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Review Article

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Mapping Value Chains and Technology Needs Assessment for Livestock in Laikipia County, Kenya

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ABSTRACT

Livestock sector plays a critical role in the Kenyan economy, generating approximately 12 percent of the national GDP while serving as an important source of food and income for most households. However, productivity in this sector, is hampered by various constraints such as weak market infrastructure, high costs of feeds, poor quality feeds and climate change impact. This survey aimed to estimate the current status of the livestock value chain system and practices as well as appropriate technology needed for innovation based competitiveness of the small and medium enterprise(SMEs). Data collection was based on structured questionnaires and interviews. Findings suggest that livestock value chains in Laikipia County are strongly rooted, suggesting clear pathways while weak linkages have to be reinforced. Dairy value chain remains one of the biggest avenues for community level empowerment in general and more so, women, youth including persons living with disability. The main challenges affecting the livestock and livestock products value chain are production, processing and marketing related. In addition, low application of technology on one hand or lack of presence on the other. The survey recommends the embedding of supporting functions such as policies, research and development, ICT, infrastructure, engineering, and related services in the value chain for optimization of service delivery.

Keywords: Livestock sector, Value chain, Technology needs, Market infrastructure, Climate change, Environmental sustainability

Introduction

Laikipia County, Kenya, is home to a dynamic pastoralist community that relies heavily on rangelands for livestock grazing. These lands are essential to the local economy and the livelihoods of pastoralists. However, climate change, coupled with increasing livestock populations, has placed significant strain on these fragile ecosystems. Degraded rangelands not only reduce livestock productivity but also threaten the ecological balance and long-term sustainability of the region.

On this basis, the Kenya Industrial Research and Development Institute (KIRDI) in collaboration with the Ministry of Investment Trade and Industry (MITI), undertook value chain mapping of livestock products and by-products in Laikipia County to address recurring needs in the community. The survey under the KIRDI-Kenya Industry and Entrepreneurship Project initiative, aimed to inform sustainable management practices that can mitigate the effects of climate change and promote resilience in arid and semi-arid lands (ASALs).

Given the increasing vulnerability of ASALs to climate variability, this survey is timely, relevant and is aligned with the aspirations of the government's development blue-print, the Bottom-up Economic Transformational Agenda (BETA). It contributes to the broader discourse on sustainable rangeland management by offering practical solutions to policymakers and stakeholders involved in pastoralist economies. Furthermore, the research aligns with global efforts to combat land degradation, as outlined in the United Nations' Sustainable Development Goals (SDGs), particularly Goal 15 (Life on Land) and Goal 13 (Climate Action).

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Review of Literature

Study Area

Laikipia County, located in Kenya's Central Rift Valley region, is one of the 47 counties formed under the 2010 Constitution. The county's administrative center and headquarter is Rumuruti Town [1]. Laikipia is known for its diversity, with around 32 different communities, including the Maasai, Samburu, Rendille, Somali, Pokot, Kalenjin, Meru, Kikuyu, and Turkana. The name "Laikipia" comes from the Maasai language, meaning "vast plains with pastures," which aptly describes the county's large highland plateau [1].

The county's economy is mainly driven by crop farming, livestock rearing, tourism, and trade. Key crops include wheat, maize, beans, Irish potatoes, sorghum, and various vegetables, while livestock farming primarily focuses on cattle, goats, sheep, and poultry. Laikipia is also a popular tourist destination, known for its wildlife, unique Maasai cultural practices, and natural attractions like Thomson Falls. Its proximity to Mount Kenya, Meru, Aberdares, and Samburu game parks further boosts tourism in the region [1].

Most of the county's trade activities are centered in urban areas like Nanyuki, Kalalu, Matanya, Nyahururu, Rumuruti, Kinamba, Wiyumiririe, Lamuria, Doldol, Ol Jabet, Mouwarak, Sipili, Pesi, Ilpolei, Karuga, Karandi, Lonyiek, Gatundia, and Naibor [1]. Administratively, Laikipia is divided into six sub-counties: Laikipia East, Laikipia North, Laikipia West, Laikipia Central, Nyahururu, and Kirima. These sub-counties are further divided into 16 divisions, 57 locations, and 115 sub-locations. Additionally, the county is represented by three constituencies - Laikipia East, Laikipia West, and Laikipia North - each comprising a total of 15 electoral wards [1].

Rangelands and Livestock Management in Arid and Semi-Arid Lands (ASALs)

Rangelands are vital ecosystems that provide essential resources, like forage and water, for livestock in arid and semi-arid regions [2]. These lands are especially important for pastoralist communities, whose livelihoods depend on them [2]. However, rangelands in ASALs (Arid and Semi-Arid Lands) are increasingly under pressure from climate change, overgrazing, and land degradation [2,3].

Climate change has brought about more frequent and severe droughts, which greatly impact vegetation cover and water availability in rangelands [3]. This reduces livestock productivity and weakens the overall resilience of pastoralist systems [3]. Overgrazing, caused by growing livestock populations and unsustainable grazing practices, further worsens land degradation and decreases the rangelands' carrying capacity [2,4].

Several studies have demonstrated the effectiveness of remote sensing and GIS in monitoring rangeland productivity and managing livestock [4]. These tools help track vegetation changes across different seasons and identify areas at risk of overgrazing [4]. By merging satellite imagery with on-the-ground data, researchers can gain a comprehensive understanding of how rangeland conditions vary over time and space [4,5].

Involving pastoralist communities in the research process and incorporating their traditional ecological knowledge ensures that proposed interventions are culturally sensitive and socially acceptable [4,5]. This collaborative approach can lead to solutions that address the needs of both the ecosystem and the local communities [5].

In summary, the literature review underscores the importance of rangelands in ASALs and the challenges they face due to climate change and overgrazing. This study contributes to the wider discussion on sustainable rangeland management and supports global efforts to combat land degradation and enhance climate resilience [6].

Methodology

Scoping

The scoping exercise was carried out in several stages to ensure a thorough understanding of the research objectives and to identify key stakeholders. The process began with the research team reviewing the Terms of Reference (ToR) and the tools for both the Technology Needs Assessment and the Sectoral Value Chain Mapping. This initial step helped to clearly outline the study's scope and specific objectives [7].

Next, the team conducted extensive desktop research to familiarize themselves with existing literature and activities in Laikipia County. This involved reviewing relevant publications, reports, and data sources to gain a comprehensive understanding of the local context and to identify any knowledge gaps [8].

Following the desktop research, the team planned the fieldwork by mapping out potential routes to meet with various value chain actors. This step was crucial for optimizing the field visits and making efficient use of time and resources. Subsequently, meetings were held with Laikipia County officials, including the County Secretary and the Chief Officer of Livestock and Fisheries, on June 18, 2024. These meetings aimed to secure official approval and support for the research project, identify key stakeholders in the value chain, and obtain guidance on the best ways to engage with these stakeholders.

Overall, the scoping exercise laid a strong foundation for the following stages of the research by ensuring the team had a clear grasp of the objectives, access to necessary information, and the support of local authorities to effectively engage with stakeholders.

Study Findings

Beef Value Chain

The beef value chain involves several key stages: input supply, animal production, processing, marketing, distribution, and waste management. Critical activities in this chain include animal slaughter, hide and skin preservation, meat marketing, and waste disposal. The main stakeholders encompass livestock farmers, buyers, transporters, abattoirs (such as those in Rumuruti, Ngare Narok, Nyahururu, and Nanyuki), hide and skin collectors, marketers, and beef traders operating at markets like the Rumuruti livestock market.

Table 1: Showing Beef Value Chain actors

Stage	Actors
Input	AI (Artificial Insemination), Animal Feed Manufacturers, Agrovets, Pasture Producers, Trainers (Technology Transfer Experts), Technology Providers, Packaging Supplies
Producers	Individual Farmers, Ranches, Co-operatives, Associates and Small Groups, Feedlot Farmers
Processors	Buyers/Middlemen, Transporters, Slaughterhouses (Private Owned, County Owned, Slaughter Slabs), Meat Inspectors and Graders, Butcheries
Marketing and Distribution	Distributors, Wholesalers, Retailers, Meat Processors, Organizations Adding Value to Meat Products, Clearing and Forwarding Companies
Environmental Concerns	Waste Management, Regulators (NEMA, Veterinary Services, County Services, KEBS, KRA)

Input supply and animal production are critical aspects of livestock farming in Laikipia. The input supply chain includes agrovets, animal feed manufacturers, distributors, fodder producers, and artificial insemination service providers, with agro-vet shops typically sourcing their supplies from larger towns. Small-scale farmers usually purchase feeds from these suppliers, while larger farms often produce their own.

Animal production in Laikipia focuses on raising cattle, sheep, and goats through methods such as pastoralism, feedlotting, and free-range ranching. The landscape is dominated by small-scale farmers, particularly in Laikipia North and West. However, these farmers face several challenges, including limited access to sufficient feed, water scarcity, inadequate infrastructure, and restricted availability of artificial insemination services. To help boost productivity, both private and government entities offer training in good husbandry practices.

The connection between input supply and animal production is vital for improving livestock health and productivity. Access to quality feeds, veterinary services, and effective training enables farmers to enhance their operations and address the challenges they face.

Challenges at Animal Production Level

At the animal production level, several key challenges have been identified:

1). Insufficient and Low-Quality Feeds: This issue can be mitigated through improved quality control measures and training in pasture production to ensure better feed quality.
2). Water Scarcity: Addressing this challenge requires education on effective water harvesting and storage techniques to ensure a reliable water supply for livestock.
3). Poor Infrastructure: Inadequate feeder roads impact livestock transport and access to markets. County government intervention, such as road grading and maintenance, is needed to improve infrastructure.
4). Inadequate Extension Services: Limited availability of extension services restricts farmer training. Increasing the number of extension officers can help bridge this gap and provide necessary support to farmers.
5). Lack of Reliable Artificial Insemination Services: The absence of trustworthy artificial insemination services and limited knowledge in this area highlight the need for reliable service providers and targeted knowledge transfer initiatives.

Addressing these challenges through strategic interventions can significantly enhance livestock productivity and overall farm performance.

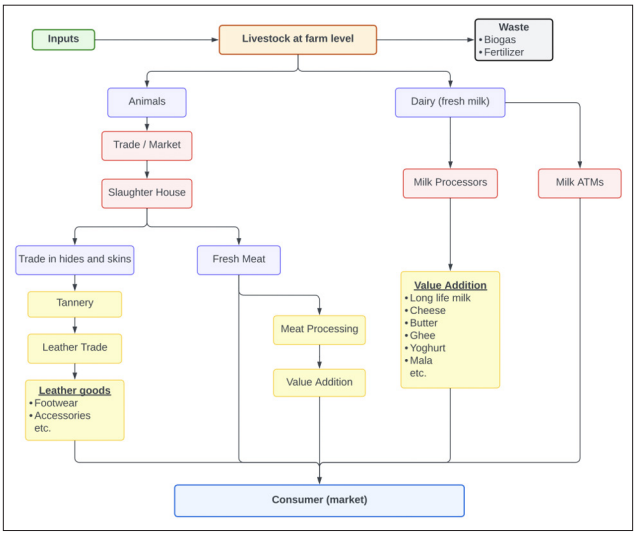

Figure 1: Figure showing the livestock products and by products sectoral value chain and the actors.

Distribution and Marketing

The livestock markets in Laikipia, overseen by the Laikipia Livestock Marketing Association (LLMA), attract producers from all over Kenya. Among these, the Rumuruti market stands out as one of the largest in East Africa. It operates weekly and handles around 1,000 cattle and 4,000 sheep and goats each time. Recent improvements in management and automation have increased the county's revenue from these markets, but several challenges remain.

Key issues include inadequate feeding and water facilities, poor infrastructure, and limited slaughter capacity. To tackle these problems, it's essential to provide proper feeding and water troughs, pave the dusty holding grounds to improve health conditions, and establish a fair revenue-sharing model between the county government and LLMA, following livestock co-management principles. The growing demand for slaughter facilities calls for expanding and modernizing slaughterhouses. Additionally, the lack of basic amenities like ablution blocks, water points, eateries, and shops can be addressed by constructing permanent structures managed by LLMA.

Slaughtering and Beef Processing

Animal slaughter in Laikipia takes place in both public and private slaughterhouses, with veterinary supervision to ensure quality control. However, many of these facilities still use traditional equipment, and the meat is typically transported to urban centers for sale. This part of the beef value chain

encounters several challenges, such as a lack of protective gear for workers, insufficient water supply, and outdated equipment.

To improve the situation, it's recommended that the county government provide proper uniforms and protective gear for slaughterhouse workers, along with high-quality detergents for sanitation. Local fabrication of flaying knives and other tools would enhance operational efficiency. Additionally, respecting labor relations is crucial, ensuring that employees are fairly compensated for working on weekends and holidays. Improving water supply through methods like water harvesting, building storage facilities, and exploring alternative sources such as boreholes will help address current shortages.

Waste Management

Waste from abattoirs, such as wastewater, blood, and organic waste, is usually managed through lagoons or septic tanks. However, during the rainy season, these systems can overflow, leading to environmental risks. On the flip side, there's potential to turn these waste streams into revenue by exploring ways to valorize them, which could mitigate environmental impacts and create economic benefits.

Figure 2: Images of waste disposal at a slaughterhouse

Technological and Management Gaps

The beef value chain encounters several technological and management challenges. Key issues include the lack of modern equipment, limited value addition activities such as roasting and boiling, and inadequate record-keeping of waste streams. The reliance on manual operations and minimal digitization further hampers efficiency.

To address these challenges, investment in modern equipment and the local fabrication of tools are essential. Implementing capacity-building programs and promoting the adoption of new technologies can also help. Enhancing feed quality and strengthening market linkages are crucial for improving competitiveness. Moreover, ensuring proper labor relations, particularly regarding fair compensation for abattoir employees, is necessary to support a more efficient and equitable value chain.

Dairy Value Chain

The dairy value chain encompasses several stages: input supply, production, milking, handling, storage, testing, transportation, and waste management. Key stakeholders in this chain include dairy farmers, cooperatives, milk collectors, graders, and dairies such as Muhotetu Dairy Cooperative, Ng'arua, Marmanet, Karaba, MOGAKA, Nyala, Laikipia Dairy Cooperative, and Country Delight Dairy Limited, as well as livestock production officers.

Table 2: Showing Dairy Value Chain actors

Category	Actors
Input	AI (Artificial Insemination), Animal Feed manufacturers, Agrovets, Pasture producers, Trainers (Technology transfer experts), Technology providers (Provide equipment), Packaging supplies
Producers	Individual Farmers, Ranches, Co-operatives, Associates and Small groups and Chamas, Feedlot farmers, Energy Regulation (Clean Energy like biogas)
Processors	Milking (farmers), Transporters, Collectors, Dairy plants (Individuals, big factories, cooperatives)
Marketing and Distribution	Distributors, Wholesalers, Retailers, Logistics service providers, Dairy processors, Organizations that add value to dairy products (e.g., Happy Cow), Export market (if applicable), Clearing and forwarding companies
Environmental Concerns	Waste management, Regulators (NEMA), Veterinary services, County Services, KEBS, KRA, Kenya Dairy Board

Input Supply

In the dairy value chain, input supply includes agrovets, feed manufacturers, distributors, fodder producers, and artificial insemination providers. Dairy cooperatives play a key role by offering veterinary services and animal feed to farmers at subsidized rates.

Milk Production

Dairy production is primarily carried out by smallholders who typically manage 2-3 cows each. These farmers are organized into cooperatives that handle milk collection, cooling, and sales. However, they face several challenges, such as low-quality feed, water scarcity, poor infrastructure, and inadequate artificial insemination services. Addressing these issues is crucial for improving dairy production and overall farm productivity.

Figure 3: Images illustrating how milk is transported from the farms to the dairy cooperatives.

Milk Processing

Milk collected by trained transporters is delivered to cooling centers, where it undergoes testing and is stored. However, many of these cooling centers lack facilities for value addition. While there is some training available in quality control, the production of value-added products, such as cheese, remains limited. Developing facilities for value addition and expanding the range of products could enhance the dairy value chain and improve profitability for farmers and cooperatives.

Figure 4: Images illustrating the cooling and processing plants and the locally produced Mozzarella cheese.

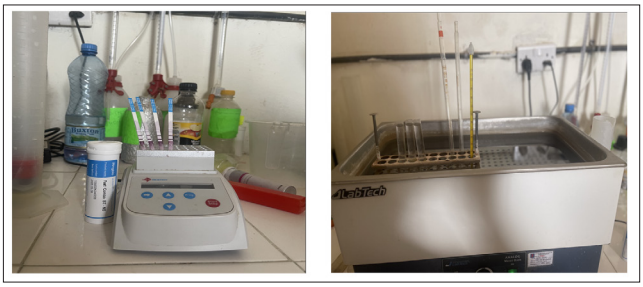

Figure 5: Images illustrating some of the quality tests the milk goes through before processing.

Waste Management

Dairy waste, such as dung and spoilt milk, is often repurposed for uses like biogas production or as animal feed. Despite these efforts, waste management remains underdeveloped, and disposing of whey poses a particular challenge. Improving waste management practices and exploring innovative solutions for whey disposal could enhance sustainability and efficiency within the dairy value chain.

Distribution and Marketing

In Laikipia, most of the milk is sold to processors, while smaller amounts are sold directly as fresh milk to local consumers via hawkers and milk ATMs. Raw milk is transported in cooling tanks to processing facilities. The market is largely dominated by three major processors: Kenya Cooperative Creameries (KCC), Brookside Dairies, and Country Delight Dairy Limited. Cooperatives have the option to sell their milk to any of these processors based on their contractual agreements.

Challenges and Possible Interventions

The dairy value chain in Laikipia faces several key challenges. Improving feed quality can be achieved through better quality control and farmer training in fodder production. Addressing water scarcity involves educating farmers on water harvesting and storage techniques. Poor infrastructure, such as inadequate feeder roads, calls for county intervention to facilitate road grading. Financial constraints affecting production and feed access could be eased by providing credit facilities. The shortage of reliable artificial insemination services needs to be tackled by promoting trustworthy providers. Additionally, addressing issues like misuse of antibiotics and delayed payments from processors requires enhanced farmer education, stricter quality control, and better enforcement of contractual agreements. To stabilize milk prices, establishing a guaranteed pricing system is recommended.

Technology and Management Gaps

Dairy cooperatives face notable technology and management challenges that impact their competitiveness. Key issues include a lack of investment in high-value product manufacturing and limited digitization of records. There's also insufficient adoption of technologies for whey valorization and innovations in feed formulation. To bridge these gaps, cooperatives should focus on capacity building, embrace advanced technologies, and invest in producing high-value dairy products. Improving record-keeping with digital solutions and developing new methods for feed and whey utilization are essential steps to enhance efficiency and boost competitiveness in the dairy value chain.

Conclusion And Recommendations

Laikipia County boasts a thriving livestock sector, particularly in dairy, which presents significant opportunities for growth and community empowerment. With around 55,000 dairy cattle and a peak production of 100,000 liters per day, the dairy value chain emphasizes inclusivity and environmental sustainability. Local co-operatives are increasingly engaging in value addition, producing items like ghee and yogurt, which boosts incomes and strengthens community ties. Additionally, the hides and skins industry, which produced over 12,000 hides and 82,000 sheep and goat skins in 2017, has the potential to generate around Kes 100 million through processing. By prioritizing these sectors, Laikipia aims to enhance livelihoods and foster a more inclusive economy.

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