MINISTRY OF AGRICULTURE
AND LIVESTOCK DEVELOPMENT

REPUBLIC OF KENYA

THE GOVERNMENT OF MAKUENI COUNTY

Department of Agriculture, Irrigation, Livestock, Fisheries and Cooperatives Development

MAKUENI COUNTY ANIMAL FEED STRATEGY

2023 - 2033

Strategic Partner:

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Food and Agriculture Organization of the United Nations

Overall Design & Layout

Clare Muthui

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H.E. Hon. Mutula Kilonzo Jr.

GOVERNOR

Government of Makueni County

Governor's Note

Agriculture is the economic mainstay of Makueni County. The sector is the highest contributor to Gross County product (GCP) at 29.2% and accounts for over 80% of the total household income. The livestock sub-sector contributes 43% of the agricultural incomes and involves 65% of the farm families in the county. However, production and productivity of the livestock sector has remained low primarily due to inadequate and poor quality feeds.

Introduction of the Makueni County Animal Feed Strategy will ensure growth of the livestock sub-sector in this arid and semi-arid (ASAL) county. It will encourage investments in fodder production and feeds processing, as well as stimulate the cultivation of industrial oil crops which will provide vital raw materials for the manufacturing sector and create employment opportunities for our young people.

As spelled in my manifesto, my government is steering agriculture to prosperity by supporting the development of requisite infrastructure, improve access to inputs and finance, and collaborate with industry stakeholders to create conducive environment for investments. The location of Makueni County is central in access to market and is poised to spur growth of the livestock sub sector as well as other agribusiness ventures.

I have a special interest in this feed strategy and are partnering with development partners, stakeholders and governments in translating this noble initiative into reality.

Lose of livestock to drought and feed-related shortages must come to an end.

Hon. Mutula Kilonzo Jr.

H.E. Hon. Mutula Kilonzo Jr.

Governor | Government of Makueni County

Joyce Mutua

COUNTY EXECUTIVE COMMITTEE MEMBER

Agriculture, Irrigation, Livestock, Fisheries and Cooperative Development

Foreword

Agriculture is the backbone of Makueni County's economy, putting it at a pivotal position in the continued effort to end hunger, achieve food security and improve nutrition in line with Sustainable Development Goals (SDGs Number Two). It is also in line with the Makueni Vision 2025 that aims, among other things, at achieving accelerated and inclusive economic growth and development; increased household incomes and sustainable food security. This, therefore, calls for the agriculture sector to develop suitable strategies that will lead to the achievement of these goals.

The key existing policies this strategy aligns to are the National Livestock Policy 2020; the Range Management and Pastoralism Strategy 2021-2031; the Bottom-Up Economic Transformation Agenda (BETA) 2022-2027; and, the Makueni County Agriculture and Livestock Policy 2020 as well as the Makueni County Integrated Development Plan III 2023-2027.

The Department of Agriculture, Irrigation, Livestock, Fisheries and Cooperative Development remains committed to its vision: A food secure, healthy and wealthy county for sustainable socio-economic development. Our mission is to improve the livelihoods of the Makueni citizens through sustainable management of crop and livestock resources and prudent management of co-operative societies.

Makueni County experiences inadequate feed resources to meet the increasing demand that has been occasioned by the climate change and variability effects leading to a negative feed balance. Therefore, the County Government, in partnership with stakeholders, initiated development of an animal feed strategy as a framework to mitigate precarious feed challenges. The objective of this strategy is to enable the county offset the existing feed gaps and exploit opportunities towards an effective, commercialized, profitable, quality-oriented and sustainable animal feed industry in the county.

The focus will be on seven key strategic pillars that have been identified as critical to the sector development. These seven pillars are: feed production and productivity; animal feed quality; feed processing/value addition; feed marketing; profitability in feed value chains;

sustainable physical environment; and, enabling policy environment. These core pillars will enhance the prosperity of the feed industry in Makueni for a vibrant livestock and fish sector that improves livelihood through increased animal feed production and commercialization for enhanced income and profitability.

The county government and key partners will mobilize resources to boost the feed sector and agriculture in general, with a clearer focus on building sustainable feed enterprises that not only guarantee livestock productivity, income and food security for the people, but also increase employment opportunities for the youth and women in line with the Kenya Vision 2030.

Multi-sector support and participation was required in the successful development of this strategy. To this end, we appreciate the Food and Agriculture Organization of the United Nations (FAO), Kenya, and the National Government through the State Department for Livestock Development for their financial and technical contributions.

We appreciate the policy makers, private sector organizations including, producer co-operatives, agro-dealers, processors and financial institutions for their active engagement towards the development of this strategy.

I, therefore, invite all stakeholders, development partners and investors to collaborate with the Department of Agriculture, Irrigation, Livestock, Fisheries and Co-operative Development in the implementation of this animal feed strategy.

Joyce Mutua

CEC-M | Agriculture, Irrigation, Livestock, Fisheries and Cooperative Development

Government of Makueni County

Dr. Victoria Kyallo

CHIEF OFFICER

Agriculture, Irrigation, Livestock, Fisheries and Cooperative Development

Preface

The Makueni County animal feed strategy is informed by the livestock feed balance analysis and inventory derived from the national feed inventory of 2019. The inventory provides livestock feed status and strategic approaches and framework to address the deficit through livestock feed value chains. The common challenges facing the feed industry were identified as limited knowledge on pasture and integrated landscape management; low production/productivity; low quality natural pasture; low value addition on natural pasture; degraded rangelands; inadequate policy on range land management and uncoordinated communication approaches. The feed strategy is, therefore, developed to provide a means for addressing these challenges and improve animal feed available for sustainable and increased productivity in the livestock sub-sector.

The overall strategy objective is to increase animal feed production, income and profitability with specific objectives being:

i. To improve production and productivity of feed value chains
ii. To enhance animal feed quality
iii. To promote processing/value addition of animal feed
iv. To support marketing of feed to increase profitability
v. To conserve physical environment for sustainable production and climate change mitigation
vi. To support establishment of an enabling policy environment to support feed production

The strategy has identified opportunities including availability of land for pasture establishment; reseeding of the degraded lands; natural pasture improvement and management; commercialization of hay and seed production; and, irrigated pasture and fodder production. Consequently, the key feed value chains identified to address the feed gap are natural pastures, grass for hay, fodder for silage, maize, sorghum, cowpeas, sunflower, cotton and Black Soldier Fly (BSF).

The strategy presents a roadmap for the Directorate of Livestock and Fisheries to develop a competitive feed industry to drive vibrant commercially oriented livestock production enterprises in the county.

The successful implementation of the strategy will require substantial resources to be deployed through proper coordination mechanisms guided by clear financial and investment plans.

The success of this strategy will be measured on improved livestock management, feed and rangeland resources while promoting social inclusion and environmental resilience. Ultimately, the strategy will supply feed for animal needs and food safety to facilitate access to domestic regional and international market. Investments in feed production and value addition of livestock products will be promoted to generate income and create jobs.

The Government of Makueni County will support services to realize implementation of this strategy. Let us all join hands as we develop and exploit the available resources and opportunities in the feed sub-sector for the betterment of our people.

Dr. Victoria Kyallo

Chief Officer | Agriculture, Irrigation, Livestock, Fisheries and Cooperative Development

Government of Makueni County

Acknowledgment

The Directorate of Livestock and Fisheries Development wishes to acknowledge with deep appreciation the participants whose tireless efforts resulted in the development of the Makueni Animal Feed Development Strategy (2023-2032). Special appreciation goes to the FAO for the financial and technical support towards development of the strategy. We also acknowledge the technical support from the State Department for Livestock Production. Further appreciation goes to the team that worked tirelessly to ensure delivery of this important strategy as named below;

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David Musyoki,

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Livestock and Fisheries Development

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Acronyms & Abbreviations

AFOLU
Agriculture, Forest and Other Land Use

AKEFEMA
Association of Kenya Feed Manufacturers

AMS
Agricultural Mechanization Services

ASALs
Arid and Semi-Arid Lands

BETA
Bottom- Up Economic Transformation Agenda

BSF
Black Soldier Fly

CAADP
Comprehensive Africa Agriculture Development Programme

CECM
County Executive Committee Member

CFA
Community Forest Associations

CIDP
County Integrated Development Plan

CP
Crude Protein

CSA
County Statistical Abstract

CTTI
County Technical Training Institute

DM
Dry Mass

DVS
Directorate of Veterinary Services

EAC
East African Community

FAO
Food and Agriculture Organization of the United Nations

GMC
Government of Makueni County

GAPS
Good Agricultural Practices

GMPS
Good Manufacturing Practices

Ha/ha
Hectare

HH
Households

ICIPE
International Centre of Insect Physiology and Ecology

ICT
Information Communication Technology

KALRO
Kenya Agricultural and Livestock Research Organization

KAOP
Kenya Agricultural Observatory Platform

KAVEs
Kenya Agricultural Value Chain Enterprises

KEBS
Kenya Bureau of Standards

KES/Kshs
Kenya Shilling(s)

KRD
Kitise Rural Development

LFCP
Livestock Feeds Commercialization Project

LM
Lower Middle

LTU
Livestock Tropical Unit

MCF
MasterCard Foundation

MDAs
Ministries, Departments and Agencies

ME
Metabolizable Energy

MFI
Monetary Financial Institution

MSMEs
Micro, Small and Medium Enterprises

MT
Metric Tonnes

MTP
Fourth Medium-Term Plan

NASEP
National Agricultural Sector Extension Programme

NGOs
Non-Governmental Organizations

PESTEL
Political, Economic, Social, Technological, Environmental and Legal,

SACCOs
Savings and Credit Cooperative Organizations

SDGs
Sustainable Development Goals

SEKEB

South Eastern Kenya Economic Bloc

SWOT

Strengths, Weaknesses, Opportunities and Threats

TIMPs

Technologies, Information and Management Practices

UM

Upper Middle

VCT

Vocational Training Centre

WHO

World Health Organization

WMO

World Meteorological Organization

WRUAs

Water Resource User Associations

Executive Summary

Livestock production is a major economic activity in Makueni County and accounts for over 43% of all agricultural earnings in the area. The main livestock species reared include cattle, goats, sheep, donkeys, and poultry. Other important livestock species kept are pigs, rabbits, bees, and fish.

The overall objective of this strategy is to drive a sustainable feed value chain in line with the national agenda on food (feed) and nutrition security for the county, implement policy statements outlined in the Makueni County Agriculture and Livestock Policy 2020, and to provide guidance on feed production and utilization by outlining interventions for sustainable development of the animal feed industry.

The animal feed strategy will address challenges of feed deficits and gaps identified by the animal feed inventory and feed balance assessment study of 2019-2022 and promote investment for increased household income and job creation for the people. The animal feed include roughages, concentrates, minerals, and vitamins. The greatest proportion of feed for ruminants is roughages that include natural pastures and browse that compose 80% of the supply system while concentrates contribute 100% of feed supply for the non-ruminants

The demand for animal source foods is on the rise due to increasing human population, improved incomes especially for the expanding middle class and urbanization. The county is also producing feeds to meet demand for animals on transit that transverse the county during export to external market destinations especially in the Middle East. This demand is expected to rise as the designation of the Livestock Export Processing Zone (LEPZ) at Bachuma station offers opportunities to promote livestock productivity in Makueni County.

The effect of climate change has adversely affected pasture and fodder production in cultivated and natural vegetation systems leading to depletion of rangeland resources, encroachment of pastureland by invasive plant species and consequently affecting feed availability in the county.

The strategy proposes interventions informed by empirical data sourced from the national livestock feed balance report of 2019 and structured in four chapters namely; introduction, situation analysis, strategic model and implementation.

The scope of the strategy is to address main challenges in the areas of feed production; conservation and utilization; quality and safety; research and development cost of feed; and, regulation of the feed industry.

Chapter One on introduction, outlines the background on animal feed, rationale, objectives and scope of the strategy. **Chapter Two** on situation analysis, identifies and explains current status of animal feed, challenges, constraints and future projection. **Chapter Three** presents the strategic models anchored in seven pillars whose implementation will deliver the desired transformation in the animal feed industry. The seven strategic pillars are: production and productivity; quality; value addition/processing; marketing; profitability; policy environment; and, environmental management. **Chapter Four** outlines implementation process; co-ordination mechanism; financial and investment plans; communication; and, monitoring and evaluation plans.

The strategy is expected to direct the county feed industry in addressing the feed requirements of the current and projected livestock population increase in the next 10 years while focusing on the Makueni County vision and mission.

Vision: A prosperous animal feed industry for a vibrant livestock and fish sector, and the **Mission**: To improve livestock productivity through development of sustainable animal feed industry. The **Strategy Objective** is: To increase animal feed production, income and profitability, while Specific objectives are:

i. To improve production and productivity of feed value chains
ii. To enhance animal feed quality
iii. To promote processing/value addition of animal feed
iv. To support marketing of animal feed to increase profitability
v. To conserve physical environment for sustainable production and climate change mitigation
vi. To support establishment of an enabling policy environment to support feed production

The key feed value chains that have been identified to address the feed gap described in the strategy are natural pastures, grass for hay, fodder for silage, maize, sorghum, cowpeas, sunflower, cotton and Black Soldier Fly (BSF).

The County Directorate for Livestock and Fisheries Development, in collaboration with the National Government, private sector and development partners, is committed to implementing the strategy through mobilization of resources to fund the interventions proposed. The successful implementation of the strategy will cost approximately KES 4.9 billion over a period of 10 years. The review of the strategy shall be done after a five-year period in 2028 and 2033, respectively.

Chapter ONE

Introduction

1.1 Background Information

The agricultural sector continues to be a key economic and social driver of development in Kenya's Vision 2030, the East African Community regional development agenda, the Africa Union 2063 Agenda and the United Nations Sustainable Development Goals (SDGs). The entire focus by all agenda is sustainable development initiatives, with particular attention to agricultural production, value addition and trade.

The Africa Union agenda is fortified within economic declarations and protocols whose objective is to ensure nations within the African continent commit enhanced support to the agriculture sector. The Maputo Comprehensive Africa Agriculture Development Programme (CAADP) and the Malabo declaration recognize the need for strategic approaches towards agricultural development, value addition and trade through appropriate resource allocation and expanded efforts towards agricultural investments to grow regional economies.

The regional development agenda for the East African Community (EAC) and the Greater Horn of Africa focus at integrating communities towards a common development trajectory to economic empowerment.

The Constitution of Kenya (2010), under the Bill of Rights, provides for the "right to food of adequate quality and quantity at all times for all". The country has formulated robust policy

frameworks that provide for the development of the livestock industry. The Agriculture Sector Transformation and Growth Strategy (ASTGS) of 2019 – 2029 provide for agricultural transformation that seeks to promote increased production, productivity and profitability through optimal utilization of quality input such as animal feed under the livestock sub-sector. According to the Vision 2030, Kenya aims to promote an innovative, commercially-oriented, and modern agricultural sector.

This will be accomplished through:

i. Transforming key institutions in agriculture and livestock to promote agricultural growth;
ii. Increasing productivity of crops and livestock;
iii. Introducing land use polices for better utilization of high and medium potential lands;
iv. Developing more irrigable areas for both crops, livestock and fisheries; and,
v. Improving market access for our small holders through better supply chain management.

Makueni County has put in place Vision 2025 which is in tune and harmonious with Vision 2030. The spirit of Vision 2025 is borne in the transformation of the county and especially agriculture to realize a food secure and wealthy county. It gives priority to ensure food security, nutrition and income even as we pursue other equally important objectives of reducing poverty and generating employment to the people of the county. This technical policy draft paper highlights the challenges, opportunities and proposes interventions for sustainable development of crops, livestock and fisheries sub-sectors which are key to economic development and industrialization for Makueni County.

1.2 County Profile

Makueni County covers an area of 8,176.7 km2 with a human population of 987,653 comprising 244,669 households (HHs), with 489,691 being males and 497,942 females (KNBS 2019). The County borders Kajiado to the West, Taita Taveta to the South, Kitui to the East and Machakos to the North. Makueni County falls under the arid and semi-arid lands (ASALs) with a bimodal rainfall averaging between 300 mm and 1,200 mm per year across three main livelihood zones namely; mixed farming coffee/dairy farming/irrigation, mixed farming food crop/livestock/cotton and marginal mixed farming.

About 80% of the county is arid or semi-arid characterized by climatic variations of low and erratic rainfall. The long rains are experienced during the March-April-May season with the volume of rainfall averaging at 140 mm over the last five years. Short rains are experienced during the October-November-December season with higher volumes of precipitation being realized with a five-year average of 300 mm. The mean annual temperatures in Makueni range from 22.70C to 240C over the last five years.

The temperatures range between 180–240C in the cold season and 240 C to 330C during the hot season.

Arable land measures 504,269 Ha translating to 63% of the total land area. Makueni's 78% of the total population lives in the rural areas and are directly or indirectly engaged in a wide range of activities in crops, livestock and fisheries.

The total area under agriculture is 303,089 Ha; 281,186 (93%) Ha under subsistence agriculture while 18,730 Ha (6.18%) is under commercial farming. Of the 193,531 farming households, 183,660 (94.9%) practice subsistence agriculture while only 7,587 (3.92%) practice commercial agriculture, mainly ranching and large-scale irrigation along Athi River. Further, 93.3% of the farming household practice some form of crop farming while 81.6% own some livestock.

1.3 Overview of the Animal Feed Industry in Kenya

Animal feed play a leading role in the global food industry enabling optimal production of animal products and services. In Kenya, animal feed account for between 60% and 80% of total cost of production in livestock systems. Animal feed consist of roughages, concentrates, minerals and vitamins. The higher proportion of diet for ruminants is roughages that include pastures and browse. While for intensive livestock production, the greatest proportion is concentrates, contributing up to 100% for commercial pig and poultry farming. In low rainfall areas where extensive livestock keeping is practiced, there is minimal supplementation with concentrates and minerals.

Kenya covers an approximate area of 582,646 square kilometres with a livestock population estimated by KNBS abstract report 2021 as; 93 million head of ruminants (5.1 million dairy cattle, 21.65 million beef cattle, 25.3 million sheep, 662,000 dairy goats and 35.4 million meat goats). Non-ruminants which include poultry (57.2 million), pigs (649,000), and rabbits (725,000) are produced under intensive or semi-intensive production systems. The non-ruminants mainly depend on non-roughage feeds (cereal and cereal by-products) placing

them in direct competition with human beings for food.

The grazing animals feed on natural pastures with concentrate supplementation for the high yielding herd while non-grazing animals are fed on roughages/fodder mixed with concentrates to meet nutrient requirements. The concentrates used are from cereals (maize, wheat, barley, oats, millet, and sorghum), legumes and oilseed cakes (soybeans, cottonseed cake and sunflower cake) and animal by-products (fish meal, blood meal, meat and bone meal). Inconsistency in supply of some of these ingredients - especially, the imported ones such as oilseed cakes and meals, mineral elements, fish meal, vitamins and amino-acids - has a major effect on the feed quality. Metabolizable energy (ME) and crude protein (CP) are the most limiting nutrients in the feeds available in Kenya.

Livestock feed and feeding systems in the country are constrained by a host of factors, including;

i. Recurrent droughts,
ii. Grassland degradation
iii. Overgrazing
iv. Land tenure and land use changes
v. Resource use conflicts
vi. Encroachment of invasive plant species
vii. Low soil fertility
viii. Inadequate input and planting material
ix. Seasonal feed shortages and inefficient feed use by pastoralists and agro-pastoralist communities
x. Poor feed conservation practices
xi. Lack of knowledge on appropriate feed and feeding practices.

In addition, inadequate data on estimates of the proportion/number of animals kept within specific production systems constraint the efficient use of available feed resources thus contributing to the inefficiency and non-competitiveness of the feed industry. The rapid population growth, urbanization and rising incomes have increased demand for livestock products and will continue to do so in future. This will, inevitably, lead to a rise in the demand for feed ingredients and, subsequently, the need for increased production capacity for feed cereals and oil-seed crops estimated to be 55 million MT and is projected to rise to 320 million MT by 2030 as per the feed inventory assessment report 2019.

1.3.1 OVERVIEW OF THE ANIMAL FEED INDUSTRY IN MAKUENI COUNTY

The livestock industry in Makueni contributes significantly to households' food security and income, general economy and health. The sub-sector accounts for between 37% and 87% of cash income across the three agro ecological zones from agricultural products and provides livelihoods to 65% of the Makueni County population (County Statistical Abstract (CSA) 2021). Makueni County hosts a diverse livestock resource comprising 325,503 cattle, 133,115 sheep, 799,638 goats, 40,311 donkeys, 1,502 pigs and 1.4 million poultry, among other animals (KNBS; 2019).

The most dominant fodder varieties are Napier grass, Rhodes grass, Brachiaria, sweet potato vines and maize for silage. The county relies on the lower zones for additional supply of hay and other roughage supplies. The LH Zone (Figure 1) has slightly larger farm holdings and has become the home for dairy farming owing to higher potential for pasture production, which has a commercial orientation.

Common natural pastures are dominated by range grasses and browse species. Introduced forages include Napier grass, Rhodes grass, hybrid sorghums/millets and Brachiaria grass varieties. Farm by-products including straws and stovers also contribute to the feed supplies. The rangelands occupy the lower areas of Makueni County, also designated as a marginal mixed farming zone.

The main system of livestock production practiced is agro-pastoralism, mostly free-range grazing where the land tenure system is mainly free hold with private ownership despite majority of land owners having no title deeds. These rangelands contribute significantly to the livelihoods of some of the vulnerable populations in the county primarily by providing pastures and browse for livestock. The land carrying capacity for the county is estimated to be 6.0 acres per Livestock Tropical Unit (LTU) of about 250 kg.

1.3.2 FEED BALANCE

The national feed inventory and feed balance assessment of 2019 established Makueni County has a feed deficit of -49.1% on dry matter basis based on actual feed availability (Table 1). The feed deficit based on CP and ME requirements were -69.4 and 62.8 %, respectively. However, the feed balance based on potential feed availability was only - 6.3% implying that post-harvest losses of the feed was quite high at 50%. This, therefore, meant there was good scope for bridging the feed gap and enhancing feed availability.

Table 1: Feed Balance as Dry Matter (DM), Crude Protein (CP) and Metabolizable Energy (ME) (Survey 2019).

Potential feed availability as DM (tonnes)	Actual feed availability and use as DM (tonnes)	Livestock DM requirement as DM (tonnes)	Feed balance as DM based on potential feed availability (%)	Feed balance as DM based on actual feed availability and use (%)
643,654.3	349,853.0	687,291.6	-6.3	-49.1
Potential feed availability as CP (kg)	**Actual feed availability and use as CP (kg)**	**Livestock CP requirement (kg)**	**Feed balance as CP based on potential feed availability (%)**	**Feed balance as CP based on actual feed availability and use (%)**
9,251,009.6	20,242,054.2	66,133,107.3	-40.6	-69.4
Potential feed availability as ME (MJ)	**Actual feed availability and use as ME (MJ)**	**Livestock ME requirement (MJ)**	**Feed balance as ME based on potential feed availability (%)**	**Feed balance as ME based on actual feed availability and use (%)**
5,022,980,890.0	2,902,491,565.4	7,793,304,689.3	-35.5	-62.8

1.3.3 NON-RUMINANT REQUIREMENT

Poultry and fish enterprises comprise the main non-ruminant livestock value chain of economic significance in the county. During the national feed inventory and assessment balance study (2019), non-ruminant feed requirements were not included in the assessment. The non-ruminants, especially poultry, are kept by more than 95% of households in the county, their feed demand data was generated and used in developing this Animal Feed Strategy 2023-2033. Compared to cattle and goats, non-ruminants are short-cycle livestock that are popular among women and youths, thus present a high potential for rapid socio-

economic transformation of household incomes and nutrition.

During the 2019 national census, the county recorded the fourth highest population of 1,397,211 indigenous chickens in the country after Nakuru, Machakos and Kakamega, respectively. Comparatively, five per cent (5%) of the indigenous chickens reared in Kenya were in Makueni County. In 2019, the poultry industry in the county was worth about Kshs 2,948,084,684. This was an increase of about 30% from the 2013 value of Kshs 2,063,659,280. Annual chicken meat production grew from 4,299,290 kg to 5,669,394 kg during the same period.

Fish is a source of white meat and plays a very important role in the economic and social life of Makueni people. Production systems in the county comprise intensive and semi-intensive systems in fish ponds and extensive systems in dams. Fish farming in ponds is done across the county while the dams are highly concentrated in Mbooni, Kilome and Makueni sub counties. The fish farming currently supports about 900 households directly and 20,000 people indirectly. It is composed of the fry, fingerlings, whole fish, the brooders and ornamental production.

1.3.4 POLICY INITIATIVES

The following national, county policy and strategy blue prints guided the development of the Makueni County Animal Feed Strategy 2023-2033;

i. The Constitution of Kenya, in the Fourth Schedule, mandates the National Government to develop relevant policies and legal frameworks to steer the country's agricultural development.
ii. The Kenya Vision 2030 economic pillar provides for development programs that promote the agricultural development and attainment of food security and commercialization of agriculture sector to support industrialization.
iii. Agriculture policy of 2021 is an overarching agriculture sector framework with key objective to increase production and productivity in crops, livestock and fisheries using appropriate, high quality and affordable inputs. The policy recognized animal feed as farm input.
iv. National livestock policy of 2020 articulates broadly interventions in livestock nutrition, feeds and feeding. It comprises a number of measures to provide adequate forage resources focusing on a wide range of exploited roughage materials, their productivity and production.
v. National veterinary policy of 2020 provides for quality and safety of input such as animal feed for optimum production and productivity.

vi. The Agriculture Sector Transformation and Growth Strategy (ASTGS) provides for agricultural transformation that seeks to promote increased production, productivity and profitability through optimal utilization of quality input such as animal feed under the livestock sub-sector.

vii. The National Government, through the Bottom-Up Economic Transformation Agenda (BETA) and the Fourth Medium Term Plan MTP IV (2023 – 2027), seeks to implement policies and structural reforms that will promote investments on the five priority economic pillars which are:

- Agriculture
- Micro, Small and Medium Enterprises (MSMEs)
- Affordable Housing and Settlement
- Healthcare; and,
- Digital Superhighway and Creative Economy.

viii. The National Agricultural Sector Extension Programme(NASEP) of 2022 provides for the enhanced production and productivity through transfer of proven technologies to the farming communities with focus on pluralistic extension approaches.

ix. The South Eastern Kenya Economic Bloc (SEKEB) developed a regional economic bloc policy paper endorsed by the counties of Makueni, Kitui and Machakos to consolidate resources towards development of the whole Ukambani region.

x. Makueni County Vision 2025 and County Integrated Development Plan (2023-2027) blue prints identified the livestock industry as key economic pillar to transform the county.

xi. The County Statistical Abstract by the Department of Economic Planning provided key data and information on livestock productivity that form the basis for formulation of this strategy.

1.3.5 JUSTIFICATION

To drive sustainable feed value chain development and in line with the national agenda on food (feed) and nutrition security for our country, it became necessary to develop the Makueni County Animal Feed Strategy 2023-2033 with a view to guiding the feed industry development for investment in Makueni County. The strategy will address challenges of feed deficits and gaps identified by the animal feed inventory and feed balance assessment study of December 2019 that demonstrated the county had a negative feed balance of -49.1% on dry matter basis. The assessment also reported post-harvest feed losses of about 50% on dry matter annual basis.

Factors causing negative feed balance include, recurrent droughts; grassland degradation; overgrazing; land tenure and land use changes; resource use conflicts; encroachment of invasive plant species; soil infertility; inadequate inputs and planting material; and, seasonal feed shortages.

The strategy will facilitate supply of perquisite animal feed for the county, develop a vibrant feed industry to promote investment, increase household income and job creation for the people.

Several interventions will be employed to ensure increased efficiency of resource allocation for animal feed production while assuring quality, reduced cost of production and post-harvest losses; hence increased profitability of the animal feed industry and livestock enterprises. Additional strategies will be developed to ensure availability of different types of animal feed resources through value addition and market promotion. Other interventions will include sustainable land use given the impact of climate change and climate variability. The strategy will lobby for favourable fiscal policies for competitive animal feed industry for Makueni County.

1.3.6 SCOPE

The strategy will provide guidance to feed value chain actors who include producers, manufacturers, distributors, transporters, policy makers and consumers to participate in a thriving feed industry. It is expected a prosperous animal feed industry for a vibrant livestock and fish sector shall be realized. It will impact positively on the economic prosperity and livelihoods of the feed industry actors.

1.3.7 EXPECTED BENEFITS

The strategy aims to improve productivity along the animal feed supply chain. This will result in improved incomes, food and nutrition security, creation of employment opportunities and sustainable livelihoods. It is expected to increase availability of quality feed from resilient feed production systems that will contribute significantly to sustainable low carbon and climate resilient livestock production. The increased feed supply is expected to support improved livestock productivity and enhance access to consumption of livestock and livestock products.

Chapter TWO

Situation Analysis

2.1 Introduction

This chapter contains a comprehensive situational analysis of the animal feed industry within the county, including its market dynamics, regulatory framework, competitive landscape, technological trends, economic influences, socio-cultural factors, and environmental considerations.

2.1.1 OVERVIEW

Makueni County sits at an altitude of between 600 and 1,900 metres, with an average of 1,250 metres above sea level. The county falls under different agro-ecological zones traversing from upper-land mixed farming to lowland marginal farming (Figure 1).

The Upper Middle (UM) zone mainly covers the uplands of Mbooni and Kaiti that practice coffee, avocado, macadamia, maize, bean and dairy farming. The Lower High (LH) zone is mainly found in Makueni and Kilome sub counties where mango and citrus fruits, grains, and root tuber farming are practiced. The Lower Middle (LM) zone covers Kibwezi West and Kibwezi East where cowpeas, pigeon peas, Dolichos, green grams, sorghum are mainly grown and also characterized by rangelands suitable for livestock production.

The classification also influences the livestock feed production systems. In the UM zone, characterized by small farm holdings, fodder production is produced under the cut-and-

carry method, in most instances sub optimal. Most dominant fodder varieties are Napier, Rhodes grass, Brachiaria, sweet potato vines and maize for silage.

Figure 1: The County Agricultural Productions Based on Altitude Above Sea Level

2.1.2 PASTURE, FODDERS, BROWSE, AND CROP RESIDUE

Natural grasslands are mainly found in the lower pasture growing zones of Makueni, Kilome and Kibwezi (East and West), and the species composition changes according to conditions. The native grasses in the natural pastures that adapt well in lower altitude zone (Kibwezi) are red oat grass (*Themeda triandra*), Buffel grass/African foxtail grass (*Cenchrus ciliaris*), Maasai love grass (*Eragrostis superba*), Guinea grass (*Panicum maximum*), Horsetail grass (*Chloris roxburghiana*), *Cynodon* spp. and *Digitaria* spp. Rangeland grasses such as African fox tail grass are common in the county for hay production. They are drought-tolerant and have high biomass production making them highly adaptable in low altitude zones in the county.

The main exotic grasses grown in the county include Napier grass (*Pennisetum purpureum*), Boma Rhodes grass - (*Chloris gayana*) and *Brachiaria* (now known as *Urochloa*) spp and newly introduced hybrids such as fodder sorghum (Sugargraze) and fodder millet (Nutrifeed). The fodder sorghums and millets introduced have high biomass yield and sugar content of about 15% brix, thus reducing the need of molasses for ensiling.

Napier grass varieties Bana, Kakamega I and Kakamega II are the most popular fodder grasses grown in the small-holder farming systems in Makueni mainly in Kaiti, Kilome and medium altitude zones of Mbooni Sub-County. The *Brachiaria* varieties Piata, Basilisk and Xaraes have lately been introduced but the total area covered by the grasses is small. Boma Rhodes performs well in hills of Mbooni, Kilome and Kaiti.

Naturally growing legumes include *Desmodium* spp. and Gliricidia. Exotic legumes such as Desmodium, Sesbania, Caliandria and *Leucaena leucocephala* are being introduced and have adapted well in all the pasture growing zones of Kibwezi, Makueni and Kilome.

Browse species include *acacia*, shrubs and herbs. Their adaptability across the three pasture growing zones is varied based on the agro-ecological characteristics. Acacia are predominantly in lower zones of Kibwezi while a variety of shrubs such as Gliricidia are predominantly in medium-altitude zones and hills of Mbooni, Kaiti and Kilome.

Crop residues are from maize, sorghum, millet, green grass, cowpeas, beans, pigeon peas, Dolichos lab and sweet potato. They have played an important role as a key source of dry matter feed for the livestock until recently when revitalization of the feed sector started. Livestock are grazed freely after harvest and in some cases the stover are harvested and preserved in hay barns.

a. Concentrates

Concentrate feeds rich in energy and/or protein but low in fibre are usually processed such as dairy meal, maize germ, soybean meal, wheat bran, molasses, fishmeal and sunflower cake. In Makueni county maize is the most processed cereal especially at household level for chickens and lesser extent for dairy animals.

Sorghum, green grams, sunflower and cowpeas are also fed to chickens. At the commercial level, small scale milling plants process concentrates for chickens and to a lesser extent fish. Some agro-processing industries are producing croton, castor and cottonseed cakes, which are sources of major feed ingredients. The common concentrates, their prices and sources are shown in Table 2.

Table 2: Concentrates, Price and Source

Feed	Price(range) Kshs	Unit	Source
Dairy meal	2,200-2,600	50kg	Agrovets
Dairy cubes	1,800-2,200	50kg	Agrovets
Range cubes	1,800- 2,000	50kg	Agrovets
Calf pellets	2,600- 3,000	50kg	Agrovets
Heifer	2,400-2,600	50kg	Agrovets
Chick mash	4,000-5,000	50kg	Agrovets
Growers mash	3,000-3,500	50kg	Agrovets
Layers mash	3,000-3,500	50kg	Agrovets
Broiler mash	4,000-4,500	50kg	Agrovets
Broiler finisher	3,500-4,000	50kg	Agrovets
Pig creep pellets	2,000-2,200	50kg	Agrovets
Sow and weaner meal	1,900-2,400	50kg	Agrovets
Pig finisher	1,800-2,200	50kg	Agrovets
Rabbit pellets	2,500-2,700	50kg	Agrovets
Rice polish	1,000-1,200	50kg	Agrovets

Feed	Price(range) Kshs	Unit	Source
Wheat bran	1,600- 2,000	50kg	Agrovets
Maize bran	1,250-1,500	50kg	Agrovets
Maize germ	1,700-2,500	50kg	Agrovets
Fish meal	4,500- 5,000	50kg	Agrovets
Fish starter	10,000-22,000	50kg	Major Stockists
Fish growers	13,000- 14,000	50 kg	Major Stockists
Fish finisher	12,000- 13,000	50kg	Major Stockists
Minerals (assorted)	250-800	2-50kg	Major Stockists
Vitamin premixes	200-400	1kg	Major Stockists
Toxin binders	300-500	1kg	Major Stockists
Limiting amino acids	500-700	1kg	Major Stockists
Others (specified)			

Source: Department of Agriculture, Livestock, Irrigation, Fisheries and Co-operative Development

b. Minerals, Vitamins and Feed-additives

Cattle, sheep, goats, fish and all other livestock require minerals of different types and qualities depending on the stage of life or production cycle. A healthy cow needs about 120 g of quality dairy salts per day, which every so often is unknown by farmers, is unaffordable or simply not available. Low intake of mineral salts results in poor production, poor fertility and increased disease incidences. Each cow should have adequate and quality amount of minerals.

In Makueni, naturally occurring salts are often accessed by livestock on riverbanks. Some of the natural mineral rocks are traded but these are, however, of unknown quality and value. Commercially produced minerals and salts are bought in agrovet shops supplied by manufacturers based outside the county.

c. Water Supply

The county water sources include permanent and seasonal rivers, boreholes, shallow wells, springs, earth dams, water pans and sand dams. The county has a network of tributaries that flow downstream, successively merging into larger rivers, for example, Thwake, Kaiti, Kikuu, Muoni, Kambu, Tsavo, Mtito Andei, Kibwezi, Thange and Kiboko. The larger rivers eventually

channel their waters into Athi River. Currently the county water supplies are able to meet 42% of the domestic water demand.

d. Feed Processing

Small-scale feed processing has been growing throughout the county, especially, for chicken feed (Table 3). The main feeds, however, are supplied from outside the county by processors in Nairobi, Kajiado and Kiambu. Compliance to quality standards is a great challenge. There is need to partner with the Kenya Bureau of Standards (KEBS) to ensure adherence.

Table 3: Feed Processors in Makueni County

Sub-County	Miller/Processor	Quantities (MT)	Remark (licensing status)
Makueni	Eni, Kwakathoka	200	By-products of bio-diesel processing: cotton, croton, castor cakes
	Kauvonge ka aka	2	
	ATC Kwakathoka	2	Fish, chicken, dairy meal
	Ketima Investments Ltd	1	Chicken feed
	Befa Feeds	10	Chicken, fish feeds
Mbooni	Kayama WG	5	Chicken feed
Kilome	Miela Feeds	2	Chicken, dairy feed
	Ndumbini SHG	1	Chicken feed
Kaiti	Kati Komu SHG	1	Chicken feed
Kibwezi East	Wendowa Aka Musiini, Thange Ward	1	Chicken feed
	Mother to Mother SHG, Masongaleni Ward	1	Chicken feed

e. Feed Quality and Feed Safety

Poor-quality feed resources that do not meet feed standards affect livestock productivity and can be hazardous to both animals and humans. Therefore, manufactured feed should be of consistent quality in terms of nutritional value and feed safety. Feed quality should be constantly monitored to ensure they meet safety standards. The policy and regulatory framework governing livestock feed include the Fertilizer and Animal Foodstuff Act Cap 345, Standards Act Cap 496 and Animal Disease Control Act Cap 364. The animal feed standards include,

- KS CAC/RCP 54-2009 Kenya Standard - Code of Practice on Good Animal Feeding, and
- KS 1647:2001 Kenya Standard - Code of practice for animal feed production, processing, storage and distribution.

The competent authorities are the KEBS, SDL, DVS, KEPHIS and accredited laboratories. However, the authorities face challenges in the enforcement of the standards. Besides, only animal feed products intended for sale are currently regulated by these Acts, but animal feed manufactured on-farm for own use are left out. The danger here lies in running parallel production systems that supply the same consumer. Feed safety issues on feed premixes, medicated and additives are also poorly addressed.

f. Marketing and Trade in Livestock Feed

Animal feed currently accounts for 60-70% of livestock enterprise production costs, and marketing and trade needs to be improved to enhance supply and make the feed affordable. Concentrate feed and minerals have comprehensive marketing networks that ensure supply throughout the county. Agrovets are the main outlets but some dairy co-operative societies stock and avail the feed to farmers on credit basis. For hay, there are outlets, especially, in Mbooni, Kaiti, Kilome and Makueni sub counties. Internal trade networks in hay are inefficient making local hay relatively expensive and poorly distributed. Supply systems deliver hay from counties as far away as Nakuru at competitive prices but there is a challenge in standardization.

g. Research and Development

Partnerships with universities and research institutions is crucial for conducting research on pasture and fodder. The county works closely with South Eastern Kenya University (SEKU), International Livestock Research Institute (ILRI) and Kenya Agricultural and Livestock Research Organization (KALRO), among other partners, to participate in field trials and

build capacity of farmers to harvest local grass seeds. Through the partnerships, improved pasture varieties suited for the county have been produced _such as Brachiaria cultivars. Farmers have also been supported on bulking methods.

KALRO Muguga, has also been a significant source of Napier varieties for bulking for farmers in Mbooni, Kaiti, Kilome and parts of Makueni sub counties.

h. Climate Change and Livestock Feed Resources

The changing climatic conditions are a major concern for current livestock systems worldwide and Makueni County, which is an arid and semi-arid land, is more vulnerable. The effects of global warming and its associated changes affect feed and water resources as well as animal health and production. Climate change also has implications for the processing, storage, transport, retailing and consumption of livestock products. The ability of current livestock systems to support livelihoods and meet the increasing demand for livestock products is thus threatened.

The livestock sub-sector is highly vulnerable to the changing climatic conditions. This is evidenced by the long-term misbalance of temperatures and precipitation characteristics of the major agro-ecological and livelihood zones. The persistent and recurrent drought occurrences are creating further stress on water resources and water supply, livestock feed quality, quantity and availability while further degrading the environmental landscapes.

The changing climate is expected to heighten the vulnerability of livestock feeds through reduction of herbage yield and increase lignification in plant tissues and hence decrease the digestibility of forage. In addition, the incidences of heavy rains and flooding would likely result in loss of feeds under production or damage to those conserved in storage, with possible implications on feed safety due to aflatoxin contaminations.

Climate change has been observed to affect rangeland species richness and biodiversity. As the climate become hotter and drier pasture composition is likely to shift, in favour of plant species that may be less suitable for grazing. Also, pastures can be invaded by invasive species such as Lantana camara and dodder plants that are unpalatable.

Therefore, climate change is expected to heighten the vulnerability to livestock feed quality and quantity. The hot and dry seasons are likely to induce the greatest reduction in the biomass yield for different types of grass-growing in low agro-ecological zones

To adapt to climate change in the county animal feed industry, innovative measures are needed to help actors cope with the changes in emerging and projected climatic patterns.

The animal industry is also associated with generation of Green House Gasses (GHGs) that contribute to global warming. Increasing productivity and resilience of the industry and better feeding of livestock will reduce GHG emissions.

Use of technologies such as forage species adaptable to low precipitation, and increased temperature and fodder with short growth cycles will generate quality feed for livestock and low emissions of GHG. Similarly, reduction of GHG emissions from land use and land use change will entail innovative practices and technologies such as sustainable land management.

2.12. Animal Feed Resource Baseline Data

2.12.1 ON-FARM FEED RESOURCES

On-farm feed resources in the county include grasses, legumes, crop residues, cereals oilseed by-products, vitamins, and minerals. These feed resources, in particular pasture and crop residues, do often fluctuate seasonally both in terms of quantity and quality. Opportunities for improving availability of feed include on-farm production, pasture improvement, utilization of fodder and crop residues, formulation of feed rations, efficient storage, appropriate water harvesting technologies and development of fodder markets.

To address the feed gap described in Section 2.2 and increase livestock productivity, the strategy has prioritized key animal feed resources for promotion namely; 1) hay; 2) maize grain; 3) forage grasses (Napier grass, Sugargraze, Brachiaria, and maize fodder); 4) whole sorghum grain; 5) sunflower cake; 6) fodder legumes; 7) sweet potato vines; 8) cowpeas; 9) Black Soldier Fly Larvae and, 10) natural pastures. The resources were prioritized based on their adaptability to the local conditions and potential to increase their yield.

Table 4 below shows the current production estimates for the value chains and their projected growth over the next 10 years.

Table 4: Current Animal Feed Resources and Projected Demand for Makueni County

Feed Resources	2023 (MT)	2028 (MT)	2033 (MT)
Energy sources			
Maize	61,739.98	90,697.77	119,655.57
Sorghum	19,382.63	26,842.01	34,301.39
Protein – Plant sources			
Sunflower	32,581.24	46,560.43	60,539.61
Cotton	9,207.07	12,684.83	17,355.73
Protein source – Animal sources			
Black Soldier Fly	1,384.47	1,919.49	2,450.10
Minerals and vitamins sources	5,754.42	7,928.02	10,847.33
Minerals	11,508.83	15,856.03	21,694.67
Premix	230.18	317.12	433.89
Total	**141,788.82**	**202,805.70**	**267,278.29**

Source: Department of Agriculture, Livestock, Irrigation, Fisheries and Co-operative Development

2.12.2 FIELD-BASED FEED RESOURCES (NATURAL, OR UNCULTIVATED PASTURES)

Natural, or uncultivated pastures provide up to 95% of animal feed in the county in 2023 and is projected to provide up to 85% by 2033 (Table 4). This is a significant animal feed resource in the county which is composed of a herbaceous layer dominated by annual plants (more than 80%), and a scattered population of shrubs and low density of trees. These are naturally occurring plants generally found on uncultivated land including both the palatable and non-palatable species, which animals have access to for grazing.

These natural pastures are found in grazing lands, which are often communally owned. The predominant species are grasses with little legumes. Species composition in natural pasture differs along the agro-ecological gradient. Naturally occurring green fodder materials such as weeds from cropping areas, roadsides and grasses serve as sources of feed particularly at the onset of rains.

Natural pasture in the county rangelands is characterized by seasonal, inter- and intra-annual, and spatial variation. This is a key limiting factor to its productivity which is associated with both the temporal and spatial distribution of the precipitations. There is abundance and good quality pastures during the rainy season and scarce poor-quality pastures during the dry season.

2.12.3 ANIMAL FEED REQUIREMENTS IN THE COUNTY

Makueni County human population in 2023 was 1,042,300 and is projected to grow to 1,098,921 in 2028 and 1,153,485 by 2033, (Table 5). This growth in population shall increase the demand for animal source protein. To satisfy the demand, the livestock herd should be supplied with sufficient, affordable, quality and safe feed to produce affordable, quality and safe, animal products (milk, meat, and eggs). The animal feed requirement and supply based on the annual per capita consumption is captured in the Table 6 below:

Table 5: Current and Projected Human Population

Year	2019	Projected 2023	Projected 2028	Projected 2033
Human Population	987,653	1,042,300	1,098,921	1,153,485

Source: Kenya National Bureau of Statistics

Table 6: Demand and Supply of Livestock Products in the County

Current and Projected Per Capita Consumption of Animal Food Products								
	Milk (litres)	**Meats (kg)**						**Eggs**
Per Capita Consumption	220	Beef	Mutton	Chevon	Chicken	Fish	Total	180
		9	2.4	2	12	4	29.4	
Demand for Animal Products in '000								
Required 2023	229,306	9,381	2,502	2,085	12,508	4,169	30,645	187,614
Required 2028	241,763	9,890	2,637	2,198	13,187	4,396	32,308	197,806
Required 2033	253,767	10,381	2,768	2,307	13,842	4,614	33,912	207,627
Supply of Animal Products '000								
Produced 2023	29,206	4,787	110	2,525	5,314	9	12,745	35,208
Projected 2028	96,705	11,045	441	1,969	10,962	22	24,439	158,245
Projected 2033	203,013	17,302	1,104	3,845	16,610	33	38,894	249,153

Source: Department of Agriculture, Irrigation, Livestock, Fisheries and Co-operative Development.

2.12.4 SELECTED LIVESTOCK ENTERPRISES

Livestock production accounts for over 43% of all agricultural earnings in the county. The main livestock species reared include cattle, goats, sheep, donkeys, and poultry. Other species kept include pigs, rabbits, bees, and fish. The population trends, as projected in relation to human population by the county statistical office and published by the Kenya Bureau of Statistics (KBS) in 2022, is shown in Table 7 below:

Table 7: Makueni County Projected Human and Livestock Population 2023 to 2033

Factor	Projected Population		
	2023	2028	2033
Human population	1,042,300	1,098,921	1,153,485
Dairy Cattle	31,700	40,425	51,594
Beef Cattle	230,000	282,450	360,486
Meat Sheep	119,033	151,920	193,892
Meat Goats	900,000	1,202,335	1,534,518
Dairy Goats	16,569	21,147	26,989
Camels	727	764	803
Donkeys	45,317	50,033	55,241
Chickens local	1,761,825	2,442,402	3,117,193
Layers	94,643	190,361	382,884
Broilers	68,275	75,381	83,227
Pigs	3,316	3,661	4,042
Fish	256,000	296,774	344,043
Rabbits	19,253	22,319	25,874
Turkeys	1,164	1,486	1,897
Ducks	3,828	4,886	6,236
Number of Hives	62,280	68,762	75,919

Source: County Statistical Abstract Report 2022

2.12.5 FEED REQUIREMENT FOR MAIN LIVESTOCK ENTERPRISES

The major livestock enterprises in the county are dairy cattle, beef cattle, goats, sheep, poultry, rabbits, and apiculture. These enterprises are kept under either intensive (zero-grazing), or semi-intensive (tethering and paddocking) or extensive (ranching and free range) production systems. The main livestock enterprises contributing significantly to the county economic growth are dairy and beef cattle, meat goats, sheep, and poultry (indigenous, layers and broilers). The feed requirements for the different enterprises in the county are presented in the sub-sections that follow.

2.12.6 DAIRY CATTLE

The population of cattle in 2023 is about 272,200 of which 12% (32,664 are dairy cows. The projected population of dairy cattle in 2028 and 2033 is 40,425 and, 51,594, respectively (Table 7). A higher percentage of the dairy cattle are crosses and 70% of them are of Friesian genotype (70%), 15% Ayrshire and 15% are Jersey, Guernsey and zebu crosses. The average milk production is about four litres per day.

Dairy production is mainly concentrated in the upper zones of Mbooni, Kaiti and Kilome sub counties. Significant production is also realised in Makueni Sub-County, where dairy farming has been spreading in the drier parts of the county including Kibwezi West. The potential in the drier areas lies in the vastness of the land for pasture production both under rain-fed and irrigation systems.

The main production system is zero grazing in Kaiti, Upper Mbooni and Kilome sub counties with numbers ranging from 2-3 per farm. Zero grazing is also practiced significantly across the other sub counties. Semi-intensive production is also common where farmers tether or herd animals in the fields and supplementation is done.

Based on the recommended WHO per capita consumption, the current county milk requirement is estimated to be 229.3 million litres and is projected to grow to 241.4 million litres and 253.8 million litres in 2028 and 2033, respectively (Table 6). Currently the milk produced stands at 29,206 million litres, and it is projected to increase to 96,705 million litres and 203,013 million litres in 2028 and 2033, respectively (Table 6).

The total feed requirements were 128,779.515 MT for 2023 and are projected to increase to 186,782.02 MT and 244,059.52 MT for 2028 and 2033, respectively. In addition, total acreage required for pasture/browse production was 125,530.22 acres for 2023 and is projected to increase to 104,910.79 acres and 233,643.82 acres for 2028 and 2033, respectively (Table 8).

Table 8: Current and Projected Feed Resources Requirements for the Dairy Enterprise

Summary of Dairy TMR Per Year	2023		2028		2033	
	Feed requirements in MT	Acres required	Feed requirements in MT	Acres required	Feed requirements in MT	Acres required
Hay	60,745.1	47,643.2	75,931	49,628.4	90,392	59,080.2
Silage/Green chop - Sugargraze	18,223.5	1,656.7	31,709.9	2,883	45,196.3	4,108.8
Maize grain	9,719.2	10,799.1	21,808.24	14,253.75	33,897.3	33,897.3
Sunflower cake (26% C.P)	14,578.8	52,067.3	21,978.23	14,364.85	29,377.6	104,920.1
Cottonseed Cake (32% CP)	7,289.415	7,289.42	18,333.52	18,333.52	29,377.62	29,377.62
Cowpea/beans straws	12,149.0	6,074.5	8,334.33	5,447.27	4,519.6	2,259.8
Minerals	6,074.5		8,686.80		11,299.1	
Total	**128,779.515**	**125,530.22**	**186,782.02**	**104,910.79**	**244,059.52**	**233,643.82**

2.12.7 BEEF CATTLE ENTERPRISE

The beef cattle population is 230,000 in 2023 and projected to grow to 282,450 and 360,486 in 2028 and 2033, respectively (Table 7). The main production systems for beef cattle in the county is agro-pastoralism with a few farmers being engaged in ranching and feedlot. The predominant beef breeds are Zebu, Boran, and Sahiwal, and crosses.

The current meat requirement for the county stands at 30,644 MT and is projected to grow to 32,308 MT and 33,912 MT in 2028 and 2033, respectively (Table 6). The local beef consumption constitutes 60% of the total production while 40% is exported to other counties.

The current beef production in 2023 is 4,787 MT and is projected to increase to 11,045 MT and 17,302 MT by 2028 and 2033, respectively. The main feed resources for beef cattle include natural pastures, hay, farm residues (maize stover, cowpeas and pigeon peas straws and mineral supplements. The summary of the feed resources and requirements for beef enterprises are shown in Table 9 below:

Table 9: Feed Requirements for Beef Enterprise

Enterprise	2023		2028		2033	
	Current MT	Acreage	Required MT	Acreage	Required MT	Acreage
Agro-pastoral feed requirement	1,227,049	962,391	1,278,319	1,002,603	1,329,589	1,042,815
Ranches feed requirement	230,071	180,448	370,726	290,766	511,381	401,083
Feedlotting	1,457,120		1,649,045	76,782	1,840,970	153,564
Total	**2,914,240**	**1,142,839**	**3,298,090**	**1,370,151**	**3,681,940**	**1,597,462**

Source: Department of Agriculture, Livestock, Irrigation, Fisheries and Co-operative Development.

The three enterprises are currently practiced at different levels in the county. The agro-pastoral system is practiced by over 95% of the households. Ranches constitute less than 4% and feedlotting1%. However, feedlotting is projected to keep growing in the coming years. This will exert demand for high quality feeds rich in proteins and energy as indicated in Table 10 below:

Table 10: Feedlot Feed Requirement

Feed Resource	Requirements 2023		Requirements 2028		Requirements 2033	
	Tonnes	Acres	Tonnes	Acres	Tonnes	Acres
Hay	37,778	29,629	48,361	33,571	58,943	37,512
Silage/Green chop-Sugargraze	0	0	14,736	8,187	29,472	16,373
Maize grain	7,556	8,395	14,830	16,478	22,104	24,560
Sunflower cake (26% C.P)	8,311	29,682	13,734	49,049	19,157	68,416
Cottonseed Cake (18% CP)	3,778	3,778	3,362.5	3,362.5	2,947	2,947
Desmodium/Lucerne (18% C.P)	0	0	1,474	1,474	2,947	2,947
(22 % /Cowpea/Crotalaria	5,289	4,407	4,118	3,432	2,947	2,456
Minerals	3,778		5,573	0	7,368	
Totals	**66,490**	**75,891**	**106,188.5**	**115,553.5**	**145,885**	**155,211**

Source: Department of Agriculture, Livestock, Irrigation, Fisheries and Co-operative Development

2.12.8 SHEEP ENTERPRISE

The total sheep population is estimated at 119,033 in 2023 and is projected to increase to 151,920 in 2028 and 193,892 in 2033. The major sheep production system in the county is agro- pastoral/free range and an insignificant (1%) in ranches. It is planned that feedlots will be promoted and adopted by some farmers by 2028. The most predominant sheep breeds are Black Head Persian, Dorper and Red Maasai.

The WHO per capita consumption of mutton stands at 2.4 kg per person per year. Mutton required in the county is 2,502 MT and is projected to grow to 2,637 MT and 2,768 MT in 2028 and 2033, respectively. Mutton production for year 2023 is 110 MT. The main feed resources for sheep are natural pastures, hay, maize and mineral supplements.

The total feed requirements for sheep were 1,687,500 MT for 2023, 1,856,250 MT for 2028 and 2,025,000 MT for 2033 (Table 11). Total acreage required for pasture/browse in 2023 was 112,500 acres, and it is projected to grow to 123,750 acres and 135,000 acres by 2028 and 2033, respectively (Table 11).

Table 11: Projected Feed Resources Requirements for Sheep Enterprise

	2023		2028		2033	
	Quantity MT	Acreage Required	Quantity in MT	Acreage Required	Quantity in MT	Acreage Required
Hay	1,687,500	112,500	1,856,250	123,750	2,025,000	135,000
Minerals	84,370		92,810		101,250	

2.12.9 MEAT GOAT ENTERPRISE

Goat keeping is a popular enterprise across Makueni County. The population of meat goats in 2023 is about 900,000, while it is projected to increase to 1,202,335 in 2028 (Table7). The main meat goat production system practiced currently is agro-pastoralism. Intensive systems such as feedlot will be promoted to meet the projected increase in demands. Breeds reared include the Galla and the small East African goat. The county goat meat supply in 2023 was estimated at 2,085 MT against a demand of 2,525 MT.

The projected goat meat requirements by 2028 is 2,198 MT and in 2033 the demand will be 2,307 MT. The current feed requirement for meat goats is projected to increase from 2,025,000 MT in 2023, rise to 2,470,500 MT in 2028 and to 2,916,000 MT in 2033(Table 12).

The main meat goat feed resources for energy are natural forage and browse composed of hay, chopped forage (Brachiaria, Napier) and maize grain. Protein sources are sunflower, cowpeas and acacias. Mineral supplements are also required.

Table 12: Projected Feed Resources Requirements for Meat Goat Enterprise

	Unit	2023	2028	2033
Pasture/Hay Required	Bales	90,000,000	109,800,000	129,600,000
Pasture/Hay Required	Tonnes	1,350,000	1,647,000	1,944,000
Mineral Salts Required	Tonnes	675,000	823,500	972,000
TOTAL		**2,025,000**	**2,470,500**	**2,916,000**

The main production system for goats is free range, which involves browsing in bush lands. The browsing will be promoted together with supplementation of the young stock as well as lactating goats during drought periods. Feedlotting will also be promoted.

2.12.10 POULTRY ENTERPRISE

Poultry farming is the raising of domesticated birds such as chickens, turkeys, ducks and geese for meat and eggs. The chicken is the predominant animal being kept in the county. Some farmers specialize in rearing exotic chickens for meat only (broilers) and egg production only (layers). They buy chicks, from commercial hatcheries, which are reared in modern well-ventilated chicken houses . The chicks are fed on commercial feed and the chicken meat and eggs are marketed in urban centres.

Other farmers specialize in rearing the indigenous (Kienyeji) chicken, which is either improved or non-improved and both cocks and hens are reared together. The indigenous chicken enterprise does not require a high start-up capital since it is mainly done at subsistence level, in a free-range system. A few farmers practice a semi-intensive production system. Because the volumes are always very low, the demand for input is also very low. The input

required include housing, feed, and drugs and occasionally feeders and drinkers.

The county has an estimated poultry population of 1,830,100 and of these 96% are of indigenous chickens (Table 7). The mean annual poultry egg production is about 35,208,000 eggs, and it is expected to grow to 158,245,000 eggs and 249,153,000 eggs by 2028 and 2033, respectively (Table5).

(a) Layers Enterprise

The county had a population of 94,643 layers in 2023 and they are projected to increase to 190,361 in 2028 and 382,884 in 2033. The main production system is intensive, which can further be categorized as commercial/large-scale and backyard/small-scale. Commercial systems are operated by producers who derive a larger percentage of their income from egg production and keep between 150 and 1,500 birds per cycle. Backyard producers rear fewer layers of between 50 and 200 birds for subsistence use and supply to small-scale traders/businesses.

Common ingredients for layers feed are maize, sorghum, sunflower, Black Soldier Fly Larvae, minerals, and premixes. Demand for layers feed will increase from 3,560.58 MT in 2023 to 4,222.05 MT in 2028 and 7,349.11 MT in 2033 (Table 13).

Table 13: Required Raw Materials to Produce Layers Chicken Feed.

	2023		2028		2033	
	MT	Acreage (Acres)	MT	Acreage (Acres)	MT	Acreage (Acres)
Energy Sources						
Maize grain	1,237.8	2,750.7	1,179.1	1,348.4	3,471.4	1,542.9
Sorghum	840.9	3,114.3	1,164.4	3,236.6	1,487.8	3,684.7
Protein Sources						
Sunflower cake	420.4	7,474.4	470.6	8,679.9	520.7	1,028.6
Cottonseed Cake (18% CP)	116.788	2,076.22	130.716	1,180.97	144.642	285.71
Cowpeas	720.7	2,288.1	999.2	3,172	1,275.2	2,361.5
BSFL	60	0.0	83.2	0.0	106.3	0.0
Minerals	163.99	0.0	194.83	0.0	343.07	0.0
TOTAL	**3,560.58**	**17,703.72**	**4,222.05**	**17,617.87**	**7,349.11**	**8,903.41**

(b) Broilers Enterprise

The broiler farmers in the county mainly use an intensive system of production to produce the chickens. The county does not have hatcheries; chicks are outsourced from Kenchic, Kukuchic, KALRO Naivasha or Isinya hatcheries. The broiler population in 2023 stood at 68,275 and is projected to increase to 75,381 in 2028 and 83,227 in 2033 (Table 7).

The bird population per farm ranges from 100 to 1,500 birds. The demand for broiler meat in the county is quite high and the deficits are met through supplies from outside the county. The main factor limiting production is the high cost of commercial feed. Majority of the farmers do not have the capacity to formulate their own rations due to lack of knowledge and limited availability of the necessary ingredients. The county broiler feed requirements are presented in (Table 14).

Table 14: Required Raw Materials to Produce Feeds for Broiler Chickens

	2023		2028		2033	
	MT	Acreage (Acres)	MT	Acreage (Acres)	MT	Acreage (Acres)
Energy						
Maize	1,237.8	2,750.7	1,179.1	1,348.4	3,471.4	1,542.9
Sorghum	840.9	3,114.3	1,164.4	3,236.6	1,487.8	3,684.7
Protein						
Sunflower cake	420.4	7,474.4	470.6	8,679.9	520.7	1,028.6
Cottonseed Cake (18% CP)	140.145	2,491.47	156.858	1,417.16	173.571	342.86
Cowpeas	720.7	2,288.1	999.2	3,172	1,275.2	2,361.5
BSFL	60	0.0	83.2	0.0	106.3	0.0
Minerals	142.97	0.0	194.83	0.0	343.07	0.0
TOTAL	3,562.92	18,118.97	4,248.19	17,854.06	7,378.04	8,960.56

Source: Department of Agriculture, Irrigation, Livestock, Fisheries and Co-operative Development

(c) Indigenous Chicken Enterprise

The indigenous chicken population has been increasing. According to the livestock department records, the county chicken population in 2023 was 1,761,825 and it is projected to grow to 2,442,402 and 3,117,193 birds in 2028 and 2033, respectively (Table 7). The increase could be attributed to an increase in the demand associated with the rising human population and an emerging preference for indigenous chicken meat compared to broiler chicken meat.

The indigenous chicken is mainly kept under extensive system where farmers provide a house to shelter the chicken at night. During the day they are let loose to scavenge for feed through which they are expected to obtain 50% of their total daily feed requirements.

The common feed resources required to produce indigenous chickens include maize, sorghum, sunflower, cowpeas, pigeon peas, mineral salts, and premixes. It is anticipated that 50% of the indigenous chicken feed requirements will be provided by complete feed rations while the rest will be obtained through scavenging. The total feed requirements were 95,579.06 MT for 2023. The estimated requirements in 2028 and 2033 are 139,015.75 MT and 162,316.06 MT (Table 15).

Table 15: Required Raw Materials to Produce Indigenous Chicken Feed

	2023		2028		2033	
	MT	Acreage (Acres)	MT	Acreage (Acres)	MT	Acreage (Acres)
Energy sources						
Maize	43,164.7	95,921.6	59,838.8	90,389.3	76,371.2	84,499,162.5
Sorghum	18,499.2	68,515.4	34,964.5	68,626.5	32,730.5	60,612.1
Protein sources						
Sunflower cake	9,249.6	36,541.6	10,492.7	36,640.8	11,455.7	22,628.5
Cottonseed Cake (18% CP)	3,083.194	12,180.52	3,450.878	9,861.68	3,818.561	7,542.84
Cow peas	15,856.4	50,337.9	21,981.6	69,782.9	28,054.7	890,628.5
BSFL	1,321.4	0.0	1,831.8	0.0	2,337.9	0.0
Minerals	4,404.57	0.0	6,455.47	0.0	7,547.5	0.0
TOTAL	**95,579.06**	**263,497.02**	**139,015.75**	**275,301.18**	**162,316.06**	**85,480,574.44**

2.12.11 FISHERIES

Fish farming is done across the whole county while the dams are highly concentrated in Mbooni, Kilome and Makueni sub counties. The sector currently supports about 900 people directly and 20,000 people indirectly. The industry is composed of the fry, fingerlings, whole fish, the brooders and ornamental production. The industry is a source of white meat and it plays a very important role in the economic and social life of Makueni people. Production involves intensive and semi-intensive systems in fish ponds, and extensive systems in dams. Capture fisheries is mainly practiced in dams and has an annual fish production of 114 MT valued at KES 45,600,000.

The current aquaculture production is estimated at 9.0 MT worth Kshs 6.2 million. Nile tilapia accounts for 50.3% and African catfish 49.7% of the total production. The annual demand

for fish in 2023 was estimated at 4,169 MT. This was projected to increase to 4,396 MT and 4,614 MT in 2028 and 2033, respectively. The total current feed requirement is estimated to be 181.638 tonnes considering a feed conversion ratio of 1.5.

The total feed requirement is projected to increase to 390.714 MT for 2028 and 412.184 MT by 2033. The fish production is expected to grow to 22 MT in 2028 and 33 MT in 2033 (Table 16) even though demand for fish remains unsatisfied for the county.

Table 16: Required raw materials to produce fish feeds

	2023		2028		2033	
	MT	Acreage (Acres)	MT	Acreage (Acres)	MT	Acreage (Acres)
Energy						
Maize	62.720	139.38	128.3	189.38	193.934	193.934
Sorghum	42.597	157.77	125.7	203.28	83.115	147.32
Protein						
Sunflower cake	21.342	379.41	25.2	401.2	29.090	457.46
Cottonseed Cake (18% CP	7.114	126.47	8.405	72.81	9.697	19.15
Cowpeas	36.512	115.9	53.88	168.7	71.241	226.16
BSFL	3.043	0.0	4.429	0.0	5.937	0.0
Minerals	8.31	0.0	44.8	0.0	19.17	0.0
TOTAL	**181.638**	**918.93**	**390.714**	**1,035.37**	**412.184**	**1,044.024**

2.13 Pasture and Fodder Production Constraints

The pasture and fodder production in the county face several constraints which are articulated in Table 18. Similarly, the county has promising opportunities to boost production of pastures and fodders.

Table 18: Pasture and Fodder Production Constraints and Opportunities

No	Challenges	Opportunities
1.	High cost of input due to feed ingredient supply chain fluctuations in both quantity and quality	• Existence of strong industry governing institutions to regulate the feed sector, especially, regarding licensing, good manufacturing practices and feed quality control. • Utilization of locally available by-products such as ENI Biodiesel processing plant at Kwa Kathoka and other feed millers
2.	Feed additives, growth promoters and anti-microbials have attracted consumer concerns with regard to their safety on animals, organoleptic quality of products from animals fed with additives, and potential human health hazards	
3.	Feed products on the market lack differentiation	• Labelling for feed products in the market. • Capacity development and transfer of regulatory roles to the county authorities via the Makueni County Food Safety Co-ordination Bill under development
4.	Recurrent drought and erratic rainfall curtail local production. The county is a net importer of over 90% of the raw materials needed for manufacturing animal feed (e.g., grain and oilseed cake by-products)	• Promotion of alternative and or drought-tolerant crops such as cowpeas, sunflower and sorghum
5.	Small feed millers are disadvantaged by undercapitalization, poor equipment design and high borrowing costs	• Low technology base for feed manufacturing SMEs allows for low barriers to entry and less expenses when disrupting existing customer loyalties • Modernization of the feed milling industry to enhance feed quality and competitiveness

No	Challenges	Opportunities
6.	Increase in the number of feed processors with inadequate technical and market information	• The existing feed mills can benefit from membership to Association of Kenya Feed Manufacturers (AKEFEMA) and advocate quality feed manufacturing practices • Capacity building of farmers, feed manufacturers, regulating agencies' staff on better control and practice in the feed industry
7.	Inadequacy of accredited feed analysis laboratories to ascertain raw material chemical composition and assure good manufacturing practices	
8	Poor road network	• Adequate budgetary allocation for infrastructure development

2.14 SWOT Analysis

The achievement of the livestock industry's objectives depends on the exploitation of existing strengths, available opportunities as well as analysis of the current and emerging weaknesses and threats in the feed sub-sector. Some of the key strengths are derived from the sector's contribution to the county development in terms of contributing to improved livelihoods and income from livestock and livestock products.

The available opportunities include the increased demand for livestock products due to urbanization leading to increased feed demand. Weaknesses relate to the seasonal feed deficits while threats emanate from competition from cheap imports as well as trans-boundary pests and diseases as shown in the SWOT analysis (Table19).

Table 19: SWOT Analysis

STRENGTHS
• Presence of trained personnel • Readily available market (locally and from other counties) • Available land, especially, in Zone Three lowlands • Presence of partners within the county who are promoting fodder innovations. For, example, NAVCD, KeLCoP, KALRO KIBOKO, KCDMS, FAO, and NDMA • Political goodwill in the county • Existing policies, legal and institutional framework • Availability of water in niche areas such as Athi River, Chyulu Hills • High potential for rainwater harvesting. • Existing partnership and collaboration with research and learning institutions. • Proximity to Mombasa, Kajiado and Central Kenya regions • Existence of key feed value chain actors at various nodes • Existence of ranches and estates involved in fodder production • Existence of pasture and fodder producer and marketing organizations such as Kitise Farmers Cooperative Society • Availability of appropriate feed value chain technologies • High participation of women and youth in feed value chain • Presence of groups supported by feed processing equipment • The Makueni County CIDP III (2023-2027) has prioritized agriculture as key area for economic transformation
WEAKNESSES
• Low staffing levels (low staff farmer, ratio 1:6,400) • Inadequate resources to support staff in their work. • Inadequate budgetary allocation towards livestock development programs • Low prioritization of feed value chain by farmers • Weak co-ordination mechanism among the various stakeholders dealing with feed programs. • Inadequate policies to address issues of feed production. • Lack of awareness of animal feed as a commercial enterprise among the actors • Low adoption of feed technologies • Low feed productivity per unit area • Little access to financial services in feed business • Poor enforcement and adherence to animal feed standards • Inadequate mechanization in the feed value chain • Low control over benefit sharing by the women and youths in the feed value chain • Low collective action among small-holder farmers leading to poor marketing and negotiations for better prices of their farm produce. • Poor road network

OPPORTUNITIES

- Collaboration with the State Department for Livestock (SDL) and other agencies on programs supporting feed.
- Partners such as FAO, MCF, NAVCD willing to support investments in feed value chain
- Existence of appropriate feed value chain technologies
- Partnerships and linkages with research and academic institutions such as ¬ KALRO KIBOKO, KEFRI KIBWEZI, ILRI, ICIPE, and development partners
- Integration of feed value chains with land management practices , for example, agroforestry, reseeding, apiculture
- Employment creation along the feed value chain
- Potential to increase productivity per unit area
- Availability of water resources for irrigation and fish farming
- Availability of social and mass media platforms for marketing livestock feed and livestock products
- Potential for rehabilitation of degraded rangelands
- Promotion of feed production in the ranches
- Promotion of water harvesting technologies
- Potential for intensive fish farming technologies such as cage fish farming
- Increasing demand for livestock products

THREATS

- Adverse effects of climate change
- Land subdivision for human settlement leading to reduction in acreage under feed
- Competition for feed from wild animals due to proximity to the Tsavo National Park.
- Influx of livestock from other counties
- Competition between crops for human food and livestock feed such as maize grain for human food and livestock feed
- High cost of input for feed production
- Natural disasters and risks such as floods and wildfires
- Failure to honour insurance obligations

2.15 PESTEL Analysis

A PESTEL analysis is conducted to examine the external environment impacting on the feed industry in the county. This includes examining the political, economic, social, technological, environmental and legal issues/trends in the county.

POLITICAL ANALYSIS

i. The national Vision 2030 recognizes the agricultural sector as a key economic pillar to development.
ii. The Bottom-Up Economic Transformation Agenda (BETA) has identified agriculture as key priority for support
iii. There is increased national focus on food security policy.
iv. Devolution has provided room for lobbying for fund allocation from the national government.
v. Political stability exists in the country.
vi. National budgetary provision is inadequate to meet Makueni County needs.

ECONOMIC ANALYSIS

i. High cost of maintaining equipment and machinery
ii. High cost of input
iii. Low returns to investment due to low volumes in the feed business
iv. Expensive value addition tools and equipment
v. Inadequate capital among the feed farmers
vi. High interest rates on loans and lack of collaterals
vii. Weak national currency
viii. Lack of incentives to attract investment in the feed industry.
ix. Zero-rated agricultural machinery and equipment

SOCIAL CULTURAL FACTORS

i. Change in consumer taste and preferences for animal source protein food.
ii. High population creating demand for animal source food.
iii. Increasing number of actors, including the youth ready to take up feed production as a business.
iv. Increased literacy levels in the county
v. Existing government support for women and youth groups through credit facilities,

co-operative societies, SACCOs, and subsidies for farm input.

vi. Increasing urbanization and land subdivision likely to hinder growth of animal production.

vii. Modernization and rural-urban migration causing youthful generation to shun and abandon farming.

TECHNOLOGICAL FACTORS

i. Easy access to information and technology from the internet

ii. Availability of many technological advancements in fodder and feed production, conservation, and processing

iii. Integration of ICT tools in feed production, formulation, and processing , such as soil fertility maps, and agro-weather forecasting, including KALRO Agricultural Observatory Platform (KAOP)

iv. Increased research on feed by research institutions

v. Existence of vocational training centres (VTCs) for training artisans in mechanization of feed production

vi. Availability of technologies for water harvesting and conservation for fodder production

vii. Availability of climate smart agriculture and aquaculture technologies, information and management practices (TIMPS)

viii. Versatile Jua Kali technologies that can develop and fabricate feed production equipment.

ix. Weak research - extension liaison that needs to be strengthened.

ENVIRONMENTAL FACTORS

i. Existence of institutions that regulate environmental issues such as NEMA, public health department and county authorities.

ii. Pasture and fodder production contribute to climate change mitigation by enhancing carbon sequestration and minimizing land degradation.

iii. Invasive plant species which encroach on the pastures

iv. Emerging fish diseases and parasites leading to loss of aquatic biodiversity

v. Sustainable farming practices through diversification and integration such as push-pull fodder production technologies

vi. Human-wildlife conflict

LEGAL FACTORS

i. Inadequate legal framework to guide the industry.
ii. Slow domestication of national policies in counties
iii. Too many legal requirements to operate processing plants.
iv. Existence of a Public-Private Partnerships Act

2.16 Stakeholder Analysis

Table 20: Stakeholder Analysis and Mapping along the Animal Feed Value Chain

No	Stakeholder	Role/Responsibilities	Strength/Comparative Advantage
1.	Forage seed producers and breeders such as Advanta Seed, Advantage crops, KALRO, Kenya Seed	Provision of quality seed	• Capacity to source, breed, multiply and distribute quality seed and other planting material. • Ability to maintain the genetic pool bank
2.	Input suppliers such as agrovet shops	Stocking of quality input such as feed, fodder seeds, drugs, feed premixes,	• Accessibility to the producers • Enter credit arrangements with farmers
3.	Financial institutions such as banks, SACCOs, MFIs, insurance companies	Provision of credit, insurance facilities and business skills	• Have liquid capital. • Have a model of lending farmers and other actors in the value chain with the group being the guarantee. • Pooling resources • Information on financial management

No	Stakeholder	Role/Responsibilities	Strength/Comparative Advantage
4.	Producers (forage farmers)	Production of fodder and marketing	• Embraced commercial fodder production
	Feed manufacturers and processors such as millers	• Manufacturing of high quality and safe feed • Value addition to get feed products marketing	• Possess expertise in feed production, and can quickly adopt innovation such as pelleting. • Significant investment in processing capacity • Ability to add value to feed into feed products. • Marketing networks
5.	Farmer organizations including cooperative societies such as KRD	Lobbying for good working environment for farmers, including financial services, prices, affordable input and markets and regulatory and policy framework	• Mobilization of resources (human and financial) • Dissemination of new technologies through experiential learning • Ability to push for agenda. That is, lobby on behalf of farmers.
6.	Feed and feed transporters	Product delivery along the VC nodes	• Facilitate distribution of feed products
7.	Extension service providers	• Linkage to input, services, and technology • Provision of extension services • Linkage to markets	• Have technical knowhow on feed production, conservation, processing, and quality. • Utilizes ICT to disseminate knowledge. • Likely to know actors in the feed value chains
8.	Feed industry machinery and equipment providers such as Muharata and Jua Kali	Import, assemble, fabricate, sell, lease feed industry machinery and equipment	• Locally available to farmers • Produce affordable machinery and equipment

No	Stakeholder	Role/Responsibilities	Strength/Comparative Advantage
9.	Feed traders	Trade in feed ingredients including formulated feed concentrates, fodder, seed, minerals, and multi-vitamins	• Provide feed information and influence on the prevailing market and market prices
10.	Development partners and NGOs, for example, _Kenya Red Cross Society	• Provision of technical capacity building support and grants to value chain actors • Articulate the concerns of the marginalized and vulnerable	• Own quick decision-making process • Can easily access donor funding. • Enjoy vast regional experience. • Have existing network and partnerships
11.	Training institutions: agricultural training institutions , universities, colleges, schools, and 4-K Clubs, VTCs such as CTTI	• Provision of training to farmers and other value chain actors • Training of technical experts • Contribute to research and innovations. • Multiplication and distribution of feed breeds	• Possess technical capacity/ land and infrastructure. • Can develop and regulate training materials. That is, quality control in feed training.
12.	Research institutions e.g., KALRO, ICIPE, ILRI, KMFRI	• Conduct research and disseminate TIMPS to support actors along the feed value chains in the industry. • They are breeding feed crops with desirable traits	• Can access funds for research. • Have an experienced pool of scientists, research equipment and land for breeding trials. • Possess ability to partner and share research findings with other organizations regionally and internationally

No	Stakeholder	Role/Responsibilities	Strength/Comparative Advantage
13.	Consumers	They buy and influence quality	• Encourage production of quality feed • Have purchasing power of livestock products
14.	Ministry of Agriculture, Livestock, Fisheries, and Irrigation and other Ministries, Departments and Agencies (MDAs) in County and National Government	• Regulation, policy advisory services and development planning of the feed industry • Setting standards • Developing trade policies	• They are the main source of technical personnel in animal health and livestock production. • Play an advisory and policy formulation role. • Appraise the feed industry and monitor and evaluate on-going feed activities. • Support in enhancing technical capacities and infrastructure. • Enforce enacted laws and regulations
15.	Media e.g. electronic, print and social	Create awareness to value chain actors on GAPS, GMPS, technologies, input, and services.	• Enhance effective communication. • Enhance visibility of the feed industry

2.17 The Problem

Livestock resource management is affected by low productivity due to under-nutrition, high cost of production, high prevalence of pests and diseases, relatively low genetic potential for productive traits, poor management practices and weak marketing infrastructure.

More factors include, low youth involvement due to inaccessibility to land or ownership, low entrepreneurial skills, poor agri-technology and innovation adoption have similarly negatively impacted on the growth of the livestock industry.

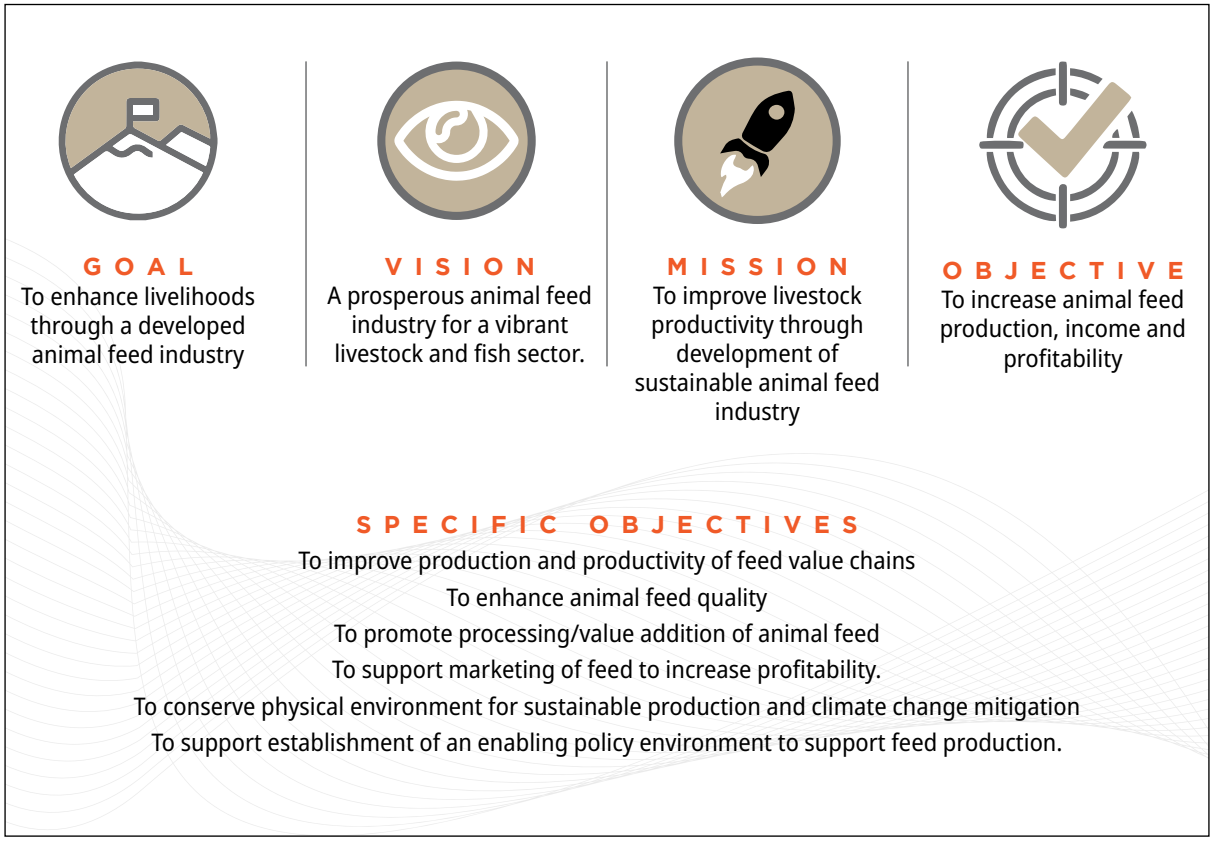
Strategic Framework

3.10 Introduction

In the pursuit of elevating the county's animal feed industry to new heights of excellence and sustainability, this chapter introduces the strategic framework that will guide the development and implementation of a robust county animal feed strategy. Building upon the insights gleaned from the situational analysis presented in the previous chapter, this framework provides a structured approach to crafting a dynamic and adaptable roadmap for the growth and enhancement of the animal feed sector.

The strategic framework encapsulates the goal, vision and mission statements and a cohesive objective, and action plans that align with the county's overarching goals and aspirations.

3.11 Goal, Vision and Mission



3.1.2 STRATEGIC FRAMEWORK FOR THE ANIMAL FEED INDUSTRY

The strategy is anchored on a new paradigm shift of developing feed strategies based on data. The data was derived from per capita consumption of animal source foods and projected over the next 10 years, and the livestock types and numbers to meet those food demands. The livestock require feed that meet their nutrients requirements in terms of energy, protein, minerals, multi-vitamins and water. To satisfy the body requirements, priority feed resources/ value chains were identified in addition to the natural pastures that supply the bulk of the feed. To improve feed and nutrition supply, seven key strategic pillars have been identified, which will define the focus of all proposed interventions for the development of the feed resources. These seven pillars are:

i. Feed production and productivity;
ii. Animal feed quality;
iii. Feed processing/value addition;
iv. Feed marketing;
v. Profitability in feed value chains;
vi. Sustainable physical environment; and,
vii. Enabling policy environment

The following are the key feed value chains that have been identified to address the feed gap described in the strategy.

i. Natural pastures
ii. Cultivated grass for hay
iii. Fodder for silage
iv. Maize grain
v. Sorghum grain
vi. Cowpeas grain
vii. Sunflower grain
viii. Cotton
ix. Black Soldier Fly (BSF)

i. Field-Based Feeds (Rangeland/Free range)

Natural pastures and browse account for 90% of grazing forage, contributing most significantly to livestock feed and nutrition. Due to frequent droughts and improper rangeland utilization, biomass production from the natural lands has decreased overtime from an estimated 3,200 kg DM to current level of less than 1,800 kg per acre per year. Subsequently, land carrying capacity has decreased from 4-6 acres per tropical livestock unit (TLU) (1 TLU is 250 kg livestock body weight) to 6-8 acres.

To meet the county demand for livestock products and sustain the contribution of the natural pastures to livestock nutrition, the county needs to not only restore the carrying capacity but also further improve it to two acres per TLU. Field trials have demonstrated that it is achievable with implementation of sound range management practices. Indeed, given the decreasing land size arising from increased human population which occasioned land subdivision the county should seek further improvement of land carrying capacity to attain two acres per TLU by 2033.

The decreased biomass production which caused low carrying capacity has been brought about by soil degradation, overstocking, invasive species of obnoxious weeds and reduction of some nutritive grass and browse species.

The strategy advocates for implementation of appropriate range management and improvement practices which entail pasture enclosures, soil conservation, reseeding, controlled grazing through paddocking and introduction of high-yielding pasture grasses. In addition, forage conservation should be diversified to hay baling alongside preservation as standing hay.

Common challenges

i. Limited knowledge on pasture and integrated range management
ii. Poor grazing practices.
iii. Low quality pasture and encroachment by invasive weed species
iv. Frequent droughts
v. Depleted soil seed bank
vi. Increased land subdivision
vii. Human-wildlife conflict
viii. Climate change and vulnerabilities
ix. Environmental degradation

Opportunities

i. Reseeding of the degraded lands
ii. Natural pasture improvement and management
iii. Availability of land for pasture establishment
iv. Commercialization of hay and seed production
v. Irrigated pasture and fodder production

The details of the field-based feeds strategic development framework are presented in Table 21.

Table 21: Strategic Framework for Rangeland/Field-Based Forages

Strategic Pillars	Strategic Issues	Strategic Objectives	Strategic interventions
Production/ Productivity	Low production/ productivity	To improve the annual carrying capacity of natural pastures from 8 acres per TLU (each 250kg) to 4 acres per TLU by 2028 and to 2 acres per TLU by 2033	• Reseed the degraded rangeland with high yielding pasture species by 2028 • Use enclosures to allow natural forage regeneration in 40% of the rangelands by 2028 • Farmer capacity building on appropriate land use practices • Promote holistic and integrated range management practices • Support mechanization of pasture production • Promote conservation and storage of feed by 2028
Forage Quality	Low quality natural pasture	• To improve the quality of 80% of natural pastures by 2033. • Introduce 3 legume species in 50% of pastures by 2033.	• Control of invasive species in natural pastures. • Develop range reseeding and restoration Programme by 2025. • Introduce palatable leguminous species in pasture lands • Evaluate 5 legume species and select 3 promising ones by 2025. • Bulk 5 tonnes of seeds of the selected legumes by 2028 • Integrate/intercrop the legumes in 50% natural pastures by 2033
Value addition of forage	Limited value addition on natural pasture	To enhance value addition of natural pastures by ensiling and hay baling	• Promote hay-baling and silage-making at the right stage
Physical Environment	Degraded rangelands	To conserve the environment by arresting soil erosion in 70% of natural pastures by 2033.	• Promote integration of pasture and agroforestry in grazing land using appropriate species. • Capacity build livestock keepers on pasture and fodder technologies, innovation, and management practices • Establish water harvesting structures to arrest erosion and degradation. • Control invasion of rangelands by invasive species

Strategic Pillars	Strategic Issues	Strategic Objectives	Strategic interventions
Policy Environment	Inadequate policy on range land management	To develop policy on rangeland management by 2026	• Formulate act and regulations to guide utilization of rangelands
	Unco-ordinated communication approaches	To promote co-ordination and communication in the livestock feed sub-sector	• Establish a multi-stake holder platform forum by 2026 • Establish joint monitoring and evaluation team by 2024

ii. Cultivated Pastures (Hay)

The hay enterprise in the county is characterized by small-holder producers, private ranches and traders who source hay from within and outside the county. A few farmers have seasonal "surplus" natural grass they harvest and sell to neighbouring farms. Most of the hay traded within the county is harvested from natural grasses. African Foxtail/Buffel grass and Maasai love grass have gained popularity in the lowlands for commercial hay production. Boma Rhodes is produced in the middle zone by a few farmers. Some of the hay sold (such as Rhodes grass hay) in the county, comes from as far as Nakuru and Central Kenya regions.

The price varies depending on season, demand, and supply. A bale of hay weighing 13-15 kg sells for between Kshs 250 and Kshs350. Transport costs and several county levies along the way contribute to the high prices. The county in partnership with development partners has constructed five hay stores in five wards with a storage capacity of about 20,000 hay bales

The Government of Makueni County (GMC) has invested in the Agricultural Mechanization Station (AMS) and equipped it with machinery to

support ripping, mowing and baling at subsidized rates for the farmers. In addition, The Food and Agriculture Organization of the United Nations (FAO), Kenya, through the MasterCard Foundation (MCF) Livestock Feeds Commercialization Project (LFCP) implemented in the county, has supported pasture producer groups with equipment for ripping and baling.

The details of the cultivated pasture strategic development framework are presented in Table 22.

Table 22: Strategic Framework for Cultivated Pasture

Strategic Pillars	Strategic Issues	Strategic Objectives	Strategic Interventions
Production and Productivity	Low cultivated pasture grasses production in Makueni County	To increase production of cultivated grass pasture from 685,638,949 MT in 2023 to 977,055,097 MT by 2033.	• Capacity build on knowledge and skills on cultivated pasture grasses • Enhance access to high yielding cultivated grass pasture planting materials. • Promote cultivated grass pasture production under irrigation. • Mechanize cultivated grass pasture production and conservation
	Inadequate extension services	To strengthen provision of extension services	• Establish synergies with private service providers. • Promote common interest group extension approach. • Lobby for increased number of extension workers • Promote extension services • Periodic retooling of extension workers
	Inadequate access to water for cultivated pasture grass production	To increase water available for irrigated cultivated pasture grasses by 10% by 2033	• Promote water harvesting and conservation. • Promote PPP engagement in water for irrigation • Promote cultivated pasture grasses production under irrigation. . • Capacity build WRUAs and WUA on management of water resources.

Strategic Pillars	Strategic Issues	Strategic Objectives	Strategic Interventions
	Low investment in cultivated pasture grasses sector	Enhance capital investments in the cultivated pasture grasses enterprise by 43% by 2033	• Lobby for increased budgetary allocation to livestock sector • Enhance incentives investments in livestock feed enterprises (tax waivers, reduced licencing, etc.) • Link cultivated fodder investors and farmers with credit facilities
Quality of cultivated pastures	Low quality of cultivated pastures produced.	To improve the nutritive value of cultivated grass pasture produced by 60% by 2033	• Capacity build farmers with knowledge and skills on production of quality cultivated fodder • Capacity build farmers on cultivated grass pasture conservation and post-harvest loses control measures • Facilitate access to high- nutritive cultivated grass pasture planting materials • Strengthen partnership with quality control and regulatory bodies
		To enhance safety of fodder produced by 100%	• Promote post-harvest management • Institute quality control assurance system
Value Addition and Processing	Low value addition of cultivated grasses	To promote value addition of cultivated pasture grasses by 30% by 2033 through adoption of modern pasture conservation technologies	• Impart knowledge and skills on value addition technologies of cultivated fodder grasses. • Facilitate access to processing and value addition machinery and equipment
Marketing	Low volumes of cultivated pasture grasses traded.	To increase the volumes of grass pasture being traded from the current 20% to the projected 40% by 2033.	• Diversification of cultivated grasses to be marketed. • Provision of strategic bulking and aggregation facilities • Promote commercialization of fodder and pastures grasses

Strategic Pillars	Strategic Issues	Strategic Objectives	Strategic Interventions
Profitability of cultivated pasture	Low returns on investment on cultivated fodder grass production	To increase the profit margin from 15% to 40% in 2033.	• Promote contract pasture production • Promote proper handling, packaging, storage and transportation techniques
	High post-harvest losses	To reduce post-harvest losses along the cultivated fodder grasses value chain from 50% to 10% by 2033	• Capacity build on cultivated fodder grasses post-harvest management • Promote appropriate storage facilities
	Inadequate knowledge on entrepreneurship	To improve entrepreneurship and business development skills of 5,000 feeds actors by 2033	• Support business development services for MSMEs • Hold cultivated fodder grasses entrepreneurial fora
Physical Environment	Adverse climate change effects	To reduce adverse effects of climate change by building capacity of 10,000 farmers on climate smart technologies by 2033	• Capacity build land users on climate smart agriculture • Enhance access to climate information services • Promote agroforestry practices. • Adopt soil and water conservation techniques by using climate smart technologies and practices. • Promote water harvesting practices • Promote real time access to and use of agro-weather information
Policy Environment	Inadequate policy on production and utilization of cultivated fodder grasses	To provide an enabling policy environment for cultivated fodder grasses value chain by developing two policy documents by 2028	• Develop an animal feed policy. • Develop county animal feed regulations

iii. Forage Fodder (Napier, Sorghums, Millets, Brachiaria and Maize)

The fodder grasses mainly grown in the Makueni County are Napier, Brachiaria, Sorghums, Millets (sugar graze, Nutrifeed) and maize. Fodder quantity and quality greatly fluctuates from one season to another due to climate change.

The current acreage for forage fodders grown in the county is 13,832.66 ha giving an output of 20,900 MT. The projection for 2033 is 33,096.28 ha to yield 49,900 MT.

Challenges

Common challenges under forage fodder include, small land sizes in the upper zones; climate change and vulnerabilities; low adoption to technology on forage fodder production; inadequate skills on conservation and preservation; and, high cost of planting materials.

The details of the forage fodder value chain strategic development framework are presented in Table 23 below:

Table 23: Strategic Framework for Forage Fodder Value Chain

Strategic Pillars	Strategic Issues	Strategic Objectives	Strategic Interventions
Production and Productivity	Low forage fodder grasses production in Makueni County	To increase production of fodder from 20,900 MT in 2023 to 49,900 MT by 2033 through increasing hectarage under production from the current 13,832.66 ha to 33,096.28 ha	• Capacity build on knowledge and skills on forage fodder production • Enhance access to certified high yielding fodder planting materials • Promote fodder production under irrigation • Mechanize fodder grasses production and conservation
		To increase production of irrigated forage fodders from the current 80 hectares (1,600 MT) to 180 hectares (3,600 MT) by 2033	

Strategic Pillars	Strategic Issues	Strategic Objectives	Strategic Interventions
	Inadequate extension services	To strengthen provision of extension services	• Establish synergies with private service providers • Promote common interest group extension approach • Lobby for increased number of extension workers • Periodic retooling of extension workers
	Inadequate access to water for fodder grass production	To increase water available for forage production by 20% by 2033	• Promote water harvesting and conservation • Promote PPP engagement in water for fodder grasses production • Partner with WRUA and Community Forests Association (CFAs) in management of water resources for fodder grasses production within the water catchments • Capacity build WRUAs and WUA on management of water resources • Capacity build farmers to utilize available water sources for forage production through irrigation.
	Low investment in livestock fodder sector	Enhance capital investments in the fodder enterprise from 30% to 80% over a period of 10 years.	• Increase budgetary allocation to livestock sector • Incentivize investments in livestock feeds enterprises (tax waivers, etc.)
Quality	Low quality of fodder produced	To increase the number of farmers producing quality cultivated fodder from the current 20% to 80% by 2033	• Capacity build farmers with knowledge and skills on production of quality fodder • Facilitate access to certified fodder planting materials • Facilitate access to high-nutritive fodder planting materials • Strengthen partnership with quality control and regulatory bodies • Promote access to machines and equipment

Strategic Pillars	Strategic Issues	Strategic Objectives	Strategic Interventions
		To enhance safety of fodder produced by 100% in the 10-year period	• Promote post-harvest management during production • Institute quality control assurance system
Value Addition and Processing	Inadequate processing and value addition of forage fodder	To promote value addition of fodder by enhancing access and adoption of fodder technologies by 50% by 2033	• Impart knowledge and skills on value addition technologies of fodder grasses • Facilitate access to processing and value addition machinery and equipment • Fortification with leguminous material and other additives
Marketing	Low volumes of fodder grasses traded	To increase the volumes of fodder grasses being traded by targeting 30% of the total acreage under fodder production for sale by 2033.	• Diversification of fodder conservation packages for varied products to be marketed • Increase choices of forage fodders • Provision of strategic bulking and aggregation facilities • Promote commercialization of fodder grasses
Profitability	Low returns on investment on fodder grass production	• To increase the profit margin from the current 30% to 60% in 2033 • Consider a range	• Match production with market demand to avoid losses • Promote proper handling, packaging, storage and transportation techniques
	High post-harvest losses	To reduce post-harvest losses along the fodder value chain by 50% by 2033	• Capacity building on post-harvest management • Promote appropriate storage facilities
	Inadequate awareness on entrepreneurship	To improve entrepreneurship and business development skills of feeds actors by 30% by 2033	• Support business development services for MSMEs • Hold feed entrepreneurial clinics

Strategic Pillars	Strategic Issues	Strategic Objectives	Strategic Interventions
Physical Environment	Adverse climate change effects	To reduce adverse effects of climate change by enhancing access and adoption of climate smart technologies by 30% by 2033	• Capacity build land users on climate smart agriculture • Promote agroforestry practices • Adopt soil and water conservation techniques by using climate smart technologies and practices • Promote water harvesting practices • Promote irrigation
Policy Environment	Inadequate policy on fodder production and utilization	To provide an enabling policy environment for fodder value chain by developing two policy documents by 2028	• Develop an animal feed policy • Develop county animal feed regulations

iv. Maize Grain Value Chain

Maize (Zea mays) is an important food crop, which is consumed mainly in form of grains, flour and fodder. The crop is adaptable to a wide range of climatic conditions and, thus, grown extensively in the country. Rainfall requirement ranges from 600-2500 mm with temperature ranges of 150C-300C. The crop is grown in all agro-ecological zones in the county. Maize is the staple food in the county and only about 1% is used as feed for livestock. Maize stover is also used to feed free range and zero-grazed livestock. Maize can grow well in a wide range of soils, but it performs best in well-drained, fertile soils with a pH range of 5.5 to 7.5.

The soil should have good organic matter content, which improves soil fertility and water-holding capacity. In areas with high rainfall, soils should be well-drained to avoid waterlogging, which can lead to poor crop growth and yield. Before planting, the soil should be tested to determine its nutrient content. If the soil lacks essential nutrients such as nitrogen, phosphorus, and potassium, fertilizers should be applied to enhance soil fertility.

Organic fertilizers such as manure and compost, are preferred over synthetic fertilizers due to their sustainability and affordability.

Soil and water conservation structures such as terraces are important to retain water *insitu*. Ripping using tractor or animal drawn rippers is the main water harvesting practice in Makueni.

Makueni is a diverse county with three ecological zones, each with its unique maize varieties and potential. Major varieties grown include the six series for high altitude zones in Mbooni, Kilome, Kaiti and some zones in Mbitini Ward such as Pioneer, DK8031 and PANA 3M. In medium-altitude zones in parts of Kilome and Kaiti, varieties grown are Sungura and Duma 43. Maize varieties that adapt well in the lower zones of Kibwezi and Makueni sub counties are DVH02, Haraka, Mituki and KDV.

Maize production is rain-fed, with irrigated maize accounting for only 1%. Production systems practiced include pure stand and intercrop with legumes such as beans and cowpeas for high altitude zones and intercrop with cowpeas, green grams and pigeon peas in low- altitude zone. Farmyard manure is the main source of nutrients for maize production in low- altitude zone while in high-altitude zone farmers incorporate both manure and fertilizer.

Irrigated maize crop accounts for only 1% of total area under maize crop, with yields ranging from five to six tonnes per hectare of grains and 5.5 to 7 tonnes of stover. Rain-fed crop production per unit area ranges from a high of 12-15 bags per acre in hilly masses of Mbooni and Kaiti to four bags per acre in Kibwezi and Makueni lowlands. Annual total acreage under maize average is 59,002 acres producing approximately 61,739 tonnes of grain. Acreage under maize production is projected to rise to 66,475 acres with corresponding yield of 119,655 tonnes of grains in 10 years.

Challenges

i. Climate change and variability resulting in low rainfall, droughts, and crop failure.
ii. Low quality of maize produced leading to low animal feed quality.
iii. High production costs due to high costs of input.
iv. Low technology uptake, especially, improved varieties.
v. Pests such as fall armyworm, stalk borers, armyworm, and migratory pests including locusts.
vi. Declining soil fertility due to soil degradation and erosion resulting in low yields.
vii. Low value addition for maize as livestock feed.
viii. Inadequate policy on maize grain production, value addition and utilization as animal feed.
ix. Competition for maize as animal and human food.
x. Poor road infrastructure

The details of the maize grain value chain strategic development framework are presented in Table 24 below:

Table 24: Strategic Framework for Maize Grain Value Chain

Strategic Pillars	Strategic Issues	Strategic Objectives	Strategic Interventions
Production and Productivity	Low production/ productivity	To increase acreage from the required 59,002 acres in 2023 to 66,475 acres in 2033 translating to 61,739 tonnes in 2023 to 119,655 tonnes in 2033	• Enhance adoption of good agriculture practices and climate-smart technologies. • Enhance access to certified high-yielding maize seeds, fertilizer, and pesticides. • Enhance mechanization along the maize value chain. • Enhancing the capacity of farmers to produce maize for food and feed. • Promote maize production under irrigation. • Increase capacity of all stakeholders on maize production for feed production
Quality	Quality of maize grain and fodder	To enhance quality of produced grains and fodder from 60% to 100%	• Enhance capacity to manage maize diseases and pests. • Consider IPM • Enhance capacity on pre-harvest and post-harvest handling of the maize crop. • Improve storage, transportation and marketing facilities including use of hermetic bags
Value Addition and Processing	Inadequate value addition and processing of maize grain	To enhance knowledge on processing of maize grain for livestock feed	• Enhance capacity of farmers on feed processing and value addition.
Marketing	Information asymmetry among various maize grain value chain actors	To develop a county livestock feed information system by 2033	• Establish and maintain a data collection, analysis, storage, and dissemination system. Profiling of current farmer/VC actors • Promote aggregation centres for maize marketing. • Improve road network infrastructure

Strategic Pillars	Strategic Issues	Strategic Objectives	Strategic Interventions
Profitability	High post-harvest losses	To reduce post-harvest losses along the feed value chain from 20% to 10% by 2033	• Enhance capacity of farmers on post-harvest management. • Promote proper handling, packaging, and transportation techniques
	Inadequate knowledge on entrepreneurship	To ensure 10,000 farmers are equipped with knowledge and skills on entrepreneurship by 2033	• Enhance entrepreneurial skills of producers. • Promote aggregation of produce for better price negotiation
Physical Environment	High losses due to soil degradation, erosion, and climate change	Reduce the soil degradation and erosion from 50% to 25% by the year 2033	• Capacity build farmers on soil conservation technologies, innovations and management practices • Promote soil health maintenance and restoration. • Promote farm water harvesting technologies. • Promote soil and water conservation technologies
Policy Environment	Inadequate policy on maize grain production, value addition and utilization as animal feed	Develop an appropriate policy, legal and regulation frameworks on maize grain production, utilization, and marketing by 2024	• Develop a policy framework on maize grain production, value addition, utilization, and marketing. • Develop a policy on subsidies and credit access in the agricultural sector

v. Sorghum

Sorghum (Sorghum bicolor) is a cereal crop used as human food, livestock fodder, manufacture of feeds and production of bio-fuels and alcoholic drinks. It is established from seeds and has various varieties for seed and fodder. Sorghum grows best from 800 metres to 2,500 metres above sea level requiring a minimum rainfall of 250 mm per year, but does best above 900 mm per year. This makes Makueni ecology perfect for sorghum production. The crop is adapted to many different soil types. However, it does best on deep, fertile, well-drained loamy soils and is more tolerant of shallow soil and drought conditions.

The crop is often intercropped with pulses such as pigeon peas, beans, cowpeas, and green grams. In Makueni County, sorghum is predominantly grown in the lower zones of Kibwezi and Makueni sub counties and some parts of the upper zones- in Kasikeu, Kiimakiu Kalanzoni, Kakowaia and Kalawa wards - in Mbooni.

Productivity in high-altitude sub counties in Mbooni, Kilome and Kaiti is constrained by low temperatures reducing grain yields and quality and taste. Fertilizer application is very limited owing to non-adoption of fertilizer application as a practice. Varieties grown are Seredo (red variety), Gadam (white variety), KARI Mtama-1 and Serena. Yield is 5-10 bags on average depending on management. Current area under crop is 35,893 acres with estimated annual production at 19,382 tonnes of grains. Area under crop is projected to increase to 63,521 acres with corresponding increase in grain production to 34,301 tonnes.

Challenges

i. Climate change and variability resulting in low rainfall and droughts.
ii. Low quality of sorghum produced leading to poor animal feed quality.
iii. High production costs due to high costs of input.
iv. Low technology uptake especially improved varieties.
v. Crop acceptability among farmers.
vi. Pests such as fall armyworm, stalk borers, armyworm and other migratory pests including Quelea birds and locusts.
vii. Declining soil fertility due to soil degradation and erosion resulting in low yields.
viii. Low value addition for sorghum as livestock feed.
ix. Inadequate policy on sorghum grain production, value addition and utilization as animal feed.
x. Competition for sorghum as animal and human food.
xi. Low accessibility of appropriate varieties for animal feed production.
xii. Poor road infrastructure.

The details of the sorghum value chain strategic development framework are presented in Table 25 below:

Table 25: Strategic Framework for Sorghum Grain Value Chain

Strategic Pillars	Strategic Issues	Strategic Objectives	Strategic Interventions
Production and Productivity	Low production and productivity	To increase acreage from the required 35,893 acres in 2023 to 63,521 acres by 2033 translating to 19,382 tonnes in 2023 to 34,301 tonnes by 2033	• Mobilize farmers to produce sorghum for feed. • Incorporate good agriculture practices and climate-smart technologies in production. • Enhance access to certified high-yielding sorghum seeds, fertilizer, and pesticides. • Enhance mechanization along the sorghum value chain. • Enhance capacity of farmers to produce sorghum for feed. • Promote sorghum production under irrigation. • Increase capacity of other stakeholders on sorghum production for feed
Quality	Low quality of harvested sorghum grain	To improve the quality of harvested sorghum grains by 100%.	• Promote proper handling, packaging, and transportation techniques. • Enhance uptake of pest and disease control technologies including IPM • Enhance capacity on pre-harvest and post-harvest handling of the sorghum crop • Improve storage facilities including use of hermetic bags • Engage research institutions to provide technologies for producing and marketing quality seeds. • Conduct periodic and regular on-farm visits to offer technical support to farmers

Strategic Pillars	Strategic Issues	Strategic Objectives	Strategic Interventions
Processing	Inadequate processing of sorghum grain	To enhance knowledge and skills on processing of sorghum grain for livestock feed to 5,000 farmers by 2033.	• Capacity build farmers on processing and value addition of sorghum for livestock feed
	High post-harvest losses	To reduce post-harvest loses along the sorghum grain value chain from 20% to 10% by 2033	• Building capacity of farmers on processing and value addition of sorghum for livestock feed • Promote appropriate storage and processing facilities
Marketing	Information asymmetry among various sorghum grain value chain actors	To develop a county sorghum grain information system by 2033	• Establish and maintain a data collection, analysis, storage, and dissemination system. • Promote access to market information through business-to-business forums. • Improve road network infrastructure
Profitability	Lack of knowledge on entrepreneurship	To equip 5,000 of farmers with knowledge on entrepreneurship by 2033	• Build capacity of value chain actors on entrepreneurial skills to enhance profits
Physical Environment	Adverse effects of climate change	To equip 5,000 of farmers with knowledge on climate-smart technologies and innovations	• Capacity build farmers on soil conservation technologies, innovations, and management practices • Promote drought-tolerant sorghum varieties. • Introduce agroforestry practices. • Promote farm water harvesting technologies. • Promote soil and water conservation technologies
Policy Environment	Lack of policy regulating sorghum grain production and utilization	To develop an appropriate policy, legal and regulation framework on sorghum grain production, utilization, and marketing by 2024	• Develop a policy framework on sorghum grain production, utilization, and marketing. • Develop a policy on subsidies in the agricultural sector.

vi. Sunflower

Sunflower, Helianthus annuus, is a herbaceous annual plant in the family Asteraceae, grown for its seeds and seed cake. Sunflower seeds are a valuable commodity as they are used in the production of cooking oil, as well as in the production of animal feed. Sunflower oil is a popular cooking oil in Kenya, and the demand for sunflower seeds is, therefore, high.

Sunflower cake is one of the major protein sources in livestock feed, especially, dairy cattle, chickens, pigs and rabbits. It has a high protein content of between 29% and 30% crude fibre of 27-31%, lignin 9-12% and lysine 3.5%. Besides, sunflower cake is a good source of calcium, phosphorus, and B vitamins.

Sunflower crop is also a relatively fast-growing crop, which means that farmers can realise a return on their investment in a relatively short time. In addition, sunflower is a versatile crop, meaning that it can be grown in a variety of different climates and soil types. It does well in loamy soils, sandy loam to clays with pH value ranging from 6.0 to 7.5. Good soil drainage is required and soils with good water-holding capacity (clays) are preferred. An average of 500 mm -750mm of rainfall per annum is adequate for sunflower production. It can be grown from sea level to an altitude of up to 2,000 metres above sea level. Therefore, it does well in all agro-ecological zones in Makueni County.

The crop mainly grown as intercrop with maize and beans with a small proportion of farmers growing it as a pure stand. The current estimated acreage in the county is 40,283 acres with production at 32,581 tonnes. Projections for the next decade is 59,792 acres producing 60,539 tonnes of seeds. Sunflower varieties, Hungarian White, Kenya Fedha and H8998 are all adaptable to all ecological conditions in Makueni.

Challenges

i. Climate: Sunflowers require a warm and sunny climate to grow and thrive. However, in Makueni, weather patterns can be unpredictable, and farmers may experience prolonged periods of drought or heavy rainfall that can adversely affect their crop yields.

ii. Pests and diseases: Sunflowers are vulnerable to a range of pests and diseases, including aphids, caterpillars, rust, and downy mildew. These pests and diseases can cause significant damage to sunflower crops, leading to reduced yields and lower

quality seeds.

iii. Limited access to high-quality seeds: Farmers in Makueni have low access to high-quality sunflower seeds that are suited to the local climate and soil conditions. This can lead to lower yields and reduced profitability for farmers.

iv. Limited access to credit and financing: Small-scale farmers in Makueni lack access to credit and financing, reducing investment in the resources they need to grow their sunflower crops. This can lead to a cycle of low productivity and limited profitability.

v. Low market prices: Sunflower farmers in the county often receive low prices for their crops due to market fluctuations and lack of access to competitive markets. This leads to financial instability and reduced investment in the crop.

vi. Limited access to information and technology: Farmers in Makueni have limited access to information and technology, which can make it difficult to adopt new farming practices, access information on pest and disease control, or take advantage of new market opportunities.

vii. Low quality and quantity of sunflower cake produced.

viii. Inadequate policy on sunflower production, value addition and utilization as animal feed.

ix. Poor road infrastructure.

The details of the sunflower value chain strategic development framework are presented in Table 26 below:

Table 26: Strategic Framework for Sunflower Value Chain

Strategic Pillars	Strategic issues	Strategic objectives	Strategic interventions
Productivity	Low production and productivity	To increase acreage from the required 40,283 acres in 2023 to 59,792 acres by 2033 translating to 32,581 tonnes to 60,539 tonnes of sunflower seed.	• Increasing acreage under sunflower production through mobilization and promotion of farmers. • Improving access to certified seeds, fertilizer and pesticides. • Build capacities of value chain actors on sunflower production and management practices • Enhance agricultural mechanisation along the sunflower value chain. • Production-incorporate good agriculture practices and climate smart technologies in production. • Adopt irrigation technologies. • Establish a sunflower value chain stakeholder forum/platform
Quality	Low quality of sunflower seed and cake	To produce and maintain 100 % quality sunflower seed and cake by 2033.	• Capacity build farmers on sunflower conservation and preservation technologies • Promote construction of standardized storage facilities • Promote public-private partnership on sunflower value addition processing and standardization.
Processing	Low processing of sunflower	To enhance processing, and utilization of sunflower by 50% by 2033	• Capacity build value chain actors on value addition technologies • Link farmers to feed processors and processing equipment and supplies

Strategic Pillars	Strategic issues	Strategic objectives	Strategic interventions
Marketing	Low volumes of traded sunflower cake	To facilitate trading of sunflower seed cake annually	• Diversification of products (e.g., seed cake, sunflower meal) • Provision of strategic aggregation facilities • To promote commercialization of sunflower seed cake. • Create a market information system. • To strengthen animal feed market linkages in the county • Improve road network infrastructure to improve market access
Profitability	Inadequate supply of sunflower seed cake	To enhance aggregation of sunflower seed and seed cake by 10% annually	• Enhance production with market demand to avoid loss. • To promote proper handling, packaging and transportation techniques of sunflower seed cake and sunflower meal • Enhance entrepreneurial skills of the value chain actors.
Physical Environment	Adverse climate change effects.	Reduce negative impacts of climate change from 50% to 25% by the year 2033.	• Capacity build farmers on soil conservation technologies, innovations, and management practices • Promote drought-tolerant sunflower varieties. • Introduce agroforestry practices. • Promote farm water harvesting technologies. • Promote soil and water conservation technologies
Policy Environment	Inadequate policy on fodder production and utilization	To develop sunflower strategy by 2024	• Develop a sunflower development and utilization strategy as a county

vii Cotton value chain

Cotton (Gossypium herbaceum) is one of the cash crops grown in Makueni due to its suitability for most of marginal areas in the county. Textile industry relies heavily on locally produced cotton as a raw material for fabric production. In addition, cottonseed (seed of the cotton plant that is left after removing the lint and fibres from the cotton plant) provides nutrients such as high protein value of about 23%, crude fibre value of 25%, and high-energy value of 14 MJ per kg to livestock. Whole cottonseed serves as a highly digestible feed which also improves the reproductive performance in livestock.

Cottonseed meal is used either alone or by mixing it with other plant and animal protein sources. Whole cottonseed is a popular choice for dairy rations because it has a unique triple-nutrient composition containing protein, available fat and effective fibre. Cottonseed contains good quality oil and protein and is, therefore, a valuable resource, but it has not received the due attention so far. Most of the cottonseed obtained after ginning in the county can directly be crushed to get crude oil -which is used for edible purposes after refining - and the residual cottonseed cake is used for ruminant feed.

Cotton farming in Makueni is primarily concentrated in specific regions that offer suitable agro-climatic conditions for its cultivation. These regions have historically been the best for cotton farming in the county. Due to its drought-tolerance ability, it performs very well in lower regions of the county that comprises Kibwezi East, Kibwezi west, Makueni and some portions of Kilome and Kaiti sub counties. In Kaiti, production is mainly in low-altitude zones bordering Makueni Sub-County. Production in Mbooni is concentrated in Kalawa and Kako Waia wards through a small proportion of farmers can be found in other wards.

Cotton plants have specific soil requirements for healthy growth and fibre production and seed. Soils should be well-drained, sandy loam with good water-holding capacity and good drainage. The soil pH should be between 6.0 and 7.0 for optimal nutrient availability to the plants. Soil pH outside of this range can affect nutrient uptake and plant health. Soils with a reasonable amount of organic matter contribute to soil fertility, moisture retention, and overall soil structure.

Cotton is sensitive to climatic conditions, and specific climate requirements are essential for successful cotton cultivation in Makueni. Warm temperatures, rainfall and dry spells experienced in the county make it ideal for cotton production. Main varieties grown are HART 89M, Fibres, HART 92M, HART 89, HOK 6S and Tumaini. Land should be prepared early and to a depth of at least 30 cm. To maintain soil organic matter, application or incorporation of plant residues and animal manure during land preparation is recommended. Planting

should be early as soon as rainfall is adequate for the germination and growth of the crop. Timely planting is essential to achieve high yields in cotton especially under normal rainfall conditions. A delay in planting after the optimal date results in a significant drop in yields. Main production systems employed in Makueni include pure cotton stand or intercrops with pulses such as green grams or cowpeas.

Current cotton seed requirement for livestock feed is 9,207 MT. This is projected to increase to 12,684 MT by 2028 and to 17,355 MT in the next decade.

Challenges in cotton production

i. Low production due to low acreage under the crop.
ii. Climate change and variability resulting in low rainfall, droughts, and crop failure.
iii. Low quality of cotton seed produced leading to low animal feed quality.
iv. High production costs associated with high costs of input (pesticides and fertilizer).
v. Low technology uptake, especially, improved varieties for cottonseed production.
vi. High incidences of diseases and pests such as cotton stainers, Africa bollworms, Army worms and mealybugs.
vii. Declining soil fertility due to soil degradation and erosion resulting in low yields.
viii. Low value addition and utilization of cottonseed as livestock feed.
ix. Declining global prices for cotton lint and cottonseed.
x. Inadequate policy on cottonseed production, value addition and utilization as animal feed.

The details of the sunflower value chain strategic development framework are presented in Table 27 below:

Table 27: Strategic Framework for Cottonseed Value Chain

Strategic Pillars	Strategic Issues	Strategic Objectives	Strategic Interventions
Production and Productivity	Low production/ productivity	To increase production and productivity to attain cottonseed requirements from current 9,207 MT to 17,355 MT in 2033	• Mobilize farmers to produce cottonseed for livestock feed. • Production-enhance adoption of good agriculture practices and climate smart technologies. • Enhance access to certified high-yielding cotton seeds, fertilizer and pesticides. • Enhance access to cotton varieties for cottonseed production. • Enhance mechanization along the cottonseed value chain. • Enhance the capacity of farmers to produce cottonseed for livestock feed. • Promote cotton production under irrigation. • Increase capacity of stakeholders on cottonseed production for livestock feed
Quality	Low quality of cottonseed for livestock feed	To increase quality of produced seed by 100%	• Enhance capacity of farmers to manage cotton diseases and pests. • Enhance capacity on pre harvest and post-harvest handling of cottonseed. • Improve storage, transportation and marketing facilities of cottonseed.
Value Addition and Processing	Inadequate value addition and processing of cottonseed for livestock feed	To enhance knowledge and skills on value addition and processing of cottonseed for livestock feed to 3,000 farmers by 2033	• Enhance capacity of farmers on feed processing and value addition. • Promote value addition of cottonseed at aggregation centres

Strategic Pillars	Strategic Issues	Strategic Objectives	Strategic Interventions
Marketing	Information asymmetry among various cottonseed value chain actors	To develop a county livestock feed information system by 2033	• Establish and maintain a data collection, analysis, storage, and dissemination system. • Promote aggregation centres for cottonseed marketing. • Enhance interactive access to market information through business-to-business forums. • Improve road network infrastructure
Profitability	High post-harvest losses	To reduce post-harvest losses along the feed value chain from 20% to 10% by 2033	• Enhance farmers' capacity on post-harvest management. • Promote proper handling, packaging, and transportation techniques
	Inadequate knowledge on entrepreneurship	To ensure 3,000 farmers are equipped with knowledge and skills on entrepreneurship by 2033	• Capacity build farmers on soil conservation technologies, innovations and management practices • Promote soil health maintenance and restoration. • Promote farm water harvesting technologies. • Promote soil and water conservation technologies
Policy Environment	Inadequate policy on cotton seed production, value addition and utilization as animal feed	Develop an appropriate policy, legal and regulation frameworks on cottonseed production, utilization, and marketing by 2024	• Develop a policy framework on cottonseed production, value addition, utilization, and marketing. • Develop a policy on subsidies and credit access in the agricultural sector

viii. Cow Peas Value Chain

Cowpea (Vigna unguiculata) is an annual leguminous crop which is grown for its seeds and leaves, and its residues can be used as livestock fodder. It can withstand drought, has a short growing period and its multi-purpose use makes it an attractive crop for farmers in marginal, drought-prone low rainfall areas.

Cowpea farming is a popular legume in Makueni due to its high nutrition value, short harvest period, and hardiness. Cowpea is used as fodder crop for green feeding, hay making, grazing and for ensiling in mixtures with sorghum or maize. The grains are used as human food as well as animal feed. It is also used as a green manure crop and as a cover crop in plantations. The feeding value of cowpea forage is high.

Cowpeas are adapted to a wide range of soils but do well in well-draining soils with a PH between 6.0 and 6.5. Its drought-tolerant attribute makes it very well adaptable in lower zones in Kibwezi and Makueni sub counties, which include Kalawa and Kako Waia wards of Mbooni as well as in Kasikeu, Kiima Kiu Kalanzoni wards in Kilome. Its production for seed is constrained by low temperatures in high-altitude wards in Mbooni and Kaiti and the crop in these wards tends to be more vegetative making it ideal for its leaves.

There are several varieties of cowpeas, each adaptable to unique characteristics and suitability for different regions. In Makueni, Ken Kunde, KVU 27-1, K80, Ken Kunde, Kunde Tamu, M66 and Kunde Soko varieties are adaptable in all zones.

Current annual acreage under crop is 26,310 acres producing approximately 16,613 tonnes of seed. This is projected to increase to 45,778 acres with corresponding increase in tonnage of seeds to 29,401 in the next decade.

Challenges

i. Low access to improved varieties among farmers resulting in low production and low fodder quality.
ii. Low adoption of production techniques and practices and input needed for higher productivity and profitability.
iii. Though the crop can withstand high periods of water deficits, weather patterns can be unpredictable, and farmers may experience prolonged periods of drought or heavy rainfall that can adversely affect their crop yields.
iv. Low level of commercialization and its adoption as animal feed
v. Insect pests, diseases (fungal, viral and bacterial).
vi. Declining soil fertility is attributed to soil degradation and erosion.

vii. Inadequate policy on cowpea production, value addition, marketing and utilization as an animal feed.
viii. Poor road infrastructure

The details of the cowpea value chain strategic development framework are presented in Table 28 below:

Table 28: Strategic Framework for Forage Legumes Crop (Cowpeas)

Strategic Pillars	Strategic Issues	Strategic objectives	Strategic interventions
Production and Productivity	Low production and productivity	To increase acreage from the required 26,310 acres to 45,778 acres by 2033 translating to 16,613 tonnes in 2023 to 29,401 tonnes of grain in 2033	• Mobilize farmers and enhance their capacity to produce cowpeas for food and feed. • Incorporate good agriculture practices and climate-smart technologies in production. • Enhance access to certified high-yielding cowpeas seeds, fertilizer and pesticides. • Enhance mechanization along the cowpeas value chain. • Increase capacity of all stakeholders on cowpeas production for feed
Quality	Low quality of legume feed	To capacity build 5,000 producers on post-harvest management for safe feed.	• Capacity building of farmers on cowpeas conservation and preservation technologies • Promote construction of standardized storage facilities • Promote public-private partnership on cowpeas processing and standardization.
Processing	Low value addition and processing of cowpeas feed and grain	To improve knowledge and skills on processing of cowpeas and grain for livestock feed to 10,000 farmers by 2033	• Capacity build value chain actors on technologies • Link farmers to feed processors equipment suppliers

Strategic Pillars	Strategic Issues	Strategic objectives	Strategic interventions
Marketing	Information asymmetry among various fodders legume value chain actors	To develop a county livestock feed information system by 2033	• Establish and maintain a data collection, analysis, storage, and dissemination system. • Support establishment of cooperative societies for fodder production and marketing • Promote stakeholder access to livestock feed market information system through business-to-business forums and platforms. • Improve road network infrastructure
Profitability	Inadequate knowledge on entrepreneurship	To improve capacity of 10,000 farmers on business development skills by 2033	• To promote commercialization and contract farming of legume fodder • Support business development services for MSMEs
	High post-harvest losses	To reduce post-harvest loses along the feed value chain from 25% to 10% by 2033	• Capacity build farmers on post-harvest management • Promote good handling and storage practises
Physical Environment	Increased soil degradation and erosion during establishment of legume fodder	Reduce the soil degradation and erosion from 50% to 25% by 2033	• Capacity build farmers on soil conservation technologies, innovations, and management practices • Promote drought-tolerant cowpeas varieties. • Promote agroforestry practices. • Promote farm water harvesting technologies. • Promote soil and water conservation technologies and practices. • Enforce existing policies on land use management practices

Strategic Pillars	Strategic Issues	Strategic objectives	Strategic interventions
Policy Environment	Inadequate policy on fodder production and utilization	To develop a policy, legal and regulation frameworks on legume fodder production, utilization, and marketing by 2024	• Develop a policy framework on legume fodder. • Develop a policy on subsidies in the agricultural sector

ix. Black Soldier Fly (BSF)

The Black Soldier Fly (Hermetia illucens) is a common and widespread fly of the family Stratiomyidae. It is presently the most widespread form of insect farming in the world. The adult fly is black, wasp-like and is 15-20 mm long. BSF are mostly reared in indoor cages with good light penetration and greenhouses. Temperatures should be maintained at about 290C-310C and humidity is kept 30-70%. Its life cycle is approximately 45 days.

During the production phase, a prolific adult female can lay 500-900 eggs at once. With good food supply, the larvae can reach their maximum body mass in six days. During the breeding phase, also referred to as the hatchery phase, the eggs deposited by adult Black Soldier Flies are placed in vertically racked containers filled with compost consisting of residual waste streams such as organic food waste.

Eggs hatch in 3-4 days and are collected in 1-2 days and taken to the production unit for rearing. The larvae can feed on materials such as rotting fruits, vegetables, coffee pulp, distillers' grains, fish offal, rabbit waste, pig waste, chicken waste and animal waste. The larvae can reach up to 27 mm in length and 6 mm in width and weigh up to 220 mg in 14 days at their last larval stage. The larvae are dull, whitish in colour. During this period, the larvae rapidly consume nutrients from the organic waste to prepare themselves for the following stage of their life as adult flies.

In ideal conditions, larvae become mature in two months, but the larval stage can last up to four months when there is inadequate feed. At the end of the larval stage (pre-pupa), the larva empties its digestive tract and stops feeding and moving. When they are ready to be harvested, the larvae consist of 40 to 65% protein.

They are an alternative source of protein for livestock feed, especially, fish, poultry when fresh and pig feeds when processed. When dried, they are then processed to provide an insect meal which is used in feed formulation.

It takes on average about 9.35 MT of food scrap (wet weight) to produce 1 MT (wet weight) of BSFL and it takes 18.7 MT of scrap food to produce 1 MT of dried BSFL. The production of BSFL in an area of 5M by 10M yields 2 MT fresh BSFL per annum.

Currently there is one farm rearing BSF in Makueni County and, therefore, there is a great opportunity for investing in this venture, because there is readily available food waste to be recycled. The waste is available from hotels, Kalimba fruit processing plant, boarding schools, poultry waste, chicken waste, among other sources.

Challenges in Black Soldier Fly farming

i. Requires intensive staffing and training on the venture.
ii. Seed funding and financial sustainability is needed.
iii. Lack of market linkages between producers and consumers in BSFL farming
iv. Lack of processing and value addition of BSFL farming
v. High organic waste requirements.
vi. Low techniques of breeding BSF
vii. Low community awareness of insect farming and opportunities therein
viii. Lack of policy on insect farming

There are over 20 farms rearing BSF in Kenya with five of them being located in Kajiado County. Farmers can also get the breeding stock from ICIPE KENYA; Insect Pro Ltd. Ressect in Njoro; Ololo Farm in Ongata Rongai; Zihanga Limited; Tripple P Ltd; Protein Masters Ltd; Sanergy; Dudu Masters; Afriprot; Ecodudu and Namahi Farm in Isinya; and, Amboseli Eco farm in Kimana.

The details of the Black Soldier Fly Larvae value chain strategic development framework are presented in Table 29 below:

Table 29: Strategic Framework for Protein Sources of Animal Origin (Black Soldier Fly)

Strategic Pillars	Strategic Issues	Strategic objectives	Strategic interventions
Production and Productivity	Expensive protein source ingredients for fish and livestock feed formulation.	• To promote BSFL farming as an alternative protein source and achieve an average annual production of 40 MT of fresh BSFL by 2033. • To establish eight BSF farming outlets by 2033	• Identify processing industries and institutions such as big hotels and schools to get volumes of waste. • Capacity build farmers and groups on insect farming technologies. • Capacity build extension staff on BSFL • Form one BSFL farmer cluster and construct BSF demonstration farm • Upscale BSFL production through establishment of one BSFL farm • Procure simple cost-effective farming equipment for BSFL rearing • Enhance access to machinery, equipment and necessary input for BSFL farming • Acquire and maximize plots and wastelands for BSF farming in urban areas
Feed quality and standardization	Lack of a certified BSF nurseries in the county	• To introduce 40 kg of BSFL brood stock in Makueni county by 2028 • Set up nurseries and seek certification.	• Certification of BSF production farms - DVS • Identification of BSFL certified farms in Kenya for brood supply • Capacity build farmers on good BSFL farming practices

Strategic Pillars	Strategic Issues	Strategic objectives	Strategic interventions
Value Addition and Processing	Lack of BSFL processing and value addition sites in the county	Establish one processing and value addition BSFL unit by 2028	• Establish processing units and rearing centres • Facilitate access to machinery and input necessary for BSFL processing and value addition. • Capacity build the value chain actors and service providers. • Train farmers on techniques for de-fatting of BSF larvae • Promote the use of simple hatchery tools and sun-drying in BSFL farming • Promote technologies such as sun drying to reduce post-harvest losses
Marketing	Lack of market linkages between producers and consumers of BSFL	To facilitate market linkage of one farmer cooperative society by 2033	• Formation of one farmer cooperative society • Train farmers on entrepreneurial skills • Promote formulation, standard packaging, and branding of BSLF-formulated feed.
Profitability	Low entrepreneurship skills in BSFL farming	Enhance entrepreneurship skills by 70% of BSFL producers by 2033	• Train farmers on entrepreneurship skills in the production of BSFL • Conduct market assessment of the demand for the BSFL
Physical Environment	High organic waste materials and lack of proper disposal	Promote recycling and utilization of organic waste materials	• Mapping of damping sites • Collection and aggregation of organic waste • Training of technical staff and farmers on waste handling procedures • Formation of linkage forums and training sessions for value chain players in BSFL production
Policy Environment	Lack of policy on BSF farming	To develop a county insect farming and management policy by 2025	• Develop a county insect farming policy

x. Other strategic interventions

These are important strategic interventions identified to be cross-cutting and captured in Table 29:

Strategic Pillars	Strategic issues	Strategic Objectives	Strategic Interventions
Production and Productivity	Inadequate extension services	To increase extension-officer-to- farmer ratio from the current 1: 2,000 to the recommended 1:400 (FAO)	• Recruitment of additional extension officers • Promote private-sector-led extension service. • Set up an extension system. • Facilitate mobility of extension service providers.
	Low access to mechanization services	To improve provision of mechanization services in feed production from 5% to 25%	• Strengthen AMS in the county structure. • Incentivize private sector investment in animal feed mechanization. • Establish and strengthen a mechanization service provider network. • Link farmers to funding opportunities for mechanization investment. • Public-private partnership on mechanization investment • Promote biogas technology • Provide insurance cover for value chain actors to mitigate risks
	Inadequate access to water for feed production	• Increase access to water for feed production by 30% • To construct and/or rehabilitate 100 water sources	• Promote water harvesting and conservation. • Incentivize private sector investment in water for feed production • Introduce and support pasture/ fodder production under irrigation

Strategic Pillars	Strategic issues	Strategic Objectives	Strategic Interventions
	High level of landscape degradation	To rehabilitate 500,000 acres by 2033	• Initiate a rangeland rehabilitation and reseeding program. • Revamp the range management division in the county • Support actors to develop land use plans and spatial plans • Establish landscape management committee
Marketing	Low storage capacity	Increase the feed storage capacity from 1,500 tonnes/year to 15,000 tonnes /year	• To establish four strategic feed reserves in the county • To construct 20 hay barns across the county • Market information dissemination • Capacity build co-operative societies on management and governance • Partner with financial institutions to empower co-operatives • Establish platform county livestock management information system
Financing	Low investment in livestock feed sector	To increase the budgetary allocation to livestock sector to 10% of the annual budget	• Lobby and advocate for meetings • Advocate for increased investments in livestock feed enterprises by private and public entities. • Incentivize investments in livestock feeds enterprises. • Promote index-based livestock insurance
		Improve access to financial services to livestock feeds VCA by 10%	• Establish a livestock fund in collaboration with private sector
		Introduce and build capacity of farmers and community on climate finance investments	• Facilitate formation of a climate finance secretariat • Capacity build stakeholders on climate finance

Strategic Pillars	Strategic issues	Strategic Objectives	Strategic Interventions
Value Addition and Processing	Inadequate value addition and processing of feed	To support three private sector players to set up an animal feed factory in the county.	• Promote public-private partnerships on feed value addition and processing. • Support formation of Makueni association of animal feed producers and manufacturers
Marketing	Information asymmetry among various feed VCA	To develop an animal feed market information system	• Develop a county livestock feed information system.
	Inadequate livestock feed marketing infrastructure	To support private sector to establish four feed business centres	• Establish the animal feed business centres
Profitability	High cost of input	To establish a county animal feed subsidies fund	• Establish a county animal feed subsidies fund to subsidize livestock feed input. • Establish linkages for input supply
Policy Environment	Inadequate policy, legal and institutional framework	To domesticate five policies and/or regulation on animal feed	• Review the county livestock movement and produce act. • Develop guidelines on land-carrying capacity. • Develop livestock identification and traceability guidelines. • Develop a PPP framework on feed • Develop landscape conservation act and regulation

Implementation Arrangements

4.1 Introduction

This chapter unveils the Co-ordination and Implementation Framework, a pivotal component within the county's animal feed strategy. As aspirations transform into actionable plans, the need for effective co-ordination of programmes and activities is paramount in transforming the strategic vision into tangible reality.

4.2 Implementation and Co-ordination Framework

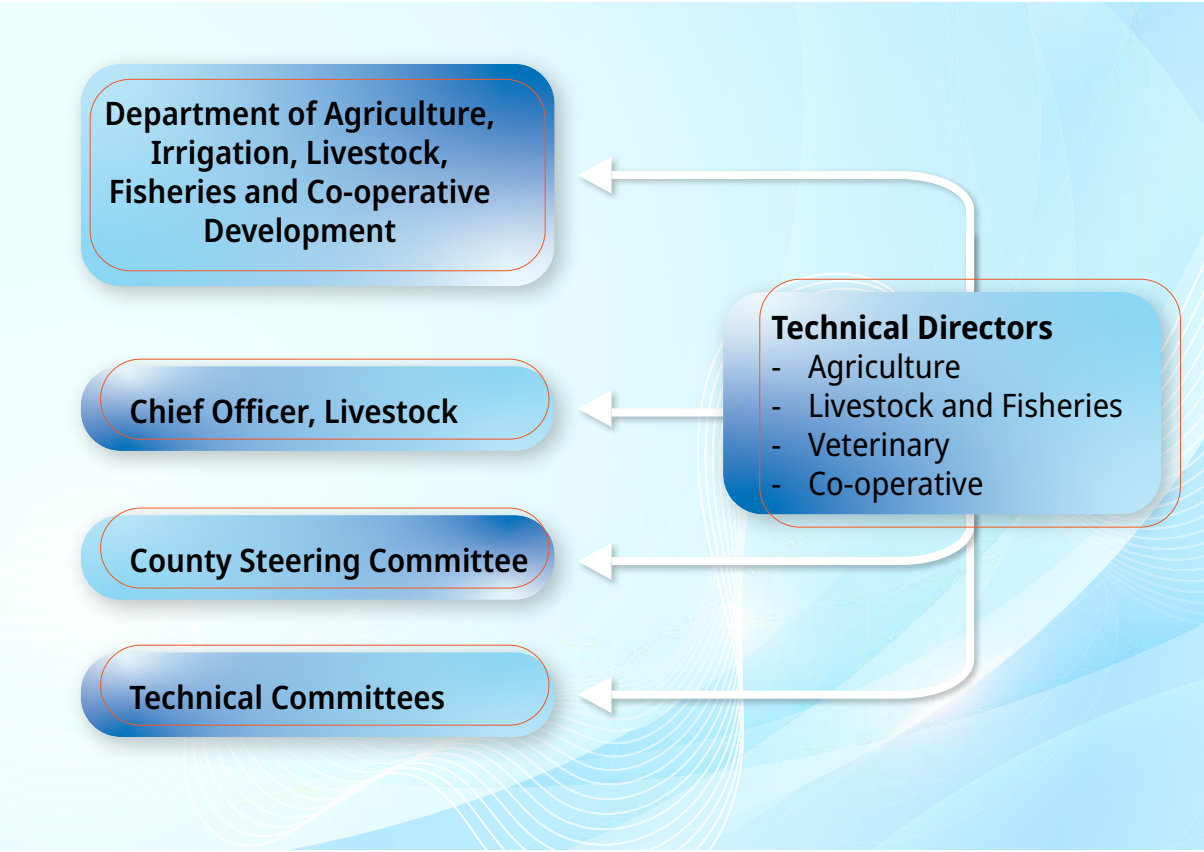
The implementation of the strategy should be in partnership with the national government and other stakeholders. The national government should provide the necessary enabling environment for the county to develop own priorities and specific context such as agro-ecological zones and farming systems. The implementation of the strategy may be driven by the ministry responsible for livestock development, involving all actors along the various livestock feed value chains, including producers, processors, marketers and input suppliers and their associations. To move from the strategic statements to the outcome level, operational plans will need to be developed to generate activities, output and outcomes that will contribute to the achievement of the goals stated in the strategy. Flagship projects will be developed out of the operational plans. Updating and detailing out the flagship projects,

in line with the county integrated development plans will be done based on this strategy, is required to obtain an operational plan from which country-specific priority programs and activities can be identified.

4.2.1 CO-ORDINATION MECHANISMS

The department responsible for livestock and fisheries will coordinate implementation of the animal feed strategy. The County Chief Officer (CCO) responsible for livestock shall convene a county steering committee to approve decisions of technical committees for animal feed. The CCO, in consultation with technical directorates, will appoint technical members of respective technical committees and shall approve implementation programs, projects proposals and plans prepared by the technical directorates.

Coordination Structures



4.3 Implementation Plan

The strategy will use drivers such as programs, projects, and annual development plans to implement strategic interventions. A detailed matrix for each value chain will be attached in the annex and a summary outlining the objectives, activities, output, indicators of performance and timeframe will be described.

4.4 Financial Plan

Approximately Kshs5.1 billion will be required to fully implement the Makueni County Animal Feed Strategic Plan over the 10-year period (Table 30). The Chief Officer shall prepare financial plans to mobilize resources for the strategy. The developed plans shall be used to secure and apply the required financing and preparation of a medium-term expenditure framework for the animal feed. The detailed implementation plans for the priority value chain are annexed.

Table 30: Resource Requirements for the Period Financial Year 2023/24 to FY 2032/33

	Resource Requirements (Million KES)										
Pillar/Year	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**Total**
Productivity	363.71	351.89	350.64	338.20	343.69	305.13	302.27	268.54	267.93	158.82	2,908.99
Quality	58.00	59.75	72.30	68.10	60.20	59.15	59.55	61.70	59.10	46.30	749.85
Value Addition and Processing	34.40	28.82	49.44	30.96	28.68	26.30	29.92	27.54	28.16	17.48	301.70
Marketing	45.30	38.60	67.15	36.50	35.05	69.35	45.40	43.80	40.70	31.30	430.55
Profitability	30.65	27.26	26.96	60.51	18.31	25.56	24.41	25.51	20.56	14.61	190.49
Physical Environment	15.75	31.17	22.59	25.65	23.01	29.73	27.55	26.37	38.29	16.43	256.14
Policy environment	66.00	59.05	17.55	12.05	7.05	62.00	24.00	7.00	36.50	7.00	298.20
Total	**613.81**	**596.54**	**606.63**	**571.97**	**515.99**	**577.22**	**513.1**	**460.46**	**491.24**	**291.94**	**5,135.92**

4.50 Investments Plans

These are plans generated to demonstrate cost-benefit analysis of the county feed value chains in terms of land to be utilized, feed quantities to be produced, income to be earned, products for pasture /fodder and how many jobs are created upon full implementation of the strategy (Table 31).

Table 31: Feed Commodity Cost-Benefit Analysis and Value Proposition to Investors

Value chains	Input Analysis			Output Analysis	
	Acres	Metric Tonnes	Total cost	Annual Net Income	Jobs creation
Energy Sources					
Hay Cultivated pastures	2,254,295	989,904,087	346,518,243	72,727,162,959	25,974
Maize Grain	132,951	119,655,571	683,050,000	4,308,742,317	1,539
Forage Grasses	80,278	45,196,344	198,100,000	8,164,150,134	2,916
Sorghum Grain	63,521	34,301,392	628,400,000.	1,266,375,368	452
Protein Sources					
Sunflower	119,584	60,539,613	353,510,000	1,751,004,208	625
Cotton	25,865.62	18,105.936	732,704,574.29	905,296,831.55	78.5
Cowpeas	91,556	29,401,193	515,240,000	727,769,282	260
Animal Protein Sources					
Black Soldier Fly	-	2,450,099	127,670,000	129,600,000	46
Natural Pastures					
Total	**2,768,051**	**1,281,466,405**	**3,585,192,817**	**89,980,101,100**	**31,891**

[1]*It is assumed 30% of net income is used for job creation and annual salary of KES 840,000/jobs created.*

[2]*Represent the required acreage to produce the required sunflower seed cake, with 95% of the sunflower seed cake being sourced from outside the county.*

4.6 Communication Plan

The Directorate for Livestock and Fisheries development will create awareness and take feedback from relevant stakeholders to ensure concerted efforts in planned programs for animal feed through public consultative means. These efforts will be replicated at the ward level.

This plan is deliberate with messages to reach out to actors and stakeholders mentioned in the strategy to fuel performance success of implementation of designed programs.

The key messages to be communicated will focus on the topics of innovations in forage production, livestock husbandry, landscape restoration, grazing management, feeding strategies during drought and policies. This will ensure harmonized and targeted messages to all actors through avenues such as mass media, pamphlets, brochures, short message services and social media.

4.7 Monitoring, Evaluation Learning and Accountability

Monitoring and evaluation will track and demonstrate realization of results emanating from implementation of the strategic plan. It will also provide feedback to the leadership and stakeholders on its performance. Monitoring and evaluation will be based on a framework, which involves various strategic pillars.

The framework will include definition of responsibilities, tracking of indicators, adoption of monitoring and evaluation mechanisms, reporting process, timeliness and financing. Tracking of the Strategic Plan targets will be done regularly and its output will form part of the department's quarterly and annual performance reports. This will, in turn, lead to critical assessment of departmental objectives.

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Annexes

Annex 1
Feed Value Chains Implementation Plan

a) Range Pastures Implementation Plan

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Production/ Productivity	To improve the land-carrying capacity of our pasture lands	To improve the annual carrying capacity of natural pastures from 8 acres per TLU (each 250 kg) to 4 acres per TLU by 2028 and to 2 acres per TLU by 2033	4,500,000.00	Communities in 15 wards carrying out reseeded of pastures	DAILFCD, Development partners, farmers
Quality	To improve the quality of natural pastures	To improve the quality of 90% of natural pastures by 2033	560,000,000.00	Number of acres reseeded	DAILFCD, Development partners, farmers
Processing and Value Addition	To enrich the value of natural pastures	To enhance value addition of natural pastures by introducing 3 legume species in 50% of natural pastures by 2033	450,000.00	Number of seed bulking centres established	DAILFCD, Development partners, farmers
Physical Environment	To conserve the environment of the natural pastures	To conserve the environment by arresting soil erosion in 70% of natural pastures by 2028	40,000,000.00	Number of ranchers	DAILFCD, Development partners, farmers
Policy Environment	To create conducive policy environment	To develop policy and implementation framework on rangeland management	10,0000	Number of acts regulation developed	DAILFCD, Development partners, farmers and policy makers
	To improve stakeholder coordination and communication	To promote coordination and communication in the livestock feed sub-sector	750,000	Number of stakeholder forums held	DAILFCD, Development partners, farmers and policy makers

b) Cultivated Grasses Implementation Plan

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Production and Productivity	To increase production of cultivated grass pasture from 685,638,949 MT in 2023 to 977,055,097 MT by 2033	Increase grass pasture production by 42%	150,000,000	1,200 farmers	Private players, GMC Developing partners
Quality	To enhance the quality of hay	To improve the quality of hay by 80%	8,000,000	1,000 farmers trained.	Private players, GMC Developing partners
Processing/ Value Addition	To promote value addition on hay	To promote 50% of hay value addition technologies by 2032	30,000,000	1,000 farmers trained.	Private players, GMC Developing partners
Marketing	To increase the volumes of hay being traded	To increase volume of traded hay from 10% i.e. 20,779,510 bales of hay to 40% i.e. 83,118,041 annually	7,000,000	Number of aggregation centres trained	Private players, GMC Developing partners
Physical Environment	To reduce adverse effects of climate change.	To enhance adoption of climate smart technologies by 80% in 2023.	2,000,000	Number of farmers sensitized	Private players, GMC Developing partners
Policy Environment	To provide an enabling policy environment for hay value chain	To develop Makueni hay strategy document by 2024	3,000,000	Policy drafted	Private players, GMC Developing partners
Total			**200,000,000**		

c) Forage Fodders Implementation Plan

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Production and Productivity	To increase production of forage fodder	To increase production of fodder from 20,900 MT in 2023 to 49,900 MT by 2033 through increasing acreage under production from the current 13,832.66 hectares to 33,096.28 hectares	1,257,000,000	• 3,853 farmers trained. • 19,263.62 hectares of fodder forage established. • 385,272 MT of silage material produced • Water harvesting structures constructed/ rehabilitated • 5 water Dams • 140 trainings and 260 meetings held	GMC, GOK, Partners
		Strengthen provision of extension services	10,000,000	Meetings held	GMC, GOK, Partners
		Enhance capital investments in the fodder enterprise by 10%	10,000,000	Number of public private forums conducted	GMC, GOK, Partners
Quality	To improve the nutritive value of fodder produced by 40% by 2033	To enhance the quality of fodder forages produced by improving fodder nutritive value by 40% by 2033	102,000,000	• 120 trainings conducted • 40 trade fairs • 20 meetings and monitoring visits made • 10 specialist inspectors trained	GMC, GOK, Partners
Quality	To improve the nutritive value of fodder produced by 40% by 2033	To enhance the quality of fodder forages produced by improving fodder nutritive value by 40% by 2033	102,000,000	• 120 trainings conducted • 40 trade fairs • 20 meetings and monitoring visits made • 10 specialist inspectors trained	GMC, GOK, Partners

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Processing/ Value Addition	To promote value addition of fodder grasses by enhancing access and adoption of fodder technologies by 50% by 2033	To promote value addition of fodder grasses by enhancing access and adoption of fodder technologies by 15% by 2032	101,700,000	• 3,000 farmers, 120 field days • 5 exhibitions and 20 stakeholders • Forums conducted	GMC, GOK, Partners
Marketing	To increase the volumes of fodder grasses being traded by targeting 30% of the total acreage under fodder production for sale by 2033.	Facilitate market access	104,200,000	• Number of producer groups trained • 20 aggregation centres established • 2,000 farmers	GMC, GOK, Partners

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Profitability	To increase the profit margin by 20% in 2033.	To increase the profit margin by 20% in 2033.	10,750,000.00	• 3,000 farmers sensitized and 10 market surveys done • 3,000 sensitized on market requirements • 3,000 farmers sensitized • 3,000 farmers trained	GMC, GOK, Partners
		To reduce post-harvest losses along the fodder value chain by 50% by 2033	11,000,000	3,000 farmers trained	GMC, GOK, Partners
		To improve entrepreneurship and business development skills of feeds actors by 30% by 2033	15,000,000	3,000 farmers trained	GMC, GOK, Partners
Physical Environment	To reduce adverse effects of climate change by enhancing access and adoption of climate smart technologies by 30% by 2033	To reduce adverse effects of climate change by enhancing access and adoption of climate smart technologies by 30% by 2033	74,250,000	• 3,000 farmers trained • 80 farmer groups trained and 80 agroforestry nurseries established • 3,000 farmers trained • Technologies promoted • 1,000 assorted equipment procured and distributed and 3,000 farmers benefited	GMC, GOK, Partners
Policy Environment	To provide an enabling policy environment for fodder value chain by developing 2 policy documents by 2028	To provide an enabling policy environment for fodder value chain by developing 2 policy documents by 2028	30,000,000	• 1 policy developed enacted and reviewed • 1 document of feed regulations developed and passed.	GMC, GOK, Partners

d) Maize Grain Implementation Plan

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Production and Productivity	To increase production of maize grain	To increase acreage from 59,002 acres to 66,475 acres. To increase production from 61,739 to 119,655 tonnes	605,000,000	• 10,000 farmers mobilized, sensitized and trained,1,500 farmers exposure tours/ benchmarking • 15,000 farmers issued with certified maize seeds • 10 sets of assorted machinery procured • 100 acres under fodder crops • 40 stakeholders mobilized	County government, national government, FAO, NGOs
Feed Quality and Standardization	To increase quality of produced grains and fodder	To increase quality of produced grains and fodder by 100%	85,800,000	• 10,000 farmers capacity build,10,000 farmers sensitized • 50 storage facilities constructed/improved	County government, national government, FAO, NGOs
Processing and Value Addition	To enhance knowledge and skills on value addition and processing of maize grain for livestock feed to 10,000 farmers by 2033	To enhance knowledge and skills on value addition and processing of maize grain for livestock feed to 10,000 farmers by 2033	32,650,000	• 10,000 farmers trained and sensitized • 10 processing machines procured and installed	County government, national government, FAO, NGOs

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Marketing	To establish maize grain market information system	To develop one county livestock feed information system by 2033	50,250,000	• 20 market surveys conducted,10 business-to-business forums held, • 50 km of feeder roads maintained	County government, national government, FAO, NGOs
Profitability	To reduce post-harvest losses in the feed value chain	To reduce post-harvest losses along the feed value chain from 20% to 10% by 2033	5,900,000	• 10,000 farmers capacity built/ sensitized	County government, national government, FAO, NGOs
	To improve entrepreneurship and business development skills of maize grain actors	To equip 10,000 farmers with knowledge and skills on entrepreneurship by 2033	7,250,000	• 10,000 farmers trained on handling packaging and transportation techniques	County government, national government, FAO, NGOs
Physical environment	To reduce soil degradation and erosion	Reduce the soil degradation and erosion from 50% to 25% by the year 2032	19,000,000	• 10,000 farmers trained	County government, national government, FAO, NGOs

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
		Promote drought-tolerant sorghum varieties.	11,100,000	• 10,000 farmers trained	County government, national government, FAO, NGOs
		Promote agroforestry practices.	7,150,000	• 10,000 farmers trained and 10 nurseries established	County government, national government, FAO, NGOs
Policy Environment	Strengthen policy, legal and institutional capacity for maize grain value chain	To develop an appropriate policy, legal and regulation framework on maize grain production, utilization and marketing by 2024	36,000,000	• One policy drafted,30 public forums conducted, • Four stakeholder forums held • Comments and reviews consolidated • Cabinet approval response • Policy launched • Public forums conducted • Stakeholders forum held • Consolidation meetings done • Cabinet response • Launching *Baraza* held	County government, national government, FAO, NGOs
Total Sum			**860,100,000**		

e) Sorghum Grain Implementation Plan

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Production and Productivity	To increase sorghum production and productivity	• To increase acreage from 35,893 acres to 63,521 acres by 2033. • To increase sorghum grain production from 19,382 tonnes to 34,301 tonnes	124,700,000	• 500 farmers trained through benchmarking tours and visits • 5,000 farmers issued with certified maize seeds, fertilizer and pesticides • 40 acres under sorghum irrigation • 20 stakeholders mobilized and sensitized	County government, national government, FAO, NGOs
Feed Quality and Standardization	To improve the quality of harvested sorghum grains and fodder	To improve the quality of harvested sorghum grains and fodder by 100%	19,000,000	• 5,000 farmers capacity built.	County government, national government, FAO, NGOs
Processing and Value Addition	• To promote value addition and processing of sorghum grain. • To reduce post-harvest loses along the sorghum grain value chain	• To improve knowledge and skills on value addition on sorghum grain for livestock feed to 5000 farmers annually. • To reduce post-harvest loses along the sorghum grain value chain from 20% to 10% by 2033	38,500,000	• 5,000 farmers trained and sensitized • 5,000 farmers capacity built on post-harvest management	County government, national government, FAO, NGOs

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Marketing	To establish sorghum market information system	To develop a county sorghum grain information system by 2025.	30,000,000	• 20 market surveys conducted • 1,000 farmers trained • 50 km of improved roads	County government, national government, FAO, NGOs
Profitability	To equip 5,000 of farmers with knowledge on entrepreneurship	To equip 5,000 of farmers with knowledge on entrepreneurship by 2033	14,500,000	• 1,000 farmers sensitized	County government, national government, FAO, NGOs
Physical Environment	To reduce adverse effects of climate change	To reduce adverse effects of climate change from 50% to 25% by 2033	30,300,000	• 20 demos conducted • 5,000 farmers planting drought-tolerant crops • 10 nurseries established	County government, national government, FAO, NGOs

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Policy Environment	To strengthen policy, legal and institutional capacity for sorghum grain value chain	To develop an appropriate policy, legal and regulation framework on sorghum grain production, utilization and marketing	20,000,000	• One policy drafted • 30 public forums conducted • Four stakeholders forum held • Comments and reviews consolidated • Cabinet approval response • Policy launched • Public forums conducted • Stakeholders forum held • Consolidation meetings done • Cabinet response • Launching baraza (meeting) held	County government, national government, FAO, NGOs

f) Sunflower Implementation Plan

Strategic pillars	Strategic Issues	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor/ Responsible
Production and Productivity	Low production/ productivity	To improve production and productivity of sunflower	To increase acreage from 40,283acres to 59,792 acres. To increase production from 32,581 tonnes to 60,539 tonnes	167,920,000	• 5,000 farmers mobilized and trained on sunflower production • 5,000 farmers accessing input for production. • 5,000 farmers trained and practicing sunflower production • 5,000 farmers trained on sunflower mechanization and accessing mechanized sunflower services • 5,000 farmers trained on climate-smart practices for sorghum production • 50 acres under sorghum production • 10 stakeholders fora held	County government, national government, FAO, NGOs
Quality	Low quality of sunflower seed and cake	To enhance the quality of the sunflower cake produced	To produce and maintain 100 % quality sunflower seed and cake by 2033.	42,750,000	• 5,000 farmers trained and practicing recommended sunflower post-harvest handling technologies • 10 facilities constructed and farmers accessing mechanized services	County government, national government, FAO, NGOs

Strategic pillars	Strategic Issues	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor/ Responsible
Processing/ Value Addition	Low processing of sunflower	To enhance processing, value addition and utilization of sunflower	To enhance processing, value addition and utilization of sunflower by 50% by 2033	10,150,000	• 5,000 farmers accessing and practicing value addition and processing of sunflower • Farmers accessing value addition equipment services	County government, national government, FAO, NGOs
Marketing	Low volumes of traded sunflower cake	To increase the volumes of sunflower cake being traded	To facilitate trading of sunflower seed cake annually	61,500,000	• Trading and utilization of diverse sunflower products • Quantities of sunflower traded increased • Cooperative capacity formed/ strengthened for sunflower production and processing • Farmers accessing markets • Farmers access to markets improved	County government, national government, FAO, NGOs
Profitability	Inadequate supply of sunflower	To lower cost of production of sunflower by 10%	To enhance aggregation of sunflower seed and seed cake by 10% annually	21,400,000	• Market demands established • Number of farmers implementing good feed handling and preservation techniques • Farmers engaging in entrepreneurship activities in feed value chain	Department of Agriculture

Strategic pillars	Strategic Issues	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor/ Responsible
Physical Environment	Adverse climate change effects.	Reduce negative impacts of climate change	Reduce negative impacts of climate change from 50% to 25% by the year 2033.	13,590,000	• Environment protection through soil and water conservation. • New drought-tolerant varieties adopted by farmers • Increased tree cover	County government, national government, FAO, NGOs
Policy Environment	Inadequate policy on feed production and utilization	To provide an enabling policy environment for feed value chain	To develop sunflower strategy by 2024	36,200,000	• One policy drafted • 30 public forums conducted • Four stakeholders forum held • Comments and reviews consolidated • Cabinet approval response • Policy launched • Public forums conducted • Stakeholders forum held • Consolidation meetings done • Cabinet response • Launching Baraza (meeting) held • Final draft approved	County government, national government, FAO, NGOs

g) Cotton Implementation Plan

Strategic pillars	Strategic Issues	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor/ Responsible
Production and Productivity	Low production/ productivity	To increase production and productivity to attain cotton seed requirements from current 9,207 MT to 17,355 MT in 2033	To increase production from current 9,207 MT to 17,355 MT in 2033	150,000,000	• 5,000 farmers mobilized • Access to certified high-yielding cotton seeds enhanced	County government, national government, FAO, NGOs
Quality	Low quality of cottonseed for livestock feed	To increase quality of produced seed by 100%	Improve cottonseed cake quality and safety	50,000,000	• Capacity to manage cotton pests and diseases enhanced • Capacity on pre-harvest and post-harvest management enhanced	County government, national government, FAO, NGOs
Value Addition and Processing	Inadequate value addition and processing of cottonseed for livestock feed	To enhance knowledge and skills on value addition and processing of cottonseed for livestock feed to 3,000 farmers by 2033		35,000,000		County government, national government, FAO, NGOs
Marketing	Information asymmetry among various cottonseed value chain actors	To develop a county livestock feed information system by 2033		62,000,000		County government, national government, FAO, NGOs

Strategic pillars	Strategic Issues	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor/ Responsible
Profitability	High post-harvest losses	To reduce post-harvest losses along the feed value chain from 20% to 10% by 2033		18,000,000		County government, national government, FAO, NGOs
	Inadequate knowledge on entrepreneurship	To ensure 3,000 farmers are equipped with knowledge and skills on entrepreneurship by 2033		10,000,000		
Physical Environment	High losses due to soil degradation, erosion, and climate change	Reduce the soil degradation and erosion from 50% to 25% by the year 2033		22,000,000		
Policy Environment	Inadequate policy on cotton seed production, value addition and utilization as animal feed	Develop an appropriate policy, legal and regulation frameworks on cottonseed production, utilization, and marketing by 2024		15,000,000		

h) Cow Peas Implementation Plan

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Production and Productivity	To increase production of cowpeas seed	To increase acreage from 26,370 acres to 45,778 acres To increase production from 16,613 tonnes to 29,401 tonnes	307,120,000	• 10,000 farmers mobilised, sensitized and trained • 1,500 farmers exposure tours/ benchmarking • 1,500 farmers exposure tours/ benchmarking • 10 sets of assorted machinery procured • 30 stakeholders mobilized	County government, national government, FAO, NGOs
Feed Quality and Standardization	To improve the safety and quality of cowpeas seed	To increase access to 100% safe and high value quality cowpeas legumes grains for livestock feed	46,300,000	• 10,000 farmers trained,10 grain stores constructed	County government, national government, FAO,NGOs
Processing and Value Addition	To improve knowledge and skills on value addition and processing of legume fodder and grain for livestock feed to 10,000 farmers by 2033	To improve knowledge and skills on value addition and processing of legume grain for livestock feed to 10,000 farmers by 2033	13,750,000	• 10,000 farmers trained and sensitized,10 business-to-business forums conducted	County government, national government, FAO,NGOs

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Marketing	To establish legume grain feed market information system	To develop one county livestock feed information system by 2033	65,000,000	• 10 market surveys conducted,50 km of feeder roads maintained, • Number of cooperative societies strenghened	County government, national government, FAO, NGOs
Profitability	To reduce post harvest losses in the feed value chain	To reduce post-harvest loses along the feed value chain from 25% to 10% by 2033	28,340,000	• 1,000 farmers sensitized on minimizing post harvest loses • 10,000 farmers trained and sensitized • 1,000 farmers sensitized on building their own stores • 20 farmers organizations trained on business development	County government, national government, FAO, NGOs
	To improve entreprenuership and business development skill of feeds actors	To improve the capacity of 10,000 farmers on business development by 2033			
Physical Environment	To reduce soil degradation and erosion	Reduce the soil degradation and erosion from 50% to 25% by the year 2033	32,400,000	• 10,000 farmers trained, drought-tolerant varieties promoted and adopted • 10 tree nurseries established and certified	County government, national government, FAO, NGOs

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Policy Environment	To develop a policy, legal and regulatory framework on production, utilization and marketing of cowpeas for feed	To develop a policy ,legal and regulatory framework on legume production,utilization and marketing as feed by 2024	36,000,000	• One policy drafted • 30 public forums conducted • Four stakeholders forum held • Comments and reviews consolidated • Cabinet approval response • Policy launched • Public forums conducted • Stakeholders forum held • Consolidation meetings done • Cabinet response • Launching baraza held	County government, national government, FAO, NGOs

i) Black Soldier Fly Implementation Plan

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Production and Productivity	To promote BSFL farming and achieve an average annual production of 89.92 tonnes by 2032	To promote BSFL farming as an alternative protein source and achieve an average annual production of 40 MT of fresh BSFL by 2033.	57,670,000	• Raw materials Baseline survey report, Technical Officers trained, Data collection report, Report for source of raw materials, Trained staff, Trained farmers • Constructed model BSF demonstration farm, Purchased BSF machinery equipment, Acquired BSF initial brooding stock, Existing BSF Status report • Purchased BSF machinery equipment	County Government, Premises owners and other stakeholders.
Feed quality and standardization	To obtain quality initial brood stock for resilient next generation	To acquire quality brood stock from a certified BSFL supplier by the year 2025	10,500,000	• One certified BSF farm identified, 40 kg of BSF brood stock acquired. • Five trainings conducted,20 technical personnel trained	Department of Agriculture, Department of Public Works, the BSF owner
Processing/ Value Addition	To implement up-to-date processing techniques on BSFL by 2027	Establish one processing and value addition BSFL units	12,200,000	• Established BSF Processing and value addition unit • Trained Value Chain Actors and service providers on BSF processing and value addition	Department of Agriculture, Department of ICIPE, the BSF farmers public Works, the BSF farm owner

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Marketing	To promote BSFL farming as an alternative protein source in fish feeds.	To facilitate market linkage of one fish farmers co-operative society by 2033	20,400,000	• One farmers cooperative society formed, 900 BSF farmers trained • A BSF standard packaging and brand developed	ICIPE, Department of Livestock and Fisheries.
Profitability	Enhance entrepreneurship skills by 70% of BSFL producers by 2033	To build the BSF farmers entrepreneurship skills	7,100,000	• BSF market-demand assessment • Approved market assessment report	Department of Agriculture, the BSF farmers, Financial institutions, Department of Monitoring and Evaluation
Physical Environment	To promote recycling of organic waste material of 840.8 tonnes through Black Soldier Fly farming	To enhance the physical environment for BSF farming	27,100,000	• Designated organic waste collection and aggregation points • Trained staff and BSF farmers on organic waste handling safety measures	ICIPE, Department of Agriculture, Department of Environment, the BSF farmers

Strategic Pillars	Strategic Objectives	Specific Objectives	Budget (Kshs)	Output	Actor / Responsible
Policy Environment	To develop a legal framework on Insect Farming and Management and improve stakeholder coordination and communication	To develop a Makueni County BSF farming and Management Act and Regulations and promote coordination and communication in the BSF farming sub-sector	13,500,000	• Developed BSF farming legal framework • Established BSF farming multi-stakeholder platform	Department of Agriculture, Relevant stakeholders, County Assembly, Department of Environment, the BSF farmers
Total			**148,470,000**		

Annex 2
National Hay Standards

Fodder Hay — Specification

Part 1: Grass Hay

Technical Committee Representation

The following organizations were represented on the Technical Committee:

Ministry of Agriculture and Irrigation - State Department for Livestock
Kenyatta University - Department of Animal Science
Kenya Agricultural and Livestock Research Organization (KALRO)
Unga Farm Care EA Ltd.
Modern Ways Ltd.
Directorate of Veterinary Services
Association of Kenya Feed Manufacturers (AKEFEMA)
Government Chemist Department
Pioneer Feeds Ltd.
Embu University
University of Nairobi
Accelerated Agriculture and Livestock Enterprises
Global Space Africa Agribusiness (GLOSAA)
Rift Valley Hay Growers Association
Marula Naivasha
Pembe Flour Mills Ltd.
Joeliz Bone meal Ltd.
Sarnergy Ltd.
Delamere Estates
Kenya Bureau of Standards — Secretariat

Revision of Kenya Standards

To keep abreast of progress in industry, Kenya Standards shall be regularly reviewed. Suggestions for improvements to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.

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Foreword

This Kenya Standard was prepared by the Animal Feeds Technical Committee under the guidance of the Standards Projects Committee, and it is in accordance with the procedures of the Kenya Bureau of Standards.

Over 70% of the nutritional requirement of ruminants or hind-gut fermenters come from forage materials. This standard provides guidelines for the nutritional, weight and safety requirements of fodder hay to facilitate trade and provides for a quality and grading system that is both locally and internationally recognized.

The main nutritional uses for hay are:

- As a supplement to high grain or lush pastured, i.e.to maintain rumen function by stimulating saliva flow and rumen contractions for intensive and grazing dairy cattle, beef and feedlot cattle, sheep and goats
- As a supplement to maintain required milk fat concentrations in dairy cows by increasing rumen acetate production.
- As a supplement to or replacement for pasture (sometimes with concentrates) to provide energy and protein for growing calves, heifers and transition cows.
- As a supplement to or replacement for pasture (sometimes with concentrates) to provide energy and protein for ruminants or hind-gut fermenters that are growing, productive or breeding including cattle, sheep, goats, horses, donkeys and camels.

In the preparation of this standard, reference was made to:

- CodexStandard 193-1995 – Codexgeneral standard for contaminants and toxinsin food and feed
- Nutritional Requirements of Dairy Cattle, 2001, National Academy of Sciences, National Academy Press, Washington
- Nutritional Requirements of beef Cattle, 2000, National Academy of Sciences, National Academy Press, Washington
- USDA Grading Standards-revised Hay quality guidelines
- South Africa Standard/Guideline- STD No. - G13 Standards and requirements regarding control of the export of feed product
- Australian Standard –Australian fodder Industry association grades
- Fertilizers and Animal Feedstuffs Act, Cap 345.
- FAO, (2006) Kenyan pastures (Orodho, A.B). Country Pasture/Forage Resource Profiles

Part 1: Grass Hay

1. SCOPE

This Kenya Standard specifies the requirements and test methods for Grass hay used as fodder.

2. NORMATIVE REFERENCES

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

i. ISO 5983 Animal feeding stuffs- determination of nitrogen content and calculationof crude protein content
ii. Codex Allimentarius Pesticide Database
iii. Codex Standard 193-1995 – Codex general standard for contaminants and toxinsin food and feed
iv. ISO 16050 Foodstuffs-Determination of aflatoxinB1 and the total content of B1, B2, G1 and G2 in cereals, nuts and derived products-High performance Liquid Chroma to graphic method

3. DEFINITIONS

For the purpose of this standard, the following definitions shall apply:

3.1. Fodder Hay

Fodder hay is grass or legume plants that have been cut and dried for use as fodder for animals.

3.2. Grass Hay

Grass hay is cultivated or natural pasture grass that has been cut and dried for use as fodder for animals. Grass hay may be single species or mixed species.

4. REQUIREMENTS

4.1. General requirements

Grass Hay shall be;

i. Free from harmful constituents such as glass, stones, soil, metallic objects and other adulterants.
ii. Free from moulds or insect infestation;e.g.Ergotspp
iii. Free from musty, rancidor uncharacteristic odour;
iv. Free from rain damage;
v. Free from poisonous plants and seeds including, but not limited to the following Cuscuta,Datura, Solanum, Moraea, Stipa, Crotalaria Ornithogalum, Senecio;
vi. Free from plant pests and diseases;
vii. Free from animal pests and disease-causing agents;

4.2. Specific Requirements for Grass Hay

Grass hay shall be classified into grades on the basis of nutritional value as follows:

i. Grass hay shall comply with the requirements prescribed in Table 1.
ii. Moisture content shall comply with the requirements prescribed in Table 2

Table 1 —Nutritional requirements for Grass Hay

S No.	Parameter at 100% DM	Grade					Test Method
		Premium	Good	Fair	Utility	Straw	
i).	Crude Protein (%)	13 (Min)	9 - 13	5 – 9	3 - 5	3 (Max)	KS ISO 5983
ii).	Acid Detergent Fibre (ADF)	45 Max					KS ISO 13906
iii).	Neutral Detergent Fibre (NDF)	75 Max					KS ISO 16472

Table 2 - Moisture Content for Grass Hay

Hay classification	Pelleted Hay	Rectangular Baled Hay up to 25 kg	Rectangular Baled Hay 26 kg - 400 kg	Rectangular Baled Hay 400 kg - 800 kg	Round Baled Hay 200 kg - 900 kg	Test Method
Moisture Content (%) (max)	12	18	16	12	15	KS ISO 6496

5. CONTAMINANTS

5.1 Pesticide Residues

All grass hay shall comply with the maximum pesticide residue limits established by the Codex Allimentarius Pesticide Database.

5.2. Other Contaminants

All Grass hay shall comply with those maximum limits for other contaminants established in CODEX STAN 193.

6.AFLATOXINS

Total Aflatoxin level shall not exceed 20 ppb (Max)

7. PACKAGING AND LABELLING

7.1 Packaging

i. Baled Hay for sale shall be baled using sufficiently strong bindings so as to withstand reasonable handling without tearing or falling open during transportation and storage.
ii. Chopped, milled, or Pelleted Hay shall be packed in containers which are of sufficient strength and sufficiently sealed so as to withstand reasonable handling without tearing, bursting or falling open during handling and transportation.
iii. Hay should be transported in clean vehicles and should be protected from the elements.

7.2 Labelling

The following particulars shall be legibly and indelibly displayed on the label.

i. **Type of hay** - if being sold as a single species, then a declaration is required stating that the contents consist of more than 90% m/m dry matter of that species.
ii. Name and physical address of the vendor.
iii. Grade of hay
iv. Crude Protein level
v. Net weight of sale unit
vi. Moisture level

vii. Lot number

viii. Production Date

ix. Use by statement of not more than five years from date of production

x. Storage instructions