

Livestock Value Chain Mapping and Technology Needs Assessment in Samburu County, Kenya

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ABSTRACT

A livestock value chain mapping and technology needs assessment exercise was carried out in Samburu County, emphasizing the beef, dairy and leather sectors and their associated needs in animal feeds, renewable energy, and engineering services. Livestock farming is central to Samburu County's economy, supporting most of its residents. However, challenges like limited infrastructure, restricted market access, and technology shortfalls limit its full potential. The aim of the survey was to assess these value chains' current conditions, assess technological requirements, and offer recommendations to bridge identified gaps. The findings show that the dairy sector remains underdeveloped, with only one cooperative, the Samburu Dairy Cooperative Society, involved in milk collection and distribution. Lack of modern cooling, processing facilities and policies restricts its growth. While the beef sector is more organized, it still requires advancements in slaughtering, meat inspection and marketing technologies to improve efficiency. Additionally, the leather sector's potential remains largely untapped, with insufficient processing infrastructure causing high wastage of hides and skins. The survey also identified significant gaps in animal feed processing and high costs due to import reliance. Renewable energy, particularly solar, is promising, especially for milk cooling and meat preservation, yet more investment is needed. Addressing waste management through biogas systems and improved handling can mitigate environmental risks. Prioritizing infrastructure, technology upgrades and policy enhancements, especially in processing, cooling and renewable energy, will increase productivity and market access.

Keywords: Value Chain Mapping, Technology Needs, Entrepreneurship, Sustainability

Introduction

In Samburu County, livestock farming is a vital component of both the economy and culture, supporting over 90% of the population with food security and income. Core sectors such as beef, dairy, and leather offer significant growth potential, yet they face challenges including limited market access, inadequate infrastructure, and outdated technologies. Addressing these issues is essential to unlock the sector's potential, improve local livelihoods, and drive sustainable regional development [1].

On this basis, the Kenya Industrial Research and Development Institute (KIRDI), in collaboration with the Ministry of Investment, Trade, and Industry (MITI), developed a value

chain mapping survey in Samburu County. The study, conducted under the Kenya Industry and Entrepreneurship Project (KIEP) and sponsored by the World Bank Group, sought to focus on the livestock value chain, which is critical to Kenya's Vision 2030, a national development blueprint aiming to transition Kenya into a newly industrializing, middle-income country [2,3]. For Samburu, Vision 2030's emphasis on productivity, market access, and infrastructure development highlights the importance of modernizing livestock value chains. Strengthening these industries would not only bolster Samburu's local economy but also position beef, dairy, and leather production as valuable contributors to the national economy.

Kenya's Bottom-Up Economic Transformation Agenda (BETA) and Vision 2030 work together to empower rural communities, particularly in livestock farming. BETA focuses on enhancing

rural income by building livestock infrastructure such as abattoirs and cooling systems, which would help Samburu County farmers' transition from subsistence to formal markets [2]. The African Union's Agenda 2063 also backs sustainable livestock farming, highlighting technology and infrastructure as drivers of agricultural growth [4]. In Samburu, innovations like solar-powered cooling, better animal breeding, and digital market platforms could significantly improve productivity and income. Globally, the UN's Sustainable Development Goals (SDGs) underscore the potential of sustainable livestock practices to alleviate poverty (SDG 1), achieve zero hunger (SDG 2), and promote responsible consumption (SDG 12) [5]. By using renewable energy in livestock processing, Samburu County can reduce its carbon footprint, enhancing both food security and environmental sustainability.

Samburu County faces climate change-driven challenges, impacting livestock rearing through reduced pasture and increased droughts [6,7]. To adapt, there's a shift toward resilient breeds like camels, supported by initiatives like the Livestock Improvement Centre. However, limited local feed production keeps farmers dependent on costly imports, affecting livestock quality [8]. Renewable energy projects, including COSAP with World Bank support, provide solar lighting and water pumping in markets, but more investment is needed for cooling and waste management [3,9]. Modernizing Samburu's livestock sector through technology, renewable energy, and infrastructure aligns with Kenya's Vision 2030, BETA, AU Agenda 2063, and UN SDGs, fostering resilience and inclusivity.

Overview of the Value Chain

Samburu County: Overview and Pastoralism

Samburu County, spanning approximately 21,000 square kilometers in Kenya's arid and semi-arid lands, is home to the Samburu people, who have thrived on pastoralism for generations [1]. Over 90% of the population relies on livestock farming, with cattle, goats, sheep, and increasingly, camels - known for their resilience to drought - playing vital roles in their economy [8,10]. Livestock serves not only as a source of food and wealth but also as a cultural cornerstone [11]. However, challenges like limited infrastructure, poor market access, and climate variability threaten this traditional way of life [2,3]. As land pressures increase, there's a gradual shift towards more sedentary practices, particularly in dairy production, highlighting the need for sustainable solutions to strengthen livestock value chains [5,4,12].

Samburu County: Socio-Economic Demography

Samburu County, with a population of about 310,000, is characterized by a youthful demographic, as 80% of residents are between 15 and 30 years old. The population is slightly more male (50.5%) than female (49%), and the average household size is 4.7. The county has a high growth rate of 4.45%, outpacing the national average of 2.3%, and around 85% of residents live in rural areas [1]. The Samburu tribe represents 80% of the population, with Turkana, Somali, Rendille, Kikuyu and Meru comprising the remaining 20%. Most families depend on livestock and crop farming for their livelihoods, yet poverty remains a significant challenge, with 71.4% of the population living below the national poverty line of \$1.90 a day [1].

Methodology

The methodology employed in this survey combined both qualitative and quantitative approaches to comprehensively assess the livestock value chains in Samburu County. The primary focus areas included beef, dairy, and leather value chains, with an additional emphasis on feeds, environmental factors, renewable energy, and engineering services as they pertain to livestock production and by-products.

Study Area

Samburu County, located in Kenya's arid and semi-arid lands (ASALs), covers an area of approximately 21,000 square kilometers [1]. The county is divided into three sub-counties: Samburu East, Samburu North, and Samburu West. These areas were selected for the study due to their significant role in livestock farming, which serves as the primary livelihood for over 90% of the county's population [2]. The terrain is characterized by dry savannas and scattered shrubs, with limited water sources, posing challenges for both agricultural and livestock activities [12,13]. Despite these constraints, pastoralism remains the backbone of the county's economy, with cattle, goats, sheep, and camels forming the core of livestock production [8,10].

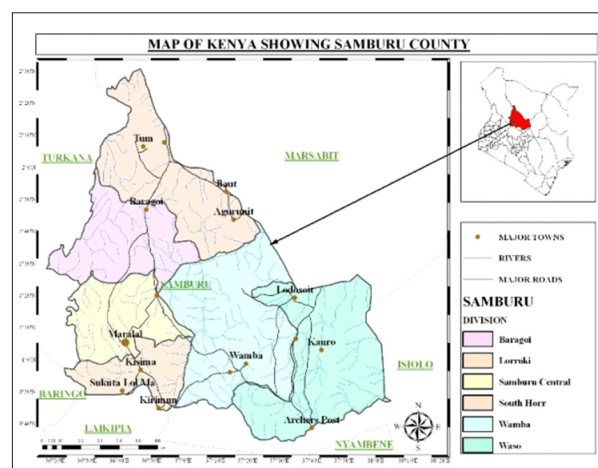


Figure 1: Map of Samburu County

Sample Study Area

Samburu East, North, and West were selected for the survey due to their crucial roles in Samburu County's livestock sector, each contributing unique strengths to the industry. Samburu East, renowned for camel rearing and milk production, is experiencing increased demand for camel milk, valued for its drought resilience [8]. The Wamba livestock market in this area also supports local trade and renewable energy adoption [3]. Samburu North, with extensive grazing lands and the Maralal livestock market, focuses on cattle and beef production, and a new abattoir promises significant advances in meat processing [1]. Samburu West hosts the Nomotio Livestock Improvement Centre, which promotes superior livestock breeding, and the Samburu Dairy Cooperative Society, a key player in milk collection and processing [10]. By focusing on these areas, the survey gained comprehensive insights into Samburu County's diverse livestock value chains, capturing the variety of agricultural practices and economic activities across the region [2,5].

Data Collection Methods

- i. **Stakeholder Interviews:** The survey involved structured and semi-structured interviews with a variety of stakeholders, including livestock farmers, cooperative members, market representatives, government officials, and representatives from development agencies such as the Kenya Industrial Research and Development Institute (KIRDI). Interviews focused on understanding the current infrastructure, market dynamics, technology use, and policy frameworks governing livestock production in the county.
- ii. **Field Observations:** Field visits were conducted in the three sub-counties of Samburu (Samburu East, Samburu North, and Samburu West). These visits provided direct observations of livestock markets, cooperatives, processing facilities, and renewable energy initiatives. Observations also focused on the condition of infrastructure, such as roads, cooling systems, abattoirs, and tannery construction sites. Environmental conditions, including pasture availability, water sources, and waste management practices, were also assessed.
- iii. **Secondary Data Collection:** Secondary data was obtained from existing county reports, policy documents, and statistical publications. This included reports on livestock productivity, market prices, and the distribution of renewable energy systems in rural markets. Additional data were drawn from academic literature on pastoralism, livestock management, and value chain development in arid and semi-arid regions.
- iv. **Focus Group Discussions:** Focused group discussion was held to gather feedback and opinions from small, diverse groups of pastoralists and farmers at the main market in Samburu West (Maralal Livestock Sale yard) which provided valuable insights and drawbacks. We used the focused group to test ideas such as encouraging environmental sustainability and using renewable energy as well as to enable us to understand their social issues.

We also used the focused group discussion to have an understanding of the most important needs in the livestock value chain and the support needed as well as a broad overview of the associations or community groups that are actively involved in livestock farming.

Data Analysis

Data collected through interviews, field observations, and secondary sources were analyzed using qualitative and quantitative methods. This approach provided insights into livestock populations, market prices, and renewable energy adoption. The findings highlighted infrastructure and technology gaps, informing targeted recommendations to enhance Samburu County's livestock sector and promote sustainability.

Value Chain Findings

This section shares survey findings on livestock value chains in Samburu County, focusing on beef, dairy, and leather sectors while assessing feeds, the environment, renewable energy, and engineering services related to livestock production and by-products. Each value chain is analyzed for key stages, existing technologies, identified gaps, and compliance with environmental management standards.

Key County Projects and Programs

Several projects have been initiated by the Samburu County government to address the challenges in the livestock sector, particularly in beef, dairy, and leather value chains. Key projects include:

Livestock Improvement Centre: Located in Samburu West, this center focuses on the introduction of superior livestock breeds, including Sahiwal cattle and improved camel breeds. The center aims to enhance both beef and dairy production through selective breeding and distribution of livestock to local farmers.

Abattoir Construction in Samburu Central: This ongoing project, supported by the EU, seeks to establish a modern slaughterhouse to improve beef processing. The abattoir will be equipped with chilling facilities and slaughtering equipment, which will allow for high-quality beef production for both domestic and export markets.

Pasture Development Programs: The county government has been involved in distributing pasture seeds to farmers and supporting them with baling machines to store feed for the dry season. This is part of a broader effort to improve animal nutrition and reduce livestock mortality during periods of drought.



Figure 2: Showing the Nomotio Livestock Improvement farm, an initiative of the Samburu County government

Renewable Energy Initiatives: The COSAP project, in collaboration with the World Bank, is working on expanding solar-powered solutions in rural livestock markets. Solar lighting and water pumping systems have been introduced in markets such as Wamba, improving market operations and reducing energy costs. IMARA program consortium funded by Northern rangeland Trust and World Bank is another initiative in promoting biogas technology in Samburu County.

National Agricultural and Rural Inclusive Growth Project (NARIGP): The World Bank-funded project aims to enhance smallholder farmers' access to markets and boost agricultural productivity. NARIGP has made strides in the dairy sector by providing dairy cows and camels

Dairy Value Chain

Key Stages in the Value Chain

- i. **Animal Rearing:** Dairy production in Samburu County relies primarily on camel and cattle farming, with camel milk gaining popularity due to its drought resistance and high yield. Cows, particularly the Sahiwal breed, are also raised but face challenges from climate change.

- ii. **Milk Processing and Cooling:** The Samburu Dairy Cooperative Society Limited manages most of the milk processing in the county. However, it struggles with outdated cooling facilities, resulting in delays that lead to spoilage.
- iii. **Milk Processing:** Current processing methods are basic, involving only simple pasteurization. There is insufficient equipment and training to produce value-added products like yogurt, ghee, and cheese, limiting the growth of the dairy value chain.



Figure 3: Showing some of the products, assets and equipment of the Samburu Dairy Cooperatives Society Limited

Gaps Identified

Table 1: showing gaps identified under the Dairy Value Chain

Gaps Identified	Details
Lack of cooling and pasteurization equipment	The cooperative lacks modern cooling and pasteurization equipment, which affects milk preservation and processing quality.
Poor milk quality assurance and hygiene practices	Insufficient quality assurance tools and poor hygiene practices result in inconsistent milk quality.
Absence of value-added products	No production of value-added products like yogurt and cheese, which limits the cooperative's ability to diversify and increase revenue.
Limited use of renewable energy	There is minimal use of renewable energy sources, such as solar, to power processing facilities.
Inadequate training	Cooperative members have limited training in dairy processing techniques, impacting overall efficiency and product quality.
Lack of uptake of biogas technology	The cooperative has not adopted biogas technology, which could improve waste management and offer additional energy solutions.
Lack of proper business structures	The cooperative lacks structured business models that could support long-term sustainability and financial stability.
Lack of guidance on importance of environmental compliance	The cooperative does not have guidance on carrying out annual environmental audits.

Beef Value Chain

Key Stages in the Value Chain

- i. **Animal Rearing:** Beef production in Samburu County is rooted in pastoralism, with farmers raising cattle, goats, and sheep for slaughter and sale at local markets like Maralal, Wamba, and Baragoi. Agro-vet shops provide essential supplies, but many smallholder farmers struggle to access these resources.
- ii. **Animal Markets:** Livestock markets operate weekly but lack modern infrastructure, such as weighing systems and cold storage. Transactions are mostly informal, relying on visual estimates for pricing.
- iii. **Slaughtering and Meat Inspection:** The beef value chain is hindered by a shortage of modern abattoirs; although one is under construction in Samburu Central (Fig. 4), it is not yet operational. Meat inspection services are underfunded, leading to health and quality concerns.
- iv. **Meat Marketing:** Beef is sold locally, with limited access to regional or international markets due to inadequate slaughtering and packaging facilities.
- v. **Technology:** There is minimal adoption of modern slaughtering equipment or cold chains for meat preservation.
- vi. **Disposal and Environmental Compliance:** Waste disposal from slaughtering is poorly managed, creating environmental risks with no structured plans for handling blood, offal, or other waste.



Figure 4: Showing construction of a modern abattoir in Samburu Central

Gaps Identified

Table 2: Showing gaps identified under the Beef Value Chain

Gaps Identified	Details
Inadequate abattoir facilities and cold storage	Lack of modern abattoir facilities and cold storage systems affects the quality and preservation of meat.
Lack of formal meat inspection systems	Meat inspection systems are informal, and poor market access hinders the sale of high-quality beef.
Limited access to veterinary services	Farmers have limited access to veterinary services and animal supplements, which impacts meat quality and animal health.
Non-compliant waste disposal practices	Waste disposal practices in slaughterhouses do not comply with environmental regulations, posing health and environmental risks.
Poor access to external markets	Limited access to regional and international markets for beef exports restricts income generation opportunities for farmers and producers.

Leather Value Chain

Key Stages in the Value Chain

- i. **Animal Rearing:** Hides and skins are obtained from cattle, goats, and camels, but most hides and skins are sold raw or semi-processed, limiting their value.
- ii. **Leather Processing:** The leather value chain is underdeveloped, with no fully operational tannery in the county. A tannery is under construction but lacks the capacity to meet local demand. Leather processing is rudimentary, with most raw materials exported in unprocessed form.
- iii. **Technology:** There is no modern machinery for leather tanning, cutting, or finishing. Skilled labor is also lacking, which hinders the growth of the leather industry.
- iv. **Disposal and Environmental Compliance:** Waste from hide and skin processing is minimal, but when processing scales up, waste management will be a critical issue. There is currently no plan for the disposal of tannery waste.
- v. **Regulation and Compliance:** There are no local regulatory bodies overseeing leather production standards, and most activities occur informally without quality assurance or environmental compliance protocols.

Gaps Identified

Table 3: Showing gaps identified under the Leather Value Chain

Gaps Identified	Details
Lack of fully operational tannery infrastructure	The region lacks fully operational tannery infrastructure, limiting leather production capabilities.
Limited technological adoption	There is minimal adoption of modern technology for leather processing, affecting efficiency and product quality.
No local market linkages or skilled labor	There are no established market linkages or availability of skilled labor to support the expansion of leather production.
Absence of environmental compliance	Environmental compliance measures for managing tannery waste are absent, posing significant environmental risks.

Feeds and Animal Nutrition

The survey found that Samburu County lacks a dedicated animal feed processing plant, which forces farmers to rely on costly imported feeds. The use of locally sourced feed ingredients such as Acacia pods is still in trial phases, but there is potential for their incorporation into animal feed formulation.

Key Gaps Identified

Table 4: Showing gaps identified under the Feeds and Animal Nutrition Value Chain

Key Gaps Identified	Details
High costs of animal feeds	The high cost of animal feeds is driven by the lack of local production, making it expensive for farmers.
Limited knowledge on feed formulation	Farmers have limited knowledge on formulating feeds and utilizing alternative feed ingredients to reduce costs.

Inadequate access to feed supplements	There is inadequate access to essential feed supplements and animal health products, affecting livestock productivity.
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Environment and Renewable Energy

Environmental management and Compliance

- **The Livestock Improvement Centre** has initiated programs to improve pasture production and reclaim degraded grazing lands, but the impacts of climate change - such as reduced pasture availability - remain a major concern. Water scarcity is also a significant challenge for both livestock and environmental sustainability.

Renewable Energy

- **Biogas Technology** has been promoted in Samburu County through initiatives such as the IMARA program Consortium launched with the aim of reducing pressure on shrinking forest habitats from charcoal and firewood harvesting by using Biogas as an alternative source of fuel. The project has targeted Kalama, Nakuprat, Gotu, Nannapa and Nalewuon conservancies in Samburu County. Each household received a portable 2.5 cubic meter biogas digester and use cow dung, food waste as feedstock. Each biogas digester costs kshs 30,000. The bio-digesters were donated to the conservancies in order to initiate a revolving fund that goes into purchasing more biogas systems for the conservancies. However, challenges such as scarcity of water has led to some households not being able to maintain the technology. In some households in Maralal, some farmers complained of corrosion of pipes and biogas cook stoves caused by hydrogen sulfide in the biogas.



Figure 5: Showing a biogas digester unit that provides enough energy to meet the needs of a household with up to 12 people. Biogas use in slaughterhouses was observed to be limited.

More investments in waste-to-energy systems are needed to manage livestock waste sustainably.

- **Solar Technology** - The Kenya off grid solar access Samburu, funded by World Bank, is one of the government initiatives to promote renewable energy in Samburu County. It targets Communities, households, Enterprises and water pumping facilities. The components for the project include; mini-grids for community facilities, enterprises, and households, standalone solar systems and clean cooking Solutions for Households, Standalone Solar Systems and Solar Water Pumps for Community facilities, implementation support and capacity building. The project will involve construction of 4 Mini grid sites in Samburu namely; Tuum, Latakweny, Barsaloi, and Sereolipi. Solar-powered water pumps are in use in some markets, but the potential for solar energy to power cold storage systems and processing plants has not

been fully realized. The COSAP project, in partnership with the World Bank, is working on expanding solar energy in rural markets, but more investment is needed to scale this up.

Gaps Identified

Table 5: Showing gaps identified under the Renewable Energy Value Chain

Key Issues Identified	Details
Limited use of renewable energy	Renewable energy is not widely used to support livestock production needs such as cooling, storage, and waste management.
Lack of environmental compliance protocols	There are no structured environmental compliance protocols in place for managing livestock waste, leading to unsustainable practices.
Water scarcity	Water scarcity presents ongoing challenges to livestock production, the adoption of biogas technology, and overall environmental sustainability.
Impact of nomadic lifestyle on renewable energy adoption	The nomadic lifestyle of the Samburu people limits the adoption of renewable energy technologies like biogas, which require stable infrastructure.
Lack of knowledge on biogas scrubbing technologies	Hydrogen sulphide as one of the compounds in Biogas poses a challenge of corrosion of pipes and biogas cook stoves.

Engineering Services

The findings from the survey show that Samburu County lacks the necessary engineering services to support livestock processing and infrastructure development. The Kenya Industrial Research and Development Institute (KIRDI) has the potential to assist in designing and fabricating equipment such as coolers, choppers, and pelletizers. However, no such collaborations have yet materialized.

Gaps Identified

Table 6: Showing gaps identified under the Engineering Services Value Chain

Gaps Identified	Details
Lack of locally fabricated equipment	There is a lack of locally fabricated equipment for livestock processing, which hinders the efficiency of production.
Limited maintenance services	Existing machinery lacks proper maintenance services, leading to frequent breakdowns and reduced productivity.
No partnerships with technical institutions	There are no partnerships with KIRDI or other engineering institutions to provide technical support for infrastructure development.

This detailed analysis of the beef, dairy, leather, and feeds, renewable energy, and engineering services reveals significant gaps in infrastructure, technological adoption, and environmental management. Addressing these gaps through targeted investments, policy reforms, and capacity building will be essential for the growth of the livestock sector in Samburu County.



Figure 6: Showing some of the engineering machinery at the Agricultural Machinery Services premises in Samburu Central

Value Chain Actors

- i. **Input Suppliers:** The livestock value chains in Samburu County begin with input suppliers, such as agro-vet shops and distributors, who provide essential veterinary medicines, supplements, and animal feeds. However, due to limited local feed production, many farmers resort to expensive imported feeds, impacting livestock productivity.
- ii. **Producers:** The backbone of the livestock sector consists of smallholder pastoralists who rear cattle, goats, sheep, and camels. These producers often operate informally, with restricted access to formal markets and limited opportunities for value addition.
- iii. **Cooperatives:** The Samburu Dairy Cooperative Society Limited plays a vital role in milk collection and marketing, though its effectiveness is hindered by inadequate infrastructure, like cooling facilities. The beef and leather sectors have less organization, with limited cooperative activity in cattle marketing.
- iv. **Dairy Processors:** Processing is minimal, involving only basic pasteurization, with no value-added products like yogurt or cheese being produced due to poorly equipped facilities.
- v. **Beef Processors:** The absence of fully operational abattoirs limits meat quality, although one is under construction in Samburu Central.
- vi. **Leather Processors:** The leather sector is underdeveloped, with raw hides sold without significant value addition, although a new tannery offers potential for growth.
- vii. **Traders/Wholesalers:** Livestock traders operate primarily in local markets like Maralal and Wamba, facilitating transactions but facing challenges due to limited infrastructure, such as cold storage.
- viii. **Retailers:** Retailers typically sell raw or semi-processed livestock products, which limits profit margins due to the lack of processed goods.
- ix. **Consumers:** Consumers include local and regional buyers, with potential for exports, especially for beef and camel milk. Enhancing value addition and processing capabilities could open larger markets.

x. **Government and Development Partners:** The county government and development partners, such as the World Bank, support infrastructure development, capacity building, and policy formation, focusing on improving market access and technology adoption to enhance value chains.

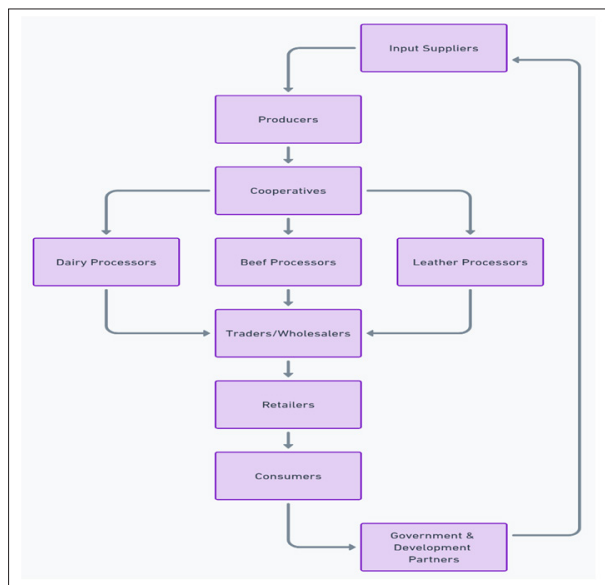


Figure 7: Showing the Value chain structure/ map

Technology Needs Assessment Findings

This section highlights technological gaps in Samburu County’s livestock value chains, including dairy, beef, leather, and renewable energy. Field surveys and discussions reveal that outdated infrastructure hinders livestock production, necessitating an intervention matrix to identify essential improvements.

Table 7: Showing technologies in place under the Dairy Value Chain

Technologies in Place	Details
Modern coolers	No solar-powered or efficient cooling systems are in place. This limits the milk’s quality and shelf-life, particularly in rural areas where spoilage is exacerbated.

Table 8: Showing intervention matrix for enterprises visited

Enterprise/Cooperative	Technology Gaps	Required Interventions	Priority Level
Samburu Dairy Cooperative Society Limited	<ul style="list-style-type: none"> No cooling systems for milk preservation No pasteurization equipment Lack of quality assurance tools 	<ul style="list-style-type: none"> Install solar-powered cooling systems Invest in pasteurization units Provide quality assurance tools like lactometers 	High
Nomotio Livestock Improvement Centre	<ul style="list-style-type: none"> Limited use of renewable energy Lack of advanced breeding technology 	<ul style="list-style-type: none"> Introduce solar-powered systems for water pumping Implement advanced livestock breeding techniques 	Medium

Quality assurance equipment	The cooperative lacks basic tools such as lactometers and milk testing kits, which are essential for ensuring milk quality before processing.
Energy supply	Diesel-driven generators are used to power equipment. Renewable energy solutions like solar-powered coolers are not yet in use.
Waste management	Milk waste management is poorly organized, with little focus on recycling or producing biogas from dairy waste.
Training and management	Limited training in dairy processing, hygiene practices, and quality assurance. Technical reporting and financial management require improvement, despite the cooperative being registered and licensed locally.

The Technology Needs Assessment identified critical gaps in Samburu County’s beef, dairy, and leather value chains. Outdated technologies hinder product quality, while underutilized renewable energy solutions offer opportunities to improve efficiency, productivity, and market access in livestock production. Key findings include:

- **Dairy Value Chain:** Limited access to cooling systems and pasteurization technology results in high milk spoilage rates, with insufficient value addition, like yogurt or cheese production, reducing income for dairy farmers.
- **Beef Value Chain:** The lack of operational abattoirs and modern meat inspection compromises beef quality and restricts market access.
- **Leather Value Chain:** The absence of a fully operational tannery and processing equipment limits value addition to hides and skins, hindering income for pastoralists.
- **Renewable Energy:** There is minimal adoption of solar-powered cooling systems or biogas for waste management, despite their potential to enhance sustainability and energy efficiency.

Intervention Matrix as Per Enterprise Visited

The intervention matrix shown in table 8 below provides a summary of the technological gaps identified during the field visits and offers recommendations for addressing these issues. The matrix is categorized by enterprise and value chain segment.

Abattoir (Samburu Central)	<ul style="list-style-type: none"> No modern slaughtering equipment Lack of cold storage facilities 	<ul style="list-style-type: none"> Install automated slaughtering lines Establish cold storage and meat inspection systems 	High
Leather processing facility (under construction)	<ul style="list-style-type: none"> No leather tanning and finishing machinery Lack of skilled labor for processing 	<ul style="list-style-type: none"> Install leather processing equipment Provide technical training for skilled labor 	Medium
Wamba livestock market	<ul style="list-style-type: none"> Minimal adoption of renewable energy Lack of weighing systems 	<ul style="list-style-type: none"> Expand the use of solar energy Introduce weighing systems for market operations 	Medium

Dairy Value Chain: Technologies in Place

Table 9: Showing technologies in place under the Dairy Value Chain

Technology	Details
Modern coolers	No solar-powered or efficient cooling systems are in place.
Quality assurance equipment	Lacks basic tools such as lactometers and milk testing kits.
Energy supply	Relies on diesel-driven generators; no solar-powered coolers.
Waste management	Poorly organized waste management with no biogas production from dairy waste.
Training and management	Limited training in dairy processing and management practices.

Beef Value Chain: Technologies in Place

Table 10: Showing technologies in place under the Beef Value Chain

Technology	Details
Slaughtering equipment	Informal slaughtering, with no modern abattoir or automated systems.
Cold storage facilities	No cold storage for meat preservation, leading to spoilage and market issues.
Waste management	Poor disposal practices with minimal compliance to environmental management standards.

Leather Value Chain: Technologies in Place

Table 11: Showing technologies in place under the Leather Value Chain

Technology	Details
Leather processing machinery	No advanced machinery for tanning and leather finishing.
Skilled labor	Limited availability of skilled labor for leather processing.
Waste management	No structured waste management system for tannery waste.

Conclusion and Recommendations

The value chain mapping in Samburu County has identified key opportunities to enhance livestock production through technology adoption, training, and value addition. In Samburu County, the dairy value chain struggles with high spoilage rates due to limited access to cooling systems and pasteurization technology, which

in turn reduces farmers’ incomes by preventing the production of value-added products like yogurt and cheese. Similarly, the beef sector suffers from a lack of operational abattoirs and modern meat inspection, compromising quality and limiting market access. The leather value chain faces challenges as well, with no fully operational tannery or processing equipment, hindering income for pastoralists. Furthermore, the potential for renewable energy solutions, such as solar-powered cooling and biogas systems, remains largely untapped, despite their promise for enhancing sustainability and efficiency. Addressing these gaps will not only boost productivity and profitability but also contribute to long-term sustainability and poverty reduction in Samburu County. By improving livestock production, the region can better align with national development goals, such as Kenya’s Vision 2030, and international targets, including the UN Sustainable Development Goals (SDGs). Partnerships with development agencies, NGOs, and private investors will be critical in realizing these objectives and ensuring the socio-economic upliftment of the local communities.

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