ANALYSIS OF FACTORS INFLUENCING FARMER PARTICIPATION IN HAY FODDER MARKETING FOR IMPROVED PERFORMANCE OF MARKET OUTLETS IN LAIKIPIA COUNTY, KENYA

MUTUKU STEPHEN MUEMA

A Thesis Submitted to the Graduate School in Partial Fulfillment of the Requirements for the Master of Science Degree in Agrienterprise Development of Egerton University

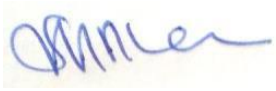
EGERTON UNIVERSITY

AUGUST, 2024

DECLARATION AND RECOMMENDATION

Declaration

This thesis is my original work and has not been presented in this University or any other for the award of a degree.

Signature:  Date: 12th April 2024

Mutuku Stephen Muema

KM23/14602/18

Recommendation

This thesis has been submitted with our approval as University supervisors.

Signature: Date: 2nd July 2024

Prof J. K. Lagat, PhD

Department of Agricultural Economics and Agribusiness Management,

Egerton University.

Signature: Date: 4th June 2024

Dr. Florence A. Opondo, PhD

Department of Commerce,

Laikipia University.

COPYRIGHT

DEDICATION

I dedicate this work to my mother (Elizabeth Mutuku), wife (LucyAnn Ngari), Children (Jabin Amani and Keren Zawadi), family and friends for their sincere prayers, inspiration and support.

ACKNOWLEDGEMENTS

I sincerely thank the Almighty God for His bounty providence throughout the entire period of study. I am grateful to Egerton University and Department of Agricultural Economics and Agribusiness Management for the opportunity to study a Master of Science in Agrienterprise Development. Special gratitude goes to my supervisors Prof. J.K Lagat and Dr. Florence Opondo, for their academic advice, patience, guidance and support in my research work. Their tireless support cannot go unappreciated.

I am immensely indebted to CESAAM a World Bank funded programme who fully funded my studies. The scholarship is deemed as a highly cherished treasure without which it wouldn't have been possible to realize my dream: a Master's degree.

Special thanks to my dear mother, wife, brothers, sisters and colleagues for their prayers, encouragement and support.

May the Lord bless you all.

ABSTRACT

The increased demand for livestock products due to the growing human population has led to a rise in demand for fodder in Kenya. Fodder, thus, offers viable business opportunities for agripreneurs in the country. In order capitalize on the available market outlets and the rising demand for fodder in Laikipia County and its environs, farmers' involvement in fodder business activities are not clearly understood. The general aim of this study was to contribute to the up-scaling of fodder production and marketing through analysis of factors that influence farmer participation in fodder markets for improved performance of market outlets in Laikipia County. The specific objectives were to: map the fodder markets, determine the factors influencing decisions, and commercialize fodder and to analyze the performance of fodder market outlets. Data was collected from 204 randomly selected fodder farmers based on a list of 769 farmers provided by the ASDSP II Laikipia and analyzed using STATA software. Functional and institutional analytical approaches were used to map the fodder markets. The Univariate and Multivariate Probit models were used to determine the factors influencing decisions to commercialize fodder. Lastly, market margin analyses were conducted to measure the performance of fodder market outlets. Findings revealed that the fodder market system holistically consisted of input providers, fodder farmers, fodder traders, fodder end-users and support/enabling institutions. The factors significantly influencing farmer participation in fodder markets were age, marketing costs, market agreements, market information access, credit access and proactivity. Further, the choice of local livestock farmers, local traders and buyers from other counties' outlets was significantly influenced by age, experience, commercialization index, fodder quality, marketing costs, market agreement, distance to the nearest market, market information, proactivity and price. Finally, the market margin analyses pointed to favorable, attractive and viable performance of the fodder outlets. Therefore, government policies that seek to enhance collective action and networking, create business as well as address bottlenecks in various nodes of the market should be explored. Interventions to stimulate market information access, improved feed quality, market linkages and reduced marketing costs are also recommended. In order to capitalize on the existing fodder demand and viability, interventions and policies for financial and technical support for investment, formalization of the fodder market as well as market cost reduction are highly recommended.

TABLE OF CONTENTS

DECLARATION AND RECOMMENDATION ..... **ii**
COPYRIGHT ..... **iii**
DEDICATION ..... **iv**
ACKNOWLEDGEMENTS ..... **v**
ABSTRACT ..... **vi**
LIST OF TABLES ..... **x**
LIST OF FIGURES ..... **xi**
LIST OF ABBREVIATIONS /ACRONYMS ..... **xii**
CHAPTER ONE **1**
INTRODUCTION **1**
1.1 Background information 1
1.2 Statement of the problem 4
1.3 Objectives 4
1.3.1 General objective: 4
1.3.2 Specific objectives: 4
1.4 Research questions 5
1.5 Justification of the study 5
1.6 Scope and limitations of the study 5
1.7 Operational definition of key terms 6
CHAPTER TWO **7**
LITERATURE REVIEW **7**
2.1 The mapping technique for analyzing fodder market actors and activities in the ASALs of Kenya. 7
2.2 Trends of fodder production and marketing in ASALs of Kenya. 9
2.3 Factors influencing decisions to commercialize fodder in the ASALs of Kenya. 11
2.4 Performance of fodder market outlets in the ASALs of Kenya 13
2.5 Theoretical framework 15
2.5.1 The expected utility theory 16
2.5.2 The profit maximization theory 16
2.5.3 Achievement theory of entrepreneurship 17

2.6 Conceptual framework 17
CHAPTER THREE 19
METHODOLOGY 19
3.1 The study area 19
3.2 Target population 20
3.3 Sample size determination 20
3.4 Sampling procedure 21
3.5 Data collection 21
3.6 Analytical framework 22
3.6.1 Objective one: To map the fodder markets for Laikipia County. 22
3.6.2 Objective two: To determine the factors influencing decisions to commercialize fodder in Laikipia County. 22
3.6.3 Objective three: To analyze the performance of fodder market outlets in Laikipia County. 27
CHAPTER FOUR 29
RESULTS AND DISCUSSIONS 29
4.1 Mapping of fodder markets 29
4.1.1 The fodder market map 29
4.1.2 Input provision 31
4.1.3 Fodder production 32
4.1.4 Fodder farmer characteristics 33
4.1.5 Fodder trade 36
4.1.6 Fodder end-markets 40
4.1.7 Institutional support in fodder production and marketing 40
4.1.8 Challenges in fodder production and marketing 43
4.2 The determinants of farmers' commercial decisions in fodder marketing in Tigithi ward. 45
4.2.1 The determinants of farmers' fodder market participation 45
4.2.2 The determinants of farmers' choice of fodder market outlets 48
4.3 Performance of fodder market outlets 54
4.3.1 Fodder market margin analysis 54
4.3.2 Marketing costs and net market margins 55

CHAPTER FIVE 57
CONCLUSIONS AND RECOMMENDATIONS 57
5.1 Summary 57
5.2 Conclusions 57
5.3 Recommendations 58
5.4 Suggestions for further research 59
REFERENCES 60
APPENDICES 70
Appendix A: Questionnaire for Fodder Farmers 70
Appendix B: FGD Guide/Check list to map fodder market activities 74
Appendix C: Interview guide for Key Informant Interview (KII) 76
Appendix D: Multicollinearity test for the Probit model 76
Appendix E: Probit regression for market participation decision results (coefficients) 77
Appendix F: Multicollinearity test for the Multivariate Probit model 77
Appendix G: Predictive probability for the fodder market outlets 78
Appendix H: Multivariate Probit regression for the choice of fodder market outlets 78
Appendix I: Research License (NACOSTI permit) 81
Appendix J: Publication (Abstract Page) 82

LIST OF TABLES

Table 3. 1: Description of variables used in the empirical models. 26
Table 3. 2: Variable costs incurred in fodder marketing. 28
Table 4. 1: Fodder production characteristics in Tigithi ward……..……32
Table 4. 2: Age, household size and production experience of fodder farmers in Tigithi ward... 33
Table 4. 3: Gender, education levels and marital status of fodder farmers in Tigithi ward 34
Table 4. 4: Source of livelihood, land acquisition and sources of labour in Tigithi ward..... 35
Table 4. 5: The role of support institutions in fodder production and marketing in the study area 41
Table 4. 6: Measurements of goodness of fit for the Probit regression. 46
Table 4. 7: Marginal effects of decision for market participation by fodder farmers in Tigithi ward..... 46
Table 4. 8: Results of the Multivariate Probit model for the choice of fodder market outlets 49
Table 4. 9: Prices and market margins for a bale of hay fodder in Tigithi ward 54
Table 4. 10: Marketing costs and net market margins for a bale of hay fodder. 55

LIST OF FIGURES

Figure 2. 1: Conceptual Framework…….18
Figure 3. 1: Map of Tigithi ward, Laikipia central sub-county…….……20
Figure 4. 1: Fodder market map in the study area……..……...30
Figure 4. 2: Percentage of fodder farmers sourcing inputs from input providers. 31
Figure 4. 3:Modes of payment for fodder 37
Figure 4. 4: Reasons why farmers sold fodder to traders and brokers. 38
Figure 4. 5: Volumes of hay fodder sold through different channels 39
Figure 4. 6: Challenges to fodder production and marketing in Tigithi Ward. 44

LIST OF ABBREVIATIONS /ACRONYMS

AAK	Action Aid Kenya
ASALs	Arid and Semi-Arid Lands
ASDSP	Agricultural Sector Development Support Programme
ASTGS	Agricultural Sector Transformation and Growth Strategy
AU-IBAR	African Union Inter-African Bureau for Animal Resources
CAADP	Comprehensive African Agriculture Development Programme
CAGR	Compound Annual Growth Rate
CBOs	Community Based Organizations
CIDP	County Integrated Development Plan
CIGs	Common Interest Groups
FAO	Food and Agriculture Organization of the United Nations
FGDs	Focus Group Discussion
GDP	Gross Domestic Product
GM	Gross Margins
GoK	Government of Kenya
HLPE	High Level Panel of Experts on Food Security and Nutrition
IGAD	Intergorvernmental Authority on Development
KALRO	Kenya Agriculture and Livestock Research Organization
KARI	Kenya Agricultural Research Institute
KCDMS	Kenya Crops and Dairy Market Systems
KEPHIS	Kenya Plant Health Inspectorate Services
KIIs	Key Informant Interviews
KVDA	Kerio Valley Development Authority
LCDA	Laikipia County Development Authority
MENA	Middle East and North America
MICCA	Mitigation of Climate Change in Agriculture
MoALFI	Ministry of Agriculture, Livestock, Fisheries and Irrigation
MTEP III	Third Medium Term Plan
NDMA	National Dry-lands Management Authority
NGOs	Non-Governmental Organizations

RAE	Rehabilitation of Arid Environments Charity Trust
REGAL IR	Resilience and Economic Growth in Arid Lands- Improving Resilience
SDG	Sustainable Development Goal
SNV	Netherlands Development Organization
VCG	Value Chain Groups
WFP	World Food Program

CHAPTER ONE
INTRODUCTION

1.1 Background information

Feed and fodder are essential requirements in livestock production accounting for 60% to 70% of total cost of livestock production (AU-IBAR, 2023). Sustainable support of livelihoods by the livestock sub-sector is highly dependent on supply of adequate quality livestock feeds throughout the year. Production of adequate amounts of milk, meat, eggs, honey and other foods of animal origin to meet the demands of the growing human population, require substantially high amounts of quality feeds, therefore feed is the mainstay of the livestock industry. Feed and fodder deficiencies limit livestock productivity in pastoral and agro-pastoral production systems in the developing countries *(*Auma *et al*., 2018).

Fodder production and marketing at the global level varies widely by country, depending on the cropping pattern, climate, social-economic conditions, and type of livestock kept. According to Alltech (2020), global feed production in 2019 was 1126.5 million metric tonnes (MT) and the leading producers were; USA, China, Brazil, Russia, India, Mexico, Japan, Spain and Germany with a total production of 653.5 million MT of feed. HLPE (2016), reported that permanent meadows and pastures represent 26 percent of global land area and feed crops account for one-third of global arable land.

The rising demand for livestock products to meet the needs of the growing world population is driving the market for forage feeds (Mordor Intelligence, 2023). Accordingly, the forage feed market is expected to record a compound annual growth rate (CAGR) of 4.5% during the period 2023 – 2028 with North America accounting for the largest forage feed market share and Asia Pacific being the fastest growing feed market. Other major global forage feed markets are Europe, India and China. Additionally, IGAD (2017), revealed that there existed a high domestic, regional and international demand for fodder and typical examples of regional and international demand for feed include the export quarantines of Djibouti and Somalia as well as in the Middle East and North America (MENA) countries.

In 2014, three East African countries, namely; Kenya, Uganda and Tanzania had a demand for animal feeds amounting to six million MT against a production of 1.7 million MT representing a deficit of 4.3 million MT (Kilimo Trust, 2017). The production figure in the region was expected to increase by 60% in 2020 hence reducing the deficit gap. Kenya was the leading in demand

because it had the most dynamic animal feed industry in the region. Auma *et al.* (2018) observed that Kenya suffered an annual fodder deficit of over 3.6 billion bales of hay out of a total requirement of 5.5 billion bales (Mureithi, 2018). GoK (2019a) established that the actual annual feed production for Kenya was 25 million MT of dry matter (DM) against a requirement of 55 million MT. Recent statistics indicate that Kenya had a 60% feed deficit representing approximately 2.6 billion bales of fodder. The deficit was attributed to inadequate fodder production and conservation, overgrazing, poor land management practices and climate change (AU-IBAR, 2023). The most common fodder types grown in Kenya include Napier grass, *Boma* Rhodes, Lucerne, and natural pastures.

The livestock sector plays an integral role in contributing to Kenya's economy. It contributes 12% of the national GDP, 42% of the agriculture GDP and employs above 50% of the agricultural labour force (GoK, 2019b). Therefore, the Government of Kenya recognizes the livestock sub-sector as a key driver to economic growth in its Vision 2030, Agricultural Sector Transformation and Growth Strategy (ASTGS) and Draft National Livestock Policy (GoK, 2018; GoK, 2019b; MoALFI, 2019). Despite this outstanding importance, the livestock sector suffers varied pressures including maintaining sustainable production systems. The sector is negatively affected by fodder and feed scarcity which arises from erratic rainfall and changing land use patterns resulting in massive livestock losses.

The Arid and Semi-Arid Lands (ASALs) play a major role in fodder production and when well utilized; they could play a key role in reducing the current fodder scarcity in the country. Eighty nine percent (89%) of Kenya's land is classified as ASAL which is ideal for livestock production with about 70% of the national livestock herd valued at KES. 70 billion and is home to some 14 million pastoralists (GoK, 2012a). Pastoralist in ASALs experience recurrent and prolonged droughts which result to frequent fodder scarcity. Njarui *et al.* (2016) observed that a relatively high percentage of farmers (79%-99%) experience shortage of fodder.

Recurrent fodder scarcity results to massive livestock deaths year after year. For instance, due to 2008-2011 drought deaths of domestic animals were estimated at KES 56.1 billion (GoK, 2012b; Mureithi, 2018). To manage fodder scarcity, farmers reportedly engage in roadside grazing, buying off-farm and commercial feeds and feed conservation (Nangole *et al*., 2013).

Ouma (2017) revealed that due to the collapse of customary resource management, recurrent droughts and invasive weeds, pastoralists in the ASALs, Laikipia included, seasonally

migrate in search of pastures and water contributing to the exhaustion of pasture over time. To overcome this challenge, the Government through Kenya Agriculture and Livestock Research Organization (KALRO) introduced several fodder improvement technologies in the ASALs which included; conservation of natural pasture, range pasture reseeding among others (Lugusa *et al.*, 2016; Manyeki *et al*., 2015; Ouma, 2017). These technologies were aimed at enhancing feed availability during the dry season further improving production and diversification of household incomes through the sale of hay and grass seed.

Pastoral communities in the ASALs are venturing into fodder production to avert massive livestock deaths as well as selling the surplus to stabilize household incomes (Bayala *et al.*, 2014; Lugusa *et al.*, 2016). Fodder production and marketing has gained popularity in most ASALs due to the rising demand for livestock feeds. This suggests that fodder production and marketing present an entrepreneurial opportunity that needs to be up-scaled due to the expanding demand for fodder.

The increasing demand for fodder has led to emergence of a commercial fodder sector where small holder farmers are producing hay and selling to other farmers as well as fodder seed to other producers.

There are a number of the fodder production systems that can be identified namely, backyard fodder production, under-sowing and inter-planting, contour forage strips, forage crop production, stock exclusion/ forage bank, permanent pastures and over-sowing among others (Fekade, 2019; SNV, 2017). Auma *et al*. (2018) affirmed that commercial fodder and fodder seed production, bulking, transportation and trade, are viable business opportunities which have not been fully exploited in Kenya.

Ohmstedt *et al*. (2018) revealed that hay production and marketing is a promising business in the North Rift and Laikipia County where about 5000 hay farmers had been counted in 2016. ASDSP II-Laikipia (2019) established that there were 2151 fodder farmers in Laikipia County cultivating some 23,380 acres of hay yielding 2,686,324 (15kg) bales of hay valued at KES. 537, 264, 800. Of the total yield some 1,136,744 bales of hay were sold at an average price of KES. 200 giving revenue of KES. 227,348,700. In Kinangop, Nyandarua County, hay is traded in 14-16 kg bales sold at off farm-gate price of between KES. 225 – 300. Laikipia County is a home of ranches and major feedlots in Kenya. The County has identified needs and planned initiatives to scale up fodder and pasture establishment by about 5000 acres while stressing range reseeding (CIDP,

2018; MoALFI, 2019). Many fodder types are produced and marketed in Laikipia County but the main forage product in the market is hay fodder.

In this study, it is recognized that fodder production is market oriented with potential that could be adequately exploited to yield immense returns to the farmers. A scrutiny of the fodder market activities and whether farmers participate in these markets in response to emerging opportunities could help in providing solutions to constraints as well as exposing the potential business opportunities.

1.2 Statement of the problem

The increased knowledge in the management of livestock to meet the growing demand for their products such as meat and milk has led to an increase in derived demand for fodder in Laikipia County and its neighborhoods. The increased demand for fodder has in turn motivated public and private investment in fodder business activities. With the county carrying about half the number of fodder farmers in the North Rift region, the enterprise offers viable business opportunities for the farmers. In order to satisfy the market demand, commercial fodder farming is rapidly expanding and there is an emerging market formation involving different market actors engaging in various commercial fodder activities. Coupled with the county initiatives to upscale fodder production among farmers, it was unclear whether farmers were engaged in fodder business activities such as input supply, production, bulking, baling, transportation and trade in order to exploit the rising demand. However, the success of these activities is depended on the degree of performance of the fodder market outlets, which was yet to be determined. This study was therefore, necessary to fill this knowledge gap.

1.3 Objectives

1.3.1 General objective:

The general objective of this study was to contribute to the up-scaling of fodder production and marketing through analysis of factors that influence farmer participation in fodder markets for improved performance of market outlets in Laikipia County.

1.3.2 Specific objectives:

i. To map the fodder markets for Laikipia County.
ii. To determine the factors influencing decisions to commercialize fodder in Laikipia County.
iii. To analyze the performance of fodder market outlets in Laikipia County.

1.4 Research questions

i. Who are the players and what fodder market activities are conducted in Laikipia County?
ii. What are the factors that influence the decisions to commercialize fodder in Laikipia County?
iii. How do fodder market outlets perform in Laikipia County?

1.5 Justification of the study

The study is important for Laikipia County because a holistic and comprehensive understanding of the fodder market activities is the linchpin step in making viable fodder business decisions. Information on determinants of farmers' commercial decisions in fodder marketing is indispensable for making sustainable development policy frameworks that maximize entrepreneurial growth. An understanding of the performance in terms of market margins for various fodder market outlets is crucial for product and market planning for increased returns, increased farm incomes and improved livelihoods.

Improved fodder business activities will immensely contribute to the Laikipia County Integrated Development Plan, Bottom-up Economic Transformation Agenda(Agricultural Transformation pillar), Vision 2030's Third Medium Term Plan (MTEP III) economic pillar to increase value in livestock subsector, Agricultural Sector Transformation and Growth Strategy (ASTGS), Comprehensive African Agriculture Development Programme (CAADP) Compact, African Agenda 2063 and Second Sustainable Development Goal (SDG 2) on Zero Hunger.

1.6 Scope and limitations of the study

The study was carried out in Tigithi Ward of Laikipia Central sub-County. The scope was fodder market structure, determinants of fodder farmer commercial decisions and performance of the fodder market outlets in the year 2020. It involved fodder agripreneurs, service providers and the enabling environment. The major limitations of the study were first, the expansive area involving long distances to be covered during data collection. This was overcome by increasing the number of enumerators. Second was the poor responses by the actors. This was improved by convincing respondents that the results would be used to design policies which would enhance their activities.

1.7 Operational definition of key terms

Agripreneurs: Owners of agri-enterprises. In this context it refers to persons engaging in fodder activities as a business or for commercial purposes (input suppliers, producers, traders, bulkers, balers and transporters).

Arid and semi-arid lands (ASALs) - This refers to the 29 moderately dry to dry counties of Kenya characterized by periodic droughts, unreliable rain and intermittent water scarcity.

Decisions to commercialize: This refers to fodder farmers' resolution to engage into market-oriented fodder production and subsequent choice of market outlet to sell to for financial gain.

Enablers: Refers to stakeholders in the fodder market that provided the suitable policy and legal business environment to facilitate fodder production and marketing.

Fodder market outlet: This refers to customers or buyers of fodder produced in Tigithi Ward.

Fodder: Also, Hay Fodder. In this context it refers to hay produced, harvested and sold with the aim of providing feed to livestock.

Mapping: Visual representation of the sequence of market functions that fodder goes through from input provision to final consumption.

Market margin: This refers to the difference between value of fodder received by farmers at farm gate and value of fodder paid by the customers/buyers at the market level.

Performance: This refers to the measure of the results of fodder market outlets in terms of gross market margins.

Supporters: Refers to stakeholders in the fodder market that provide both financial and technical services to facilitate fodder production and marketing.

CHAPTER TWO
LITERATURE REVIEW

This chapter outlines previous studies containing information related to the subject matter of this study. The reviewed literature embraces the mapping technique for analyzing fodder market actors and activities, trends of fodder production and marketing, factors influencing decisions to commercialize fodder and performance of fodder market outlets in the ASALs of Kenya.

2.1 The mapping technique for analyzing fodder market actors and activities in the ASALs of Kenya.

There are many techniques for analyzing markets. Mapping, which is one of the techniques, is a visual representation of the sequence of functions that a product passes through from input provision to final consumption showing the actors/operators, service providers and enabling environment and how these links with each other. According to Stein and Barron (2017), mapping involves joint analysis, interpretation and discussions of opportunities and constraints for chain upgrading.

A value chain is the full range of business activities required to bring a product or service from conception, through the different phases of transformation, delivery to consumers, and final disposal after use. It refers to all activities that are undertaken in transforming raw materials into a product that is sold and consumed. These include the direct functions of input supply, primary production, collection, processing, wholesaling, and retailing, as well as support functions such as, financial services, transport, packaging and advertising. The performers of these activities include: Input suppliers, farmers, traders, processors, transporters, wholesalers, retailers and service providers (GTZ, 2007; Kaplinsky & Morris, 2002; Webber & Labaste, 2007).

Studies conducted in the past identify two approaches to map fodder business activities. First, Stein and Barron (2017) applied the social network approach, to present interactions and flows between actors in the fodder enterprise in the Sahelian agro-ecological zone of Burkina Faso. Secondly, Lugusa *et al*. (2016) used the functional and institutional approach to map the grass seed value chain in Baringo County. Here, institutional analysis was used to represent the chain actors and their functions, while the functional analysis presented the forms of interactions between the actors. The former approach which is in its early stages having been used in a few cases is suitable when the chain is a network rather than a single vertical chain as is in the latter. Stein and Barron

(2017) stated that mapping helped to understand constraints and opportunities faced by market actors and that this could be used to inform policy and practice. In addition, Stein and Baron's visual network approach presented a coherent picture/map of fodder functions and positioning of actors.

Ohmstedt *et al*. (2018) observed that forage market environment in Kenya and Ethiopia involved coordination of input suppliers, forage producers, traders, processors, transporters and consumers each with distinct and in some cases overarching roles to play. All other functions existed in both countries with the exception of processing and transporting. Processing was common and well-defined in Kenya as was transport in Ethiopia. Additionally, brokers existed in Ethiopia to arbitrate between forage producers and traders.

A number of analyses have been conducted to map fodder markets in Kenya identifying input suppliers, producers, traders, processors and consumers as key chain actors with distinct roles and interdependence with each other (Gichuki *et al*., 2017; Lugusa *et al*., 2016; Nangole *et al*., 2013; Ohmstedt *et al*., 2018; Omollo *et al*., 2016; Sala, 2019). Service providers in the market offered services such as feed transporting, processing and hay making (Nangole *et al*., 2013).

While mapping the fodder activities in Baringo County, Lugusa (2015) identified fodder production as a source of livestock feed and income to the farmers. The study also mapped fodder seed processing and bulking as major value chain activities in the County. Local producers bought grass seed for reseeding and pasture establishment. Kerio Valley Development Authority (KVDA), Kenya Agriculture and Livestock Research Organization (KALRO) and Rehabilitation of Arid Environments Charity Trust (RAE Trust) provided inputs to producers while buying seed from them on contractual basis. In order to enhance sustainable development of grass seed in the County, public private partnerships between KALRO, KVDA, RAE Trust and SNV were formed to provide services in fodder production.

Omollo *et al*. (2019) reported that service providers such as KALRO, Non-Governmental Organizations (NGOs) and Community Based Organizations (CBOs) supported fodder in the southern rangelands of Kenya. These provided information, skills, funds and markets in order to up-scale, out-scale and commercialize fodder production. CBOs facilitated access to technical support, information and interaction with other fodder stakeholders. Stakeholders (service providers) worked in coordinated partnerships thus harmonizing their contributions as well as avoiding duplications of efforts.

Sala (2019) identified World Food Programme (WFP), Action Aid Kenya (AAK), SNV, National Dry-lands Management Authority (NDMA), University of Nairobi, County Government and Resilience and Economic Growth in Arid Lands- Improving Resilience (REGAL IR) as key service providers in fodder project implementation in Isiolo County. These organizations offered production-oriented interventions and dismal market-oriented support. Lugusa *et al*. (2016) and Omollo *et al*. (2016) in Baringo County and Kajiado and Makueni Counties respectively found out that support organizations provided inputs as well as purchasing fodder from the producers.

2.2 Trends of fodder production and marketing in ASALs of Kenya.

Pastoralist in ASALs of Kenya experience recurrent and prolonged droughts which result to frequent fodder scarcity and massive livestock deaths. To mitigate this, Stakeholders such as the Agricultural Productivity and Climate Change in Arid and Semi-Arid Kenya project in partnership with KALRO introduced and monitored the Sudan grass (*Sorghum sudanense*) and African fox tail grass (*Cenchrus ciliaris)* among target groups in Ijara Sub- County, Garissa. Fodder production increased in the county and farmers were able to produce about 3.6 tonnes of Sudan grass feed annually (Kuria *et al*., 2015).

Lugusa (2015) revealed that fodder production was practiced in Baringo County as a source of livestock feed and income for pastoral households who had formed fodder production groups in order to improve their incomes. Fodder producers there were mainly men keeping livestock and had attained primary level education. Elsewhere, Marshall *et al*. (2012) disclosed that *Cenchrus ciliaris* was most preferred grass species in the ASALs due to its fast growth, drought tolerance ease of harvesting seeds, high nutritional value and soil conservation. Other grasses grown in ASALs included *Bracharia sp, Sorghum drummondii, colombus grass, Panicum maximum, Digitaria macroblephara, Themeda triandra* and *Chloris gayana extozi* (Kidake *et al*., 2016).

Sala (2019) argued that pastoralists in Isiolo County embraced fodder production and marketing as a livelihood enterprise. Production was small-scale and rain fed with African fox tail grass (*Cenchrus ciliaris*) and Maasai Love grass (*Eragrotis superba*) being the main fodder species grown in the County. Marketing of fodder involved selling of hay and grass seed and there were two kinds of fodder markets namely; primary market and secondary market. The primary market targeted group members while the secondary market included neighbors and traders.

According to Ouma (2017), pastoral and agro-pastoral communities in the dry lands of Kenya grew fodder as a source of livestock feed and income. Pasture reseeding fodder technology

was the most common in Kajiado and Makueni Counties and was practiced by 48% of the producers. Here, fodder production was done by individual farmers and groups who used own labour while sourcing grass seed from KALRO and other stakeholders. KALRO linked producers to the fodder markets (informal and unregulated) as well as offering training services. Traders dominated the fodder market where they bought grass seed at low prices and sold to FAO and Red Cross Society for free distribution to other producers in the county and beyond.

Fodder production and marketing like any other agricultural crop is faced by many challenges. Bonabana *et al.* (2013) identified low sales prices and high cost of transportation as the main constraints in potato marketing. These were linked to institutional challenges such as long distance to the markets, lack of access to credit facilities, lack of ready market and inadequate packaging materials. Lugusa (2015) reported that frequent droughts, inadequate grass seed and unpredictable market constrained fodder production. Lukuyu *et al.* (2016) established that the main factors that limited success of the fodder value chain in Tanzania encompassed lack of technical knowledge, inadequate land, inadequate supply of fodder as well as capital deficiencies. Ouma (2017) also established that fodder production in Kajiado and Makueni was constrained by poor rainfall, low quality seeds, high labour requirements, poor grazing methods and poor harvesting skills. In a related study, Ahmed *et al.* (2021) identified inadequate capital base, lack of storage facilities, seasonality of supply and sale, high cost of transportation, lack of market infrastructures, high taxation and price uncertainty as key constraints to marketing of groundnut haulm in Northern states of Nigeria.

Marketing of hay and grass seed is done in varied outlets. According to Lugusa (2015), a bale of hay in Baringo County was sold to other fodder farmers at KES. 150 per bale, a kilogram of grass seed to the same at KES. 200 and KES. 350 to independent seed bulkers, traders and processors. The former was dictated by social ties and kinship while the latter was dictated by the expectations of resale of the grass seeds. Pasture seed prices in Kenya ranged from KES. 175 - KES.1000 and were sold to Government entities and NGOs for distribution to pasture producers or pasture reseeding in degraded areas (Kidake *et al*., 2016). Abdullah *et al.* (2015) while conducting a study on rice market structure and marketing margins found that, rice producers in Pakistan sold their produce through many outlets. The main rice outlet was commission agents through which 90% of rice produced was sold. Commission agents provided farmers with credit,

transport, storage as well as cash needs for the next crop prompting farmers to sell to them. Other outlets were direct sales to rice millers (8%) and personal consumption (2%).

Generally, Fodder production has reoriented itself to a commercial one with the degree of commercialization varying with location (Sala, 2019). For instance, in Baringo fodder production is largely advanced, demand-driven and mechanized thus high level of commercialization. Moreover, fodder marketing here is formalized, well developed, integrated and involving the private sector (Lugusa *et al*., 2016). On the other hand, in Kajiado and Makueni fodder ventures are still developing with rudimental private sector participation (Omollo *et al*., 2016).

In Laikipia County and other ASAL regions, fodder types such as *Boma* Rhodes, Napier grass, fodder shrubs, oats, kikuyu grass and sweet potato vines among others are produced and mainly marketed informally. However, the grass seed certification by Kenya Plant Health Inspectorate Services (KEPHIS) is at an advanced stage which could see seed marketing improved (Gichuki *et al*., 2017).

2.3 Factors influencing decisions to commercialize fodder in the ASALs of Kenya.

Factors influencing decisions to commercialize fodder can be regarded as a series of decision-making processes conducted in stages over time. It is a hierarchical process in which the first stage involves the decision to commercialize fodder for financial gain and the second is the subsequent decision to choose the fodder buyer among the existing possible marketing outlets and the amount of fodder to sell to each outlet. This is a crucial activity in sustainable fodder management.

Many studies have in the past been conducted on the factors determining household involvement in fodder management activities. Akpan *et al*. (2012) disclosed that family size, farm size, price, years in farming extension visits, number of shoats kept influenced adoption of fertilizer in Southern Nigeria. Bongiwe and Micah (2013) identified farmer's age, education level and amount of baby corn produced as factors influencing choice to sell vegetables through NAMBoard marketing channel. Additionally, the study established that farmer's age, group membership, market distance and marketing agreement influenced the choice to sell through non-wholesale market channel. Collective action and networking were thus recommended in order to link farmers to agricultural supply chains.

Omollo *et al*. (2018) revealed that gender of the household head, education, group membership and access to extension services influenced households' involvement in fodder

production in Kajiado and Makueni Counties. In relation, chances to participate in fodder production were 29% and 49% for group membership and extension services respectively. Extension service held a stake in transforming subsistence agriculture to market-oriented agriculture (Fekade, 2019). Rabbi *et al.* (2019) established that gender, age, household size influenced market entry for smallholder rice farmers. The authors also opined that market participation could be improved through subsidized input prices cold storage, training, technology, and extension service. Lugusa (2015) found that age of household head, access to grazing reserves, herd size, drought experience and number of livelihood options influenced participation in fodder production groups.

Mutoko *et al*. (2015) revealed that adoption of different fodder crops in the Mitigation of Climate Change in Agriculture (MICCA) pilot project in Kenya was highly depended on access and cost of planting materials and seeds, fodder productivity/yield, ease to harvest, growth rate, extension services and drought/pests/diseases resistance. Further, extent of adoption of fodder crops was highly depended on farm size, number of livestock owned, availability of seed/planting materials and labour availability. However, adoption was constrained by inadequate labour availability, information deficiency on suitable fodders, inadequate capital, small land sizes, inadequate planting materials, availability of grazing pastures and low product prices. Issa and Chrysostome (2015) and Lu and Dudensing (2015) opined that improved quality of produce augmented value and customer appeal for products as well as facilitating lucrative market access. Additionally, gender, education level, farm size and credit access influenced participation in vertical integration of the coffee value chain in Rwanda (Issa & Chrysostome, 2015).

A study by Sala (2019) further revealed that participation in fodder markets was greatly influenced by age of farmer, herd size, exposure to shocks, credit access and information on prevailing market and weather conditions. These affected the quantities of fodder sold by producers as well as those purchased by potential customers. The author reported that only18% of total amount of fodder produced in Isiolo County was sold. Moreover, lack of an elaborate transport system, failure to set aside land for fodder and overreliance on external support limited commercial fodder production. Liu *et al*. (2018) identified age, experience, education, risk preference, heritage, lifestyle, time preference, environmental consciousness, farm size, land tenure, production type, soil type, along with, expected farm income and financial incentives as factors influencing decision by farmers to take up best management practices. Further, the study

outlined the role of location, policies, market availability, information and awareness as key factors influencing decision making by the farmers. Auma *et al*. (2018) pointed out that stringent regulations on seed certification by the Kenya Plant Health Inspectorate Service (KEPHIS) is an impediment to fodder and fodder seed production and marketing opportunities in Kenya Crops and Dairy Market Systems (KCDMS) Counties. Further, Geoffrey *et al.* (2014) established that gender, collective action, amount of produce, price information and contract farming influenced the selection of pineapple market outlets in Kericho County.

Entrepreneurial orientation is considered as a driving force behind the organizational pursuit of entrepreneurial activities, and therefore a great focus in many studies (Covin & Wales, 2012). Vantilborgh *et al*. (2015) defined entrepreneurial orientation as group of five personality traits that characterize entrepreneurs which included innovativeness, proactivity, risk taking, need for achievement, and need for autonomy. The study observed that, risk taking; innovativeness, need for achievement, and need for autonomy are positively related to enterprise performance therefore, giving a valuable framework to understanding entrepreneurship. In relation to this, Manzano *et al*. (2020) found out that proactive orientation had a positive bearing with entrepreneurs' satisfaction on business success. Al Mamun *et al.* (2017) and Tarek (2018) established that innovativeness increased the value of the product therefore increasing market participation. Moreover, Tarek (2018) found an inverse relationship between risk-taking and organizational responsiveness. Prokopy *et al.* (2014) while conducting a study Central Indiana inferred that farmers were risk-averse and were incentivized by financial gain. Similarly, Liu (2013) found that cotton farmers in China were risk and loss-averse in technology adoption. Finally, Setyowibowo (2019) constructed that risk-taking and preparedness to accept failure will inspire an individual to participate in the market in response to changes in consumer demand. From these studies it is noted that entrepreneurial orientation traits are key household factors that can help an individual to make a decision to engage in fodder business as well as choosing the buyer to sell to from among the available fodder market outlets.

2.4 Performance of fodder market outlets in the ASALs of Kenya

The fodder market performance in terms of market margins is a key factor that farmers consider while making a decision to participate in the fodder market and choice of a fodder market outlet. Several studies have been conducted to evaluate market margins for various enterprises. Islam *et al*. (2017) revealed that average yield for fodder in Bangladesh was 207t/ha/year. Gross

margin for market-oriented fodder was Tk. 255,610/ha. The benefit cost ratio was estimated at 2.01 for market-oriented fodder on full cost basis indicating that fodder production was viable, motivating farmers to turn to Napier fodder production from cereal crops. Fodder contributed 0.47% to farmers' household income and led to high milk and meat production increasing land under fodder production.

In the southern rangelands of Makueni County, Manyeki *et al.* (2015) found out that range reseeding using *Cenchrus ciliaris*, *Chloris roxbohurghiana*, *Enteropogon macrostachyus* and *Eragrostis superba* grass species had a positive gross margin (GM). Hay production per hectare was depended on grass species and ranged from 125-212 bales while that of grass seed per hectare ranged from 116 – 415 Kgs. The average price per bale of hay was KES.175 while that of grass seed ranged from KES.350 – KES.650. Therefore, revenues from sale of hay and grass seed ranged from KES. 106,113 to KES. 160,563 per hectare. With the cost of production ranging from KES.39, 949 – KES.51,756 per hectare, the GM for hay and grass seed in the said rangelands therefore ranged from KES.66,163 –KES.118,965. Gross margin values realized suggest that the costs invested in fodder improvement were recovered and benefits were realized. Ouma (2017), revealed that, direct costs incurred in production of an acre of fodder in Kajiado and Makueni totaled to KES. 18,550, a value far below the per acre revenue realized of KES. 32,050. This yielded a positive gross margin of KES. 13,500 indicating that the venture is profitable. Market outlets for fodder were buyers within and outside the county.

In Garissa County, the Agricultural Productivity and Climate Change programme supports production of Sudan grass (*Sorghum sudanense*) by target farmers group in Ijara Sub-County. It is reported that farmer groups cultivating one acre of Sudan grass got 3.6 tonnes of Sudan grass. This gave an additional KES 100,000 into the group's kitty per year through the sale of Sudan grass feed (Kuria *et al*., 2015). This yield adequately sustained milk production during the annual four-month feed deficit period. In Marigat Sub-County, Lugusa (2015) reported that individual fodder producers and fodder groups received some KES. 1,087 and KES.474 profit per acre respectively from sale of hay and grass seed. As such, sale of hay, grass seed and lease out grazing contributed some 5.71% to the individual producers' income and 0.42% to the group's income. Fodder production groups' profit margin per acre was 17.20% and that of individual producers was 14.33% indicating that fodder production is a profitable venture in the sub-county.

Sanchi *et al.* (2015) established that fresh fish market margin was N190 and that the percentage market margin was 30% in Ngaski, Kebbi State, Nigeria. The related absolute and percentage market efficiencies were 0.582 and 58% respectively. In their study, Abdullah *et al.* (2015) established that the price spread (absolute cash margins) for 57kgs of basmati rice marketing channel members ranged from Rs.100 earned by rice traders to Rs.657 earned by retailers. Similarly, the price spread for 40 kgs of non-basmati rice ranged from Rs. 70 by commission agents to Rs. 230 by retailers. Tesfaw (2017) identified seven marketing channels for haricot bean in Ethiopia. According to the study gross marketing margins span from 13.2% to 38.6% of the final consumer price for farmer traders and city wholesalers respectively while the net marketing margins ranged from 7.4% to 11.5% for processors and rural assemblers respectively.

Singh *et al*. (2018) established that there were three channels for green fodder marketing in Punjab. Channel one involved fodder producers selling directly to the consumers; channel two involved fodder farmers selling green fodder to chaff cutters who then sell to consumers and lastly, channel three involved fodder farmers selling to directly consumers (dairy owners). The marketing margins was 20₹ per q in channel two. The price spread was 52₹ per q and 36₹ per q for channels two and three respectively. Costs incurred in marketing green fodder in Punjab included weighing, loading and offloading, chaffing, transportation and commission charges.

Gichuki *et al*. (2017) and Nangole *et al*. (2013) established that an acre of Oats, *Boma* Rhodes and sweet potato vines generated gross margins of KES.216,850, KES.132,302 and KES. 78,000 respectively to fodder producers in Central and North Rift Valley Regions of Kenya. Other fodder/forage enterprises in the region included Napier grass, baled barley, ground *Boma* Rhodes and dry maize stovers whose gross margins ranged from KES 11,770 to KES 33,900. Moreover, Nangole *et al*. (2013) found out that fodder sales contributed 2% of the fodder producer's incomes indicating low entrepreneurial orientation. The figures above suggest that fodder presents viable business opportunities in ASALs that agripreneurs could exploit in order to realize immense returns while improving their incomes.

2.5 Theoretical framework

The expected utility theory, the profit maximization theory and the achievement theory of entrepreneurship underpin this study.

2.5.1 The expected utility theory

The Expected Utility Theory propounded by Daniel Bernoulli in 1738, was used to explain fodder farmer decision making behavior. It was assumed that a fodder farmer participated in fodder markets based on expected utility for his/her decision under conditions of uncertainty and rationality. The decision to commercialize fodder production and choice of a particular outlet was depended on household, product, institutional and market factors. Given the alternatives to commercialize or not, a fodder farmer commercialized fodder production if the expected utility for commercializing fodder production was higher than that of not commercializing fodder production. Similarly, a fodder farmer chose a specific fodder market outlet if the expected utility for choice of that outlet was higher than not choosing the outlet.

By comparing the net expected utilities from both decisions, fodder farmers commercialized fodder production in the market as well as choosing a given market outlet as shown:

$$EU_{ik} - EU_{ij} > 0 \quad \text{..... (1)}$$

Where, EU_{ik} represented the expected utility for commercializing fodder production and choosing to sell fodder to a specified market and EU_{ij} represented the expected utility for not commercializing fodder production and choosing not to sell to a specified market outlet.

Thus, a fodder farmer participated in the fodder market if the expected utility from commercializing fodder production and choice to sell fodder to a specified outlet was greater than that from not commercializing fodder production and choice not to sell fodder to a specified outlet.

2.5.2 The profit maximization theory

Marketing fodder was premised on profit maximization theory (Tripathy, 2019). In principle, a fodder farmer commercialized fodder production with the expectation of making economic gains. Given a vector of household, product, institutional and market factors, a fodder farmer decided and thereby participated in fodder markets in order to maximize the financial gains from the venture.

Profit maximization for fodder sale was expressed as follows:

$$Max\pi = P_y Y - P_x X \quad \text{..... (2)}$$

Where, π denoted profit, P_y denoted price of fodder P_x denoted value of marketing costs which included storage, personal, communication, transport, cess, and labour costs. X and Y denoted fodder output sold and marketing costs respectively

2.5.3 Achievement theory of entrepreneurship

The McClelland's "Achieving Society" of 1961 postulates that high level of need for achievement will push an individual to work harder, even without special rewards such as time off from work or money prize. Based on this theory it was assumed that fodder farmers engaged in fodder markets in a new and better way under conditions of uncertainty given, household characteristics, fodder characteristics, institutional and market factors. Moreover, these farmers had achievement orientation characterized by the drive to excel, advance and grow businesswise. As a result, fodder farmers were assumed to be problem solvers, risk takers, users of feedback and strived to reach set goals in fodder production and marketing. Finally, it was assumed that decision by farmers to commercialize fodder and the resultant fodder market outlet performance was positively related to their need for achievement (Collins *et al*., 2004; Rishipal, 2012).

2.6 Conceptual framework

Engagement in fodder markets depended on the fodder farmer's characteristics, fodder characteristics, institutional factors and market factors. The household/farmer characteristics included age, gender, education level, household size, land size, experience, innovativeness, proactivity and risk taking. Fodder characteristics included price of hay, amount produced, quality and commercialization index. Market factors included distance to the market, market information, market agreements and market costs while institutional factors included credit access, extension services, group membership and road infrastructure.

With the stated household characteristics and fodder characteristics, a fodder farmer decided to commercialize fodder production depending on distance to market, market information, market agreements and marketing costs. Commercialization of fodder production was further influenced by access to credit, extension services, group membership and road infrastructure. The decision to commercialize fodder production resulted to the choice of better fodder market outlets, increasing fodder sales and thus proportional market margins. Increased fodder sales also resulted to improvement of other market related fodder business activities as illustrated in Figure 2.1.

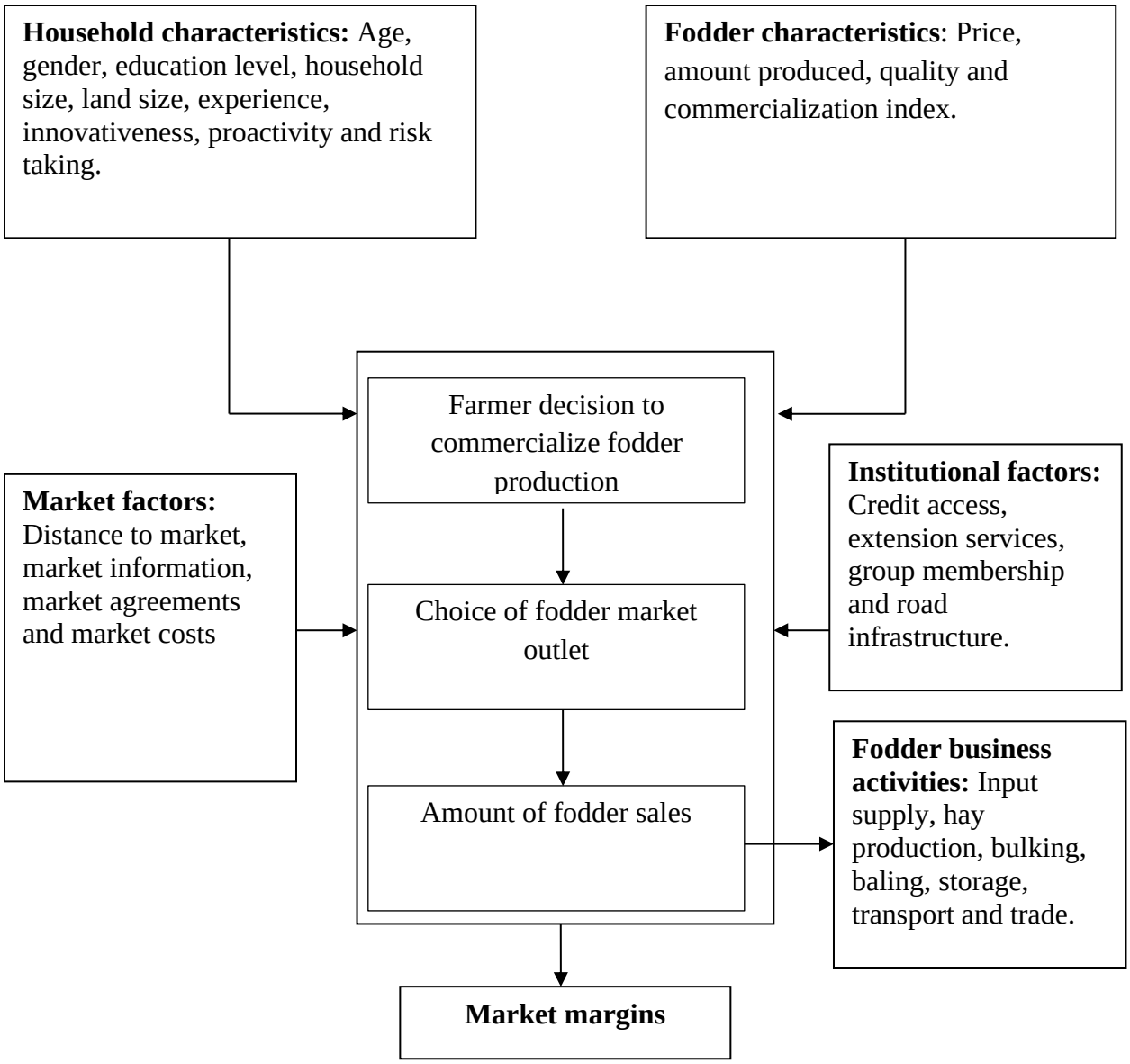


Figure 2. 1: Conceptual Framework

CHAPTER THREE
METHODOLOGY

3.1 The study area

The study was conducted in Laikipia County which lies between latitudes 0^0 18'S and 0^0 51'N and longitudes 36^0 11' and 37^0 24'E. It covers an area of 9,532.2 km^2 of which 20.5% is high and medium potential suitable for crop farming while the remaining proportion is low potential, suitable for livestock and wildlife. The county's population in 2019 was estimated at 518,560 persons, 49.97% being women and 50.03% men. However, 73% of the total population comprises of youths (KNBS, 2020). The CIDP (2018) estimated the county's labour force is 291,837 persons.

Ranching, crop farming, dairy farming, tourism and trade are the main economic activities in the county. The major soil types are loam, sand, and clay. The county receives an average rainfall ranging from 400mm and 750mm on a bimodal pattern. The long rains fall between March and May and short rains in October and November. The County has five administrative sub counties which include Laikipia East, Laikipia North, Laikipia West, Laikipia Central and Nyahururu.

Laikipia Central Sub-County was purposively selected for the study because of its high concentration of fodder farmers compared to other sub-counties. The area also has a high potential for fodder production and it is one of the areas where fodder production technologies were piloted by KALRO (then KARI) in 1998. The study was carried out in Tigithi Ward. The selection of the ward was due to the fact that it had the highest number of fodder farmers compared to other wards in the sub-county (KNBS, 2020). It had relatively easier mobility compared to the other wards given the limited budget and time allocated for the study. The study area is shown in Figure 3.1.

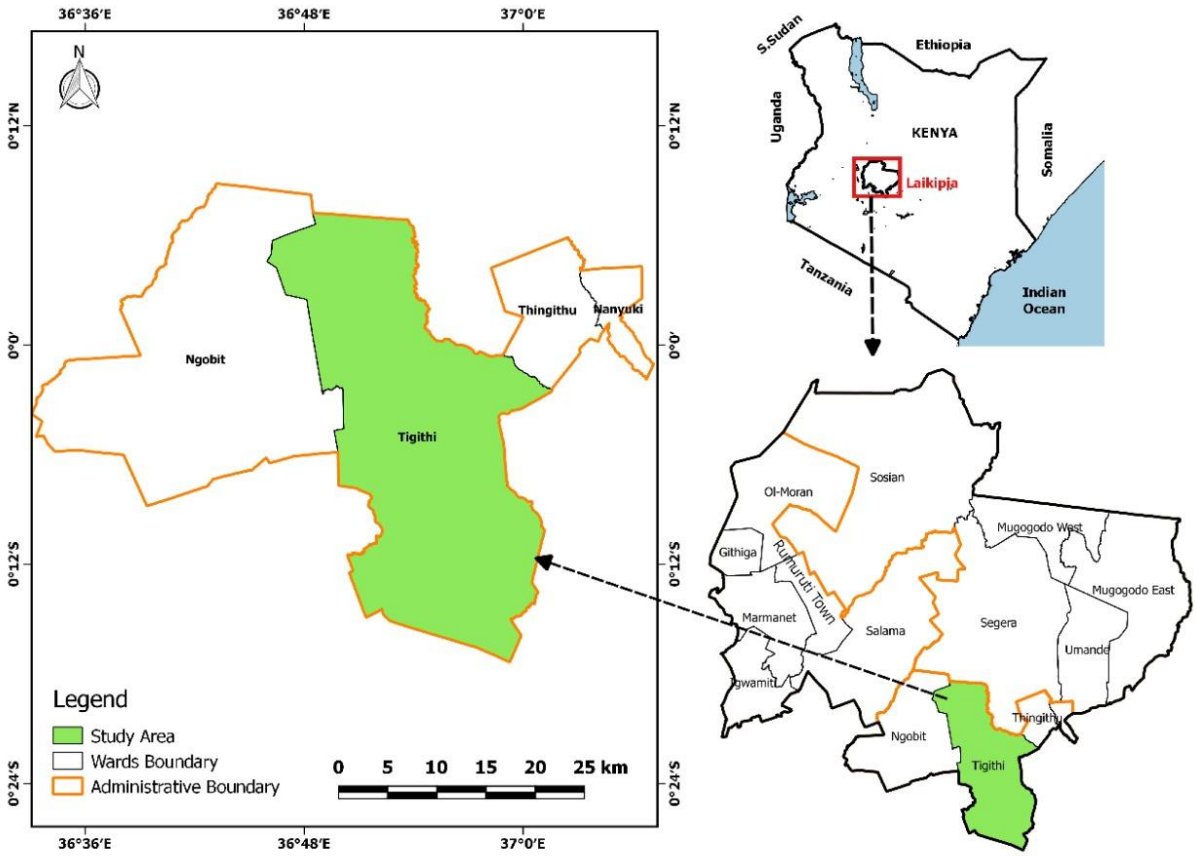


Figure 3. 1: Map of Tigithi ward, Laikipia central sub-county.

Source: Geography Department Egerton University (2020)

3.2 Target population

The target population was fodder agripreneurs engaged in production, baling, and marketing of fodder including public and private support agencies and enablers.

3.3 Sample size determination

A sample of 204 farmers was selected from a total of 769 fodder farmers (ASDSP II-Laikipia, 2019; KNBS, 2020). The sample size was determined by the desired level of precision and the appropriate formula was probability proportionate to size from Yamane (1967).

$$n = \frac{N}{1 + N e^2} \quad \text{..... (1)}$$

Where n was sample size, N was total population and e was desired precision level (margin of error)

The total population N = 769 fodder farmers and a precision level e = 0.06 were used giving a sample size of 204 fodder farmers as shown below:

$$n = \frac{769}{1 + 769(0.06)^2} = 204 \quad \text{.....} \quad (2)$$

Kothari (2004) pointed out that a margin of error less than 0.1 is appropriate for a study. Therefore, a margin of error(e) 0.06 was found appropriate to fit the budget and time allocated for the study.

3.4 Sampling procedure

First, purposive sampling was used to select a county dealing in fodder production and Laikipia County was selected because it is an ASAL area with relatively high level of commercial fodder production. Second, Laikipia central sub-county was purposely selected because it had the highest number of entrepreneurs dealing in fodder production and marketing. Third, Tigithi ward was then purposely selected for the high concentration of fodder farmers/enterprises compared to other wards in the sub-county. Finally, simple random sampling was conducted on 204 respondents using a list provided by the ASDSP, Laikipia.

To select participants of Key informant Interviews (KIIs) and Focus Group Discussions (FGDs), purposive sampling was used. Participants for the KIIs were key stakeholders in the livestock sector and had vast knowledge in fodder production and marketing. Members of FGDs were fodder market participants comprising an input supplier, producer, baler, bulker, transporter, trader, supporter and enabler. These were purposely selected based on the recommendations of the community.

3.5 Data collection

A pre-tested semi-structured questionnaire (see Appendix A) with open and close-ended questions in Open Data Kit (ODK) was used to collect both quantitative and qualitative data. Primary data collected included household characteristics, fodder characteristics, institutional factors, market factors, fodder market participation and fodder market outlet performance.

Two FGDs were convened to map the fodder market activities using a checklist (Appendix B). Similarly, eight Key Informant Interviews (KIIs) were conducted to provide a comprehensive understanding of the fodder market activities using an interview guide (Appendix C).

3.6 Analytical framework

3.6.1 Objective one: To map the fodder markets for Laikipia County.

Following Kaplinsky and Morris (2002) and GTZ (2007), functional and institutional analyses were used to map fodder market activities in Laikipia County. The first step in mapping the market was to identify primary fodder activities/functions and the operators performing these functions, their vertical linkages, product flow channels and relevant quantities (outputs, averages, percentages, volumes, costs or value added). The second step was to identify supporters and enablers and their roles at different stages/ nodes of the market. Finally, a fodder market map capturing primary fodder functions and activities, volumes traded along different channels, quantity of production, types of actors and value added at different stages was drawn. Descriptive statistics such as means, standard deviation and percentages were used to report the results.

3.6.2 Objective two: To determine the factors influencing decisions to commercialize fodder in Laikipia County.

Fodder farmer's decisions to commercialize fodder production were viewed as a series of decision-making stages. These were modeled as a hierarchical process in which the first stage entailed the decision to participate in fodder marketing. The second stage entailed deciding the buyer to sell to among the existing fodder market outlets which included local livestock farmers, local traders and buyers from other counties. When the choice consists of two options, binary econometric models are used for analysis. However, if the options are more than two, then the multinomial/multivariate models are used (Green, 2018).

In this study, two empirical choice models were used; Univariate Probit model to determine the dichotomy as to whether to commercialize fodder production or not and Multivariate Probit model to estimate the determinants of farmers' choice of multiple fodder market outlets.

Fodder farmer's decision to participate (to commercialize or not) in the fodder market was regarded as a discrete choice which could be determined using the Logit or Probit models. The Logit model assumes logistical distribution of the error term while the Probit model assumes independence and standard normal distribution of the error term. In addition, the Probit model which has specification advantage over the Logit model in dealing with smaller samples of less than 1,000 respondents according to Johannes *et al*. (2010), was found suitable for this study. The Probit model belongs to the general class of binary choice model, where the dependent variable is dichotomous (Greene, 2018). Among studies which have adopted the Probit model

include Achandi and Mujawamariya (2016), Fikadu *et al*. (2017), Mkuna and Baiyegunhi (2019). It is assumed that the model is of the form,

$$\Pr(Y=1|X)=\Phi(X',\beta) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

Where Pr represents probability and Φ is the Cumulative Distribution Function (CDF) of the standard normal distribution. The parameters β for commercialization of fodder production are estimated by log-likelihood as shown below.

$$In\ L(\beta)=\sum_{i=1}^{n}\left(y_i\ In\ \Phi(x_i'\beta)+(1-y_i)\ In\ (1-\Phi(x_i\beta))\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \text{(2)}$$

Assuming independence and normal distribution of the error term, the decision to commercialize fodder production by the i^{th} fodder farmer using Probit model can be expressed as follows.

$$D_i^* = Z_i\beta+\mu_i \;\; ; \;\; \mu_i \approx N(0,1) \qquad Where, \quad D_i=\begin{Bmatrix} 1, & if \quad D_i^*>0 \\ 0, & otherwise \end{Bmatrix} \ldots\ldots\ldots\ldots\ldots\ldots..\ldots\ldots.. \text{(3)}$$

Where, D_i^* is the latent variable for decision to commercialize fodder production, D_i is a dummy variable that takes the value one (1) to represent decision to commercialize fodder production and value zero (0) otherwise; Z is a vector of predictor variables; β is a vector of parameters and μ is the error term.

The empirical model showing the variables determining the decision to commercialize fodder production was specified as shown below:

$$D^{CFP}=\beta_0+\beta_1 Age+\beta_2 Crdt+\beta_3 RInfr+\beta_4 MInfo+\beta_5 MAgree+\beta_6 MCost+\beta_7 Qlity+\beta_8 \Pr oa$$
$$+\beta_9 Risk+\varepsilon_i$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(4)}$$

The Multivariate Probit model was used to determine the factors that influence choice of market outlets. Fodder farmers in Laikipia had options to choose from different fodder market outlets which included local livestock farmers, local traders, and buyers from other counties. It

was assumed that farmers were using these market outlets simultaneously to dispose-off their product. The empirical specification of choice decision over the three outlets can be modeled by multinomial or multivariate regression analysis. Multinomial models assume that error terms of the choice equations are mutually exclusive (Greene, 2018). However, the choices among the outlets are not mutually exclusive as fodder farmers may sell their fodder to more than one market outlet at the same time and therefore the random error components of the market outlets may be correlated. Therefore, a multivariate model was chosen for this study because it allows for the correlation of error terms and simultaneity in the choice of the three market outlets.

Multivariate Probit model has been used in a number of studies. These include, Jenkins *et al*. (2011), Ngenoh *et al*. (2019) and Tarekegn *et al.* (2017). The framework allows for increased efficiency in estimation where simultaneity of outlet choice exist. The Multivariate Probit model used for the i^{th} fodder farmer is of the following form:

$$Y_{ij}^{*} = \beta_j X'_{ij} + \varepsilon_{ij} \quad (j = Y_1, Y_2, Y_3) \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..\ldots\ldots\ldots\ldots\ldots \text{(5)}$$

This translates into the observed binary outcome equation for each choice as follows:

$$Y_{ij} = \begin{Bmatrix} 1, & if \quad Y_{ij}^{*} > 0 \\ 0, & otherwise \end{Bmatrix} \quad (j = Y_1, Y_2, Y_3) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots... \text{(6)}$$

Where, Y_{ij}^{*} is the latent variable for choice of market outlet j, Y_{ij} denotes the choice of the three fodder market outlets (local livestock farmers, local traders, and buyers from other counties), X'_{ij} is a vector of explanatory variables of outlet choice decision, β_j is a vector of parameters and ε_{ij} is the error term.

In the choice of the three fodder market outlets, the error terms (ε_{ij}) jointly followed a multivariate normal distribution with zero conditional mean and variance normalized to unity and a symmetric covariance matrix ε expressed as:

$$\varepsilon = \begin{bmatrix} 1 & \rho_{12} & \rho_{13} \\ \rho_{21} & 1 & \rho_{23} \\ \rho_{31} & \rho_{32} & 1 \end{bmatrix} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(7)}$$

The correlation coefficient ρ between the stochastic components captured the influence of unobservable factors that were hardly measurable and not measured in the study such as self-control, motivation and preference.

The variables determining the choice of fodder market outlets are shown in the equation below:

$$C^{MC} = \beta_0 + \beta_1 Age + \beta_2 Expr + \beta_3 Crdt + \beta_4 RInfr + \beta_5 MDist + \beta_6 MInfo + \beta_7 MAgree + \beta_8 MCost + \beta_9 A\Pr od + \beta_{10} \Pr ice + \beta_{11} CIndex + \beta_{12} Qlity + \beta_{13} Inno + \beta_{14} \Pr oa + \beta_{15} Risk + \varepsilon_i$$

…….…… (8)

Prior to running the Probit and Multivariate Probit models, diagnostic tests for multicollinearity were done using Variance Inflation Factor (VIF) to ascertain the fitness of the models. Curto and Pinto (2011) indicated that VIF values less than ten (10) point to inexistence of multicollinearity among the predictor variables. Table 3.1 describes variables used in the empirical models.

Table 3. 1: Description of variables used in the empirical models.

Dependent Variables	Description	Unit of measurement	Expected sign
D^{CFP}	Whether farmers commercialize fodder production or not	Dummy(1=Yes, 0=No)	
C^{MC}	Choice of market outlet	Dummies	
	Local livestock farmers	1 for livestock farmers, 0 otherwise	
	Local traders	1 for traders, 0 otherwise	
	Local farm groups	1 for farm groups, 0 otherwise	
	Buyers from other counties	1 for other counties, 0 otherwise	
Independent variables			
Age	Age of farmer	Years	+/-
Expr	Experience in fodder business	Years	+
Crdt	Credit access	Dummy (1=Yes, 0=No)	+
RInfr	Road infrastructure	Dummy (1=Good, 0=Bad)	+
MDist	Distance to the market	Kilometers	-
MInfo	Access to market information	Dummy (1=Yes, 0=No)	+
MAgree	Market agreements	Dummy (1=Yes, 0=No)	+
MCost	Marketing costs	KES	-
AProd	Amount produced	Bales	+
CIndex	Commercialization index	Percentage	+
Qlity	Quality of fodder	5 Likert= (SD - SA)	+
Inno	Farmer innovativeness	5 Likert= (SD - SA)	+/-

Proa	Farmer proactivity	5 Likert= (SD - SA)	+/-
Risk	Farmer risk taking	5 Likert= (SD - SA)	+/-
Price	Price of a bale of fodder	KES	+

3.6.3 Objective three: To analyze the performance of fodder market outlets in Laikipia County.

Market margin analysis was used to evaluate the distinct performance of different fodder market outlets. The outlets included; sale to local livestock farmers, sale to local traders (bulkers, brokers and traders) and sale to buyers from other counties (Nyeri, Kiambu, Kajiado, Isiolo). Many authors such as Abdullah *et al*. (2015), Akbari and Mehrjerdi (2011), Bonabana *et al.* (2013) and Dalipagic and Elepu (2014) have used this approach in their studies.

Askan (2019) defined marketing margin as the difference between the prices obtained by farmers and prices paid by consumers. According to Mendoza and Rosegrant (1995), gross market margin for a fodder farmer(trader) in a particular market outlet is arrived at by getting the difference between the total value of fodder supplied at farm gate and total value of fodder sold at the market as specified below:

$$GMM = \left(\frac{V_2 - V_1}{V_2} \right) * 100 \quad \text{..... (9)}$$

Where, *GMM* is the gross market margin, V_1 is the total value of fodder supplied at farm gate and V_2 is the total value of fodder sold at the market.

To get the total value of fodder supplied at farm gate (V_1), the fodder output (Q) in bales sold was multiplied by the farm gate price (P) of a bale of fodder as shown below:

$$V_1 = \sum P_{1j} Q_j \quad \text{..... (10)}$$

Where, P_{1j} was the farm gate price of a j^{th} bale of fodder and Q_j denoted the number of bales of fodder supplied at farm gate to a market outlet.

On the other hand, the total value of fodder sold at market level (V_2) was calculated by getting the value of fodder at the market level as shown below:

$$V_2 = \sum P_{2j} Q_j \quad \text{..... (11)}$$

Where, P_{2j} denoted the market price of a j^{th} bale of fodder and Q_j denoted the number of bales of fodder sold to a market outlet.

Fodder market outlets were identified then market margins for the same calculated. Gross market margins for various market outlets were ordered for comparison. The absolute gross market margins for various market outlets were adjusted for marketing costs (Table 3.2) in order to realize the net margins.

Table 3. 2: Variable costs incurred in fodder marketing.

Variable cost	**Unit of measure**	**Variable cost**	**Unit of measure**
Transport	KES	Communication	KES
Storage	KES	Personal expenses	KES
Cess/toll tax	KES	Loading and unloading	KES

CHAPTER FOUR
RESULTS AND DISCUSSIONS

The first section of this chapter presents the map of the fodder market and a description of the main fodder flow stages, institutional support and challenges in fodder production and marketing. This is followed by an analysis of the factors influencing decisions to commercialize fodder and finally the performance of fodder market outlets.

4.1 Mapping of fodder markets

4.1.1 The fodder market map

Figure 4.1 displays the fodder market map which explicitly shows the stages (nodes), activities, actors, support and enabling institutions. In the first node, input providers avail production inputs to fodder farmers while in the second node the fodder farmers (core actors) produce and sell fodder to traders who eventually supply to livestock farmers within and outside Laikipia County. Traders and middlemen (brokers) on the other hand buy fodder from producers and sell to the end-market consumers including livestock farmers in Laikipia and neighboring counties such as Nyeri, Nyandarua, Murang'a, Kiambu, Kajiado and Isiolo.

At the *meso* level of the market are stakeholders who provide technical and financial support to the core actors/operators at the micro level. These include government departments, government programmes, non-governmental organizations (NGOs), Laikipia County Development Authority (LCDA), transporters and financial institutions. At the macro level are enablers provide suitable policy and legal business environment to facilitate fodder production and trade. The map, therefore, provides a holistic view of the entire sequence of market activities that deliver fodder to livestock farmers. It shows the interdependence between actors and processes thereby making stakeholders cognizant of each other's roles in the fodder market.

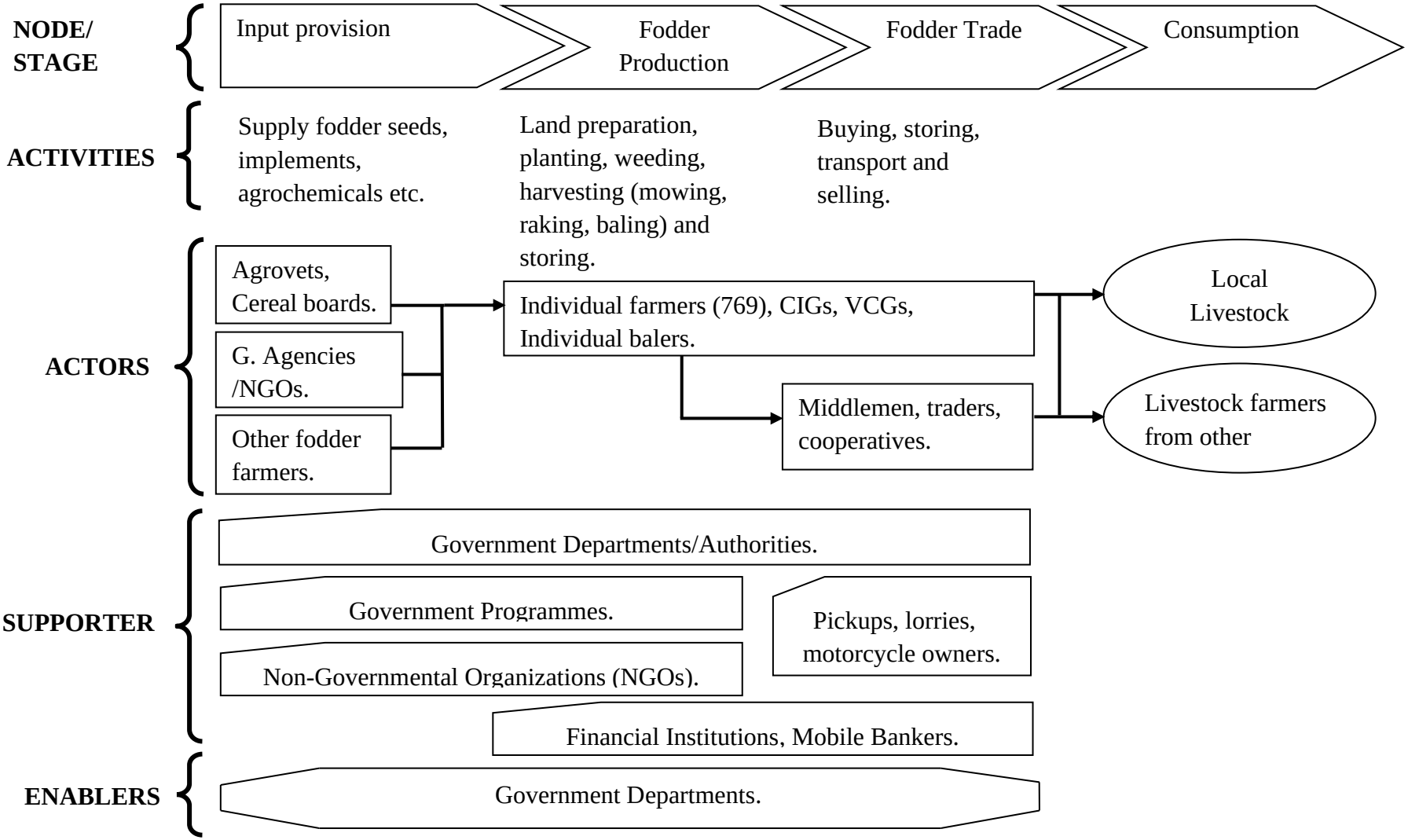


Figure 4. 1: Fodder market map in the study area.

4.1.2 Input provision

Input providers included agrovets, National Cereals and Produce Board, government agencies such as Agricultural Finance Corporation, NGOs and other fodder farmers as well. Their role is to supply production inputs to the fodder farmers.

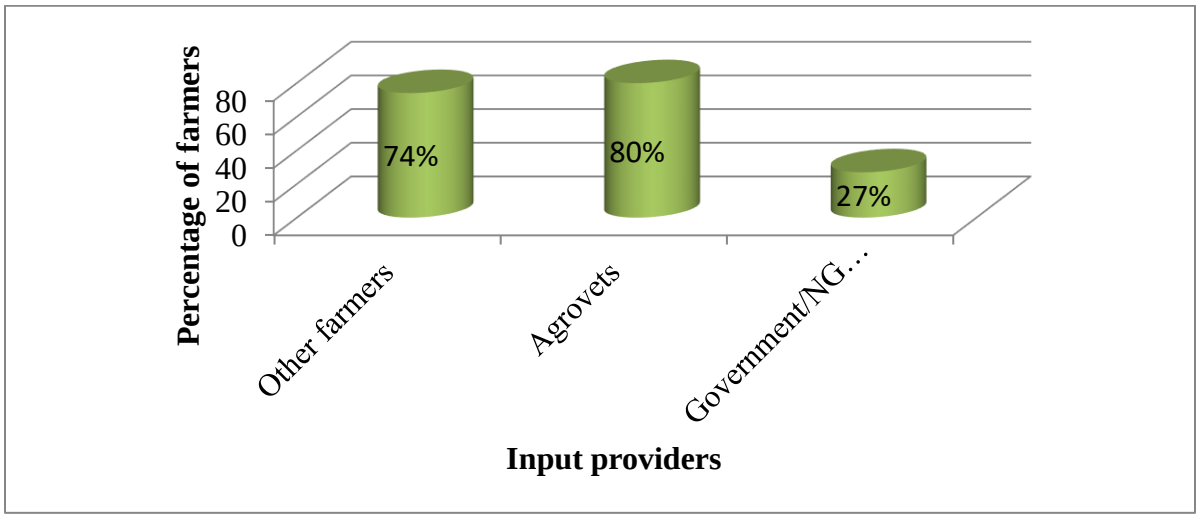


Figure 4. 2: Percentage of fodder farmers sourcing inputs from input providers.

Figure 4.2 shows that 74%, 80% and 27% of the fodder farmers in the ward sourced inputs from other fodder farmers, agrovets and government agencies/NGOs respectively. The main agrovets that stocked inputs were located in Nanyuki and Nyahururu towns. Inputs sold by these organizations included fodder seed (Rhodes grass, oats, Sudan grass, desmodium, brachiaria and Lucerne), agrochemicals (fertilizers, herbicides, inoculants and pesticides), implements and twines/straps in addition to provision of agricultural credit. Prices for fodder seed varied with fodder type. For instance, a kilogram of *Boma* Rhodes ranged from KES 900 to KES 1000 across the stockists. The agrovets mainly sourced seeds from the Kenya Seed and Simlaw Seed companies.

Both agrovets and government agencies additionally provided extension service/agronomic advice, follow-up, market linkages, fodder purchase, storage and sale. This finding corroborates with Lugusa *et al.* (2015) who established that inputs in Baringo County were provided by agrovets, government agencies and non-governmental organizations (NGOs) and further deconstructs Nangole *et al.* (2013) findings that only agrovets and general retail shops supplied fodder production inputs in the Central and North Rift Valley Region of Kenya.

4.1.3 Fodder production

Table 4.1 shows that fodder farmers grew *Chloris gayana* (*Boma* Rhodes) grass species whose mean yield was 174 bales per acre. The commercialization index was 47% and the farm gate prices for a bale of hay fodder ranged from KES 100 to KES180 with the average farm gate price being KES 146 per bale.

Table 4. 1: Fodder production characteristics in Tigithi ward.

Variable	Frequency	Mean	Standard deviation	Minimum	Maximum
Chloris gayana yield (15kg bale)	204	174.11	105.56	0	375
Commercialization index (%)	204	47.29	39.47	0	100
Farm gate price (KES)	204	146.41	13.25	100	180
Land size (acres)	204	4.73	2.33	1	20
Land under fodder (acres)	204	2.32	1.83	1	20

According to Heuzé *et al*. (2016), *Boma* Rhodes (*Chloris gayana)* grass is persistent, drought resistant, high yielding and is of high quality compared to other grasses. The highest recorded mean yield for *Boma* Rhodes ranged from 270-432 bales per acre explaining why fodder farmers opted to produce it. Kipchirchir *et al.* (2015) established that the *Boma* Rhodes withstood water stress and had a quick recovery compared to other grasses, therefore, suitable for pasture establishment in semi-arid lands. Further, it was established that the mean land size was 4.73 acres of land of which 2.32 acres was under fodder farming pointing to the importance of fodder production in Tigithi ward.

The mapping established that fodder production was mainly done by small scale individual fodder farmers who grew fodder in a traditional rain-fed system with the intention of feeding their livestock and for sale. This agrees with Ohmstedt *et al*. (2018) who revealed that fodder farmers in Kenya produced fodder in small scale with the main aim of feeding their livestock and for commercialization. Accordingly, fodder farmers performed production activities such as land preparation, planting, weeding, harvesting (mowing, raking, baling) and storage. Land preparation was mainly done using tractors while planting was done through broadcasting agreeing with Sala (2019) findings on fodder farming in Isiolo County.

Harvesting which included mowing, raking and baling was done mechanically using mowers, rakes and balers. Individuals owning harvesting and baling machinery visited fodder farms to inspect, mow and bale hay fodder at a cost of between KES 50 and KES 80 per bale payable on cash and on-site. However, in some instances harvesting was done using the harvesting and baling implements provided by government programmes at a subsidized cost. Due to the fixed nature of baling charges, profitability in baling business was directly proportional with the number of bales achieved. Ohmstedt *et al*. (2018) also found that hay mowing and baling was done in a fixed pricing system suggesting that a fixed rate was charged per bale of hay. In addition, individuals baling fodder occasionally paid farmers cash of between KES 40 and KES 100 in exchange for the quantity of hay baled after deducting the cost of baling. A small quantity of harvested fodder was stored in make shift stores owned by individual farmers for future use or for sale. Moreover, farmer groups/cooperatives also offered storage services to their members at KES 5 per bale per month.

4.1.4 Fodder farmer characteristics

The characteristics of fodder farmers are presented in Tables 4.2 to 4.4. The split was necessary because the results were obtained using two different analyses: means and percentages. Further, the tables presenting results in percentage were split to reduce their length to manageable levels. Table 4.2 presents the mean age, household size and experience in fodder production for the fodder farmers.

Table 4. 2: Age, household size and production experience of fodder farmers in Tigithi ward

Variable	Observations	Mean	Standard deviation.	Minimum	Maximum
Age	204	51.00	11.42	25	86
Household size	204	4.26	1.53	1	10
Fodder production experience	204	3.90	2.23	1	15

The mean age of the fodder farmers was 51years which is in agreement with Bezabih *et al.* (2020) that the mean ages of similar producers in two sites: Hossana and Bahir Dar Zuria of Ethiopia were 50 years and 53 years respectively. However, these results post the minimum and maximum age of 25 and 86 years respectively, implying that fodder farming was practiced by both

youthful and aged farmers. This observation is similar to that of Kimei (2016) who opined that bean farming was valued and practiced by all age groups in Rwanda. The mean household size was 4 persons and the farmer experience in fodder production ranged from 1 to 15 years.

Table 4.3 presents the results of gender, education levels and marital status of fodder farmers. Majority (65.69%) of the farming households were male headed while 34.31 % were female headed. Male headed households are endowed with productive resources and have access to market information therefore increasing the likelihood of taking up and practicing agricultural business activities (Okello, 2017; Olila, 2014; Sanchi *et al.*, 2015).

Table 4. 3: Gender, education levels and marital status of fodder farmers in Tigithi ward

Variable	Frequency	Percent	Cumulative
Gender			
Male	134	65.69	65.69
Female	70	34.31	100.00
Education level			
No formal education	2	0.98	0.98
Primary	62	30.39	31.37
Secondary	89	43.63	75.00
Tertiary	51	25.00	100.00
Marital status			
Single	7	3.43	3.43
Married	154	75.49	78.92
Divorced	10	4.90	83.82
Widowed	33	16.18	100.00

The highest percentage (43.63%) had attained secondary school education suggesting that fodder farmers with better education were innovative and knowledgeable and were likely to invest in fodder activities compared to less educated farmers. This confirms Cofre-Bravo *et al*. (2018) and Teklewold *et al.* (2013) findings that well-educated farmers have high capacity to access, process and analyze production information effectively. Majority (75.49%) of the fodder farmers

were married and are traditionally assumed to be rational thinkers and responsible thus the likelihood of investment in fodder activities (Mustapha *et al.,* 2022; Ngeywo *et al.,* 2015).

Table 4.4 presents results of fodder farmers' livelihood sources, land acquisition and source of labour. There were varied sources of livelihoods which included livestock keeping (96.57%), crop farming (55.88%), business (42.16%) and salaried employment (22.06%). These sources provided farming households with disposable income that was used as capital to start and run fodder business.

Table 4. 4: Source of livelihood, land acquisition and sources of labour in Tigithi ward

Variable	Frequency	Percent	Cumulative
Livestock income			
Yes	197	96.57	96.57
No	7	3.43	100.00
Crop income			
Yes	114	55.88	55.88
No	90	44.12	100.00
Business income			
Yes	86	42.16	42.16
No	118	57.84	100.00
Salary income			
Yes	45	22.06	22.06
No	159	77.94	100.00
Land acquisition			
Inherited	149.00	73.04	73.04
Purchased	55.00	26.96	100.00
Family labour			
Yes	158	77.45	77.45
No	46	22.55	100.00
Hired labour			
Yes	120	58.82	100.00
No	84	41.18	41.18

Land is a critical determinant of household food security in agricultural economies and its shortage can lead to immense poverty and food insecurity. It is equally important for fodder producers in that, adequate land is essential for fodder business to thrive. It was established that land owned by fodder farmers had been inherited or purchased. Accordingly, 73.04% of the farmers acquired their land through inheritance and 26.96% through purchase.

Fodder farmers were using both family and hired labour to conduct farm operations corroborating Lugusa *et al*. (2016) findings that fodder producers in Baringo County were using family and hired labour in their undertakings. Labour availability is crucial for successful fodder business. The study results show that, 77.45% of the farmers were using family labour while 58.82% were using hired labour to conduct fodder production activities. Family labour was mainly used while planting and weeding while hired labour was used during fodder harvesting.

4.1.5 Fodder trade

Fodder trade in the ward was typically a collection of fodder business activities that included; buying, storing, transporting and selling. Performers of these activities were fodder traders, cooperatives and middlemen who acted as a link between fodder farmers and livestock keepers within and outside Laikipia County. Fodder traders operated informally in the farms and urban areas. They bought fodder from the farms, transported, stored and sold to livestock keepers in the urban and rural areas within and outside the county. Cooperatives, also operated informally by buying and selling fodder from and on behalf of fodder farmers. Ohmstedt *et al*. (2018) revealed that fodder marketing in Kenya was both formal and informal with traders operating in the rural and urban areas. Further, the mapping exercise established that brokers played the role of mediation in fodder trade. They acted as a link between fodder farmers and traders and sometimes between traders and end users (livestock keepers) for a commission which ranged from KES10 to KES 20 per bale of hay.

Modes of payment for fodder varied significantly across the ward. Traders and cooperatives paid for fodder bought either on credit or cash basis. Results in Figure 4.3 show that 66.01% of the fodder farmers prefered to sell their fodder to traders who paid in cash terms. On the other hand a negligible percentage (2.46%) of the farmers prefered selling through cooperatives. This huge difference shows how the farmers are often in dire need for cash, possibly,

for domestic and business use. Sala (2019) who established that fodder market transactions in Isiolo County were cash-based in an informal market structure.

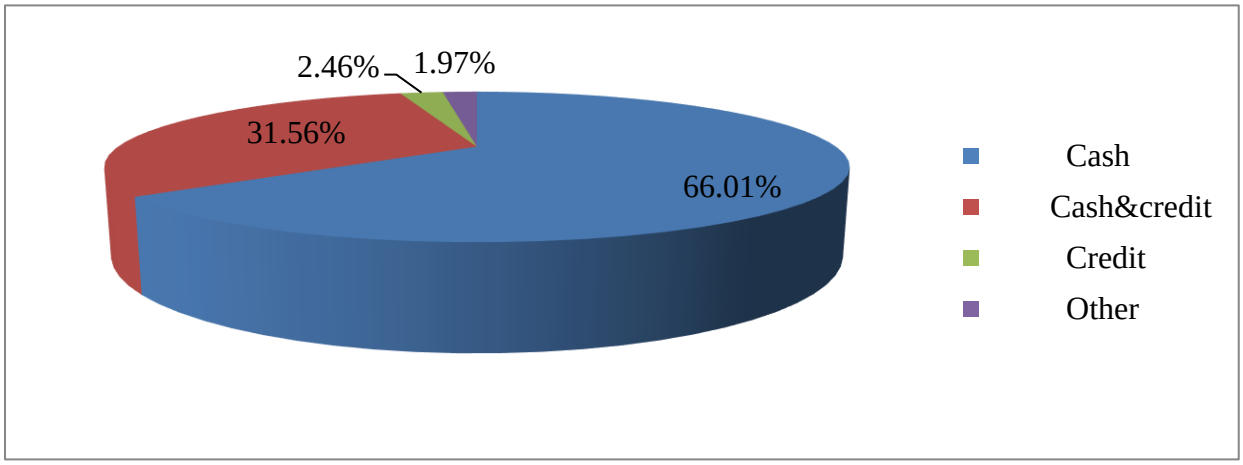


Figure 4. 3:Modes of payment for fodder

The results also indicated that fodder trade was buyer-led and that farmers were mainly price-takers in the market system. Majority (77.83%) of the farming households sold their fodder to traders and other buyers at the prevailing price. These households had less control over this price since it was determined by the potential buyers.

Figure 4.4 shows that the most pressing reason for sale of fodder by farmers to traders and brokers was the need for immediate cash for domestic and farm use. This was followed by the high cost of logistics (especially transportation costs) and lastly the lack of storage facilities. These results coincide with the findings of Abdullah *et al.* (2015).

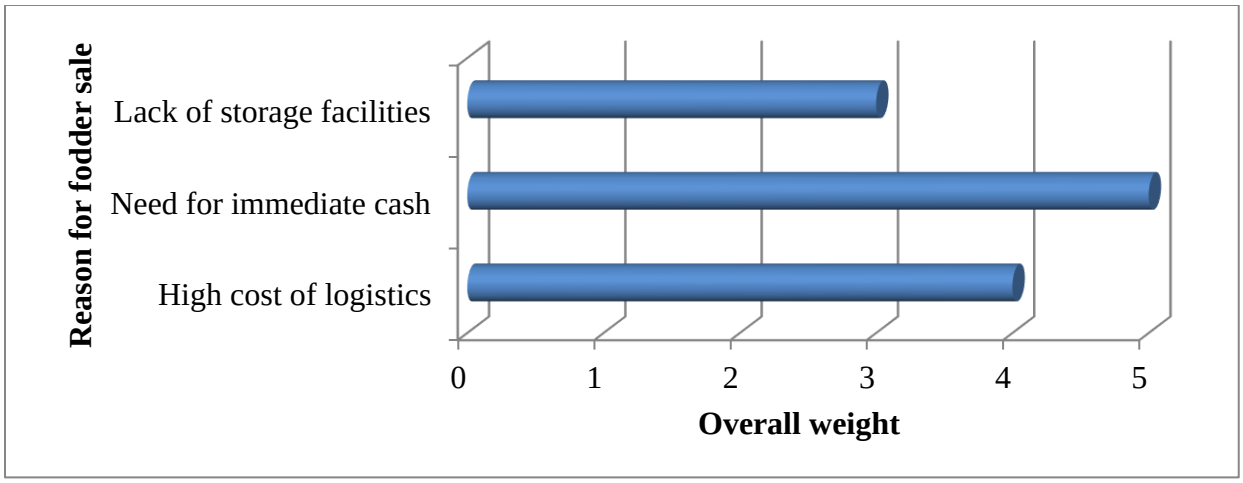


Figure 4. 4: Reasons why farmers sold fodder to traders and brokers.

Fodder was distributed through four main channels. Fodder goes through various stages/pathways from the point of production to the point of final use by the livestock keepers within and outside the county. The following marketing channels were identified:

1. Channel I: Fodder Farmers → Local Livestock Farmers
2. Channel II: Fodder Farmers → Fodder Traders → Local Livestock Farmers/Livestock farmers from other counties
3. Channel III: Fodder Farmers →Farm-based cooperatives → Local Livestock Farmers/Livestock farmers from other counties
4. Channel IV: Fodder Farmers → Local Livestock Farmers

The quantities, percentages, and related prices of fodder supplied through different channels are shown in Figure 4.5. Fodder prices in the market ranged from KES130 to KES300 per bale depending on the number and type of actors and their stage of operation in the market. Equally, quantities supplied at different levels of the market varied significantly with the type and number of actors involved. Individual fodder farmers produced and sold their fodder at average farm gate price of KES146 per bale. Fifty three percent (53%) of hay produced was either stored for domestic use or prospective sale while 47% of this was offered for sale through different channels.

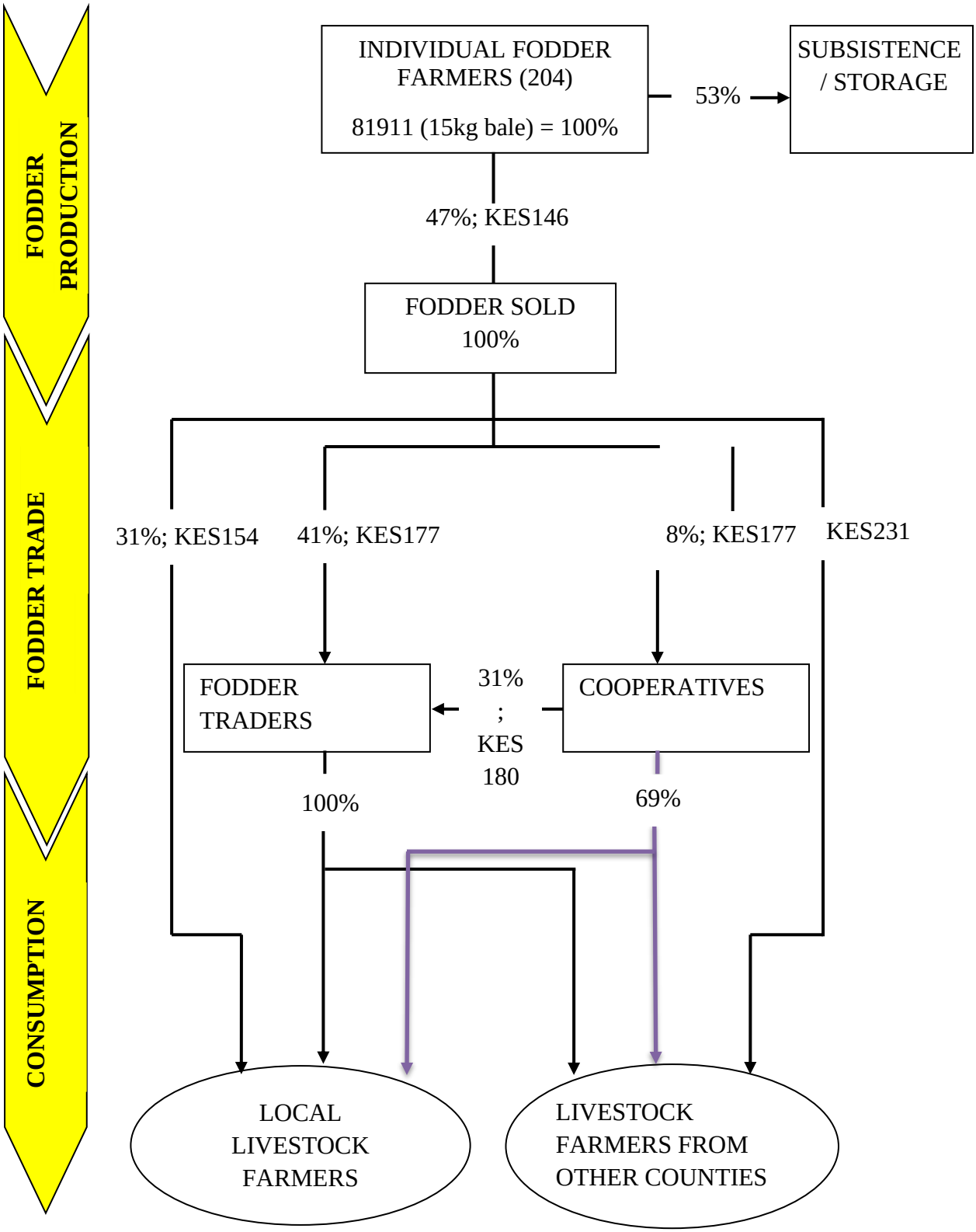


Figure 4. 5: Volumes of hay fodder sold through different channels

In the first channel of distribution fodder farmers sold 31% of their disposable fodder output to local livestock farmers at an average price of KES154. The second channel involved fodder farmers selling 41% of their sellable hay at an average price of KES177 per bale to fodder traders who then sold to local livestock farmers and buyers from other counties. The third channel comprised of fodder farmers who sold 8% of their disposable hay at an average price of KES177 per bale to farm-based cooperatives who then sold to local livestock farmers and buyers from other counties. Lastly, channel 4 included fodder farmers who disposed of 20% of their disposable fodder through buyers from other counties at an average price of KES 231.

Lugusa *et al*. (2016) identified eight channels in grass seed marketing in Baringo County. Fodder seed exchanged hands between many stakeholders before it reached its end users in Makueni and Kajiado Counties (Omollo *et al.*, 2016). Sala (2019) also established that fodder and seed were sold through two channels namely; primary and secondary market channels. The current result is therefore a confirmation that fodder products were distributed through various channels at different volumes and at different prices. It was observed that hay prices varied with channels as well as the number and type of actor involved in the specific channels.

4.1.6 Fodder end-markets

Most small and large-scale livestock producers face frequent feed scarcity as they cannot produce enough for themselves, therefore they buy feeds especially in the dry season (Ohmstedt *et al*., 2018). In this study, the bulk of purchased feed was grass hay (*Boma* Rhodes). The end-markets for *Boma* Rhodes were livestock farmers within and outside Laikipia County who kept sheep, goats, and dairy/ beef cattle for subsistence while commercializing the surplus. The other high-end fodder buyers were large scale livestock farmers who included individual livestock farmers, feedlot operators, ranchers and cooperatives. The result of the FGDs indicated that the latter mainly kept livestock on commercial scales and majority of them produced livestock products with the aim of selling to potential customers in the urban areas within and outside the county.

4.1.7 Institutional support in fodder production and marketing

The key institutions involved in fodder marketing, their interrelationships and the roles they perform in fodder market development were obtained through Key Informant Interviews (KII) and Focus Group Discussions (FGD). There existed various kinds of stakeholders with exclusive

and sometimes overarching roles in the fodder market chain. These institutions provided support and enabling environment in the production and marketing of fodder and were categorized into two: supporters and enablers. Supporters provided both financial and technical services to facilitate fodder production and marketing. Enablers on the other hand provided the suitable policy and legal business environment to facilitate fodder production and marketing. Table 4.5 provides a presentation of support/enabling agencies, their level of operation in the fodder market chain and their roles in fodder production and marketing.

Table 4. 5: The role of support institutions in fodder production and marketing in the study area

Institution	Category	Level of operation	Role/function
Government Departments	Supporters	Input provision, fodder production and trade	• Implementing fodder development strategies. • Extension service provision to fodder farmers. • Coordinating fodder development undertakings. • Overseer of fodder improvement projects. • Offering fodder business development services. • Market linkages. • Sensitization and up-scale of best practice in fodder management. • Farmer group registration.
Government Programmes /Projects.	Supporters	Input provision and fodder production.	• Initiating and funding of fodder projects. • Supervising implementation of fodder projects. • Offering inputs for fodder production.

			• Market linkages. • Capacity building BDS providers and fodder farmers.
Non-governmental Organization (NGOs)	Supporters	Input provision and fodder production.	• Provision of fodder production inputs. • Capacity building fodder farmers. • Initiation and funding of fodder projects.
Lending /financial institutions	Supporters	Fodder production and trade.	• Value chain/business finance. • Facilitating BDS for fodder farmers.
Transporters	Supporters	Trade	• Moving inputs from the market to fodder farms. • Moving hay from the point of production to the end-users.
Government Departments/ Authorities	Enablers	Input provision, fodder production and trade	• Development of relevant policies, strategies and regulations. • Quality assurance. • Taxation and regulatory services. • Business permit issuance to fodder traders.

Government departments played a lead role in agricultural service provision therefore a crucial institution in fodder market development and upgrading. The departments worked closely other stakeholders while coordinating and supervising all fodder development and improvement projects. The government departments were responsible for extension services provision, market linkages, best practice, registration of fodder groups and business development services. These were also responsible for regulation and institutionalization of relevant policies and issuance of business permits.

Government programmes were pivotal in initiation, funding and supervision of fodder upgrading projects. These programmes worked in coordination with other support institutions to

facilitate the provision of fodder production inputs, training service providers and farmers on fodder upgrading as well as linking them to the output and input markets.

Non-governmental organizations (NGOs) were vital in initiation and funding of fodder improvement projects, capacity building and provision of fodder production inputs. Other partners that incentivized fodder upgrading practices as well as supporting fodder project implementation financial/lending institutions. These extended credit to farmers as well as facilitating Business Development Services (BDS) to service providers and fodder farmers. It was established that only 29% of the fodder farmers had access to credit services due to collateral requirements, high interest rates and lack of awareness which hampered credit access. Transporters moved fodder output to the market as well as inputs to the point of production.

The findings corroborate with Bezabih *et al.* (2020), Lugusa *et al.* (2016) and Omollo *et al*. (2019) revelations that in fodder/feed value chains there existed stakeholders who had various support and regulatory functions in developing the chains. Lugusa *et al.* (2016) established that NGOs and government institutions offered extension services to fodder farmers in Baringo County which believably resulted to good planning and decision making while reducing production risks. Bezabih *et al.* (2020) also revealed that a group of stakeholders that offered diverse support services characterized the feed value chain in Bahir Dar Zuria and Hossana sites in Ethiopia noting that these supporters had clear-cut and sometime overlapping roles in the value chain. Omollo *et al*. (2019) also disclosed that in the southern rangelands of Kenya, various stakeholders in the fodder value chain played a number of roles which influenced their position in decision making along the supply chain.

4.1.8 Challenges in fodder production and marketing

Figure 4.6 is a summary of challenges in fodder production and marketing in Tigithi ward. Frequent and prolonged drought topped the list of challenges that negatively affected fodder production and marketing. This is similar to Sala (2019) exposure that frequent droughts negatively affected production of fodder thereby constraining the amount supplied to the market for sale. Frequent droughts negatively affect the quantity of fodder produced thereby reducing the amount offered for sale. The decreased amount of fodder reaching the end-users contribute to reduced livestock output as well as livestock deaths.

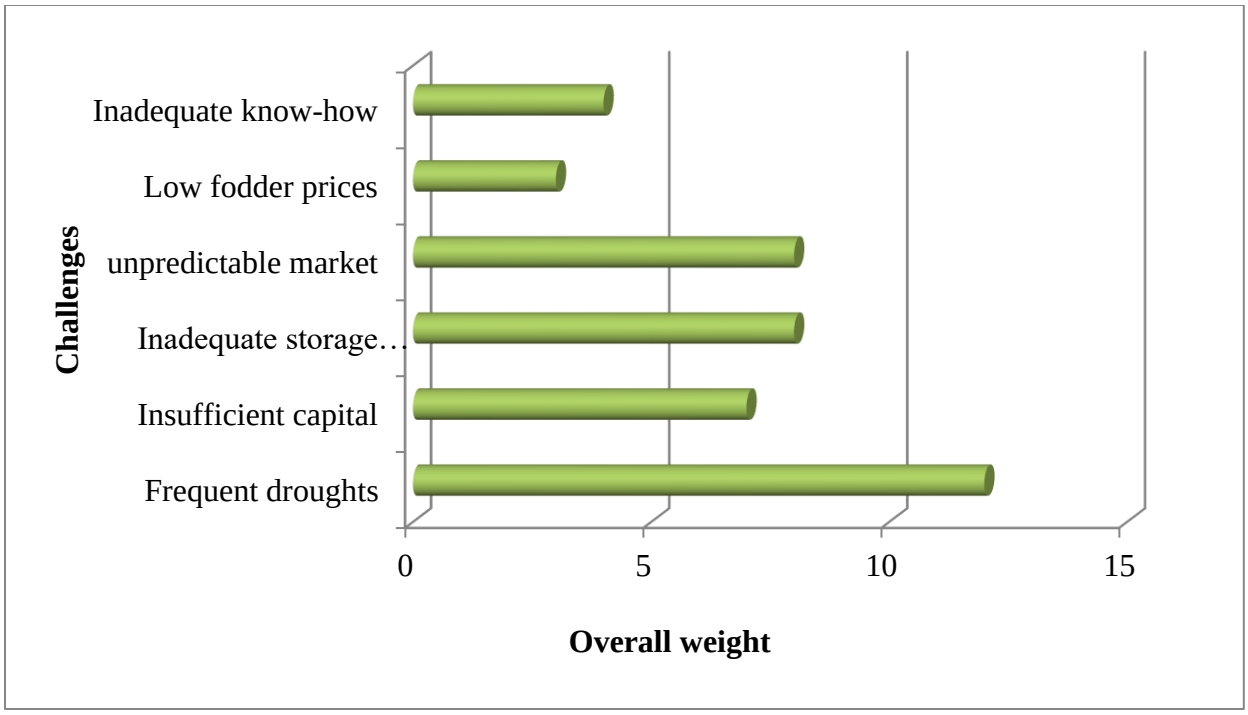


Figure 4. 6: Challenges to fodder production and marketing in Tigithi Ward.

It is evident from the results that insufficient capital limited fodder development practices. Inadequate capital hindered investment in fodder activities across the market system. The result reduced amount of fodder that got into the market system. Nangole *et al.* (2013) also established that, farmers in Central and North Rift region of Kenya were negatively affected by lack of capital to manage fodder business.

Lack of storage facilities was also a challenge to fodder production and marketing. The lack of reliable and sufficient storage space for fodder forced farmers to dispose-off their fodder at throw away prices to avoid spoilage. Poor storage degenerated the stored fodder reducing its quality further leading to reduced prices affecting the venture's profitability. Many studies such as Bezabih *et al*. (2020), Nangole *et al*. (2013) and Sala (2019) have cited this challenge. Nangole *et al*. (2013) observed that actors in the feed value chain lacked storage facilities exacerbating feed scarcity while at the same time hurting fodder trade due to spoilage and reduced quality.

Farmers cited unpredictable fodder markets as a factor deterring fodder production and the amount offered for sale. Fodder markets were inadequate, seasonal and unpredictable thus farmers were forced to sell their fodder on first come first serve basis. Fodder buyers were not guaranteed

while fodder was marketed seasonally especially during the dry seasons. Very little fodder or none was marketed during the wet seasons. In view of this, fodder prices which were usually low kept on fluctuating affecting profitability. These results correspond to Lugusa *et al*. (2016) who established that farmers in Baringo County were negatively affected by lack of consistent fodder markets.

Inadequate knowhow also constrained fodder production as well as quality of fodder produced. Lack of technical knowhow was perceived to lead to poor pre- and post-harvest handling practices. Sala (2019) observed that scant technical knowledge among fodder value chain actors constrained production. Gichuki *et al*. (2017) established that fodder farmers had no access to information on good agricultural practices for fodder production improvement notwithstanding knowledge sources at their disposal.

4.2 The determinants of farmers' commercial decisions in fodder marketing in Tigithi ward

4.2.1 The determinants of farmers' fodder market participation

Prior to fitting the Probit model, a VIF (Variance Inflation Factor) was conducted to test for multicollinearity as shown in Appendix D. The results of the test established that the VIF values were significantly lower than the value of 10 which is recommended by Curto and Pinto (2011) and further lower than 5 as opined by Akinwande *et al*. (2015) suggesting that the independent variables were not correlated hence no evidence of multicollinearity.

Table 4.6 summarizes the values for significance and goodness of fit for the model. The Wald statistics following a chi-squared distribution with 16 degrees of freedom was used to measure the model significance. The likelihood-ratio chi-squared (LR Chi^2) had a value of 121.29 with explanatory power of Pseudo-R2 of 45.54 percent and a log likelihood of -72.517009 thus the model is statistically significant at $p<0.01$. The hypothesis that all the coefficients except the constant were equal to zero was rejected suggesting that the predictor variables significantly explained variations in the dependent variable.

Table 4. 6: Measurements of goodness of fit for the Probit regression.

Number of observations	203
LR $Chi^2(16)$	121.29
Prob > Chi^2?	0.0000
Pseudo R2	0.4554
Log likelihood	-72.517009

The results of the binary Probit model showing the decision for market participation by fodder farmers and the related marginal effects are presented in and Table 4.7 and Appendix E.

Table 4. 7: Marginal effects of decision for market participation by fodder farmers in Tigithi ward.

Variable	**dy/dx**	**Std. err.**	**z**	**P>|z|**	**[95%C.I.]**		**X**
Age of farmer	0.0079**	0.0038	2.110	0.035	0.0006	0.0153	51.054
Quality of fodder	-0.1061	0.1013	-1.050	0.295	-0.3046	0.0924	4.360
Marketing Costs	0.0001*	0.0000	1.660	0.098	0.0000	0.0001	753.473
Market Agreements^	0.2026**	0.0881	2.300	0.021	0.0300	0.3751	0.291
Market Information^	0.4792***	0.1056	4.540	0.000	0.2721	0.6862	0.621
Credit Access^	0.1772*	0.1061	1.670	0.095	-0.0308	0.3852	0.296
Road Infrastructure^	-0.1401	0.0987	-1.420	0.156	-0.3335	0.0533	0.631
Risk-taking	-0.0475	0.0877	-0.540	0.588	-0.2195	0.1244	4.325
Proactivity	0.1748*	0.0901	1.940	0.052	-0.0018	0.3513	4.458

(^) dy/dx is for discrete change of dummy variable from 0 to 1. Statistical significance level: ***1%; **5%; *10%.

The results in Table 4.7 established that the fodder farmer's age was positively associated to fodder market participation at $p<0.05$. Age is associated with technology adoption and networking. Older farmers are more resource endowed enabling them acquire production technology. Technology adoption enhances efficiency in production of marketable surplus

improving participation in fodder markets. Older farmers also have deep-rooted links and social networks that help them to find potential fodder buyers. They have knowledge about market trends, weather vagaries and price dynamics which further guide market participation. This finding agrees with Rabbi *et al.* (2019) who disclosed that age of the farmer was positively associated with rice commercialization. It is however inconsistent with Obiero *et al*. (2019) findings that age is negatively associated with technology adoption and Kgosikoma and Malope (2016) who opined that age is negatively associated with farmers' commercial decisions.

Marketing costs were presumed to limit market participation by fodder farmers *a priori.* However, results depict a positive marginal effect on market participation at $p<0.1$. The implication is that fodder farmers were more likely to participate in fodder markets based on their willingness to incur marketing costs such as extra cost to transport fodder to distant markets, store fodder, pay *cess*/toll tax, load and unload fodder, pay for personal expenses and to communicate with potential buyers. This result is in conformity with Opondo (2018) who found that market entry by farm households increased with increase in cassava marketing costs.

Engaging in formal or informal market agreements had a positive and significant effect on participation in the fodder markets at $p<0.05$. Market agreements reduce information search and bargaining costs while allowing fodder farmers to take advantage of ready markets thereby, enhancing market participation. This matches Sala (2019) who discoursed that, selling arrangements enabled farmers take advantage of ready market opportunities. This result is also consistent with Geoffrey *et al.* (2014) and Taye *et al.* (2018) who opined that contract marketing guaranteed farmers with ready market enhancing the likelihood of market participation. Similarly, access to market information had a positive and significant effect on market participation at $p<0.01$. Market information is an incentive to market participation by fodder farmers. It motivates farmers to partake in high incentive markets by offering large quantities of fodder to the market with expectations of high returns. Moreover, fodder farmers with access to market information are privy to input and output prices and therefore more likely to participate in the market with favorable prices. This finding corresponds to findings of Dlamini and Huang (2019) and Kimei (2016) that favorable access to market information increases market participation.

Access to credit was positive and significant on market participation at $p<0.1$. A plausible reason for this is that credit availability broadens the farmers' financial base. Loans taken are used

to buy inputs as well as pay for production and marketing costs. This action translates to increased fodder production and the related increase in sellable output which motivates farmers to participate in fodder markets. This finding agrees with Opondo (2018) who opined that access to credit invigorated commercialization of cassava production. Dlamini and Huang (2019) also found that access to credit was directly associated with cattle market participation in Eswatini.

Proactivity had a significant positive bearing in fodder market participation at $p<0.1$. Vantilborgh *et al.* (2015) disclosed that proactivity strongly related to market participation. The positive coefficient implies that proactive farmers will respond fast when they find an opportunity in market demand. This agrees with Bolton (2012) and Manzano *et al*. (2020) opinions that a change of market demand will motivate an entrepreneur to immediately turn the condition into an opportunity and therefore respond by participating in the market.

4.2.2 The determinants of farmers' choice of fodder market outlets

A multicollinearity test of the explanatory variables using VIF (Variance Inflation Factor) was conducted for the predictor variables in the market outlet choice model as shown in Appendix F. VIF values for the test were significantly lower than the values of 10 and 5 suggested by Curto and Pinto (2011) and Akinwande *et al*. (2015) respectively an indication of non-existence of multicollinearity. Table 4.8 presents the results from the Multivariate Probit regression for the choice of existing fodder market outlets (Also see Appendix G and H).

The likelihood (predicted probability) of choosing local livestock farmers outlet is 76.47% ($p<0.01$) a value reasonably higher than the likelihood of choosing local traders' outlet which is 38.24% ($p<0.01$) and buyers from other counties at 20.59% ($p<0.01$). This indicates that fodder farmers were more likely to sell to local livestock farmers perhaps due to lower transaction/marketing cost despite the higher incentives offered by other market outlets.

Table 4. 8: Results of the Multivariate Probit model for the choice of fodder market outlets

Coefficients and standard errors (Market outlet choice equations)						
Variable	**Local livestock farmers (1)**		**Local traders (2)**		**Buyers from other counties (3)**	
	Coefficient	**Std. err**	**Coefficient**	**Std. err**	**Coefficient**	**Std. err**
Age of farmer	0.0017	0.0045	-0.0016	0.0063	0.0087**	0.0042
Experience	-0.0040	0.0206	0.0558*	0.0289	-0.0055	0.0194
Amount Produced	0.0001	0.0001	0.0003	0.0002	-0.0001	0.0001
Commercialization Index	-0.0039	0.0031	0.0027	0.0043	0.0061**	0.0029
Quality of fodder	-0.0334	0.0736	0.1357	0.1031	-0.1167*	0.0694
Marketing Costs	0.0000	0.0000	0.0000	0.0000	0.0001***	0.0000
Market Agreements	0.5659***	0.1434	-0.3128	0.2008	0.2275*	0.1351
Market Distance	0.0099	0.0132	0.0049	0.0185	-0.0226*	0.0124
Market Information	-0.1967	0.2105	-0.4737	0.2948	0.4875**	0.1984
Credit Access	0.0158	0.0952	0.0915	0.1334	0.0815	0.0897
Road Infrastructure	0.1226	0.0957	-0.1787	0.1339	0.0964	0.0901
Innovativeness	-0.1154	0.1017	-0.1079	0.1424	0.1466	0.0958
Proactivity	0.0074	0.0781	-0.2599**	0.1094	0.1559**	0.0736
Risk-taking	0.0931	0.0760	0.0148	0.1065	-0.0433	0.0716
Price of fodder	-0.0035	0.0024	0.0011	0.0033	0.0077***	0.0022
_cons	1.3178	0.8105	1.4853	1.1350	-3.1662	0.7636

Predicted probability	0.7647***	0.3824***	0.2059***
ρ21			-0.3524***
ρ31			0.3209***
ρ32			-0.2857***
	Breusch–Pagan test of independence: chi2(3) = 20.996, Pr = 0.0001		

Statistical significance level: ***1%; **5%; *10%.

The market outlet selection behavior varied among the fodder farmers. This is reflected in the likelihood ratio statistics of estimated correlation matrix. The ρ values *(ρij)* show the degree of correlation between each pair of market outlets. The findings revealed that the correlations between the choice for local traders and local livestock farmers' outlets (*ρ21*) and the choice for buyers from other counties and local traders' outlets (*ρ32*) were negative and statistically significant at 1% level. This implies that fodder farmers selling to local traders were less likely to sell to the local livestock farmers (*ρ21*). Similarly, fodder farmers selling to buyers from other counties were less likely to sell to local traders (*ρ32*). In contrast, the association between the choice of buyers from other counties and local livestock farmers' outlets (*ρ31*) was positive and significant at 1% level. This suggests that farmers selling fodder to buyers from other counties were more likely to sell to local livestock farmers (*ρ31*). This outcome is an indication of high competitiveness among local traders and local livestock farmers' outlets and between buyers from other counties and local traders' outlets. Nonetheless, there is less business rivalry between buyers from other counties local livestock farmers' outlets.

Further, the findings disclosed that selecting the right mix of fodder market outlets was determined by varied factors. Table 4.8 presents the factors that determine the choice of various fodder market outlets. The results pointed to a positive and significant relationship between farmers' age and choice to sell fodder through buyers from other counties at 5% significance level. Due to their market experience, resource endowment, access to credit and long-term relationships, older farmers are aware of outlets with relatively higher prices and profit incentives compared to young fodder farmers. Accordingly, they are more likely to supply fodder through buyers from other counties offering relatively higher prices confirming Taye *et al.* (2018) related findings.

Fodder farmer experience was significant and positively associated with choice of local traders' outlet at 10% level. Experience created strong bonds and trust between fodder farmers and local traders which enhanced its choice compared to the other market outlets. More experienced farmers were likely to supply their fodder through local traders. This was occasioned by experienced farmers' knowledge on profitability of delivering to various markets. It was conceivably profitable to supply to local traders' outlet. This confirms Kifle *et al.* (2015) significant and positive consequence of using cooperative market outlet. Kgosikoma and Malope (2016) opined that experienced fodder farmers are efficient and have strong social networks and

links that assist in searching for the fodder market thereby increasing the chance of selling their marketable surplus through local traders' outlet.

Fodder commercialization index (percent) was positively associated with buyers from other counties, but the relationship is statistically insignificant for local livestock farmers and local traders. The coefficient for buyers from other counties outlet is statistically significant at 5% level. The higher the percentage of fodder offered for sale, the higher the commercialization and the higher the probability of choosing other counties as a market outlet. This implies that fodder farmers intending to sell a greater proportion of their sellable fodder output are likely to sell to buyers from other counties due to the quantity they procure. This finding is consistent with past studies that include Muthini *et al.* (2017) and Tarekegn *et al.* (2017) that farmers selling large quantities of produce prefer to sell to market outlets that have capacity to buy in large quantities at reasonably better prices.

Quality of fodder was negative and significant for supply of fodder through buyers from other counties at 10% significance level. An increase in fodder quality results in increase in its price reducing the quantity demanded by customers. This implies that fodder trade is predominantly is based on quantity rather than quality. On the contrary, Lu and Dudensing (2015) opined that improved product quality augments value and customer appeal as well as facilitating lucrative market access. The outcome also contradicts Heuzé *et al*. (2016) reorientation of fodder trade from the quantity-based to the quality-based trade. Buyers from other counties buy fodder in large volumes at a cheaper price with the aim of selling to less quality-conscious customers at a relatively higher price

The effect of marketing costs on the choice of buyers from other counties was positive and statistically significant at 1% level. Following this, it can be argued that farmers who proactively incurred an extra coin in search of and delivery to distant fodder customers were likely to supply more fodder to buyers from other counties. This result controverts Ochieng *et al*. (2015) who established a negative association while corroborating the findings of Opondo (2018) who pointed to a positive relationship.

Market agreement was found to positively and significantly influence choice of local livestock farmers and buyers from other counties outlets at 1% and 10% significance levels respectively. Formal and informal marketing contracts/agreements create strong ties between the

farmers and potential fodder buyers. Due to market agreements, farmers are guaranteed with ready market therefore they are assured of sale, better terms and better prices by local livestock farmers and buyers from other counties hence the high likelihood of supplying to these outlets. Geoffrey *et al.* (2014) argued that a ready market reduced the costs of market search for the buyers and transport for pineapples. Kangile *et al.* (2020) also established that, contractual arrangements expressively determined access to lucrative markets for staple food commodities in Dodoma and Morogoro, Tanzania. This result further agrees with Ngenoh *et al*. (2019) finding that contract farming by smallholder farmers in Kenya plays a significant role in the competitiveness of high value market chains.

The likelihood of selecting buyers from other counties was significantly and negatively influenced by distance to the nearest market at 10% level. The implication is that the farther the fodder market, the higher the transportation cost and the lower the market margin. The fear of low market margins demotivates fodder farmers from choosing such outlets, hence the negative effect. This finding is consistent to Taye *et al.* (2018) who established that onion farmers residing far from the nearest market were likely to sell to wholesalers than assemblers and retailers. Gedefaw and Sisay (2020) also found that distance to the input market had a negative effect on uptake of agronomic practices. Atsbaha (2015) also opined that distance to nearest market was negatively associated with choice of retailers' channel.

Access to and use of fodder market information was positive and significant for deliverance of fodder to buyers from other counties at 5% significance level. A plausible reason is that access to market information (price and quantities information) helped farmers analyze the potential prices across all market outlets settling on buyers from other counties with relatively higher prices. This result conforms to Bezabih *et al.* (2015) positive outcome for selection of potato retailer channel and contradicts to Tarekegn *et al.* (2017) negative effect on choice of collector outlet.

The results showed a significant influence of proactivity on the choice of market outlets by fodder farmers in diverse directions. Proactivity was significant and negative for the choice of local traders' outlet while at the same time exhibiting positive significance at 5% in choosing buyers from other counties. This means fodder farmers would seize the high price-driven opportunity typical of buyers from other counties over local traders who bought small quantities

and offered relatively low prices. This confirms Delle and Amadu (2015), Manzano *et al*. (2020) and Vantilborgh *et al*. (2015) revelations on the role of proactive orientation in business ventures.

Hay fodder price offered by buyers from other counties was had a positive coefficient and significant at 1%. Higher prices offered by buyers from other counties outlet conceivably increased the fodder market margin and profitability incentivizing its choice. Due to this, large fodder producers were likely to sell to buyers from other counties. This finding agrees with Mutura *et al*. (2015) observation that large dairy producers incentivized by price, preferred selling large volumes of milk through cooperative societies.

4.3 Performance of fodder market outlets

4.3.1 Fodder market margin analysis

Table 4.9 discloses fodder prices for a bale of hay fodder at the farm gate and along the chain and the related market margins. It was established that the average farm gate prices offered for a bale of hay fodder to local livestock farmers, local traders and buyers from other counties were KES 144, KES 146 and KES 143 respectively. After the farm gate, the market prices charged for a bale of hay fodder to local livestock farmers, local traders and buyers from other counties were KES 157, KES 182 and KES 230 respectively. These price differentials determine the market margins. This finding is consistent with the previous studies such as Hassan *et al.* (2012), Mohammadi *et al.* (2020) and Sajida *et al.* (2013) which established that prices of farm produce varied across marketing channels/outlets.

Table 4. 9: Prices and market margins for a bale of hay fodder in Tigithi ward

	Market outlets		
Item	**Local livestock farmers**	**Local traders**	**Buyers from other counties**
Farmgate price (KES)	144.13	145.93	142.83
Market price (KES)	157.33	182.26	229.72
Absolute market margins (KES)	13.20	36.33	86.89
Market margins (%)	8.39	19.94	37.83
Farmers' share of market value (%)	91.61	80.06	62.17

The absolute market margins were KES 13, KES 36 and KES 87 for local livestock farmers, local traders and buyers from other counties' outlets respectively. The market margins represented 8.39%, 19.94% and 37.83% of the market price for local livestock farmers, local traders and buyers from other counties respectively. The market margin in relation to buyers from other counties' outlet was significantly larger than those of other market outlets. A plausible explanation for this is that buyers from other counties offered higher market prices for hay fodder thus higher margins compared to other outlets. These results highlight the importance of farmers broadening fodder trade with buyers from other counties. Singh *et al.* (2015) established that the market margin for dry fodder in Bihar India was 65 % of the retailers' price. Bonabana *et al.* (2013) also revealed that market margins for various potato varieties in Kisoro and Kabale districts ranged from 18% to 72%.

The farmers' share of market price in respect to various market outlets was 91.61% (local livestock farmers), 80.06% (local traders) and 62.17% (buyers from other counties). The large share of market price is a basis for motivating fodder farmers to increase investment in production and trade. This corroborates with Abdullah *et al.* (2015) who revealed that rice growers in Pakistan had the largest share of market price for various rice varieties.

4.3.2 Marketing costs and net market margins

In this subsection the absolute market margins in relation to various fodder market outlets were adjusted for marketing costs to establish the net market margins for a bale of hay fodder. Table 4.10 reveals costs (KES) incurred in marketing fodder and net fodder market margins (KES and percentage) for various market outlets.

Table 4. 10: Marketing costs and net market margins for a bale of hay fodder.

	Market outlets		
Item	**Local livestock farmers**	**Local traders**	**Buyers from other counties**
Absolute market margins (KES)	13.20	36.33	86.89
Marketing costs (KES)	6.07	3.06	8.18
Net margins (KES)	7.13	33.28	78.71
Market margins (%)	4.53%	18.26%	34.26%

Fodder marketing costs were incurred in varying proportions and differed with market outlet. The marketing costs incurred included; transport cost spent on moving fodder from the farm gate to the market, storage, cess, loading and unloading charges, communication costs such as mobile phone charges and personal expenses.

Marketing costs incurred by the fodder farmers to market a bale of hay fodder through local livestock farmers totaled to KES 6 and the corresponding net market margin being KES 7 which represented 4.53% of the market price. Similarly, trading a bale of hay fodder through local traders cost approximately KES 3 while giving a net margin of KES 33 representing 18.26% of the market price. Finally, to trade a bale of hay fodder through buyers from other counties cost a total of KES 8 earning KES 79 net market margin that represented 34.26% share of market price.

CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The general objective of this study was to contribute to the up-scaling of fodder production and marketing through analysis of factors that influence farmer participation in fodder markets for improved performance of market outlets in Laikipia County. The specific objectives were to map the fodder markets, to determine the factors influencing decisions to commercialize fodder and to analyze the performance of fodder market outlets. To achieve these objectives, data was collected using a semi structured questionnaire, focus group discussions and key informant interviews. To map the fodder market, functional and institutional analytical approaches were used. To determine the factors influencing decisions to commercialize fodder, the Univariate and Multivariate Probit models were used. Finally, to measure the performance of fodder market outlets market margin analyses were conducted.

5.2 Conclusions

i. Market mapping revealed that the fodder market system holistically consisted of persons and institutions performing various exclusive and, in some cases, overlapping activities. These included input providers, fodder farmers, fodder traders, fodder end-users and support/enabling institutions. Input providers were involved in the supply of fodder seed, implements and agrochemicals. Activities conducted by fodder farmers included land preparation, planting, weeding, harvesting and storage. Traders participated in buying, baling, storing, transporting and selling activities of fodder marketing. Support/enabling institutions offered technical and financial support as well as enabling environment for fodder production and trade. The study also established that hay fodder was distributed through distinct channels and that the fodder market system was hampered by know-how, market, capital, pricing and storage deficiencies along with recurrent droughts.

ii. The factors influencing decisions to commercialize fodder were twofold: univariate probit results indicated that age of farmer, marketing costs, market agreements, market information, credit access and proactivity positively influenced farmer participation in fodder markets. Multivariate probit (MVP) results revealed that market agreements, farmer experience positively

influenced the choice of local livestock farmers' outlet while proactivity had a negative influence on the choice of local traders' outlet. Further age of farmer, commercialization index, marketing costs, market agreements, market information and proactivity positively influenced the choice of buyers from other counties' outlet while quality of fodder and distance to the nearest market influenced the choice of this outlet negatively.

iii. Market margins revealed that buyers from other counties outlet presented the highest net market margins followed by local traders and then the local livestock farmers' outlets. The market margins suggest a favorable performance and that fodder enterprise is attractive and viable.

5.3 Recommendations

i. In order to contribute to the up-scaling of fodder production and marketing, the following interventional and policy recommendations are suggested:

- To enhance access to technical support, effective information and product flow, stakeholders in fodder market need to work in well-coordinated partnerships so as to harmonize their contributions while avoiding duplications of efforts,
- A multi-agency approach to service provision is recommended to facilitate collective action among stakeholders in the value chain. This will strengthen interconnectedness and interdependence between actors and processes in the fodder market while enhancing commercial fodder production as well as market participation by the farming households,
- Policies and innovative models to reduce know-how, drought, market, capital, pricing and storage deficiencies are also recommended,
- Government policies that seek to incentivize youthful and presumably formally educated fodder farmers create business in various nodes of the market should be explored,
- Policies should target to create business in seed supply, training, fodder contracting and operation of scaled farm machinery,
- In order to improve pre- and post-harvest hay fodder management, the government and other key stakeholders should invest in water harvesting/storage infrastructure, hay fodder harvesting machinery and hay storage facilities at strategic locations in the county. This will ensure availability of hay fodder, steady fodder prices as well as maintaining its nutritive value throughout the year.

ii. To stimulate market participation by fodder farmers while improving fodder production and marketing the following interventions are recommended. First, collective action by fodder farmers for easy access to credit and market information, better prices and proactive uptake of fodder business opportunities. Second, fodder conferences, digitized marketing and fodder exhibitions are suggested to enhance market information access. Third, promotion fodder quality through feed laboratory analysis, quality-based pricing, feed standards, enhanced mechanization from seed to feed and good management practices. Fourth, establishment of market linkages through market agreements and improvement of roads to fodder markets for enhanced marketability of fodder. Fifth, policy interventions to reduce marketing costs. Finally, to improve fodder productivity while simultaneously augmenting the amount of fodder offered for sale at different fodder outlets, stakeholders should take advantage of age of the farmer, farmer' experience and farmer' proactivity to guide their investments.

iii. Owing to the favorable performance and viability of the fodder enterprise, financial and technical support as well as formalization of the fodder market is recommended so as to ignite the business in fodder production and marketing. This will increase farmer' incomes and create jobs for potential players across the market system. Policy initiatives to reduce marketing costs will enhance farmer' involvement in the fodder market while facilitating better market margins across the fodder market outlets. Policy and advocacy for transitioning to fodder value chain and its inclusion as a mainstream value chain in the county is also recommended.

5.4 Suggestions for further research

The results of this study indicate that fodder enterprise is viable. This calls for a more inclusive approach to identify the contribution of fodder business to the farmer's livelihoods. Future research could thus focus on analyzing the effect of fodder commercialization on the farming household incomes as well as the effect of fodder improvement technologies on performance of fodder enterprises. This will indispensably provide vital insights in improving fodder competitiveness.

REFERENCES

Abdullah, M., Li, J., Ghazanfar, S., Khan, I., Ishaq, M. N., & Ahmed, J. (2015). Domestic rice marketing structure and marketing margins in Pakistan. *Journal of Economics and Sustainable Development*, *6*(12), 226-238.

Achandi, E. L., & Mujawamariya, G. (2016). Market participation by smallholder rice farmers in Tanzania: A double hurdle analysis. *Studies in Agricultural Economics*, *118*(2), 112-115.

Ahmed, B., Egwuma, H., Siewe, F., & Idris, M. K. (2021). Groundnut (Arachis hypogea) Haulm marketing and constraints in selected Northern States, Nigeria. *Journal of Dryland Agriculture*, *7*(2), 12-21.

Akbari, S. M. R., & Mehrjerdi, M. Z. (2011). Analysis of marketing margins, dry garden products in Iran. *Chinese Business Review*, *10*(7), 526-531.

Akinwande, M. O., Dikko, H. G., & Samson, A. (2015). Variance inflation factor as a condition for the inclusion of suppressor variable (s) in regression analysis. *Open Journal of Statistics*, *5*(07), 754-767.

Akpan, S. B., Nkanta, V. S., & Essien, U. A. (2012). A double-hurdle model of fertilizer adoption and optimum use among farmers in Southern Nigeria. *Tropicultura*, *30*(4), 249-253.

Al Mamun, A., Kumar, N., Ibrahim, M. D., & Bin, M. N. H. (2017). Validating the measurement of entrepreneurial orientation. *Journal of Economics and Sociology*, *10*(4), 51-66.

Alltech. (2020). *Global Feed Summary*. https://www.alltech.com/sites/ (accessed: 15/01/2021).

ASDSP II-Laikipia. (2019). *Hay data for Laikipia County.* Department of Agriculture Livestock and Fisheries, Laikipia County. Nanyuki.

Askan, E. (2019). Economic analysis and marketing margin of pistachios in Turkey. *Bulletin of the National Research Centre*, *43*(1), 1-7.

Atsbaha, M. (2015). *Value chain analysis of movable frame hive honey: The case of Ahferom Woreda, Tigray, Ethiopia*. (MSc. Thesis. Aksum University, Ethiopia).

AU-IBAR. (2023, October 31). *Addressing Kenya's Feed and Fodder Challenges: Strategies for Food and Nutrition Security* [Press release]. https://www.au-ibar.org/au-ibar-news/press-release-addressing-kenyas-feed-and-fodder-challenges-strategies-food-and

Auma, J. O., Omondi, I. A., Mugwe, J. G., Rao, E. J. O., Lukuyu, B. A., & Baltenweck, I. (2018). *USAID-Kenya Crops and Dairy Market Systems (KCDMS): Feed and fodder value chain assessment report*. https://cgspace.cgiar.org/server/api/core/bitstreams/795d35f5-d9bc-4c81-

843c-ef2e89c1f761/content

Bayala, J., Ky-Dembele, C., Kalinganire, A., Olivier, A., & Nantoumé, H. (2014). A review of pasture and fodder production and productivity for small ruminants in the Sahel. *ICRAF Occasional Paper*, (21). https://www.researchgate.net/profile/Jules-Bayala/publication/262943657_A_review_of_pasture_and_fodder_production_and_productivity_for_small_ruminants_in_the_Sahel/links/53dfc0920cf27a7b8306a828/A-review-of-pasture-and-fodder-production-and-productivity-for-small-ruminants-in-the-Sahel.pdf

Bezabih, E., Mengistu, K., Jeffreyson, K. M., & Jemal Y. (2015). Factors affecting market outlet choice of potato producers in Eastern Hararghe Zone, Ethiopia. *Journal of Economics and Sustainable Development*, *6*(15), 159-172.

Bezabih, M., Abera, D., Adie, A., Lefore, N., & Jones, C. (2020). *Analysis of stakeholders' roles and relationships in the feed value chain in Ethiopia*. ILRI Discussion Paper 39. ILRI. Nairobi. https://cgspace.cgiar.org/server/api/core/bitstreams/34898e39-ed0f-42e3-9ca0-35c92c7532fc/content

Bolton, D. L. (2012). Individual entrepreneurial orientation: Further investigation of a measurement instrument. *Academy of Entrepreneurship Journal*, *18*(1), 91-212.

Bonabana-Wabbi, J., Ayo, S., Mugonola, B., Taylor, D. B., Kirinya, J., & Tenywa, M. (2013). The performance of potato markets in South Western Uganda. *Journal of Development and Agricultural Economics*, *5*(6), 225-235.

Bongiwe, G. X. & Micah, B. M., (2013). Factors affecting the choice of marketing channel by vegetable farmers in Swaziland. *Sustainable Agriculture Research*, *2*(1), 112-123.

CIDP. (2018). Laikipia County Integrated Development Plan 2018-2022. https://laikipia.go.ke/assets/file/7518c091-second-county-integrated-development.pdf

Cofre-Bravo, G., Engler, A., Klerkx, L., Leiva-Bianchi, M., Adasme-Berrios, C., & Caceres, C. (2019). Considering the farm workforce as part of farmers' innovative behavior: A key factor in inclusive on-farm processes of technology and practice adoption. *Experimental Agriculture Journal*, *55*(5), 723-737.

Collins, C. J., Hanges, P. J., & Locke, E. A. (2004). The relationship of achievement motivation to entrepreneurial behavior: A meta-analysis. *Human Performance Journal*, *17*(1), 95-117.

Covin, J. G., & Wales, W. J. (2012). The measurement of entrepreneurial orientation. *Entrepreneurship Theory and Practice Journal*, *36*(4), 677-702.

Curto, J. D., & Pinto, J. C. (2011). The corrected vif (cvif). *Journal of Applied Statistics*, *38*(7),

1499-1507.

Dalipagic, I., & Elepu, G. (2014). *Agricultural value chain analysis in northern Uganda: Maize, rice, groundnuts, sunflower and sesame*. Action Against Hunger International. https://www.actionagainsthunger.org/publication/2014/03/agricultural-value-chain-analysis-northern-uganda-maize-rice-groundnuts

Delle, E., & Amadu, I. M. (2015). Proactive personality and entrepreneurial intention: Employment status and student level as moderators, *International Journal of Small Business and Entrepreneurship Research*, *3*(4), 1-13.

Dlamini, S. I., & Huang, W. C. (2019). A Double Hurdle estimation of sales decisions by smallholder beef cattle farmers in Eswatini. *Sustainability*, *11*(19), 5185-5211.

Fekade, M. (2019). Improved forage production in Ethiopia : Utilization , challenges and prospects for adoption : A Review. *Journal of Biology, Agriculture and Healthcare*, *9*(21), 5-11.

Fikadu, A. A., Tilaye, K. A., Mebrat, M. A., & Elimnh, L. A. (2017). Adoption and intensity of use of modern beehives in Wag Himra and North Wollo zones, Amhara region, Ethiopia. *Ethiopian Journal of Economics*, *26*(2), 1-30.

Gedefaw, A., & Sisay, D. (2020). Determinants of recommended agronomic practices adoption among wheat producing smallholder farmers in Sekela District of West Gojjam Zone, Ethiopia. *Journal of Development and Agricultural Economics*, *12*(1), 17-24.

Geoffrey, S. K., Bett, K. H., Kiprop, K. J., & Odipo, O. T. (2014). Factors influencing the choice of marketing outlets among small-scale pineapple farmers in Kericho County, Kenya. *International Journal of Regional Development*, *1*(5), 2100-6755.

Gichuki, T., Njiru, M. J., & Kipchirchir, T. (2017). *Alternative value chains to livestock in Baringo , Isiolo, Laikipia and Samburu: Feasibility Study Report.* Upeo Consulting. Nairobi, Kenya. https://www.academia.edu/33352590

GoK. (2012a). *National Policy for the Sustainable Development of Northern Kenya and other Arid Lands.* Office of the Prime Minister, Ministry of State for Development of Nothern Kenya. Nairobi, Kenya.

GoK. (2012b). *Kenya Post-Disaster Needs Assessment (PDNA): 2008–2011 Drought*. https://www.gfdrr.org/sites/default/files/publication/pda-2011-kenya.pdf

GoK. (2018). *Kenya Vision 2030: Third Medium Term Plan 2018.* National Treasury and Planning. Nairobi, Kenya.

GoK. (2019a). *National Feed Inventory and Feed Balance Assessment: The Case of 23 ASAL Counties of Kenya-Final Report*. State Department for Livestock Development. Nairobi, Kenya.

GoK. (2019b). *Draft National Livestock Policy*. Ministry Of Agriculture, Livestock, Fisheries And Irrigation, State Department For Livestock. Nairobi, Kenya.

Greene, W. H. (2018). *Econometric Analysis.*Eigth Edition. Pearson Education Inc. New York University, USA.

GTZ. (2007). *ValueLinks Manual:The methodology of value chain promotion.* First Edition. Eschborn. Germany.

Hassan, S., Hussain, A., Khan, M. A., & Mahmood, I. (2012). Rural-urban retail prices and marketing margins of fresh fruits and vegetables in Pakistan. *Pakistan Journal of Agriculture Research*, *25*(3), 206-217.

Heuzé, V., Tran, G., Boudon, A., & Lebas, F. (2016) *Rhodes grass (Chloris gayana)*. Feedipedia, a programme by INRAE, CIRAD, AFZ and FAO. https://www.feedipedia.org/node/480

HLPE. (2016). *Sustainable agricultural development for food security and nutrition: What roles for livestock?* A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome. http://www.fao.org

IGAD. (2017). *Good Practices in Fodder and Fodder Seed Production and Marketing for Increased Private Sector Investment.* https://icpald.org

Islam, S., Begum, J., Sarker, N. R., & Khatun, M. (2017). Economics of fodder production for dairying in selected areas of Bangladesh. *Bangladesh Journal of Animal Science*, *46*(2), 140-149.

Issa, N., & Chrysostome, N. J. (2015). Determinants of farmer participation in the vertical integration of the Rwandan coffee value chain: Results from Huye District. *Journal of Agricultural Science*, *7*(9), 197-211.

Jenkins, A., Velandia, M. M., Lambert, D. M., Roberts, R. K., Larson, J. A., English, B. C., & Martin, S. W. (2011). Factors influencing the selection of precision farming information sources by cotton producers. *Agricultural and Resource Economics Review Journal*, *40*(1203), 307-320.

Johannes, T. A., Vabi, M. B., & Malaa, D. K. (2010). Adoption of maize and cassava production technologies in the Forest-Savannah zone of Cameroon: Implications for poverty reduction. *World Applied Sciences Journal*, *11*(2), 196-209.

Kangile, R. J., Mgeni, C. P., Mpenda, Z. T., & Sieber, S. (2020). The determinants of farmers' choice of markets for staple food commodities in Dodoma and Morogoro, Tanzania. *Agriculture Journal*, *10*(5), 142-153.

Kaplinsky, R., & Morris, M. (2002). *A Handbook for Value Chain Research*. International Development Research Centre (IDRC), Ottawa.

Kgosikoma, K., & Malope, P. (2016). Determinants of market participation and the institutional constraints: Case study of Kweneng West, Botswana. *Agriculture Extension and Rural Development Journal*, *8*, 178-186.

Kidake, B. K., Manyeki, J. K., Kubasu, D., & Mnene, W. N. (2016). Promotion of range pasture and fodder production among the pastoral and agro pastoral communities in Kenyan rangelands: Experiences and lessons learnt. *Livestock Research for Rural Development Journal*, *28*(8), 72-81.

Kifle, T., Tekeste, B., & Abadi, A. (2015) Determinants of the choice of marketing channel among small-scale honey producers in Tigrai Region of Ethiopia. *Journal of Business Management & Social Sciences Research*, *4*(4), 295-305

Kilimo Trust. (2017). *Characterisation of markets for animal feeds raw materials in the East African Community. Focus on maize bran and sunflower oil seed cake.* https://www.kilimotrust.org/index.php/regional/96-regional-studies/121-characteristics-of-markets-for-animal-feeds-raw-materials-in-the-eac

Kimei, S. (2016). *Analysis of bean commercialization and food sufficiency trade-off: A case of smallholder farmers in Rwanda* (Doctoral dissertation, Egerton University).

Kipchirchir, K. O., Ngugi, K. R., Mwangi, M. S., Njomo, K. G., & Wanjogu, R. (2015). Water stress tolerance of six rangeland grasses in the Kenyan semi-arid rangelands. *American Journal of Agriculture and Forestry*, *3*(5), 222-229

KNBS. (2020). *Laikipia County Statistical Abstract 2020*. Government printer. Nairobi, Kenya. https://www.knbs.or.ke/wp-content/uploads/2023/09/2020-County-Statistical-Abstracts-Laikipia.pdf

Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International. http://eprints.itn.ac.id/id/eprint/13616

Kuria, S. G., Mwaura, J. M., Kinyua, M. G., Nduma, B., Okoti, M., Wamuongo, J. W., & Ofwona, E. (2015). *Adapting dryland livestock production to meet climate change challenges in Kenya*. Kenya Agricultural and Livestock Research Organization (KALRO). https://idl-bnc-

idrc.dspacedirect.org/server/api/core/bitstreams/9e4b4070-4cdb-4310-b9ae-b7bbc21b263a/content

Liu, E. M. (2013). Time to change what to sow: Risk preferences and technology adoption decisions of cotton farmers in China. *Review of Economics and Statistics*, *95*(4), 1386-1403.

Liu, T., Bruins, R. J. F., & Heberling, M. T. (2018). Factors influencing farmers' adoption of best management practices: A review and synthesis. *Sustainability Journal*, *10*(2), 1-31.

Lu, R., & Dudensing, R. (2015). What Do We Mean by Value - added Agriculture? *Agricultural and Applied Economics Association Journal*, *30*(4), 1-8.

Lugusa, K. O. (2015). *Fodder production as an adaptation strategy in the drylands: A case study of producer groups in Baringo County, Kenya*. (Doctoral dissertation, University of Nairobi).

Lugusa, K. O., Wasonga, O. V., Elhadi, Y. A., & Crane, T. A. (2016). Value chain analysis of grass seeds in the drylands of Baringo County, Kenya: A producers' perspective. *Pastoralism Journal*, *6*(1), 1-15.

Lukuyu, M. N., Njehu, A., Mwilawa, A., Lukuyu, B. A., Omore, A. O., & Rao, E. J. O. (2016). *A study to understand fodder markets and fodder trading patterns in MoreMilkiT sites and other selected regions in Tanzania*. Consultative Group on International Agricultural Research (CGIAR). https://cgspace.cgiar.org/server/api/core/bitstreams/e09dc694-d927-4c21-a4fb-887a8dfccf64/content

Manyeki, J. K., Kirwa, E. C., Ogillo, P. B., Mnene, W. N., Kimitei, R., Mosu, A., & Ngetich, R. (2015). Economic analysis of natural pasture rehabilitation through reseeding in the southern rangelands of Kenya. *Livestock Research for Rural Development Journal*, *27*(3), 49-61.

Manzano-García, G., & Ayala-Calvo, J. C. (2020). Entrepreneurial Orientation: Its Relationship with the Entrepreneur's Subjective Success in SMEs. *Sustainability Journal*, *12*(11), 4547-4563.

Marshall, V. M., Lewis, M. M., & Ostendorf, B. (2012). Buffel grass (Cenchrus ciliaris) as an invader and threat to biodiversity in arid environments : A review. *Journal of Arid Environments*, *78*, 1-12.

McClelland, D. C. (1961). *Achieving society* (No. 15). Simon and Schuster.

Mendoza, M.S., & Rosegrant, M.W. (1995). *Pricing Behavior in Philippine Corn Markets: Implications for Market Efficiency (Vol. 101).* International Food Policy Research Institute.

Mkuna, E., & Baiyegunhi, L. J. (2019). Determinants of Nile perch (Lates niloticus) overfishing and its intensity in Lake Victoria, Tanzania: A Double-hurdle model approach.

Hydrobiologia, *835*(1), 101-115.

MoALFI. (2019). *Agricultural Sector Transformation and Growth Strategy 2019-2029.* https://www.kilimo.go.ke

Mohammadi, P., Kavoosi-Kalashami, M., & Zanganeh, M. (2020). Olive marketing analysis in northern Iran: Marketing margins and indices. *Alinteri Journal of Agriculture Science*, *35*(1), 15-21.

Mordor Intelligence. (2023). *Forage Feed Market Size & Share Analysis - Growth Trends & Forecasts (2023 - 2028)*. MordorIntelligence. https://www.mordorintelligence.com/industry-reports/forage-feed-market

Mureithi, S. M. (2018). *Commercial pasture production and its economic feasibility in asal counties*. (AgriFoSe2030/ILRIPolicyBrief). Swedish University of Agricultural Sciences. https://www.ilri.org/knowledge/publications/commercial-pasture-production-and-its-economic-feasibility-asal-counties

Mustapha, S., Man, N., Shah, J. A., Kamarulzaman, N. H., & Tafida, A. A. (2022). Factors Influencing the Adoption of ICT'S in Extension Service Delivery among the Extension Agents in North-East, Nigeria. *Sarhad Journal of Agriculture*, *38*(1), 149-159.

Muthini, D. N., Nyikal, R. A., & Otieno, D. J. (2017). Determinants of small-scale mango farmers market channel choices in Kenya: An application of the two-step Cragg's estimation procedure. *Journal of Development and Agricultural Economics*, *9*(5), 111-120.

Mutoko, M. C., Rioux, J., & Kirui, J. (2015). *Barriers, incentives and benefits in the adoption of climate-smart agriculture: Lessons from the MICCA pilot project in Kenya*. Food and Agriculture Organization of the United Nations (FAO). Rome.

Mutura, J. K., Nyairo, N., Mwangi, M., & Wambugu, S. K. (2015). Analysis of determinants of market channel choice among smallholder dairy farmers in Lower Central Kenya. *International Journal of Innovative Research and Development*, *4*(10), 264-270.

Nangole, E., Lukuyu, B., Franzel, S., Kinuthia, E., Baltenweck, I., & Kirui, J. (2013). *Livestock feed production and marketing in Central and North Rift Valley Regions of Kenya.* East African Dairy Development Project. Nairobi, Kenya.

Ngenoh, E., Kurgat, B. K., Bett, H. K., Kebede, S. W., & Bokelmann, W. (2019). Determinants of the competitiveness of smallholder African indigenous vegetable farmers in high-value agro-food chains in Kenya: A Multivariate Probit regression analysis. *Agricultural and Food Economics Journal*, *7*(1), 1-17.

Ngeywo, J., Basweti, E., & Shitandi, A. (2015). Influence of gender, age, marital status and farm size on coffee production: a case of Kisii County, Kenya. *Asian Journal of Agricultural Extension, Economics & Sociology*, *5*(3), 117-125.

Njarui, D. M. G., Gichangi, E. M., Gatheru, M., Nyambati, E. M., Ondiko, C. N., Njunie, M. N., ... & Ayako, W. (2016). A comparative analysis of livestock farming in smallholder mixed crop-livestock systems in Kenya: 2. Feed utilization, availability and mitigation strategies to feed scarcity. *Livestock Research for Rural Development*, *28*(4), 1-15.

Obiero, K. O., Waidbacher, H., Nyawanda, B. O., Munguti, J. M., Manyala, J. O., & Kaunda-Arara, B. (2019). Predicting uptake of aquaculture technologies among smallholder fish farmers in Kenya. *Aquaculture International Journal*, *27*(6), 1689-1707.

Ochieng, J., Knerr, B., Owuor, G., & Ouma, E. (2015). *Agricultural commercialization and household food security: The case of smallholders in Great Lakes Region of Central Africa*. Paper presented at the International Conference of Agricultural Economists, Milan, Italy.

Ohmstedt, U., Notenbaert, A. M. O., & Burkart, S. (2018). *Analysis of the forage value chains in Kenya and Ethiopia with special focus on seed systems and progressing*. International Centre for Tropical Agriculture (CIAT). Cali, Colombia. 70p.

Okello, D. O. (2017). *Effect of ICT use on performance of Agri-enterprises. A case of smallholder pineapple farmers in Kiambu County, Kenya* (MSc. Thesis, Egerton University).

Olila, D. O. (2014). Economic evaluation of factors affecting farmers participation in development groups: A case of Trans-Nzoia County, Kenya. *Journal of Agricultural Economics, Extension and Rural Development*, *2*(6), 74-81.

Omollo, E. O., Jawuoro, S. O., Wasonga, O. V., & Simatele, D. (2019). Mapping and characterization of stakeholders in the fodder value chain in Southern Rangelands of Kenya: Understanding their roles, interactions and influences. *Agricultural Science and Practice Journal*. 4(5), 151-164.

Omollo, E. O., Wasonga, O. V., Elhadi, M. Y., & Mnene, W. N. (2018). Determinants of pastoral and agro-pastoral households' participation in fodder production in Makueni and Kajiado Counties, Kenya. *Pastoralism Journal*, *8*(1), 1-10.

Omollo, E., Wasonga, O. V., Elhadi, Y. A. M., & Mnene, W. N. (2016). Grass seed value chain analysis in the Southern Kenya range lands of Makueni and Kajiado Counties. In *Fifth African Higher Education Week and RUFORUM Biennial Conference 2016," Linking agricultural universities with civil society, the private sector, governments and other stakeholders in*

support of agricultural development in Africa", Cape Town, South Africa, 17-21 October 2016 (pp. 645-651). RUFORUM.

Opondo, F. A. (2018). *Evaluation of cassava commercialization among smallholder farmers and its effect on household income: A case of Siaya and Kilifi counties* (Doctoral dissertation, Egerton University).

Ouma, E. O. (2017). *Analysis of Fodder Production and Marketing in the Range Land of Southern Kenya*. (MSc Thesis, University of Nairobi) http://erepository.uonbi.ac.ke

Prokopy, L. S., Towery, D., & Babin, N. (2014). *Adoption of agricultural conservation practices: Insights from research and practice*. Purdue Extension: West Lafayette, IN, USA.

Rabbi, F., Ahamad, R., Ali, S., Chandio, A. A., Ahmad, W., Ilyas, A., & Din, I. U. (2019). Determinants of commercialization and its impact on the welfare of smallholder rice farmers by using Heckman's two-stage approach. *Journal of the Saudi Society of Agricultural Sciences*, *18*(2), 224-233.

Rishipal, N. J. (2012). Need for achievement an antecedent for risk adaptiveness among entrepreneurs. *Global Journal of Management and Business Research*, *12*(22), 102-114.

Sajida, T., Khan, M. T. I., Mazher, A., & Arshed, B. (2013). Price spread and marketing margins of cut rose in Punjab, Pakistan. *Pakistan Journal of Agricultural Research*, *26*(1), 16-23.

Sala, S. M. (2019). *An analysis of the factors influencing participation of pastoralists in commercial fodder value chain for livelihood resilience in Isiolo County, Kenya* (Doctoral dissertation, University of Nairobi).

Sanchi, I. D., Baba, M. D., & Manga, T. A. (2015). Analysis of fresh fish marketing in Ngaski local government area of Kebbi State, Nigeria. *International Journal of Sustainable Agricultural Research*, *2*(1), 22-30.

Setyowibowo, F. (2019). *Revisiting Individual Entrepreneurial Orientation Theory: A Study of Indonesian Entrepreneurs*. (Doctoral disertation, Curtin University)

Sichoongwe, K., Mapemba, L., Ng'ong'ola, D., & Tembo, G. (2014). *The determinants and extent of crop diversification among smallholder farmers: A case study of Southern Province, Zambia* (Vol. 5). International Food Policy Research Institute.

Singh, H., Singh, V. P., & Kaur, I. (2018). Marketing Pattern and Price Spread of Green Fodder in Punjab. *Indian Journal of Economics and Development*, *14*(2), 267-273.

Singh, R. K., Singh, K. M., Jha, A., & Kumar, A. (2015). A micro analysis of fodder production and marketing in Bihar. *Indian Journal of Animal Sciences*, *85*(12), 1379-1383.

SNV. (2017). *Forage Production and Management*: Training manual for extension workers. https://snv.org/cms/sites/default/files/explore/download/eth_fomap.

Stein, C., & Barron, J. (2017). *Mapping actors along value chains: Integrating visual network research and participatory statistics into value chain analysis* (Vol. 5). International Water Management Institute (IWMI). CGIAR Research Program on Water, Land and Ecosystems (WLE).

Tarek Abdel Azeem, M. (2018). Measuring the Mediating Role of Entrepreneurial Orientation on the Relationship between Affective Organizational Commitment and Organizational Responsiveness: A Study of Egyptian Incubated Startups in ICT Sector. *Scientific Journal for Economics& Commerce*, *48*(3), 625-685.

Tarekegn, K., Haji, J., & Tegegne, B. (2017). Determinants of honey producer market outlet choice in Chena District, southern Ethiopia: A Multivariate Probit regression analysis. *Agricultural and Food Economics Journal*, *5*(1), 1-14.

Taye, M., Degye, G., & Assefa, T. (2018). Determinants of outlet choices by smallholder onion farmers in Fogera district Amhara Region, Northwestern Ethiopia. *Journal of Horticulture and Forestry*, *10*(3), 27-35.

Teklewold, H., Kassie, M., & Shiferaw, B. (2013). Adoption of multiple sustainable agricultural practices in rural Ethiopia. *Journal of Agricultural Economics*, *64*(3), 597-623.

Tesfaw, H.A. 2017. Market structure and chain analysis of Haricot Bean (PHASEOLUS VULGARIS L). *International Journal of Development and Economic Sustainability* 5(5) 35-47.

Tripathy, A. (2019). Profit Maximization Theory and Value Maximization Theory. *International Journal of Scientific Development and Research*, *4*(6), 284-289.

Vantilborgh, T., Joly, J., & Pepermans, R. (2015). Explaining entrepreneurial status and success from personality: an individual-level application of the entrepreneurial orientation framework. *Psychologica Belgica*, *55*(1), 32-56.

Webber, M., & Labaste, P. (2007). *Using value chain approaches in agribusiness and agriculture in Sub-Saharan Africa: A methodological guide. Tools that make value chains work, Discussion and cases*. World Bank. https://www.technoserve.org/wp-content/uploads/2012/01/vcguidenov12-2007.pdf

Yamane, T. (1967). *An introductory Analysis*. Second Edition. New York: Harper and Row.

APPENDICES

Appendix A: Questionnaire for Fodder Farmers

Section 1: General Information

Questionnaire number: ……. Date of Interview: ……

Phone number/name of respondent……..

Sub-County: …….. Ward: ……..…… Village: ……..……..

GPS Reading: …….

Section 2: Socio-economic Profile of Respondents

2.1 Age (in years) [ ]

2.2 Gender: Male [ ] Female [ ]

2.3 Marital status: Single [ ] Married [ ] Divorced [ ] Widowed [ ]

Other(specify)……

2.4 Education level: None [ ] Primary [ ] Secondary [ ] Tertiary [ ]

Other(specify)……..

2.5 Household size……

2.6 What do you do as source of livelihood/income?

Activity(tick as appropriate)	**Livestock keeping [ ]**	**Crop farming [ ]**	**Business [ ]**	**Salaried employment [ ]**	**other (specify)**
Rank(1-4; 1 means most important)					

2.7 For how long (in years) have you been in fodder production? ……

Section 3: Fodder and fodder seed production

3.1 Land and other resources

3.1.1 How much land in acres is available for this household? [ ]

3.1.2How much of this land in acres is;

Owned? [ ] Rented in? [ ] Rented out? [ ] Communal?[ ]

Other(Specify)……

3.1.3 How was the owned land acquired? Purchased [ ] Inherited [ ]

3.1.4 How much of the total land in acres is devoted to fodder production? [ ]

3.1.5 What is your source of labour for fodder production?

Family labour [ ] Hired labour [ ] Other (specify)……

3.2 Fodder production and marketing

3.2.1 What fodder species do you grow in your farm?

Fodder species	**Acreage (acres)**	**Yield(last season) in bales**
Chloris gayana		
Cenchrus ciliaris		
Eragrostis Superba		
Other(specify)		

3.2.2 What is your opinion on this statement?

Quality of fodder is key to satisfying fodder buyers and enhances buyer loyalty and amount sold.

Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree [ ]

3.2.3 What need to be done to improve fodder production in terms of yield and quality? (Tick √ as appropriate)

Use of new improved varieties [ ] Implement better fodder management practices [ ]

Enforce quality standards [ ] Training (BDS) [ ] Use of machinery [ ] Fortification [ ]

3.2.4 From where do you get inputs used in pasture production in your farm?

Other farmers [ ] Agrovets [ ] Government/Local NGOs [ ] Other(Specify)……

3.2.5 Do you sell your fodder? Yes [ ] No [ ]

3.2.6 If yes, to whom did you sell your fodder in the last season?

Buyer/ outlet (Tick where appropriate)	Local livestock farmers [ ]	Local traders (traders/ bulkers/brokers) [ ]	Local farm groups/ cooperatives [ ]	Buyers from Other Counties [ ]	Other (specify)..

Number of buyers					
Quantity sold					
Market price					

3.2.7 How much money did you spend on the following while marketing fodder in the last season?

Activity/market cost	**Unit of measure**	**No. of units**	**Value per unit**	**Total amount**
Transport	KES			
Storage	KES			
Cess/toll tax	KES			
Communication	KES			
Personal expenses	KES			
Loading and unloading	Man hours			
Other(specify)				

3.2.8 In what form do you sell fodder?

Fresh form [ ] Baled form [ ] Other(specify)…….

3.2.9 What is the price of a bale of fodder at farm gate? KES……..

3.2.10 How do you determine the selling price for fodder?

Going rate [ ] Mark-up [ ] Other(Specify)……

3.2.11 How do your customers pay for fodder and fodder seed purchased?

Cash [ ] Credit [ ] Other (specify)……..

3.2.12 Are you engaged in any market agreements? Yes [ ] No [ ]

3.2.13 If yes, what is the nature of the agreement? Formal [ ] Informal [ ]

3.2.14 Do you sell your products to the nearest local market? Yes [ ] No [ ]

3.2.15 If yes what is the distance to the nearest local fodder market in kilometers? [ ]

3.2.16 What mode of transport do you use to transport your fodder to the market? Tick √ as appropriate.

Foot [ ] Cart [ ] Bicycle [ ] Motorcycle [ ] Pickups [ ] Truck [ ] Other (specify)……..

3.2.17 Do you get any fodder market information? Yes [ ] No [ ]

3.2.18 If yes above, from where do you get the information from?

County officials [ ] NGOs [ ] Media [ ] Traders/brokers [ ] Group members [ ]

Community meetings [ ] Other(specify)……

3.2.19 What kind of market information do you get?

Prevailing fodder prices [ ] Current market demand and supply [ ] Other(specify)……

3.2.20 Generally, what challenges do you face while producing and selling fodder?

Challenge faced	**Rank 1-4 (1 to mean most severe)**	**Suggested solution**

Section 4: Information on fodder institutional factors

4.1 Do you have access to credit facilities? Yes [ ] No [ ]

4.2 If yes, what are the sources of credit accessed in the last season? Tick √ where appropriate.

Commercial banks [ ] Microfinance institutions [ ] Group savings/*chamas* [ ]

Mobile credit [ ] Friends/family [ ] other (specify)……..

4.3 If yes, what total amount of credit (in KES) did you receive in the last season? [ ]

4.4 How did you spend the money borrowed in the last season?

Purchased inputs/assets [ ] Paid labour costs [ ] Domestic uses [ ] other (specify)……

4.5 If no above what are the reasons for lack of access of credit?

Collateral requirements [ ] High interest rates [ ] Not aware of lending facilities [ ] Other (specify)…….

4.6 Do you get any extension services? Yes [ ] No [ ]

4.7 If yes, from what source do you get the said services?

County Department of Agriculture [ ] NGOs [ ] Private Service Providers [ ] Research and development institutions [ ] Other (specify)……

4.8 What kind of extension information did you receive?

Husbandry [ ] Marketing [ ] Post-harvest handling [ ] Other (specify)……

4.9 Are you a member of any farm group? Yes [ ] No [ ]

4.10 If yes, which type of group?

Cooperative society [ ] Self-help group [ ] CIG [ ] Other (specify)……

4.11 What benefits do you get by being a member to the said groups?

Stronger bargaining power [ ] Ease of credit access [ ] Ease of access to extension services [ ] Ease of access to input and output markets [ ] Other (specify)……

4.12 How is the status of road infrastructure in this area? Good [ ] Bad [ ]

4.13 What form of road infrastructure is common in your area?

Tarmac [ ] murram [ ] loose earth road [ ] pathway [ ]

Section 5: Information on entrepreneurial orientation

In your own opinion do you agree or disagree with the following statements?

5.1 I like improving on my original plans in fodder production.

Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree [ ]

5.2 Nothing can prevent me from doing an activity that I believe will improve fodder production.

Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree [ ]

5.3 I am willing to take risks if the anticipated gains are favorable.

Strongly disagree [ ] Disagree [ ] Neutral [ ] Agree [ ] Strongly agree [ ]

Appendix B: FGD Guide/Check list to map fodder market activities

FGD Location: _____ **Date:** _____ **Time:** _____		
S/No.	**Topic**	**Research question**

1.	Identifying key fodder functions/nodes/stages and activities.	• *What are the main functions/stages that fodder pass before reaching the final users?* • *What are the main activities carried out in the above functions to have fodder reach the final users?*
2.	Identifying primary actors/operators.	• *Who are the operators involved in these activities and what are their roles?*
3.	Identifying the product flow/ channels of product and information flow	• *How do fodder, information and knowledge flow in the market?* • *What types of relationships and linkages exist among the various market actors?*
4.	Quantification at different stages/nodes	• *What are the input and output volumes/quantities handled, their sources, costs incurred, market outlets and the number of actors at each node?*
5.	Identifying supporters and enablers and their roles	• *Which organizations/institutions provide support to the operators above in developing fodder from raw materials to final product? What type/form of support do they provide?* • *Which organizations/institutions provide an enabling environment to the operators above in executing their activities? What is their role in strengthening the value chain?*
6.	Calculating value added at each value chain node.	• *How does the value change through the value chain? What is the price of a bale of fodder at each node? What percentage of the final fodder price goes to each node?*
7.	Challenges and opportunities for improvement	• *What are the challenges faced in the fodder enterprise? What are the opportunities available for improvement?*

8.	Synthesis, discussion and wrap up	

Appendix C: Interview guide for Key Informant Interview (KII)

1. What is your role in supporting fodder enterprises? Which level of the chain do you target?
2. What are your current initiatives/services and milestones in executing the said role?
3. Which are the most common fodder types in this area? Where do farmers get fodder seed? At what price? What are the key cost drivers in fodder production?
4. What volume of fodder was produced in the last one year? How much of this was sold to various buyers/outlets and at what price? Does production meet the market demand? Does fodder produced meet quality standards? What needs to be done to improve quality and quantity of fodder?
5. How does fodder move from input provision to final users? Give examples of channels of distribution.
6. What are the average farm gate and market price for fodder? How is price determined for fodder? Are the fodder enterprises organized?
7. What challenges do fodder enterprises encounter and possible remedies for the same?
8. Give your opinion on the status of market participation by fodder farmers.

Appendix D: Multicollinearity test for the Probit model

Variable	VIF	1/VIF
Risk	2.62	0.382320
MInfo	2.50	0.399516
Qlity	2.37	0.422642
Proa	2.28	0.439208
Crdt	1.63	0.614898
RInfr	1.53	0.652787
MAgree	1.45	0.687601
MCost	1.11	0.897527

Mean VIF	**1.94**

Appendix E: Probit regression for market participation decision results (coefficients)

Probit regression	Number of obs = 203
	LR chi2(9) = 121.29
	Prob > chi2 = 0.0000
Log likelihood = -72.517009	Pseudo R2 = 0.4554

DSell	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
Age	.0250627	.0119226	2.10	0.036	.0016948	.0484305
Qlity	-.3359732	.3232387	-1.04	0.299	-.9695094	.2975629
MCost	.0001777	.0001074	1.66	0.098	-.0000327	.0003882
MAgree	.7248521	.3839751	1.89	0.059	-.0277253	1.477429
MInfo	1.457338	.3351271	4.35	0.000	.8005008	2.114175
Crdt	.6204919	.4273975	1.45	0.147	-.2171918	1.458176
RInfr	-.4654031	.3450262	-1.35	0.177	-1.141642	.2108357
Risk	-.1505884	.2781697	-0.54	0.588	-.695791	.3946142
Proa	.5535185	.294704	1.88	0.060	-.0240907	1.131128
_cons	-2.086193	1.409739	-1.48	0.139	-4.849231	.6768439

Appendix F: Multicollinearity test for the Multivariate Probit model

Variable	VIF	1/VIF
Price	3.11	0.321975
CIndex	2.73	0.366117
Inno	1.96	0.509712
MAgree	1.92	0.521716
Risk	1.90	0.525931
Proa	1.64	0.609779
Crdt	1.55	0.643277

RInfr	1.46	0.683039
MDist	1.43	0.700926
Qlity	1.42	0.705953
AProd	1.39	0.721324
MCost	1.35	0.743225
MInfo	1.28	0.778764
Expr	1.11	0.897216
Mean VIF	**1.73**	

Appendix G: Predictive probability for the fodder market outlets

Outlet	**Predictive probability - Delta-method**					
	Margin	**std. err.**	**t**	**P>|t|**	**[95% conf. interval]**	
Loclivfarmers	.7647059	.0365883	20.90	0.000	.6912862	.8381256
Loctraders	.3823529	.0512352	7.46	0.000	.2795419	.4851639
Buyfocounties	.2058824	.0344708	5.97	0.000	.1367116	.2750531

Appendix H: Multivariate Probit regression for the choice of fodder market outlets

Equation	**Obs**	**Parms**	**RMSE**	**"R-sq"**	**F**	**P>F**
Loclivfarm~s	68	16	.3017145	0.6131	5.493805	0.0000
Loctraders	68	16	.4224965	0.4220	2.530916	0.0068
Buyfocount~s	68	16	.2842537	0.6221	5.706291	0.0000

Outlet/Variable	**Coefficient**	**Std. err.**	**t**	**P>t**	**[95% conf. interval]**	
Loclivfarmers						
Age	.0016825	.0045056	0.37	0.710	-.0073586	.0107236
Expr	-.0039737	.0206039	-0.19	0.848	-.0453183	.037371
AProd	.0000663	.0001366	0.48	0.630	-.0002079	.0003404
CIndex	-.0038576	.0030604	-1.26	0.213	-.0099987	.0022834

Qlity	-.0333761	.0736475	-0.45	0.652	-.1811606	.1144084
MCost	-.0000122	.0000265	-0.46	0.645	-.0000653	.0000408
MAgree	.5658533	.1434203	3.95	0.000	.2780594	.8536472
MDist	.0098679	.0131763	0.75	0.457	-.0165722	.036308
MInfo	-.1967169	.2105398	-0.93	0.354	-.6191959	.2257621
Crdt	.015815	.0952435	0.17	0.869	-.175305	.206935
RInfr	.1226098	.0956554	1.28	0.206	-.0693368	.3145563
Inno	-.1154203	.1017191	-1.13	0.262	-.3195346	.088694
Proa	.0074156	.0780954	0.09	0.925	-.1492942	.1641255
Risk	.0931379	.0760349	1.22	0.226	-.0594374	.2457131
Price	-.0034546	.0023507	-1.47	0.148	-.0081716	.0012624
_cons	1.317837	.8105231	1.63	0.110	-.3085967	2.94427
Loctraders						
Age	-.0015579	.0063092	-0.25	0.806	-.0142183	.0111026
Expr	.0558359	.028852	1.94	0.058	-.0020598	.1137316
AProd	.0003195	.0001913	1.67	0.101	-.0000644	.0007035
CIndex	.0026949	.0042855	0.63	0.532	-.0059045	.0112944
Qlity	.1357113	.10313	1.32	0.194	-.0712342	.3426567
MCost	-.000013	.000037	-0.35	0.726	-.0000874	.0000613
MAgree	-.3128048	.2008342	-1.56	0.125	-.7158081	.0901984
MDist	.0049417	.018451	0.27	0.790	-.0320829	.0419662
MInfo	-.473665	.2948229	-1.61	0.114	-1.06527	.1179404
Crdt	.0915467	.1333712	0.69	0.496	-.1760822	.3591756
RInfr	-.1787215	.133948	-1.33	0.188	-.4475078	.0900649
Inno	-.1078519	.1424392	-0.76	0.452	-.393677	.1779732
Proa	-.2598952	.1093585	-2.38	0.021	-.479339	-.0404513
Risk	.0147934	.1064731	0.14	0.890	-.1988606	.2284474
Price	.0010653	.0032917	0.32	0.748	-.00554	.0076706
_cons	1.485287	1.134991	1.31	0.196	-.7922383	3.762813
Buyfocounties						
Age	.0086582	.0042448	2.04	0.046	.0001403	.0171761

Expr	-.0054727	.0194115	-0.28	0.779	-.0444247	.0334793
AProd	-.0001292	.0001287	-1.00	0.320	-.0003876	.0001291
CIndex	.0060788	.0028833	2.11	0.040	.0002931	.0118645
Qlity	-.1166534	.0693854	-1.68	0.099	-.2558854	.0225785
MCost	.0000694	.0000249	2.78	0.007	.0000193	.0001194
MAgree	.2274982	.1351203	1.68	0.098	-.0436406	.4986369
MDist	-.0225933	.0124137	-1.82	0.075	-.0475033	.0023166
MInfo	.4875422	.1983555	2.46	0.017	.0895128	.8855716
Crdt	.0815168	.0897315	0.91	0.368	-.0985427	.2615763
RInfr	.0964253	.0901196	1.07	0.290	-.0844129	.2772635
Inno	.1465591	.0958324	1.53	0.132	-.0457427	.3388609
Proa	.155926	.0735759	2.12	0.039	.0082852	.3035668
Risk	-.0433492	.0716346	-0.61	0.548	-.1870946	.1003962
Price	.0076692	.0022146	3.46	0.001	.0032252	.0121132
_cons	-3.166183	.7636166	-4.15	0.000	-4.698492	-1.633875

Correlation matrix of residuals:

Market Outlets	Loclivfarmers	Loctraders	Buyfocounties
Loclivfarmers	**1.0000**		
Loctraders	**-0.3524**	**1.0000**	
Buyfocounties	**0.3209**	**-0.2857**	**1.0000**

Breusch–Pagan test of independence: chi2(3) = 20.996, Pr = 0.0001

Appendix I: Research License (NACOSTI permit)

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **870098**

Date of Issue: **03/January/2022**

RESEARCH LICENSE

This is to Certify that Mr.. Stephen Muema Mutuku of Egerton University, has been licensed to conduct research in Laikipia on the topic: ANALYSIS OF FACTORS INFLUENCING FARMER PARTICIPATION IN FODDER MARKETING FOR IMPROVED PERFORMANCE OF MARKET OUTLETS IN LAIKIPIA COUNTY, KENYA for the period ending : 03/January/2023.

License No: **NACOSTI/P/22/14979**

870098

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix J: Publication (Abstract Page)

Vol. 19(5), pp. 501-507, May, 2023
DOI: 10.5897/AJAR2023.16368
Article Number: C80009B70701
ISSN: 1991-637X

http://www.academicjournals.org/AJAR

ACADEMIC JOURNALS
expand your knowledge

African Journal of Agricultural Research

Full Length Research Paper

Determinants of farmers' choice of fodder market outlets in Laikipia County, Kenya

Stephen Muema Mutuku[1]*, Florence Achieng' Opondo[2] and Job Kibiwot Lagat[1]

[1]Department of Agricultural Economics and Agribusiness Management, Egerton University, P. O. Box 536-20115, Egerton-Njoro, Kenya.
[2]Department of Commerce, Laikipia University, P. O. Box 1100-20300, Nyahururu, Kenya.

Received 27 March, 2023; Accepted 28 April, 2023

Commercial fodder farming is rapidly expanding in Laikipia County, Kenya and there is an emerging market formation involving different market actors. Several market outlets are at the farmers' disposal for channelling their fodder to consumers. The purpose of this study was therefore, to determine the factors which influence choices of fodder market outlets in Laikipia County. Using data from 204 fodder farmers, the Multivariate Probit model was used to estimate the determinants of farmers' choice of fodder market outlets. Findings revealed that, the choice of local livestock farmers, local traders and buyers from other counties' outlets was significantly influenced by age, experience, commercialization index, fodder quality, marketing costs, market agreements, market distance, market information, proactivity and price in varied directions and intensities. Therefore, collective action is recommended for easy access to market information, better prices, reduced marketing costs and proactive uptake of fodder business by fodder farmers. Policy interventions should focus on improving fodder quality and strengthening market linkages through contract farming and promoting access to fodder markets. To improve fodder productivity while simultaneously augmenting the amount of fodder offered for sale at various fodder outlets, stakeholders should take advantage of farmers' experience and entrepreneurial orientation to guide their investments.

Key words: Fodder, fodder farmers, multivariate probit model, determinants, market outlets, choice.