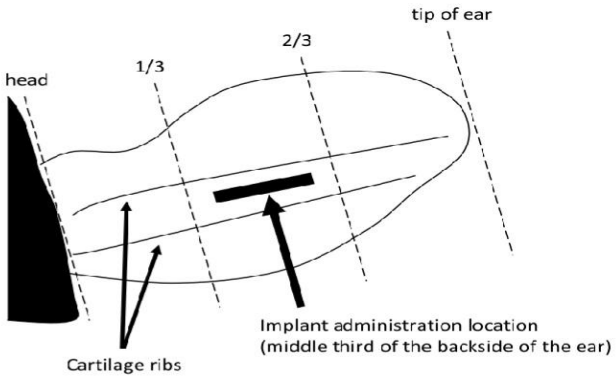

Figure 1.2: Shows location of the implant administration/ insertion.

Source: Mississippi State University, EXTENSION, Growth-Promoting Implants for Beef cattle, (Karisch, et al., 2022)

2.5.3 Grazing and Nutrition.

Cattle's growth, carcass quality, and general performance can all be greatly impacted by the way they are fed and nourished. As pointed out in the FEEDMIX (2024) article, in comparison to cattle finished in feedlots, cattle grown on pasture or veld usually take longer to reach the necessary live weight and carcass fat content for two or more years. Cattle raised in feedlots are typically provided a well-balanced ration that is formulated to promote optimal muscle growth and fat deposition there by ensuring a desirable quality of the final product. In contrast, cattle grazing on pastures or veld has specific feed requirements that are influenced by the type and availability of the grazing resources, which can affect their growth rate and overall condition.

Gororo (2016) further highlights the importance of matching the nutrient content of the feedlot ration with the specific requirements of the animals. The diet for pen-fattened cattle should be highly digestible and palatable to encourage better feed intake and utilization. Conversely, the diet for cattle raised on pastures or veld is typically richer in nutrients, such as roughages and fiber, compared to the grain-based rations commonly used in feedlots (Gororo, 2016).

Furthermore, a study conducted by Reinhardt et al. (2012) found that cattle finished in feedlots had higher carcass weights and better marbling scores compared to those raised on pastures. Similarly, Lowe et al. (2015) reported that the feeding regime, whether intensive or extensive, had a significant influence on the fatty acid composition and sensory attributes of the beef.

2.5.4 Management practices.

According to Gororo (2015), efficient management techniques are crucial for managing and feeding cattle since they affect the feedlot business's profitability. This entails making sure they follow the right feeding schedules, creating a stress-free atmosphere, and keeping a close eye on their health. On the other hand, for cattle kept on veld, this is accomplished by giving them access to enough grasses and keeping an eye on their health, which is the cattle's well-being. Kikuyu grass is one type of pasture that can be sown to feed cattle grown on veld.

The management practices are categorised into three major practices which are feedlot management, health management and daily management.

In order to keep cattle herds healthy and productive, proper daily management is essential. This includes making sure the cattle always have access to fresh, clean water (Cooke and Bohnert, 2011). Furthermore, a free-choice, well-balanced, high-quality diet is necessary to enable cattle to control their consumption and attain ideal market condition (Ensminger and Olentine, 2011). Whether cattle are housed in feedlots or pasture-based systems, efficient herd health management is crucial to preventing disease and minimizing mortality (Radostits et al., 2007). Giving vinegar can aid in the release of trapped gasses and offer symptomatic relief for issues such as bloat, a condition in which excess gas builds up in the rumen (Merck Veterinary Manual, 2022).

In addition, other essential herd health practices include routine vaccinations, parasite control as well as a prompt treatment of injuries or illnesses (Dohoo et al., 2003). Proper cattle handling techniques during management procedures can also reduce stress and disease risk (Grandin, 2014).

Furthermore, in feedlot management, the pens need to be strong and categorized by breed, age as well as sex, including the steer-age male cows. This is according to FEEDMIX (2024). In order to extend the duration that the water remains clean, the water troughs must to be positioned in one location. Water must to always be supplied, with each cattle unit needing roughly 50 liters. In order to precisely arrange the cattle in the feeding lot, their weights should be recorded. They should also be dosed to prevent internal parasites such liver flukes, tapeworms, and roundworms.

2.6. Beef production systems

There are two main categories into which Zimbabwe's beef production can be divided these include extensive and intense systems (Greenwood, 2021). Rangelands, pastoral, agro-pastoral and mixed farming are examples of vast systems that rely heavily on natural grazing resources. To maximize cattle performance in these settings, proper nutritional supplementation is frequently necessary, especially during the finishing period (Butterworth, 1985). On the other hand, the animals' surroundings and nutritional needs can be more closely managed in intensive systems (Greenwood, 2021). This degree of management may need larger expenses for capital, but it can also lead to increased profitability and productivity. According to Cottle (2014), a variety of factors, such as genetics, disease prevention, nutrition, management techniques and environmental circumstances can affect how efficiently beef is produced. Optimizing these critical factors is essential to raising the overall efficiency and productivity of systems used in the production of cattle.

Beef production systems are classified according to the age at which animals emanating from a production unit are sold. The production unit could be a farm or one of the enterprises in a larger undertaking. A full description of a system includes the age, mass and carcass class at which animals are marketed, as well as the breeding, management and feeding practices followed. Establishing strong market linkages is another critical component of Zimbabwe's beef industry development strategy (Makudera et al., 2021). Also, by enhancing an access to domestic and international markets can help ensure the sustainability and growth of the sector. Furthermore,

research by A. Charles (2023), states that in 2022, the cattle industry in Zimbabwe had favourable growth, characterized by a decline in tick-borne disease related mortality rates. The adoption of an intensive dipping method, involving 5 to 54 dipping cycles, has been associated with this improvement since it successfully reduced the risk of disease and controlled the spread of ticks. (Ndhlovu et al., 2009).

Additionally, the government's "Blitz Tick Grease" program was mentioned as an effective measure to control infections spread by ticks (A. Charles, 2023). These kinds of focused treatments can be extremely important for raising herd health and lowering productivity losses. However, the acting director of the Ministry of Lands, Agriculture, Fisheries, Water and Rural Development, Munyaradzi Chimowa, noted that the "January disease," also known as Theileriosis, continued to cause significant mortalities within the cattle population. In spite of these difficulties, the national beef herd of Zimbabwe had a 2% growth in 2022, totaling 5.64 million head of cattle, compared to 5.5 million the previous season. This expansion shows the industry's adaptability and the possibility of more productivity increases by using comprehensive disease management techniques.

In 2022, with 80% coming from the proper sector and the remaining 20% from the illegal industry. A total of 68,654 metric tons of beef were produced during the year as a result of this slaughter volume. The meat sector's ultimate objective is to produce 90,000 metric tons of beef by 2025 (A. Charles, 2023). Maintaining productivity and an efficiency gain throughout the value chain will be necessary to meet this challenging objective. Cattle raised in post-weaning systems need to consume enough nutrients from pastures and receive supplemental feeding, according to Greenwood et al. (2018). Giving the animals the ideal dietary balance can encourage quick growth and raise total profitability. Hynd (2014) also emphasizes how important it is to offer high-energy concentrate feeds to cattle toward the end of their lives in order to promote healthy growth and fattening. In addition to helping to satisfy consumer demands, this strategy maximizes the effectiveness of the system used to produce beef.

The type of animal, the environment, and the economic variables all have a role in the veld system of grazing used for beef production. Additionally, the technique aids in preserving the pasture and livestock productivity.

2.7. Constraints to pen fattening

Mupangwa (2021) noted that the two biggest challenges to smallholder commercial farmers implementing pen fattening techniques are limited availability and high expense of good-quality feed resources. The implementation and performance of intensive fattening methods are significantly hampered by the lack of access to affordable, high-quality feeds. Munyati et al. (2022) highlight inadequate knowledge and training on pen fattening techniques as an additional challenge to wider adoption, in addition to the limitations on feed resources. Farmers frequently lack the knowledge and abilities needed for organizing and managing intensive fattening operations.

It is essential for developing adequate training and extension services in order to solve these issues (Moyo et al., 2018). It is essential to greatly increase the adoption and application of this production system by giving farmers the information, abilities as well as technical support required for efficient pen fattening. The primary goal of extension services should be to inform farmers about the best techniques for pen fattening, including housing needs, health management as well as feeding schedules (Ncube et al., 2020).

2.8. Literature Review Conclusion

The literature suggests that pen fattening can improve beef productivity and profitability in small-scale commercial farming systems. Studies have consistently demonstrated higher weight gains, feed conversion efficiency and improved market prices associated with pen fattening. However, there are challenges associated with this practice, and further research is needed to address these challenges and optimize the benefits of pen fattening. This study aims to contribute to this knowledge gap by assessing the impact of pen fattening on beef productivity and profitability in small-scale commercial farming systems.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0. Introduction

This chapter outlines the methodology that was used in this research in relation to the description of study area and data collection methods how it was collected. It also lays out the data sampling procedure which consist of the sample size as well as the variables used and the analytical tool that were used. In this chapter, it reviews the clear presentation of findings which includes a justification for method used to investigate the research topic, the procedures used, the ethical issues, the strengths and weaknesses for the method.

3.1. Description of the study area

Chireka farm is a wholly owned Zimbabwean agro-business enterprise with special interest in pen fattening, cattle ranching amongst other horticulture practices. The study was carried at Chireka Farm, which is located in Zimbabwe along Bindura to Domboshava road in Mashonaland central. The area is characterised by an average annual rainfall of about 750mm to 1000mm of rainfall as well as an average annual temperature which ranges between 25^{o} C to 30^{o}C in agro-ecological zone 2b (Chikodzi et al., 2013). It is also referred as an intensive farming region for crops and livestock production which is based on pastures and pen-fattening which in turn can utilize crop residues as well as grain. Beef, dairy, pig and poultry are the main livestock production systems practised in this region, (FAO).

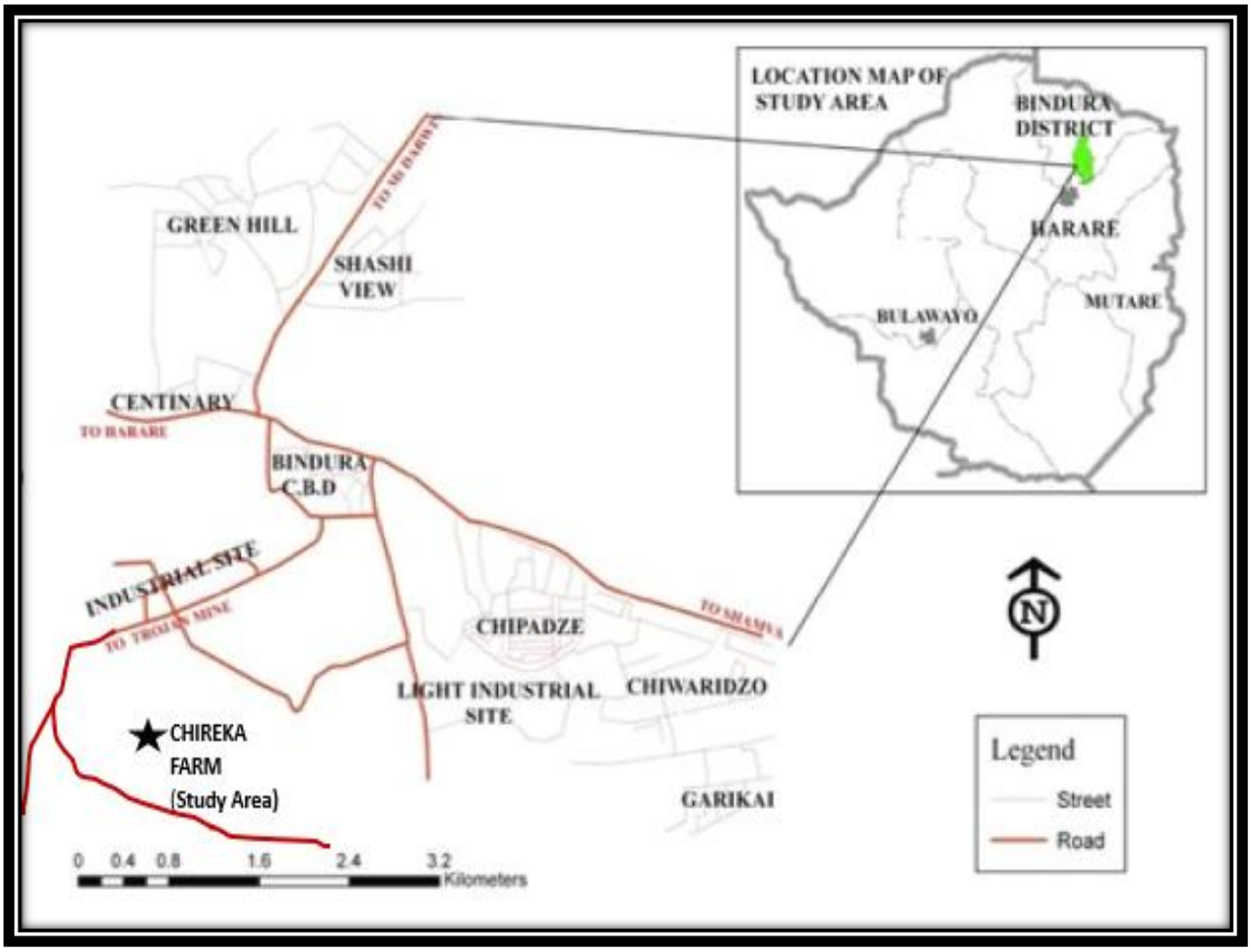

Figure 3. Showing the Bindura Map and the study area. Source: (Majoni et al., 2018)

3.2. Conceptual framework

The conceptual framework is crucial for highlighting the main objective of the study, which is to evaluate the impact of pen fattening on the performance of beef cattle at Chireka Farm compared to those raised solely on grazing veld. The framework considers a variety of factors that affect the outcomes of both pen fattening and veld-only raising systems. These key factors can be summarized in Figure 3.1 below.

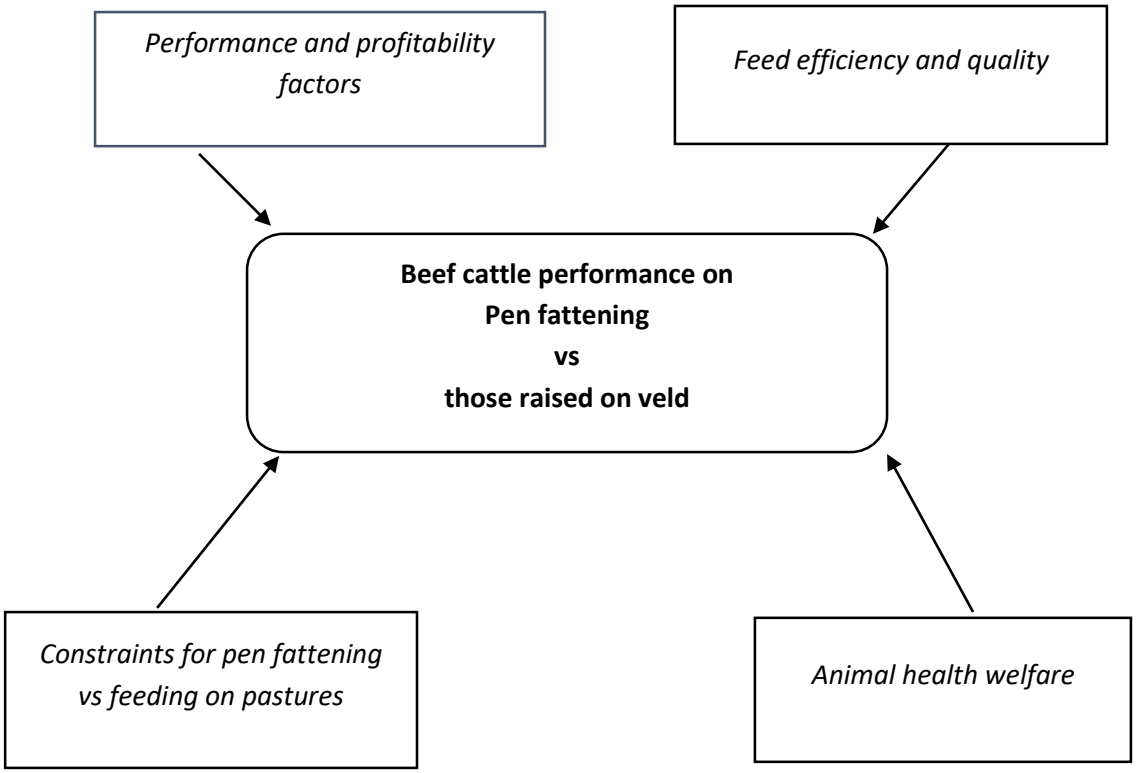

Figure 3.1. The conceptual framework diagram for beef cattle performances on pen fattening vs those raised on veld.

3.3. Data collection methods

Bhandari (2020) defines data collection as a systematic method of obtaining measurements or observations. There are many different ways to gather data, and each has pros and cons of its own (Saunders et al., 2019). In order to identify results based on the research topic and assess prospective outcomes, data collecting essentially entails the gathering and analysis of reliable data from several sources (Creswell & Creswell, 2018). For research objectives, strategic planning, and decision-making, efficient data collecting is essential (Bryman, 2016).

This study will primarily focus on collecting data through two methods questionnaires and interviews with the general manager of Chireka Farm and other workers from the farm. As the key source of information, the general manager will provide the primary data for the study which is referred as primary data collection. Additionally, the researchers will gather secondary data from

existing sources, such as academic journals, books as well as government entities. This secondary data will complement the primary information obtained directly from the farm's management

3.3.1 Data collection using questionnaires

Researchers use questionnaires, which are sets of questions with choices for respondents to choose from so as to gather data (Bhat, 2024). Multiple-choice, closed-ended, open-ended, and scaled questions are some examples of these options (Saunders et al., 2019). There are several ways to distribute questionnaires this include via mail, phone, internet or in-person (Bryman & Bell, 2015). With this research they were distributed as in person and over the phone.

The benefits of using questionnaires include the following:

- Quick data collection and analysis (Creswell & Creswell, 2018)
- Highly objective responses in a standardized format (Bryman, 2016)
- Ability to cover a wide range of topics and make informed decisions (Neuman, 2014)

However, questionnaires also have some limitations which are shown below:

- Respondents may not answer all questions which would result or leads to missing data (Saunders et al., 2019)
- Respondents may misunderstand the questions and this may result in biased information (Creswell & Creswell, 2018)

3.3.2 Data collection using interview.

Interviews are a qualitative data collection method that involves asking questions to gather information (George, 2023). Interviews can be structured, unstructured, or semi-structured, and can be conducted in-person, online, or over the phone (Saunders et al., 2019).

The advantages of using interviews include the following:

- Providing a wide range of in-depth information from a small number of participants (Bryman & Bell, 2015)
- Allowing for adaptability and flexibility to explore new questions as they emerge (Creswell & Creswell, 2018)

- They are effective in collecting qualitative data (Neuman, 2014)

However, interviews also have some disadvantages which are outlined below:

- They are time-consuming and resource-intensive, due to factors like scheduling (Bryman, 2016)
- They can lead to inaccuracy and bias in the information collected (Saunders et al., 2019)

3.4. Sampling procedure

Sampling is the process of selecting a subset or sample from a larger population in order to make observations and draw conclusions (Cooper & Schindler, 2014). The act of sampling involves deciding on a group from the data that can be used to make inferences about the broader population. From this study, a random sampling technique was used by the researcher so as to obtain information about pen fattening and raising cattle on pastures which is veld. This technique is also referred as probability sampling technique. At Chireka farm, has about 110 individuals who works at this farm and from this total, a sample of 20 individuals who have more knowledge and working on beef section were selected to give information of pen fattening which include the farm managers, livestock supervisors for beef, livestock cattle foreman as well as the cattle feeders. These were the target population who were given the questionnaires and interviewed by the researcher by conducting focus groups as well as other workers at Chireka Farm. Cattle under pen fattening were 145 and 2 bulls to make it 147 and those on veld were 200 cattle. The results were ranked especially on the constraints for cattle fattening and the average weights for the cattle steers were recorded and computed.

3.5. Data analysis

Table 2: Shows the analytical framework for data analysis of research questions, the objectives, analytical tools and the variables.

Research Questions	Objectives (specific)	Analytical tool	Variables
1. What are the growth patterns for pen-fattened cattle at Chireka farm?	To investigate growth patterns of pen-fattened cattle	Descriptive statistics analysis ie means, standard deviation, frequencies, range, percentiles	-Weight trends against time
2. What are the performance differences for veld versus pen-fattened beef at Chireka Farm?	To compare the performance of veld /grass versus pen-fattened beef at Chireka farm, Zimbabwe.	Gross margin analysis	Cost of production for pen-fattened and veld-finished cattle (feed, veterinary drugs, labor, slaughtering costs, transport costs, permits, council levies etc) -growth rate, -Live weights (final)
3. What are the challenges faced in pen fattening at Chireka farm?	To identify the challenges/ constraints of beef pen-fattening at Chireka Farm, Zimbabwe	-SWOT analysis -Ranking analysis	-Challenges -Ranking of challenges

3.5.1. Descriptive statistics as data analytical tool:

According to Hayes et al. (2024), descriptive statistics are concise informational coefficients that offer details on a particular data set, which may represent the full population or a sample. Measures of variability, which describe the distribution of the data, includes standard deviation, variance, minimum and maximum values as well as measures of central tendency, such as the mean, median and the mode.

The formulas for calculating the mean and standard deviations are shown below:

- **Mean** ($\bar{x}$)= $\sum x / n$

  Where $\bar{x}$ the mean and $\sum x$ is is sum of values in each sample.

  And **n** is the number of values in a sample. (Source: Bhandari 2020)

- **Standard deviation** = $\sqrt{\frac{\sum(X-\bar{x})}{n-1}}$,

  Where, $\sum$ is the sum of,

  X, represents each value and $\bar{x}$ is the mean,

  n, is the number of values is the data. (Source: Bhandari 2020)

In this study, it is based on investigating the pen fattening practices and the analytical tool to be used is the descriptive statistics in measuring the feeding strategies as a variable consisting of feed type and the feeding quantity. The data would be analysed as the means, standard deviation as well as the percentiles.

3.5.2. Gross margin (GM) Analysis

GM (Gross Margin) in this research is used as an analytical tool for measuring the variables related to the cost of production on pen-fattened and veld-finished cattle. These variables include measures on feed, veterinary drugs, labour, transport costs, permits, council levies (i.e., veterinary care), growth rate, carcass grade and the final live weights (Heifer et al., 2021).

According to Bloomenthal et al., (2024), the formular for Gross Margin is as follows:

Gross Margin= Total Revenue- Total Variable Costs, where

- Total Revenue (TR) is the revenue or can be referred as total amount of money generated by sales of that period thereby including all the discounts as well as the deductions of returns.
- Total Variable Costs (TVC) includes costs for feeds, fuel, labour cost, transport costs, livestock veterinary drugs costs e.tc. TVC are costs that needed to be consistently apportioned to the specific animals. Gross margin analysis is a financial tool used to evaluate the profitability of a business or activity (Maverick et al., 2021). This analysis estimates the difference between the total revenue earned by the business and the variable expenses directly associated with generating that revenue. The remaining revenue, after

covering variable costs, contributes towards covering fixed costs and generating profit, which is represented by the final gross margin.

Moreover, on Gross Margin there is also gross profit margin ratio and current ratio in which Gross margin ratio measures the relative profitability of the enterprise's sale after the cost of sale is subtracted whilst the Current ratio current ratio according to (Moyer, et. al. 2001) it measures the creditor's margin of safety as well as indicating the relationship between current assets and current liabilities on monetary basis. Gross margin ratio designates the return on every single dollar invested on the fattening enterprise. It is calculated as follows:

- Gross profit margin ratio = $\frac{\text{Sales} - \text{Cost of sales}}{\text{Sales}}$

If there is higher ratio, it means that the profitability would be higher as well.

- Current ratio = $\frac{\text{Current assets}}{\text{Current liabilities}}$

A low ratio shows that the enterprise would be unable to meet its short-term debt in an emergency, while a high ratio is considered favourable to creditors (Helmkamp, et. al. 1999).

3.5.3. SWOT analysis and Ranking analysis

When comparing pen fattening with veld-raised cattle, SWOT analysis is a useful analytical method for determining the benefits, difficulties, opportunities, and threats associated with a specific scenario (Kenton et al., 2023). This framework examines components that may affect the performance and sustainability of these cattle production systems from both the surroundings, such as market conditions and the competitive environment, and the inside, such as organizational competencies and resources (Barney, 2007; David & David, 2017).

3.5.3.1 Strengths

In Swot analysis, the strength are the internal attributes and resources that gives or enables the organization an advantage over others and in this case, it helps in identifying the key advantages of pen fattening, for instance managing the cattle's living conditions, monitoring their development, and controlling feeding and weight increase. Cattle grown in veld can become adaptable to their natural surroundings and adjust to them.

3.5.3.2 Weaknesses

It is also possible to determine the limitations of pen fattening and those that are produced on veld due to the SWOT analysis. They are also the internal factors which takes place inside the organization, for instance, it permits the detection of feed input and feeding restrictions for pen fattening, however it also provides the identification of natural predators that impact cattle in the veld, which could pose a threat to their safety and security.

3.5.3.3 Opportunities

SWOT analysis assists in determining the potential for both cattle reared in veld and pen fattening which are the external factors. This means having the capacity to apply the best resources for producing beef in an effective manner, as well as managing the environment and feeding practices. In terms of veld, this involves putting into practice sustainable grazing pastures and methods that would raise the standard of the cattle's grazing area. Additionally, there might be potential for a rise in the market demand for cattle produced in veld.

3.5.3.4 Threats:

SWOT analysis is also used to identify the dangers to veld and pen fattening which are the external factors. For example, it improves waste management, animal welfare monitoring, and the identification of risk infections that can be transmitted to cattle being fattened in pens. Furthermore, the influence of climate change on veld poses a threat to cattle and damages the natural environment.

Moreover, ranking analysis using Garrett's ranking technique includes organizing constraints according to their level of importance, which can inform decision-making for pen fattening operations (Anavrat et al., 2017). This approach offers several advantages which are shown below:

- It provides a structured framework to analyse and rank challenges which would result in enabling an assessment of their relative significance (Saaty, 1980).
- It permits the practical application of analysing constraints to pen fattening thereby improving the adaptability and utility (Kinuthia et al., 2021).
- It also allows the arrangement of multiple factors that are vital for decision-making and important in solving problems for pen fattening (Saaty & Vargas, 2012).

Nevertheless, Garrett's ranking analysis also has some weaknesses which are shown below;

- The technique may introduce biases in the assessment of pen fattening factors (Hair et al., 2019).
- The technique is based on relative comparisons rather than absolute values which can be complex in analysing the constraints for pen fattening (Kinuthia et al., 2021).

3.6. Ethical considerations:

The set of guidelines, standards, norms, or principles that are applied to evaluate and determine the best course of action while dealing with different issues is known as ethical considerations. Key ethical considerations for the study of assessing the impact of pen fattening on beef productivity and profitability at Chireka Farm included the following:

- Informed consent.
- Animal welfare.
- Confidentiality and data protection-Chireka is not the real name of the farm and this was used after the directing manager of the farm requested anonymity.
- Conflict of interest and respect for local communities as well as cultures.
- Research integrity.

3.7. Limitations of the study:

According to Ross et al., (2019), defines limitations of study as a representation of weaknesses for a research study which may influence and to affect the outcomes or conclusions of the study. These limitations may vary in different forms. This study was limited in that:

- The availability of data on beef productivity and profitability was not fully accurate or complete since the study was done within a short period.
- Data maybe bias, as there is reliance from people who live at Chireka farm for providing information.
- Funding and resources were also limitations in terms of time for getting the data as well as money for making the conclusions of the research.
- The other limitation was that there was information which was confidential, so meaning that confidentiality issues.

3.8. Conclusion

This chapter shows the methods that were used by the researcher in the research for collecting data including questionnaires, interviews as well as focus groups. It gives the knowledge on how the data will be analysed so as to give the accurate results and has also highlighted the study area for the research, sampling procedure and some of the drawbacks of the research which are the limitations and the ethical issues for instance confidentiality for data representation as well as the informed consent. Therefore, this is how the methodology is organized and data analysis will be presented in the next chapter.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.0 Introduction:

This chapter presents the findings of the research study which are the results and the discussion for the objectives of the study. Tables and graphs used for in representing the findings of the research.

4.1. To investigate growth trends of pen fattened beef at Chireka farm

The weights for the feeder steers were measured which also enabled the researcher to use descriptive statistics for determining the average weights or mean weights for the cattle. The information is shown below is for group A up-to group E in which all the groups add up to 145 total number of feeder steers.

Table 4.1.1. Shows the data source weights for 20 steers in group A.

WEIGHTS FOR THE STEERS IN KGS					
DATE WEIGHED	**12/9/2022**	**2/1/2023**	**2/15/2023**	**3/1/2023**	**3/14/2023**
TAG NUMBER					
(1-87)	415	445	483	500	513
216	380	415	420	448	450
(1-78)	399	440	458	472	481
(1-77)	390	416	458	466	482
(1-11)	407	460	491	508	515
127	374	406	416	435	449
('0120)	344	384	402	409	415
('0260)	380	423	441	444	456
2001	380	423	447	455	476
10.20-1	364	437	446	468	468
(1-21)	387	442	443	471	464
(1-3)	410	441	454	470	469
76	424	456	464	485	486
E2	282	348	364	388	398
207	384	421	426	429	435
PM005	415	401	393	395	405
Z23A	401	415	418	420	420
12-23A	316	359	385	405	410
6A001	330	360	395	390	405
E6	350	345	380	405	445
TOTALS	**('7532)**	**('8237)**	**('8584)**	**('8863)**	**('9042)**
AVERAGES	**376.6**	**411.85**	**429.2**	**443.15**	**452.1**
Standard Deviation	**45.961941**	**70.71067812**	**72.8319985**	**67.17514421**	**48.0832611**
MAX	**424**	**460**	**491**	**508**	**515**
MIN	**282**	**345**	**364**	**388**	**398**

The table is showing the dates at which the steers' weights were recorded thereby allowing to come up with the maximum weights and the minimum weights. For instance, on the 14th of March 2023, a maximum weight which was recorded was 515 kgs and the minimum weight of 398kgs was also recorded. In addition, the table is also showing the average weights/ mean weights for the feeder steers which also helps in coming up with the standard deviation for this data weights of feeder steers. Tag number for each cattle is also shown on the table for better identification of the cattle during weighing or vaccinating it with vaccines if it is sick. The highest standard deviation

recorded for the days in which the steers weighed was 72.8kg with a minimum standard deviation of 45.9kg. Therefore, this implies that there is high variability in the weights of cattle meaning that are not more considered whilst the lowest will be considered where the cattle would be selected for market. The total weights for the feeder steers would be also recorded.

The information shown above on the table can also represented graphically as shown below on a bar graph.

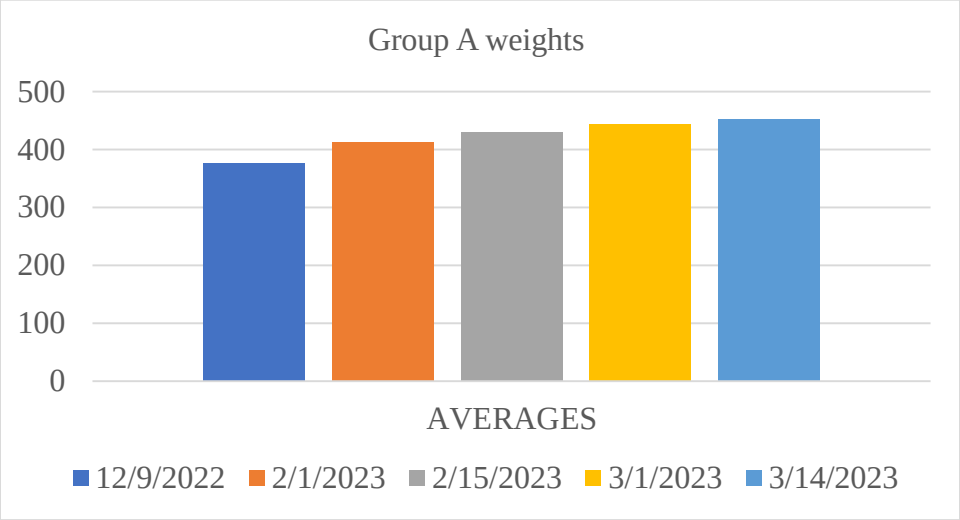

Figure 4.1.1. Group A weights for the feeder steers.

As shown on fig 4.1.1, the bar graph was constructed using the average weights/ mean weights for the 20 feeder steers in group A. An average weight of 376.6kgs was recorded on 9th of December 2022. The steers would be weighed after every two weeks. The second date in which the steers were weighed, an average mean weight of 411.85kgs was obtained showing that the cattle were gaining weight through the feed they were given. The third time an average weight recorded was 429.2kg followed with 443.15kgs on the 1st of March 2023. Lastly, an average weight of 452.1kgs was also recorded, showing the cattle had reached the required weights at the market.

Table 4.1.2. Shows the data source weights for steers in group B.

BREEDING HERD STEERS WEIGHTS IN KG DATE WEIGHED	11/4/2022	11/25/2022	12/9/2022	1/12/2023	2/1/2023	2/15/2023	3/1/2023	3/22/2023	4/5/2023	4/19/2023
A02309	205	211	234	266	290	303	337	361	375	398
A02305	158	167	169	170	215	228	244	274	296	307
A02322	220	239	254	265	322	343	364	380	398	415
A01296	236	253	265	299	336	369	394	433	450	430
A02320	190	194	213	247	284	305	327	361	377	404
A02331	215	228	235	238	278	302	335	339	341	357
A02327	192	198	218	286	297	298	327	356	348	387
A02334	198	198	205	221	258	280	325	351	372	394
A02323	236	266	266	306	327	334	370	412	425	447
A02303	206	220	233	247	287	328	361	400	427	458
A02385	247	249	285	341	378	401	423	439	462	485
A02299	175	195	200	209	274	300	308	357	370	406
A02317	175	185	201	231	277	300	301	345	364	385
A02351	215	221	238	269	282	317	341	378	393	447
21111	180	204	209	239	267	291	294	331	354	367
A02307	208	223	239	302	322	338	307	400	418	444
PM007	184	208	210	274	282	278	323	367	382	408
A02331	218	225	224	238	278	302	335	372	381	415
2111	181	204	209	245	296	291	313	354	370	395
A02308	196	197	224	260	280	302	332	334	377	396

A02314	174	195	212	245	260	313	324	320	370	390
A02341	193	198	198	235	268	290	352	318	339	361
A02324	202	209	218	262	292	324	345	361	402	421
A02336	230	239	248	254	282	291	320	348	364	387
A02312	160	175	189	206	262	272	317	353	370	397
A02342	150	165	172	202	235	250	285	317	335	354
A02337	145	153	180	166	205	257	262	280	305	334
A02301	203	228	234	250	288	328	342	274	300	313
A02332	189	192	208	274	282	266	294	286	315	345
3334	185	205	237	285	302	325	358	385	399	405
TOTALS	**5866**	**6244**	**6627**	**7532**	**8506**	**9126**	**9860**	**10586**	**11179**	**11852**
AVERAGES	**195.53**	**208.13**	**220.9**	**251.07**	**283.53**	**304.2**	**328.67**	**352.87**	**372.63**	**395.07**
Standard Deviations	**14.142 13562**	**4.242 64069**	**2.121 32034**	**13.43 50288**	**8.48 5281**	**15.55 6349**	**14.8 4924**	**16.97 0563**	**16.9 7056**	**4.949 74747**
MAX	**247**	**266**	**285**	**341**	**378**	**401**	**423**	**439**	**462**	**485**
MIN	**145**	**153**	**169**	**166**	**205**	**228**	**244**	**274**	**296**	**307**

The data shown above is for the breeding herd where calves fit for being feeder steers were selected for fattening. In group B, there were a total of 30 steers mostly from the breeding herd cattle that are kept at the farm. The first row is highlighting the tag number for the cattle specifically for easy identification. It is also indicating the dates in which the cattle are weighed to determine if their weights were increasing from the feed given. The maximum and minimum weights are also shown om each day for weighing for identifying the cattle with lowest weights as well as with the highest weight. For instance, on the 15th of February 2023, the maximum weight recorded was 401kgs and the minimum was 228kgs. The total weights for all the cattle weighed during a day was also recorded as well as their means for example on the 19th of April 2023, an average mean weight of 395.07kgs was recorded. The standard deviation for the weights is also shown on the table in which

a same highest standard deviation of 16.9kg was recorded on two different days firstly on 22nd of March 2023 and also on the 5th of April 2023 against a minimum of 2.1kgs recorded on the 9th December 2022. This information can also be represented on a graph as shown below;

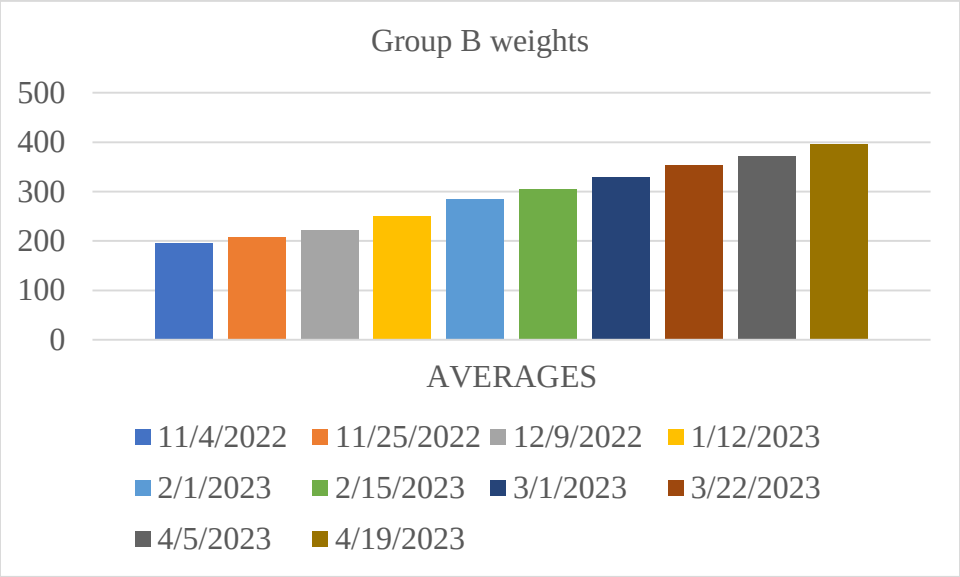

Figure 4.1.2. Group B weights for the feeder steers.

From the information above, the graph was also constructed using the average weights for the cattle selected to be feeder steers from breeding herd. Firstly, an average weight of 195.53kgs was recorded on the 4th of November 2022. The weights for these cattle were recorded after every two weeks to determine the difference or a change in weight gain for each steer. On the 19th of April 2023, an average of 395.07kgs which shows that the steers were gaining weight positively.

Table 4.1.3. Shows the data source weights for steers in group C.

WEIGHTS FOR NEW 35 STEERS DATES WEIGHED	2/1/2023	2/15/2023	3/1/2023	3/22/2023	4/5/2023	4/19/2023
TAG NUMBER						
19-0024	308	322	369	407	426	447
J07	215	222	342	377	394	425
J01	323	330	357	396	415	432
J06	261	316	303	396	361	382
9464	215	231	254	245	266	288
20-34	243	345	285	293	308	339
J02	241	256	262	287	294	314
2074	297	292	322	355	381	400
9469	224	197	250	296	308	337
J03	259	252	328	405	421	441
9458	229	222	255	297	323	350
19-0034	282	293	345	381	396	421
9461	228	234	224	294	330	339
2078	292	318	327	357	381	416
2071	322	325	369	390	414	437
9473	231	240	281	308	336	357
2040	298	333	360	384	432	462
N08	323	351	376	411	443	470
9483	175	174	197	215	234	244
9479	188	192	211	240	254	270
9484	200	213	227	249	268	279
2036	337	355	400	432	456	475
9426	229	224	271	304	327	352
9448	194	212	232	272	293	318
('20-6)	321	374	374	393	414	443
('20-9)	309	328	348	406	437	464
('0025)	309	311	336	371	372	400
('003)	273	283	321	341	358	377
20-15	341	383	410	442	471	490
J04	328	338	353	411	307	325
9435	271	278	296	329	336	378
J005	320	344	375	397	423	461
31744	222	245	294	338	384	415
441	322	334	368	394	405	410
55-23	214	244	288	320	357	365
TOTALS	('9344)	('9911)	('10910)	('12133)	('12725)	('13523)

AVERAGES	**266.971429**	**283.1714286**	**311.71429**	**346.657143**	**363.57143**	**386.371429**
Standard Deviations	**66.4680374**	**55.15432893**	**57.275649**	**61.51829**	**48.790368**	**57.9827561**
MAX	**341**	**383**	**410**	**442**	**471**	**490**
MIN	**175**	**174**	**197**	**215**	**234**	**244**

From the data shown above, are the weights for the 35 feeder steers which were purchased from CC sales. The data is showing the tag number for each cattle and also the weights recorded which are the average weights or the mean weights. The mean weight of 266.9kgs was recorded on the 1st of February 2023 and also a mean weight of 386.4 kgs was recorded on the 19th of April 2023. Therefore, this shows that the feeder steers were gaining weight. Moreover, the data is showing the maximum weight and also the minimum weights for the steers in group C, for example on the 1st of February 2023 when the cattle came a minimum weight recorded was 175kgs and also the maximum weight was 341kgs. This also implies that if cattle have high weights, it takes short time to reach maturity as well as ready for market which would reduce the expenses thereby resulting in obtaining high profits. The data is also showing the total weights for the cattle for instance a total of 9911kgs was recorded on the 15th of February 2023 and also a total of 13523kgs total weights for all the feeder steers.

However, this information for the weights of feeder steers in group C is also represented on a bar graph as shown below.

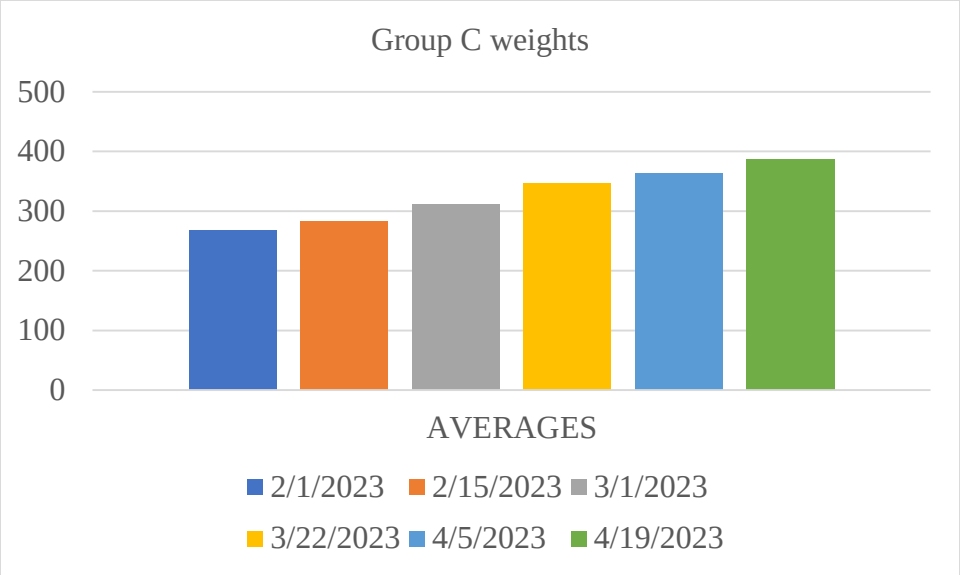

Figure 4.1.3. Shows the weights for Group C feeder steers.

The bar graph is showing how the steers are gaining weight through pen fattening and from this information the mean weights were used to construct the graph which are the averages. A mean weight of 266.97kg was recorded on the 1st of February 2023 followed by 283.17kgs the next day when weighed giving a mean weight difference of 16.2kgs. On the 22nd of March 2023 an average weight of 346.66ks was also recorded and lastly on the 19th of April 2023 an average weight of 386.37kgs was also recorded. Therefore, from this information it shows that the steers are gaining weight more quickly and this can impact the supply of the beef pen fattened to the market as well as resulting more profitability.

Table 4.1.4. Shows the data source weights for steers in Group D.

LOT 30 FROM CC-Sales (26/01/23)						
DATES WEIGHED	**2/9/2023**	**2/15/2023**	**3/1/2023**	**3/22/2023**	**4/5/2023**	**4/19/2023**
TAG NUMBER						
('12-20)	312	309	342	390	425	439
4120	381	307	404	459	488	489
('060)	275	256	270	288	292	300
J07	302	304	327	338	383	407
2025	343	243	367	402	425	451
('0520)	343	360	380	418	430	454
('08)	300	260	327	360	378	392
('34)	260	259	273	291	313	333
4020	312	321	350	390	401	417
('03)	290	258	289	335	366	385
('013)	278	264	311	342	380	416
5120	325	300	348	378	393	412
('0820)	350	345	388	427	433	465
3119	426	434	470	507	524	544
2220	310	307	340	380	390	419
('0420)	341	359	380	431	452	487
J10	297	301	330	336	380	403
('017)	297	213	301	352	378	412
J08	294	283	297	319	328	355
1720	341	306	325	368	401	417
J09	308	255	291	336	359	378
('016)	274	280	300	347	367	386
('05)	306	252	334	377	400	426
J11	282	224	229	285	335	354
3820	330	318	334	411	431	465
3620	339	303	332	386	412	440
('044)	275	277	307	364	387	413
2620	356	344	388	438	456	485
3548	260	288	335	390	404	430
5553	305	334	385	415	439	475
TOTALS	**('9412)**	**('8864)**	**('10054)**	**('11260)**	**('11950)**	**('12649)**
AVERAGES	**313.7333**	**295.46667**	**335.13333**	**375.3333**	**398.3333**	**421.633333**
S. Deviation	**4.949747**	**17.67767**	**30.405592**	**17.67767**	**9.899495**	**25.4558441**
MAX	**426**	**434**	**470**	**507**	**524**	**544**
MIN	**260**	**213**	**229**	**285**	**292**	**300**

The data on the table above also shows the weights of group D feeder steers which were also purchased from CC sales for Chireka farm. The data is also highlighting the total weights for the

steers, the mean weights which are the averages, the standard deviation, maximum value of weights and the minimum weights when the steers were weighed. This can be represented graphically as shown below.

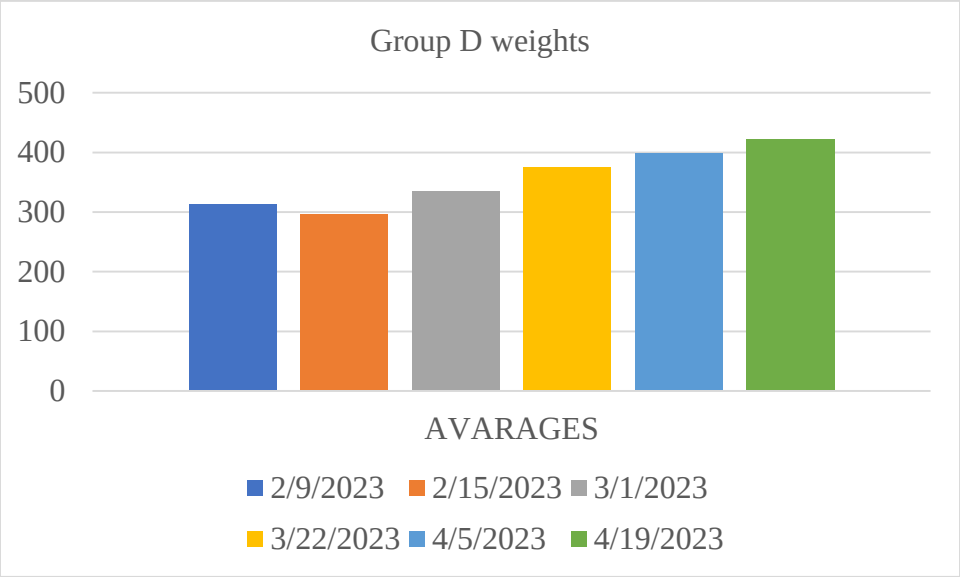

Figure 4.1.4. Shows the weights for Group D feeder steers.

The information on the graph is showing that an average of 313.17kgs was recorded on the 9th of February 2023 followed with a decrease in the average weight recorded on the 15th of February 2033 which recorded an average weight of 295.47kgs. This was caused by a change in the feed which was being given to the steers therefore it resulted in decrease of the weights. The steers decreased with a total of 17.7kgs. However, on the 1st of March, an average weight of 335.13kgs was recorded thereby showing an increase in the weights of the feeder steers up until to the 19th of April 2023 when an average of 421.63kgs was recorded. From this information, it shows that any change in the feed has an effect on the weight gain for the steers, hence it should not be changed so as to maintain the weight gain for the cattle.

Table 4.1.5. Shows the data source weights for the feeder steers in group E.

LOT 30 From CC-Sales (01-02-23)					
DATES					
WEIGHED	**2/15/2023**	**3/1/2023**	**3/22/2023**	**4/5/2023**	**4/19/2023**
TAG NUMBER					
21-00 35	270	285	325	361	377
21 0021	290	324	360	387	407
21/030 02	261	289	342	350	362
21 099	315	332	384	403	432
21 044	283	339	362	391	400
21 09	327	358	385	405	441
FB1	255	303	317	341	354
AN053 11-20	358	352	412	418	447
AN062 08-21	292	323	356	363	388
AN045 1120	308	310	381	390	431
AN069 9-21	216	248	279	301	322
AN040 1120	282	282	353	377	407
AN050 12-20	351	367	414	424	453
AN084A	275	279	345	363	387
AN081 01-21	210	200	263	264	275
('039)	248	289	314	336	367
FB2	252	285	**sick**	284	353
210061	247	276	287	320	335
FB3	285	318	353	371	399
AN079 12-21	252	288	318	347	372
AN063 8-21	269	274	303	322	344
21026	277	288	325	355	372
FB4	242	243	275	284	302
AN075 10-20	295	335	358	379	410
('040)	266	282	330	351	372
21-0055	260	285	338	360	385
210066	253	220	325	344	367
('42)	243	263	301	332	367
PM008	218	247	268	284	306
A01293	200	205	203	216	237
TOTALS	**8100**	**8689**	**9576**	**10423**	**11171**
AVERAGES	**270**	**289.63**	**330.21**	**347.43**	**372.37**
S. Deviations	**49.49747**	**56.56854**	**86.267027**	**102.5305**	**98.9949494**
MAX	**358**	**367**	**414**	**424**	**453**
MIN	**200**	**200**	**203**	**216**	**237**

The above table shows the weights for a total of 30 feeder steers in group E which were received at Chireka farm from CC sales on the 1st of February 2023. This table is showing the dates in which

the cattle steers were weighed so as to determine their weight gain after introducing them to pen fattening. These were also the weights for the other 30 feeder steers in group E which is the last group for the steers to make them 145 steers. On the table, it is showing the minimum weights and the maximum weights, total weights, average weights as well as the standard deviation. For instance, on the first day when the steers were weighed that is 15th of February 2023 a minimum weight recorded was 200kgs and the maximum was 358kgs. Also, on the 19th of April 2023, a maximum of 453kgs was recorded and a minimum of 237kgs. On the 22nd of March 2023, cattle with tag number FB2 its weight was not recorded due to sickness and it resulted in a decrease in the total weights to be recorded. The differences in weights were caused by feed intake by the cattle and also the breed for the cattle in which others may grow faster whilst others they take more time to reach maturity or the required weights for marketing. The tag numbers are for identification of the cattle. The averages weights for the feeder steers were also recorded and these were also used to construct the bar graph shown below:

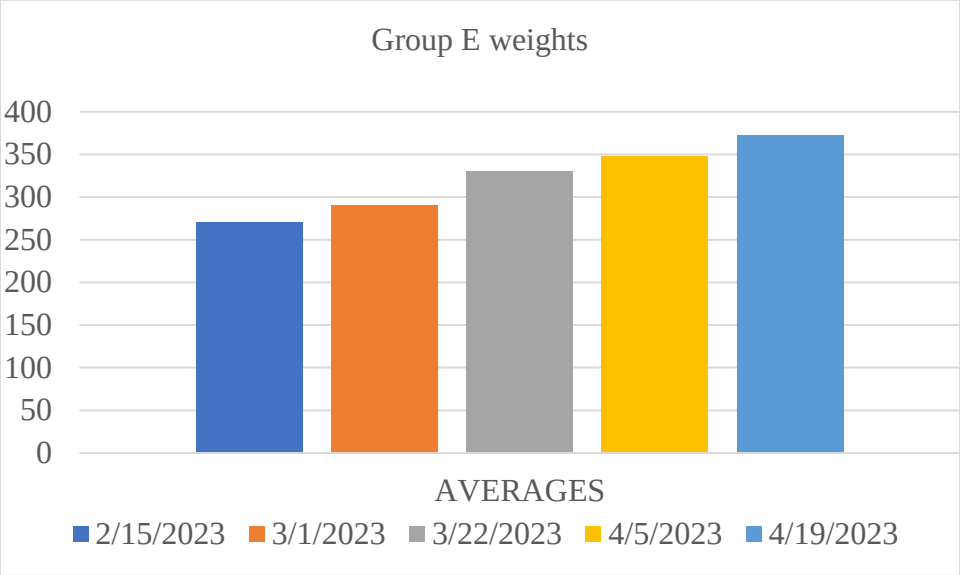

Figure 4.1.5. Shows the weights for Group E feeder steers.

The graph shows the average weights for the 30 steers in group E. The graph was constructed with the average weights and the dates in which the cattle were weighed. On the 15th of February 2023, an average weight of 270 was recorded for steers. The graph is showing that there is an increase in weight gain for the steers hence this can also lead to an impact of Chireka farm supplying more fattened beef cattle to market which is abattoirs such as Bellevue as well as Koala. Moreover, on

the 5th of April 2023, an average mean weight of 347.43kgs was also recorded followed with an average of 372.37kgs. Steers with highest weights will be selected and grouped in their own category so that it becomes easy selecting for market.

4.1.2. Justification for the growth pattern results:

From the information provided above, it is noted that some of the steers would take more time at the farm before marketed due to several reasons and these include the following. Firstly, the target market weight in which the steers would require an extended time in order to reach maturity due to the weight gain of cattle. The breed characteristics is also one of the reasons why the steers would take more time for reaching time for marketing, other breeds would mature within short time whilst others would take more time due to their genetic tendency for lean muscle growth. More so, the price fluctuations at the market were low and this would result in for the steers to stay longer hence this also resulted in the loss for the company as more feed stuffs to feed the steers would be required. Lastly, the feeding regime and nutritional managing also influenced the time taken to reach maturity for the steers.

4.2. To compare the profitability of pen fattened beef versus veld /grass

Table 4.2:1. Shows cost analysis of both fattened beef and those raised on veld only for one steer/ cattle.

Parameter	fattened cattle	Veld only
Live Selling price ($)	900	650
purchasing price ($)	200	150
permits ($)	10	10
Dipping ($)	60	100
feeds Cost ($)	200	100
Vet Care/ treatment ($)	10	10
Labor ($)	60	60
sell transport ($)	50	50
weight at start (kg)	250	200
Weight after (kg)	550	400

Table 4.2.1. Above shows the cost analysis for both cattle raised under pen fattening and also those raised on veld or growing pastures for one steer or cattle in the 2022 to 2023 farming season for Chireka farm. It is indicating the quantity of feed used to feed the cattle under pen fattening and the weights for the cattle at start and finally when ready for marketing. The results on the table shows that the purchasing price for cattle to be raised under pen fattening was $200 each cattle and the ones for veld was $150 each. These cattle were purchased from CC sales which is an auctioneering company for livestock in selling as well as marketing of cattle. If cattle have higher weight it takes short time to reach the required weight for market and the costs that would be incurred for these cattle are few hence thus resulting in making high profits to the farmers. During the season, when pen fattening each steer, a feed quantity of 24kgs on average was given to the

steers. This was the feed made at the farm, a mixture comprising of grass/ fodder crop hay, cotton cake, beef max, coarse salt, urea and molasses diluted with water. The feed would be given twice daily to the steers in the morning and in the afternoon and also supplementary feed comprising of hay mixed with maize crushes would also be given to the steers.

The required live weight after pen-fattened cattle ranges between 400kgs to 600kgs, this shows that the cattle would be ready for market and also for those raised under veld would be ranging from 300ks to 400ks this is because the cattle will be fed with supplementary feed which include feed from fodder crops that are grown at the farm for instance the farm would grow fodder crops such as soya bean and maize straws to feed the cattle. Other fodder grasses include Kikuyu grass. Supplementary block salt will be given to the cattle for stimulating the appetite for cattle thereby increasing the uptake of salt therefore at the end when weighed those cattle raised under veld would have higher weights of about 350kgs to 400kgs. Moreover, the permits for transferring cattle from the farm to market is at $10 and this would be paid to the VET officer and was issued per one load or transporting one cattle or steer either from the farm to the market or selling to other individuals.

The treatments for both cattle raised under pen fattening and on veld was $10. The hiring cost for transporting the cattle from the farm to the market was $500 for 20 cattle or steers which would be one load and it was cheaper other than transporting only one cattle with a price of $50 for one cattle or steer, however the farms would mostly consider selling the cattle in high numbers to abattoirs so as to avoid incurring losses when transporting or selling to individuals. The labor which was charged was $60 per individual during the end of month meaning that the individual on daily basis was getting around $2 excluding the livestock supervisor and feed foreman.

4.2.1. Gross Margin/ Revenue from sale of one cattle:

- <u>For fattened cattle Gross margin:</u>

From table 4, the revenue for one cattle raised under pen fattening would be $900 on average, the Variable cost are as follows: cost of hiring $50, $10 VET cost, $10 permit cost, dipping $60, feed cost $200, purchasing cattle cost $200 and labor cost $60. TVC is $590.

Gross Margin = TR - TVC

= $900 - $590

= $310

- For Veld only Gross Margin:

From table 4, the revenue for one cattle raised under grazing pastures would be for instance $650 on average, cost of hiring $50, $10 VET cost, $10 permit cost, dipping cost of $100, purchasing feed cost $100, purchasing cattle cost $150 and labor cost $60. The TVC is $480.

Gross Margin = TR - TVC

= $650 - $480

= $170

The information shown above it is profitable to raise cattle under pen fattening as comparing by raising them on grazing pastures. This is also supported by the gross margin for both systems where pen fattening gives $310 and veld gives a gross margin of $170 giving a difference of $140. Therefore, it is viable for Chireka farm, to practice pen fattening as it would be able to cover all the expenses incurred and to make the profits other than raising cattle on grazing pastures as there are more costs to be incurred.

Table 4.2.2. Shows summary of income generated for Pen fattened cattle.

Cattle category	Number of animals	Price per animal after pen fattening ($)	Average weight at selling (kg)	Average weight at start of pen fattening (kg)
Steer	145	900	550	250
Bull	2	1,500	1000	300

From the table above it reveals that a total of 145 cattle steers are under pen fattening and two full grown bulls. The income that can be generated for cattle raised under pen fattening ranges from $850 to $950 but on average is $900. For two bulls that were sold, each bull weighed about 1000kgs and it was sold at $1500 at the market place where there was auctioning of cattle. When cattle are selected for pen fattening, an average weight of 250kg is selected and at selling or market the cattle weighs an average of 550kgs. The information on the table can also be represented on the bar graph below.

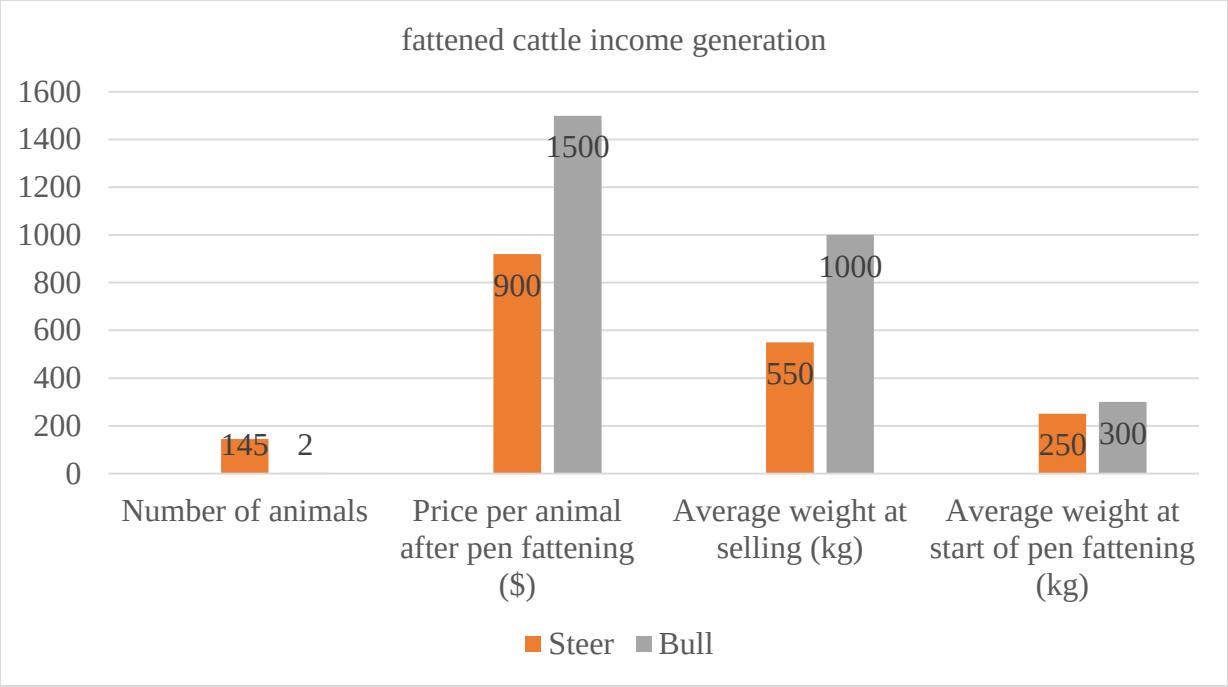

Figure 4.2.1. Shows the income generation for pen-fattening cattle.

The information shown above on fig 4.2.1 is the same that shown on table 4.2.2, only differs in that they represented differently on graph as well on graph thereby helping on clarity. The graph is showing the number of animals (cattle) in which there are 145 feeder steers and two bulls. The price of cattle after pen fattening shown refers to the total money after selling the bulls and the steer. Each bull was sold at $1500 with an average weight of 1000kgs whilst the feeder steers sold with an average weight of 550kgs. The average weight at start of pen fattening for feeder steers was 250kgs for the feeder steers whilst the bull with 300kgs.

4.3. To identify the challenges/ constraints of beef pen fattening at Chireka Farm, Zimbabwe using SWOT analysis and Ranking analysis.

At Chireka farm, the major constraints were ranked according to the order of their importance which can be referred as ranking analysis. These constraints are represented in a table.

Table 4.3.1. Shows the constraints of beef pen fattening.

SWOT ANALYSIS	Positive	Negative
Internal	Strengths: Monitoring of cattle health and growth Control feeding and the weight gain. Controlling the living space for cattle to avoid overcrowding	Weaknesses: Inadequate access to capital Lack of skilled personnel Limited to feeding inputs Lack of time management in feeding the cattle under pen fattening
External	Opportunities: Increased market demand for cattle raised on pen fattening. Optimal use of resources for efficient beef production.	Threats: Risk of diseases which spread on cattle under pen fattening and bloating. Climate change impact which would be a threat to the cattle. Low consumer purchasing power which result in lack of market

The table above shows different constraints to beef pen fattening at Chireka farm. This information can also be represented graphically as shown below starting with the Internal factors which are the strengths.

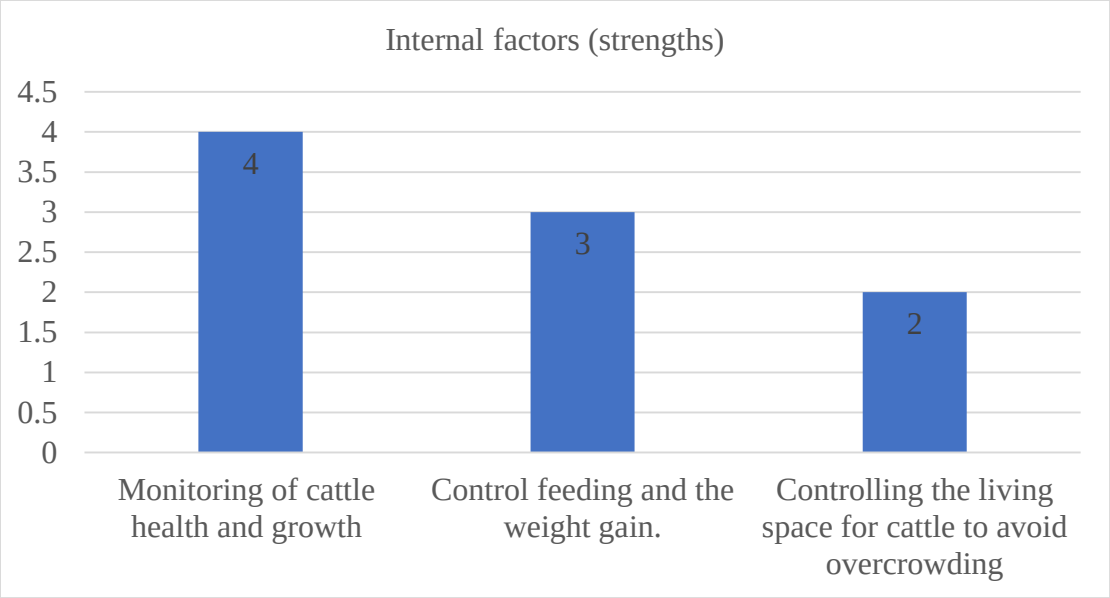

Figure 4.3.1. Internal factors for beef pen fattening (strengths).

From the graph which is fig 4.3.1, it is showing the internal factors (strengths) constraints for beef pen fattening and are ranked in the order of importance starting with monitoring for the health and growth of cattle. By monitoring healthy, it is also supported by checking diseases and controlling feeding behavior for the quantity of feed given to cattle, time of feeding as well as weight gain so as to prevent bloating which mostly affect cattle under pen fattening and in some cases, it results in deaths of cattle. Lastly, the living space for cattle also need to be controlled so as to allow free movement for the cattle.

The following graph shows the internal factors for weaknesses of beef pen fattening at Chireka farm.

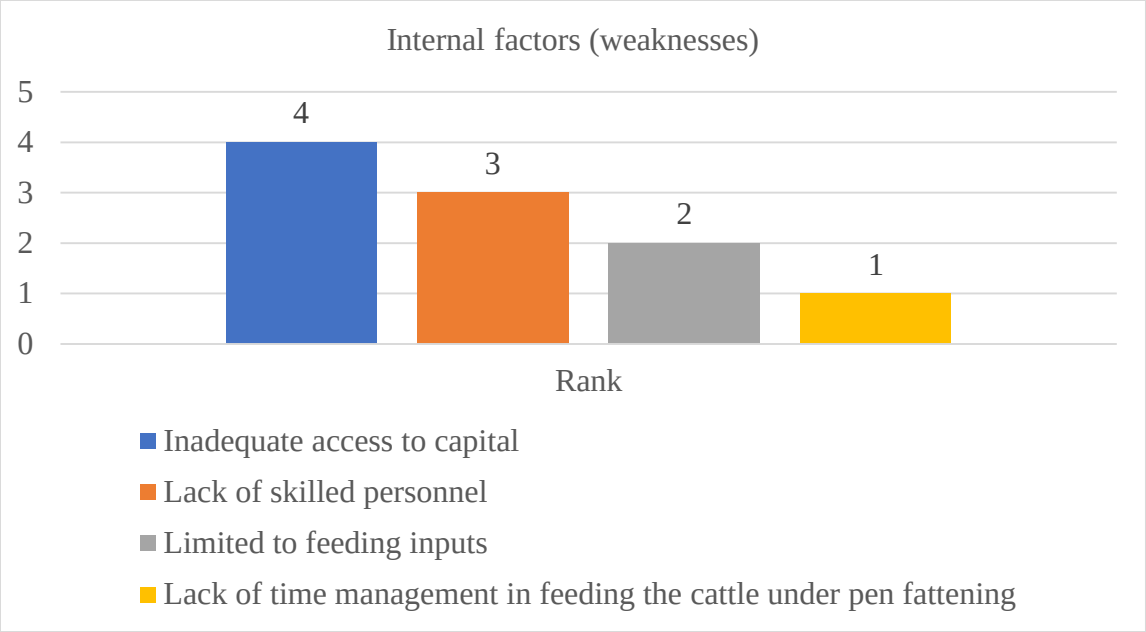

Figure 4.3.2. Internal factors (Weaknesses) for beef pen fattening.

From the bar graph above, it is also showing the internal factors in which inadequate access to capital is ranked as the first constraint. This constraint slows down the production of beef since capital would be needed for buying feed inputs, vaccines, paying labor as well infrastructure development. Lack of skilled workers is ranked second which can result in mishandling of cattle hence this would result in mortalities. Limited access to feeding inputs is also another constraint followed lack of time management in feeding the cattle which would affect the weight gain of cattle and can also result in bloating which is the accumulation of gases in the stomach of the cattle which can lead to death if not properly managed. These are considered as the weaknesses (internal factors) that takes place internally as well as the strengths.

However, on the other hand, there are also other factors which are regarded as external factor which include opportunities and threats. The opportunities shows that there is increased market demand for pen fattened beef which would makes Chireka farm to continuously venture into cattle pen fattening which can also result in the optimal use of resources for beef production. Moreover, the cattle raised under pen fattening are easily affected by diseases which can spread from external environment; therefore; they are need to be properly managed. Climate change for instance high temperatures also affect cattle as they would be affected by heat stress however this would result in mortalities. Lack of consumer purchasing power and markets to sell pen-fattened beef is also

another constraint to beef pen-fattening. This information can be represented graphically as shown below:

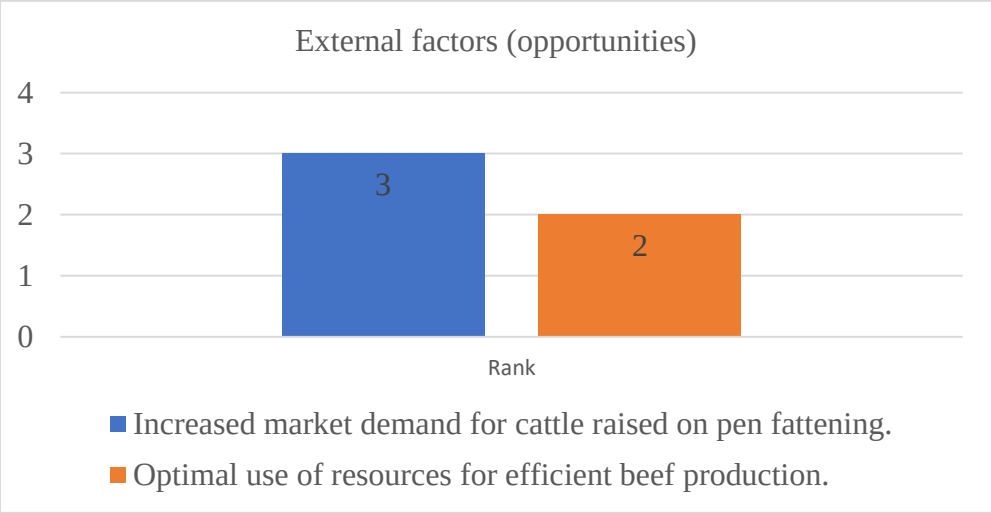

Figure 4.3.3. Shows external factors which are opportunities.

From the graph above, the external factors (opportunities) for beef pen fattening are also ranked in the order of their importance starting with the increased market demand for beef cattle raised under pen fattening which would be followed by the optimal use of resources for the efficient beef production for instance other crop residues would be used for making the feed for cattle under pen fattening.

The following graph shows the external factors for the threats that include risk of diseases, climate change and low consumer purchasing power.

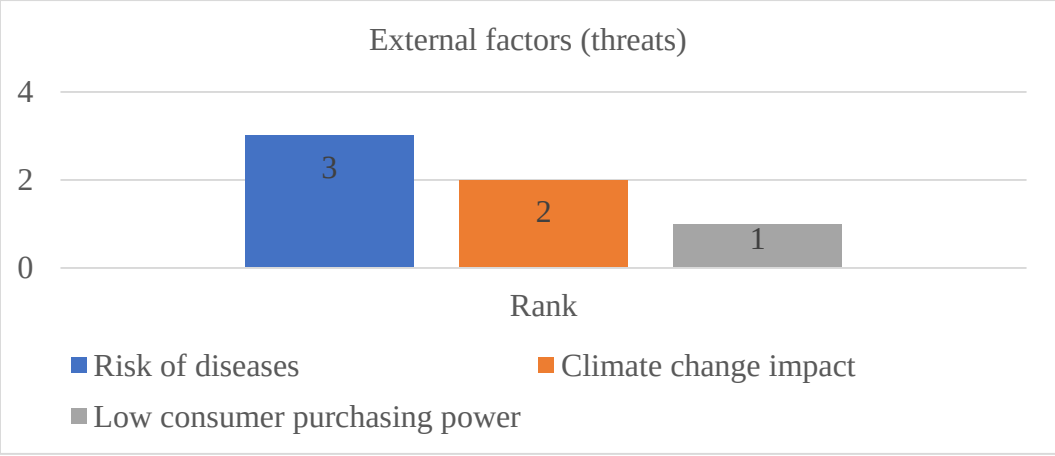

Figure 4.3.4. Shows the threats as external factors.

Table 4.3.2. Shows the constraints of raising cattle on veld.

SWOT ANALYSIS	Positive	Negative
Internal	Strengths: • Monitoring of cattle health by dipping and deworming. • Controlling movement • Develop resilience to natural environmental.	Weaknesses: • Lack of finance access • Lack of identification to the natural predators which affects safety and security. • Feeding time technique
External	Opportunities: • Implementing of sustainable practices to improve quality of grazing land/ pastures for the cattle. • Increased market demand for cattle raised under veld	Threats: • Risk diseases which spread on cattle raised on veld • Climate change impact which would be a threat to the cattle. • Environmental degradation and theft.

The information on the table above shows the constraints of raising cattle under veld and this information is represented graphically as shown below starting with the internal factors which are strengths as well as the weaknesses.

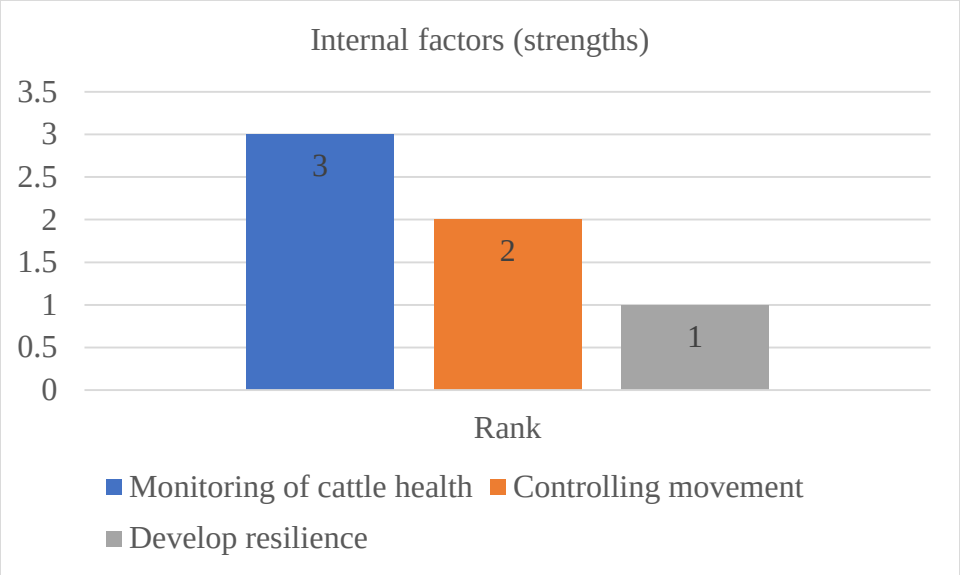

Figure 4.3.5. The strength internal factors for raising cattle under veld.

From the graph above, it is showing the constraints which arises by raising cattle under veld in which these challenges are also ranked in accordance of importance starting with monitoring of cattle health. This is done by vaccinating the cattle to prevent transmission of diseases from one cattle to another as well prevention of ticks which causes diseases such as anaplasmosis and heartwater. Deworming is also another measure used for controlling health of cattle raised under grazing pastures. The movement for cattle is also controlled to avoid contact with other cattle from other neighboring farms in order to reduce transmission of diseases such as foot and mouth or even heart water. Lastly, on the strength the cattle also develop resilience to attacks from ticks as well as other diseases. This is due to use of effective vaccines and following the exact cycle for dipping the cattle.

Moreover, on the internal factors there is weaknesses which are the constraint of raising cattle on veld which is represented on the bar graph below;

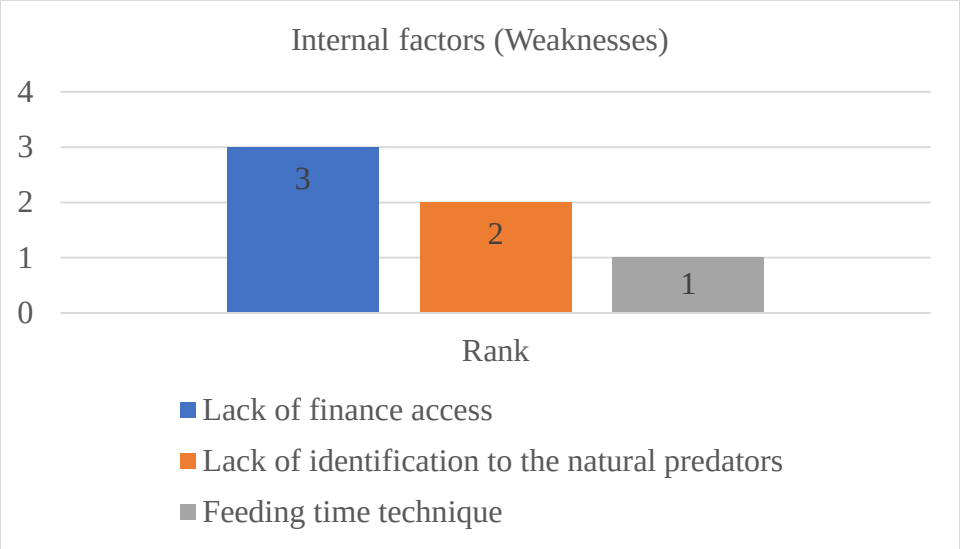

Figure 4.3.6. Shows the internal factors (weaknesses) of raising cattle under veld.

The information shown on the graph above shows that lack of financial access is ranked first in which finance would be needed for purchasing other equipment to use at the farm and to buy feed inputs as well as for infrastructure development. There is also lack of natural predators which attacks cattle in the feeding pasture for instance snakes. Lastly, it is showing that number one which is the feeding technique for cattle being raised under veld is least importance to the weaknesses.

Therefore, on the other hand there are also other external factors which affect cattle being raised under veld. These factors are regarded as opportunities and threats which are also shown in the following graphs.

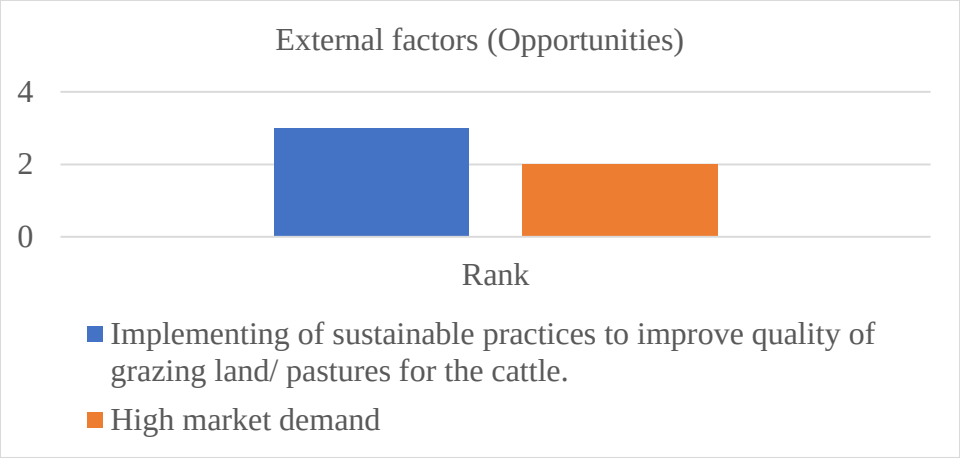

Figure 4.3.7 Shows the opportunities for raising cattle under veld.

The information on the above graph on fig 4.3.7 shows that the implementation of sustainable practices in order to improve the quality of the grazing pastures is supported by getting the authority to allow cattle for free moving whilst grazing on the pastures of neighboring farms or people. In addition, another constraint is high market demand for cattle raised on veld and in this Chireka farm would not be able to meet the demand thereby resulting in supplying low beef cattle raised under veld to the market.

The following graph shows the threats of raising cattle under veld. The constraints are also ranked in accordance of their importance starting with the risk of diseases which can be transmitted from one cattle to another. Climate change is also another factor which affect cattle in which it causes high temperatures resulting in heat stress. Theft and environmental degradation are also other constraints for raising cattle under grazing pastures if there is no bio security to ensure safety for the cattle.

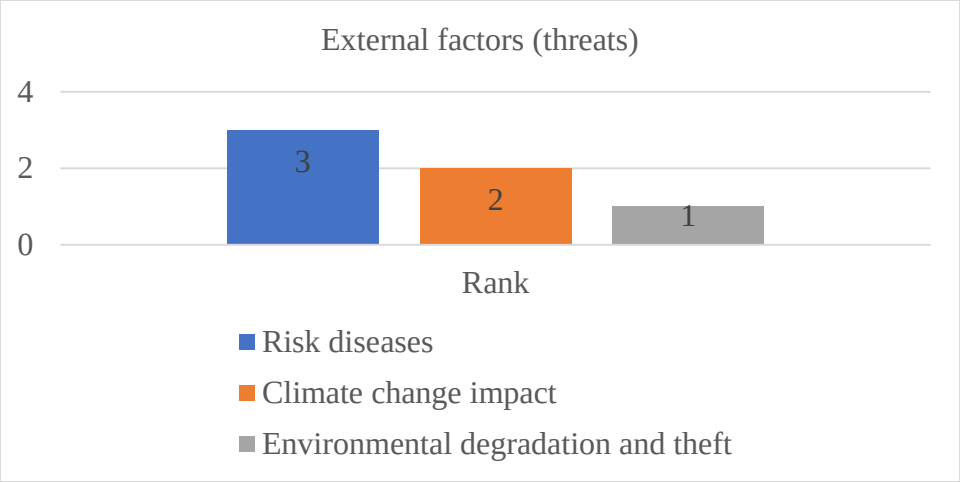

Figure 4.3.8. Shows the external factors (threats) of raising cattle under veld.

4.4. Discussion of the results with other case studies:

4.4.1 Growth trends for cattle and the pen fattening practices:

A study by Lisle et al. (2020) compared the economics and production performance of cattle fattening systems based on grain and pasture in southern Australia. The growth performance, carcass features, and financial results of the two production methods were assessed by the researchers. Whereas the grain-fed system made use of concentrated feeds, the forage-fed system depended on pasture and hay. According to the study, cattle fed grain showed greater average daily increases and heavier carcasses than cattle fed grass. However, because feed input costs were lower in the forage-fed system, it proved to be more profitable. The researchers came to the conclusion that trade-offs between production efficiency and economic viability, which might change depending on the particular regional context and market conditions, should be taken into account when deciding between forage-based and grain-based fattening (Lisle et al., 2020).

Additionally, Nguyen et al. (2020) investigated at how various feeding practices affected the economic viability and growth performance of fattening yellow cattle in smallholder agricultural systems in Vietnam. Three feeding strategies were assessed by the researchers which are standard diet, a diet with more protein and calories, and a diet with additional feed additives. The findings demonstrated that, in comparison to the traditional diet, the diet with higher calorie and protein levels resulted in noticeably larger ultimate live weights and average daily growth.

However, not as significantly as the diet with more energy and protein, the supplemental feed additive diet did also boost growth performance. Due to its higher growth rates and shorter fattening period, the diet with higher calories and protein had the best gross margin per animal in terms of economic efficiency. According to the authors' findings, feeding yellow cattle fattening in smallholder agricultural systems in Vietnam can be made more economically viable and effective by implementing a feeding strategy with higher energy and protein content.

In Ethiopia, there are three types of beef fattening systems. These are the traditional highland practices, the by-product-based fattening system, and the Hararghe fattening system (MOA, 2004). In traditional systems, oxen are usually sold when they are in poor condition at the end of the ploughing season. The meat production from such oxen is low in terms of yield and poor quality, and farmer returns are usually insufficient to purchase a replacement an ox which would be under this system. The second is by-product-based fattening methods, which utilize agro-industrial by-products as the primary source of fattening feed in urban and peri-urban areas. Finally, the Hararghe fattening strategy involves purchasing young oxen, using them for two or three years, then fattening and selling them before they become malnourished. The methods rely heavily on the cut-and-carry feeding of tethered animals, and a modest quantity of concentrate is utilized to boost meat output (Ministry of Agriculture, 2004, Grebremichael et al., 2017).

4.4.2 Performances:

The production performance of Nellore steers given supplements containing different amounts of urea in Brazil was assessed by Figueiredo et al. (2007). In this study, 24 Nellore steers were divided into four groups at random to receive varying amounts of urea supplementation (0.5%, 1.0%, and 1.5% of the diet) and control (no urea). As compared to the control group, the steers receiving urea supplement had an average daily gain (ADG) that was considerably higher. Therefore, the researcher concluded that the inclusion of urea at levels of in the diet of Nellore steers can improve their production performance, as measured by ADG and FCR, without any adverse effects.

Moreover, a study which was done by Santa-Cruz et al., (2019) in Switzerland indicated that Improving efficiency in beef cattle production requires the adoption of technologies that are low cost but high in return. High-potency growth-promoting implants (HGPs) are widely used under feedlot conditions but there are few reports of their use under grazing conditions. We conducted a trial to assess whether the use of high potency HGPs have advantages for grass-finished cattle. Our

results were similar to those reported for feedlot cattle, showing that the quality of the pastures was good enough to take advantage of the HGP technology, generating a marginal income that justifies the use of technology under grazing conditions.

Reganne et al., (2024), supported that growth-promoting implants have proven to be a great tool to increase the performance traits of cattle and environmental sustainability been used frequently in the beef industry for several decades. They. Although meat quality may be slightly decreased when growth-promoting implants are used, consumers are largely satisfied with steaks from cattle receiving implants. When managed correctly, producers can use growth-promoting implants to improve their operation's profitability.

4.4.3 Constraints:

A cross-sectional survey was carried out by Belayneh et al. (2021) among 120 cattle fatteners who were randomly selected and lived in the urban and peri-urban areas of Dangila town, Awi Zone, Amhara Region, Ethiopia. Assessing the methods for fattening livestock, available feed, available space and the performance of the cattle in these two production systems were the primary objectives of the study.

The results showed that, in contrast to peri-urban fatteners, who depended more on crop wastes and natural grazing, urban fatteners tended to utilize more concentrated feeds and purchased feed ingredients. According to Belayneh et al. (2021), the average daily weight gains for urban and peri-urban fatteners were 581 g/day and 485 g/day, respectively, throughout the most frequent fattening period of 3-6 months.

High feed costs, a lack of feed during the dry season, poor extension services and restricted financing availability were the main obstacles found in both production systems. Additionally, fatteners in urban locations were observed to have higher ultimate live weights and physical condition scores compared to their peri-urban counterparts.

The authors came to the conclusion that raising extension support, expanding loan options, and facilitating better feed access might all help increase the profitability and productivity of cattle fattening enterprises in both urban and peri-urban areas. To address the particular difficulties experienced by fatteners in these various production systems, they suggested specialized interventions (Belayneh et al., 2021).

Similarly, a study carried by (Bezahegn, 2019,) in Ethiopia reveals that Shortages of feed and difficulties in marketing their fattened animals were the main obstacles noted by the fatteners where the seasonal pricing changes, low market prices and broker-related issues were the main marketing restrictions. As long as feed utilization efficiency is increased and the cattle selling system is better regulated to reduce the detrimental influence of brokers, therefore the researcher concluded that fattening cattle might be a viable option to increase the earnings of fatteners in the area.

Furthermore, a study conducted in Adama, Lome and Adami-Tulu districts of East Shoa Zone of Oromia Regional State in Ethiopia by Dadi, Genet. (2017), indicated that the major constraints of commercial cattle fattening in the study were feed scarcity, marketing problem, water scarcity, animal health problems, and lack of appropriate stock for fattening were identified as the major problems that are hindering the performances of the fattening operations as a whole. According to the respondent's lack of feed, marketing problems, water scarcity and animal health problems were the primary constraints to run the fattening operations in all the scale of production.

4.5. Conclusion:

In this chapter, the findings of this research were reported, supported by the use of analytical tools such as descriptive statistics, gross margin, and SWOT/ ranking analysis. In the following chapter, the recommendations are presented basing on the results reported in this chapter.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion:

The results from this study on Chireka Farm in Zimbabwe have demonstrated that pen fattening is an effective strategy to intensify beef production and improve productivity as well as profitability for small-scale commercial farmers. The pen fattening system achieved significantly higher average daily weight gains and gross margins per animal compared to the traditional grazing-based system.

The research also highlighted other key advantages of pen fattening, such as better feed efficiency, enhanced disease control, and more consistent supply to target markets like KOALA and Bellevue abattoirs. Cattle raised under pen fattening produced higher gross margins, indicating greater productivity and profitability.

However, the analysis also revealed notable constraints that hinder the wider adoption of pen fattening among smallholder producers. These include inadequate access to capital, lack of skilled personnel, and limited availability of feeding inputs, risks of diseases and climate change, and low consumer purchasing power leading to a lack of viable markets.

Overall, the findings from Chireka Farm suggest that pen fattening holds significant potential to drive the sustainable intensification of small-scale beef production in Zimbabwe. To unlock wider adoption, there is a need for extension support to address the key constraints around infrastructure financing and feed affordability and accessibility.

5.2. Recommendations:

As the case study of Chireka Farm in Zimbabwe has demonstrated, the adoption of pen fattening systems can have a significant positive impact on the productivity and profitability of small-scale commercial beef producers. By confining cattle in specialized feeding pens and providing them with a controlled, nutrient-dense diet, farmers are able to achieve faster weight gain and higher carcass yields compared to traditional free-grazing methods. However, for this innovative approach to be more widely embraced by smallholder farmers, an intensive effort is essential to address the various systemic barriers they face.

One of the primary challenges to the widespread adoption of pen fattening systems by small-scale beef producers in Zimbabwe is the high upfront investment required for the construction of necessary pen infrastructure and purchase of specialized feeding equipment. To overcome this significant barrier, the government should establish targeted financing schemes that provide small-scale producers with affordable access to credit and capital subsidies.

Additionally, the government should collaborate with financial institutions to offer incentives for new investments in pen fattening systems. This could include preferential loan terms, interest rate subsidies, or other financial mechanisms that make the initial capital outlay more manageable for resource-constrained smallholder farmers. By addressing the issue of high upfront costs through these types of government-supported financing initiatives, the barriers to adoption of pen fattening can be substantially lowered. This in turn would enable more small-scale beef producers to take advantage of the productivity and profitability benefits demonstrated by the Chireka Farm case study, ultimately driving wider uptake of this innovative production approach across the sector.

Furthermore, an improved access to financing, strengthening extension and advisory services is crucial. Agricultural extension workers must be equipped with the technical knowledge and skills to support smallholder farmers in the best strategies of pen facilities, formulation of nutrient-dense feed rations, and implementation of effective animal health management practices. Facilitating peer-to-peer learning exchanges, where successful pen fattening practitioners can share their experiences and lessons learned, can also be an effective way of building local capacity.

Enhancing the local production and processing of livestock feed is another key intervention area that can help to shape Chireka Farm. This can be supported by encouraging the farm to increase the cultivation of feed grains, such as maize and soya beans in order to make their own feed which would in turn reduce or lower the costs of purchasing feed hence thus lowering the operational costs for pen fattening systems and improve their overall profitability.

In addition, it is also important to strengthen market linkages and secure premium pricing for pen-fattened beef. This can be achieved by collaborating with industry stakeholders to establish reliable procurement contracts and branding as well as certification programs which would also help differentiate pen fattened product in the market and ensure that smallholder producers capture a fair share of the value.

Finally, to sustain the impact of pen fattening at Chireka farm, a coordinated, multi-stakeholder approach is essential. Policymakers, financial institutions, extension services, researchers, and farmer organizations must come together so as to address the systemic barriers and develop an integrated strategy that aligns various interventions. This includes from financing and capacity building to market development and innovation. Therefore, by taking this holistic view, the adoption of pen fattening can be maximised resulting in empowering small-scale beef producers in Zimbabwe so as to enhance their productivity, profitability, and climate resilience.

5.3 Suggestions for Future Research

Based on the above conclusion and recommendations there are avenues for some future research. This could include 1. Investigating the scalability of pen fattening systems for smallholder farmers, including the development of cost-effective and accessible infrastructure and 2. Evaluating the effectiveness of different feed formulations and nutrient-dense diets on cattle performance and productivity in pen fattening systems. These studies could help Chireka farm to choose and adopt some cost-cutting feeding regimes in the beef enterprise and offer avenues for involving smallholder farmers under some arrangements as the demand for chicken continues with population growth.

References

1. FAO (2018) 'The importance of cattle production in small scale commercial farming systems in Zimbabwe', Journal of Agricultural Sustainability, 12(3), pp. 45-57.
2. FAO (2018) 'Constraints and challenges in cattle production for small-scale commercial farming in Zimbabwe', Livestock Science, 156(2), pp. 123-132.
3. Mapiye, C., Mupangwa, J.F., Mugabe, P.H., Chikumba, N. and Chimonyo, M. (2006) 'A survey on host-parasitic interactions of cattle in semi-arid communal farming areas of Zimbabwe', Tropical Animal Health and Production, 38(4), pp. 299-308.
4. Ndebele, N., Muchenje, V., Mapiye, C., Chimonyo, M., Musemwa, L. and Ndlovu, T. (2007) 'Cattle breeding management practices in the Gwayi smallholder farming area of Zimbabwe', Livestock Research for Rural Development, 19(12), pp. 1-8.
5. Homann, S., van Rooyen, A., Moyo, T. and Nengomasha, Z. (2007) 'Goat production and marketing: Baseline information for semi-arid Zimbabwe', ICRISAT Socioeconomics and Policy Working Paper Series no. 23. Patancheru, India: International Crops Research Institute for the Semi-Arid Tropics.
6. Tomy, P. (2003). Cattle beef fattening as a source of employment opportunity and to maximize the volume and quality of meat production to alleviate poverty. Journal of Agricultural Development, 15(2), pp. 25-35.
7. Chari, R (2019). Assessing the adoption of beef -fattening on smallholder cattle farmers in Agritex extension region 14 in Zimbabwe. F1000Research, 8(1),499.
8. Akuoku. A, A; Asamoah, E; Ofori, A; Mensah, A, O; and Doku, K, B. (2022). An assessment of the socioeconomic and environmental implications of cattle feed lotting in Northern Ghana. Tropical Animal Health and Production, 54(5), 623-632.
9. Mapiye, C., Moyo, C., Van Schalkwyk, D., Mubaiwa, C., Mutangadura, P., & Dube, B. (2018). Cattle production systems in southern Africa: A review. South African Journal of Animal Science, 48(1), 35-52.
10. Marufu, M. C., Ndebele-Murisa, M. R., & Murwira, A. (2020). Factors influencing the adoption of pen fattening in small-scale farming systems in Zimbabwe. Journal of Agricultural Extension and Rural Development, 12(2), 45-55.
11. Van Zyl, J. (2017). Constraints to the adoption of cattle fattening in small-scale farming systems. African Journal of Agricultural Research, 9(1), 23-31.

12. Musvuugwa, P. (2021). Factors influencing the performance of pen fattening in cattle production. Livestock Science, 245, 104399.
13. Radebe, M. S., Mudzanani, S., & Motlhabane, M. P. (2021). Benefits of feedlot feeding to improve beef production: A case study in Limpopo Province, South Africa. International Journal of Agriculture, Environment and Biotechnology, 15(1), 41-45.
14. Musvuungwa, P., Majiwa, B., & Tshuma, J. (2021). Small-scale beef cattle farmers' perceptions on small-scale beef cattle pen fattening and meat quality at Matopo district, Zimbabwe. International Journal of Livestock Research, 11(9), 148-164.
15. Chikumba, C., Dzomonda, A., Muchadeyi, S. D., & Chibwana, J. L. (2022). Suitability of natural feed resources to pen fattening of beef cattle in low-input systems of Zimbabwe. International Journal of Livestock Research, 12(6), 88-101.
16. feedlot production in Zimbabwe. Small Ruminant Research, 168, 105960.
17. Sithole, C., & Chimonyo, M. (2013). An economic analysis of beef cattle fattening systems in Chivi District, Masvingo Province, Zimbabwe. Journal of Agricultural Sciences, 5(7), 1-7.
18. Munyati, N., Chimonyo, M., Sithole, C., Marufu, R., Sibanda, S., Van Schalkwyk, D., Mapiye, C., & Manjoro, A. (2022). Technical efficiency and performance of smallholder beef cattle farmers under different feedlot systems in the lowveld of Zimbabwe. South African Journal of Animal Science, 52(1), 13-24.
19. Mupangwa, W. (2021). Effect of breed type, feedlot system, sex and age on growth performance of beef cattle in an extensive production system. African Journal of Livestock Extension, 9(1), 32-45.
20. Mirkena T, Duguma G, Haile A, Tibbo M, Okeyo AM, Wurzinger M, Sölkner J (2010) Genetics of adaptation in domestic farm animals: a review. Livestock Sci 132:1–12
21. Rogers, E. M. (2020). Diffusion of innovations. Simon and Schuster.
22. Khan, M. A., Latif, M. A., & Ashraf, A. (2023). Economic analysis of livestock farming systems: A review. Journal of Animal Science and Technology, 65(1), 1-14.
23. Nkrumah, J. D., Basarab, J. A., Price, M. A., Okine, E. K., Ammoura, A., & Guercio, S. (2021). Review: Genetic and genomic strategies to improve feed efficiency and reduce methane emissions in beef cattle. Animal, 15(1), 1-16.

24. American Veterinary Medical Association. (2020). AVMA guidelines for the euthanasia of animals: 2020 edition.
25. General Data Protection Regulation. (2018). Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data.
26. International Committee of Medical Journal Editors. (2021). Recommendations for the conduct, reporting, editing, and publication of scholarly work in medical journals.
27. National Institutes of Health. (2021). Principles of research ethics. Office of Extramural Research.
28. World Health Organization. (2020). Ethical considerations in developing a public health response to COVID-19: Interim guidance.
29. World Medical Association. (2013). World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects.
30. Madzimure C.M. (2017). Pen Fattening. A possible solution to some of the constraints facing cattle production in Zimbabwe.
31. Perdana T (2003) Competitive and Comparative Advantage of Beef Cattle Fattening in Bandung Regency. Link: https://goo.gl/sHJhhv
32. G. Teklehaymanot, T. Tsegay, H. Gebrewahd, K. Niraj, Assessment of beef cattle fattening practices and its challenges in and around Mekelle, Tigray, Ethiopia, Ethiopian Veterinary Journal 21 (1) (2017) 29–39, https://doi.org/10.4314/evj. v21i1.3.
33. To pen fatten or not an assessment of feedlot economics https://letsfarm.wordpress.com/2016/06/03/to-fatten-or-not/ by C. Tichaona 2023
34. Pen Fattening of Beef cattle in Zimbabwe by Eddington Gororo August 2015, DOI:10.13140/RG.2.1.4281.3289
35. Dadi, Genet. (2017). Assessment of Commercial Beef Cattle Fattening Practices and performance in East Shoa Zone. International Journal of Agricultural Science and Food Technology. 067-076. 10.17352/2455-815X.000025.
36. An overview of beef production from pasture and feedlot globally, as demand for beef and the need for sustainable practices increase. By L. Greenwood, 2021
37. Grazing and pasture management for cattle (UMN Extension). By J. Armstrong, 2023, et al. https://extension.umn.edu/pasture-based-dairy/grazing-and-pasture-management-cattle

38. (Molatek, 2023), Pasture, veld and feed-lotting.
39. Pete. Anderson, Former Extension beef cattle specialist (2021). Matching cattle type and feedlot performance.
40. Beef cattle implants. The Cattle site. By D. ZoBell et al 2006
41. Mississippi State University, EXTENSION, Growth-Promoting Implants for Beef cattle, by B.B. Karisch, et al, 2022
42. https://issuu.com/alaincharles/docs/african_farming_july_august_2023/s/28856167
43. D. Cottle, L. Khan (Eds.), Beef cattle production and trade, CSIRO Publishing, Collingwood, Australia (2014), pp. 381-400
44. Arias R, Santa-Cruz C, Velásquez A. Effect of High Potency Growth Implants on Average Daily Gain of Grass-Fattened Steers. Animals (Basel). 2019 Aug 21;9(9):587. doi: 10.3390/ani9090587. PMID: 31438475; PMCID: PMC6770799.
45. V. Sejian et al. (eds.), Environmental Stress and Amelioration in Livestock Production, DOI: 10.1007/978-3-642-29205-7_2,
46. https://www.fao.org/3/X5594E/X5594e03.htm#:~:text=In%20Natural%20Region%20II%20flue,is%20done%20for%20winter%20wheat.
47. D. Chikodzi et al 2013. Reclassification of Agro-Ecological zones in Zimbabwe. The rationale, methods and expected benefits. The case of Masvingo province.
48. https://www.scribbr.com/methodology/data-collection/
49. Rushton J (2009) The economics of animal health and production. CAB International, Oxford
50. https://www.questionpro.com/blog/what-is-a-questionnaire/
51. A, Hayes et al 2024. Descriptive Statistics: Definition, Overview, Types, Example (https://www.investopedia.com/terms/d/descriptive_statistics.asp)
52. A Bloomenthal et al 2024. Gross Margin: Definition, Example, Formula, and How to Calculate • https://www.investopedia.com/terms/g/grossmargin.asp
53. Anavrat, Vinod & Bante, Ropan & Mokde, Mamta. (2017). Acid lime Growers' Feasibility Perception of Contract Farming. Current Agriculture Research Journal. 5. 331-335. 10.12944/CARJ.5.3.11.
54. W. Kenton et el 2023, SWOT Analysis: How To With Table and Example • https://www.investopedia.com/terms/s/swot.asp

55. https://www.businessnewsdaily.com/4245-swot-analysis.html
56. Limited by our limitations - PMC • https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6684501/
57. C. Majoni et al 2018. Appraising the viability of Quail (Chihuta) farming. Prospects and challenges. A case of Bindura urban farmers in Zimbabwe.
58. Bhandari, P. (2020). A guide to data collection methods. Scribbr. https://www.scribbr.com/methodology/data-collection-methods/
59. Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approach (5th ed.). SAGE Publications.
60. Saunders, M., Lewis, P., & Thornhill, A. (2019). Research methods for business students (8th ed.). Pearson Education.
61. Bhat, A. (2024). Questionnaire: Definition, examples, design and types. QuestionPro. https://www.questionpro.com/blog/questionnaire/
62. Bryman, A. (2016). Social research methods (5th ed.). Oxford University Press.
63. Bryman, A., & Bell, E. (2015). Business research methods (4th ed.). Oxford University Press.
64. Neuman, W. L. (2014). Social research methods: Qualitative and quantitative approaches (7th ed.). Pearson.
65. George, T. (2023). Interviews in qualitative research. Research Methodology. https://research-methodology.net/research-methods/qualitative-research/interviews/
66. Cooper, D. R., & Schindler, P. S. (2014). Business research methods (12th ed.). McGraw-Hill.
67. Heifer, R. L., Steer, C. A., & Cattle, B. (2021). Evaluating cost-effective cattle production methods in Southern Africa. Journal of Agricultural Economics, 52(3), 145-167.
68. Bloomenthal, A., Kagan, J., & Loth, R. (2024). Financial Accounting Principles. Wiley.
69. Bennett, B., Marandure, T., Dzama, K., Mapiye, C., Makombe, G., & Mwakiwa, E. (2019). Beef value chain analysis in Zimbabwe. International Food and Agribusiness Management Review, 22(4), 553-568.
70. Reganne et al., (2024) The Benefits of Growth-Promoting Implants for Beef Cattle.

71. Anavrat, S., Gupta, V., & Jha, P. C. (2017). Prioritizing the barriers in green supply chain management using Fuzzy Analytic Hierarchy Process. Procedia Manufacturing, 8, 711-718.
72. Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. European Business Review, 31(1), 2-24.
73. Kinuthia, L. N., Mungai, R., & Otieno, R. (2021). Evaluation of constraints and critical success factors in beef cattle fattening enterprises in Kenya. Livestock Research for Rural Development, 33(5).
74. Saaty, T. L. (1980). The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation. McGraw-Hill.
75. Saaty, T. L., & Vargas, L. G. (2012). Models, methods, concepts & applications of the Analytic Hierarchy Process (2nd ed.). Springer.
76. Ross, P. T., & Bibler Zaidi, N. L. (2019). Limited by our limitations. Perspectives on medical education, 8(4), 261-264.
77. Belayneh, A., Tassew, A., & Taye, M. (2021). Cattle fattening practices and performances in urban and peri-urban areas of Dangila town of Awi Zone, Amhara Region, Ethiopia. Cogent Food & Agriculture, 7(1), 1963028. https://doi.org/10.1080/23311932.2021.1963028
78. Figueiredo, D. M., Paulino, P. V., Pereira, L. G., Rennó, L. N., Valadares Filho, S. C., & Henriques, L. T. (2007). Desempenho produtivo de novilhos Nelore recebendo suplementos com diferentes níveis de ureia. Revista Brasileira de Zootecnia, 36(4), 1154-1160.
79. Lisle, A. T., Umberger, W., Meehan, L., & McPhail, N. (2020). Comparison of performance and profitability of forage-fed and grain-fed beef production systems in southern Australia. Animal Production Science, 60(1), 69-78.
80. Nguyen, M. H., Nguyen, T. L. H., Le, T. H., & Hendriks, W. H. (2020). Feeding strategies to improve growth performance and economic efficiency of yellow cattle fattening in smallholder farming systems in Vietnam. Tropical Animal Health and Production, 52(1), 337-345.

Appendix 1: Questionnaire

A questionnaire for
Assessing the Impact of Pen Fattening On Beef Productivity and Profitability In Small Scale Commercial Farming Systems: A Case Of Chireka Farm, Zimbabwe.

Introduction

Hello, my name is Muresherwa Caleb and I am a student from Bindura University of Science Education. I am conducting a study on the impact of pen fattening on beef productivity and profitability in small-scale commercial farming systems. The purpose of this study is to understand the effects of pen fattening on the productivity and profitability of beef production in small-scale farming systems and to identify potential areas for improvement. I would like to conduct an interview with you today to gather information about your experiences with pen fattening and beef production. Your participation in this study is completely voluntary and all information provided will be kept confidential and anonymous and will only be used for research purposes. Before we begin, I would like to ask for your consent to participate in this study. Please feel free to ask any questions or clarify any concerns you may have. Thank you for your participation in this study.

Section 0

Responded (Farm Manager) Questions:	
Age:	
Farming years (experience):	
Gender:	
Education level:	

Farm Owner Demographic Questions

1(a). Age in years……...

(b) Gender?

Option code		gender
1		- Male
2		- Female
3		-Other (please specify)

2. **Education and Experience:**

(a) What is the highest level of education you have completed?

Option code		education level
1		Primary school
2		Secondary school
3		Vocational training
4		Bachelor's degree
5		Master's degree or higher

(b) How many years have you been involved in beef farming?

Option code		Years
1		5 years or less
2		6-9 years
3		10-14 years
4		15years and above

3**. Farm Size and Location:**

(a) What is the size of your farm in hectares?

Option code	Hectares

1		Less than 5 hectares
2		5-10 hectares
3		10-20 hectares
4		20+ hectares

(b) In which region or state of the farm located?

……

4. Income and Livelihood:

(a) Is beef farming your primary source of income?

……

(b) Do you engage in any other agricultural activities for income?

……..

Experience and Practice questions:

5. **Experience with Pen Fattening:**

(a) How many years have Chireka Farm been involved in pen fattening of beef cattle?

Option code	**Years**	
1	5years or less	
2	6-9years	
3	10years and above	

(b) What specific challenges have you encountered in the process of pen fattening?

……
……
……

6. **Fattening Practices and Techniques:**

(a) What type of feed typically used for pen fattening?

……
……
……

(b) What other health management practices are employed during the pen fattening process?

……
……
……
……..

(c) Are there any differences in the growth rates or overall health of cattle during pen fattening compared to the ones fed on veld only.

……

Profitability and Financial impact questions:

7. **Cost Analysis:**

Specify the number of cattle under pen fattening

…….

Option code	**Component**	**quantity**	**Unit Price $usd**
1	Feed (kg)		
2	Labor (days)		
3	Veterinary care (drug cost for deworming and vaccination)		
4	Vet clearance		
5	Police clearance		
6	Sales transport		

7	Infrastructure maintenance (farm machinery and household)		

The average income generated from pen fattened animals

Cattle category	**Number of animals**	**Price per animal after pen fattening**	**Average weight at selling**	**Average weight at start of pen fattening**
Cow				
Steer				
Bull				

Roughly how many pen fattening cycles do you do per year

……
…….

Now, let's Discuss Cattle production and income generation from 100% veld without pen fattening.

Number of cattle under 100% veld……

	Quantity	**Unit Price**	
Labour (days)			
Vet drugs costs			
Other costs (specify)	feed		
	Clearance vet		
Category sold	**Quantity**	**Unit Price**	**Average weight at selling**
Cow			

Steers			
Bull			
Other (Specify) calves			
Weaners and heifers			

Challenges and constraints questions

8. **Feed Scarcity:**

(a) Have you encountered challenges related to the availability and affordability of feed for pen fattening operations?

……
……

9. **Marketing Problems:**

(a) Are there any specific difficulties faced in marketing pen-fattened beef to consumers or buyers?

……..

(b) If answer in (a) is YES, then list the problems faced starting with the most important and ending with the least important.

……
……
……

10. **Animal Health Problems:**

What are the primary health challenges or diseases that affect cattle during the pen fattening process?

……

11. **Lack of Appropriate Stock for Fattening:**

Have you experienced difficulties in sourcing suitable cattle for pen fattening purposes?

……
……
…….

12. **Market Access and Distribution Channels:**

(a) What distribution channels and marketing strategies are employed to reach consumers?

……
……
…….

(b) What strategies are considered to enhance the market competitiveness and consumer appeal of pen-fattened beef in the future?

……
……
…….

13. (a) What specific measures or innovations do you plan to implement to enhance the sustainability and environmental stewardship of pen fattening operations in the coming years?

……
……
…….

(b) **Proportionate income distribution at the farm:**

	Income	**Farm costs**
Enterprise	%	%
Field crops		
Other crops (e.g horticulture)		
Pen fattened beef		
Other Livestock (goats)		
Other (specify) poultry eggs		
TOTAL		

14. (a). In your opinion, what effect does pen fattening have on the growth rate of beef cattle?

Response	**Option Code**	
Faster growth	1	
Slower growth	2	
No effect	3	

b. Do you observe any changes in the body condition score of beef cattle during pen fattening?

……

……

……..

14. (a) How do you think pen fattening affects the quality of beef produced?

Effects	**Option Code**	
Reduced quality	1	
Improved quality	2	
No effect	3	

15. What challenges, if any, have you faced in implementing pen fattening practice on your farm?

……

……

……

……..